# Identify Various Manual Drafting Tools and Equipment

MANUAL DRAFTING TOOLS have slowly changed and developed over hundreds of years. Manual drafting, however, is now becoming a lost art with the advent of the computer. There is a series of creatively engineered instruments, each performing different functions; in combination, these tools can draw just about anything. The foundation of these tools is essential for everything written, designed, engineered, and built, so having high-quality instruments is important.

## Objectives:

1. Identify the basic manual drafting tools.
2. Describe the types of pencils, leads, pens, and erasers used for manual drafting.
3. Describe the types of tables and chairs used for manual drafting.
4. Describe the common drafting instruments.

## Key Terms:

30°–60° triangle
45° triangle
architect's scale
automatic pencil
beam compass
bow compass
civil engineer's scale
compass
dividers
drafting tape
dusting brush
erasing shield
irregular curve
manual drafting
mechanical pencil
metric scale
proportional dividers
T-square
technical pen
template

# The Basic Manual Drafting Tools

**Manual drafting**, also known as hand drafting, is done by hand with pencil or ink. It involves the use of drafting instruments on a medium such as paper, vellum, or polyester film. Drafting tools can be purchased as a kit or bought separately. For accuracy and long life, always buy high-quality equipment. Following is a list of the traditional tools used in manual drafting.

1. Mechanical or automatic pencils and leads (e.g., HB, F, H, 2H, and 4H)
2. Erasers
3. Erasing shield
4. Dusting brush
5. Technical pens
6. Drawing board (approximately 20" × 24"), drafting table, and chair
7. T-square (24")
8. Compass
9. Dividers
10. Triangles
11. Templates
12. Irregular curves
13. Scales: architect's, engineer's, and metric
14. Drafting tape
15. Lettering guide
16. Sandpaper pad or other sharpening device

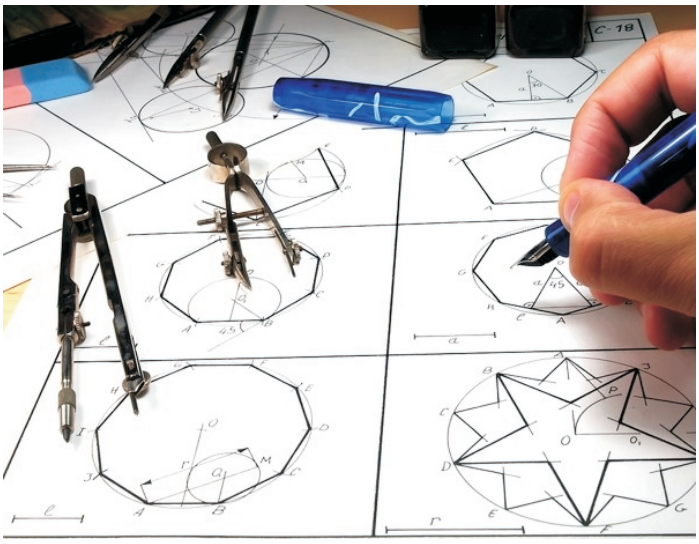

**FIGURE 1. Some traditional drafting tools have been replaced by modern computer drafting equipment.**

# Types of Pencils, Leads, Pens, and Erasers Used for Manual Drafting

High-quality drawing pencils, leads, pens, and erasers should be used in technical drawing. Low-quality products can result in inaccurate lines and create drawing difficulties.

## PENCILS

There are two basic types of pencils used in manual drafting. Both pencils can be refilled after the leads are used.

### Mechanical

A **mechanical pencil** is typically made of metal and has a shaft in the center that holds the lead. It has been around for hundreds of years and is also called a lead holder. The tip opens and closes by some physical action, a push or a twist, allowing the lead to advance. The lead is typically about $^{1}/_{16}$ inch thick and 3 inches long. The normal line weights used in drafting are thinner than this, so the lead requires sharpening. The mechanical pencil can use any type or grade of lead, including plastic leads.

### Automatic

The automatic pencil is a much newer evolution. An **automatic pencil** is typically made of plastic and has a lead chamber in the center that can usually hold more than one lead. The leads for an automatic pencil are much smaller than those for a mechanical pencil. They typically come in standard widths, those used as common line weights in drafting. Thus, they do not require sharpening. Automatic pencils are available in many different lead sizes. Each pencil has a different grade of lead and is used for a specific technique or line type. When a button on the back end of the pencil is pushed, the lead advances to the writing tip.

**FIGURE 2. The automatic pencil is a more recent invention.**

## LEAD GRADES

The lead grade is responsible for the line weight. Different line weights create thick (dark) lines or thin (light) lines. Following are three categories of lead.

### Hard

A hard lead is used to draw light, thin lines, such as lettering guidelines and light construction lines. The hard grades include 9H, 8H, 7H, 6H, 5H, and 4H.

### Medium

A medium lead is commonly used to draw thick lines on mechanical and architectural drawings. The medium grades include 3H, 2H, F, HB, and B.

### Soft

Soft leads are usually too soft to be effective in mechanical drafting, but they are used for various kinds of art work. The soft grades include 2B, 3B, 4B, 5B, 6B, and 7B.

## PENS

A **technical pen** is typically made of plastic and has a removable metal tip and an ink reservoir. It functions by capillary action. This means that the tip, a needle, acts as a valve to allow a uniform amount of ink to flow. A thin metal tube connects the tip to a reservoir. The reservoir stores the ink and can be refilled as needed. Technical pens come with different sized tips. These tips create different line weights, similar to the effects of the different grades of lead. Technical pens can be very expensive and require much care and maintenance.

## ERASERS

There are soft and hard erasers. Soft erasers can be formed into any shape; hard erasers are usually in the form of sticks or rectangular.

There are three basic types of erasers: one for pencil, one for ink, and one for plastic. Choose the eraser for the material being used.

An **erasing shield** is a thin piece of metal with different sized and shaped holes in it. The shield permits accurate erasing.

A **dusting brush** is a soft, wide brush. It is used to remove all the eraser particles from a drawing. Clearing away the particles will reduce the chance of smudging lines.

# Types of Tables and Chairs Used for Manual Drafting

Many varieties of drafting tables and chairs are available. They range from economical models to complete professional workstations. Drafting tables are typically sized according to the dimension of their tops. Standard sizes range from 24 × 36 inches (600 × 900 mm) to 42 × 84 inches (1000 × 2000 mm).

Tables have hard or smooth tops that may be ready to draw on. However, most tables need to be covered with a specially designed smooth surface, such as vinyl.

Many different features are found on high-quality drafting tables. A table may allow you to position the board vertically for use with a track drafting machine. It may have foot and hand controls to tilt and raise the drawing board. Drawers to store drawings and supplies, as well as an electrical outlet, are also sometimes included.

**Drafting tape** is generally used to fasten a drawing to the tabletop. Drafting tape is similar to masking tape except it is less sticky. This allows it to be easily removed without tearing the drawing.

Drafting chairs also have a range of features and qualities. The features to look for in a high-quality drafting chair include a contoured or padded seat design, a footrest, height adjustment, and solid construction.

## Common Drafting Instruments

Accuracy, neatness, and speed are achieved in manual drafting with the use of various drafting instruments. The base design of these tools has been around for many years. Although there are some variations for each specific tool, the important aspect is the quality. Higher-quality instruments will make it easier to create accurate drawings.

### T-SQUARE

A **T-square** consists of a long strip (the blade) fastened tightly at right angles to a shorter piece (the head). It is used to create straight, consistent, and parallel lines. T-squares may be made of metal, plastic, or wood. Having one that has a transparent edge is helpful. This is so you can see the drawing in the area around where the lines are being drawn.

### COMPASSES

A **compass** is used to draw arcs and circles. It is essentially a metal adjustable "A." One leg has a pin tip, to be placed at the center of the circle, and the other leg has a pen or lead holder on it. It is particularly useful for large circles. There is a wide range in size and complexity of compasses, and some have many add-on features.

The two basic types of compasses are the bow compass and the beam compass. A **bow compass**

**FIGURE 3. Compasses have been used for hundreds of years.**

has a socket joint in one leg for the insertion of either pencil or pen attachments. This is the more standard and simpler compass. A **beam compass** consists of a bar with an adjustable needle and a pen or pencil attachment. The bar allows an extension on the leg of the "A." This type of compass can be used for creating larger circles or arcs.

## DIVIDERS

**Dividers** are used to transfer distances and to divide distances into a number of equal parts. A divider is basically the same instrument as a compass except there is no pen or pencil attachment. Dividers are usually made of metal, are adjustable, and come in several sizes.

**Proportional dividers** are used to enlarge or reduce drawings or objects within a drawing. A proportional divider is similar to a compass or divider except the two legs are attached in the center. This connection is also adjustable, allowing proportions and ratios to be made. A proportional divider can be a very expensive tool and is rarely used.

## TRIANGLES

There are two standard triangles. They are the 30°–60° triangle and the 45° triangle. The **30°–60° triangle** consists of angles at 30°, 60°, and 90°. The **45° triangle** has angles at 45°, 45°, and 90°. Most triangles are made of transparent plastic so you can see the drawing beneath. There are also versions that are adjustable. They can be very useful in creating a full range of angled lines.

## TEMPLATES

A **template** serves as the pattern of a standard size symbol or shape, usually one that is commonly used. It is typically made of plastic and, like a stencil, functions as an aid in recreating the symbol or shape. Templates can be found for drawing almost any commonly used drafting symbols or recurring features. Circle templates are grouped around sizes and can range from as large as the template to as small as $^{1}/_{16}$ inch. There are also ellipse templates. These can be very useful in creating isometric drawings. In these 3D drawings, objects are projected at an angle and can look skewed or slanted.

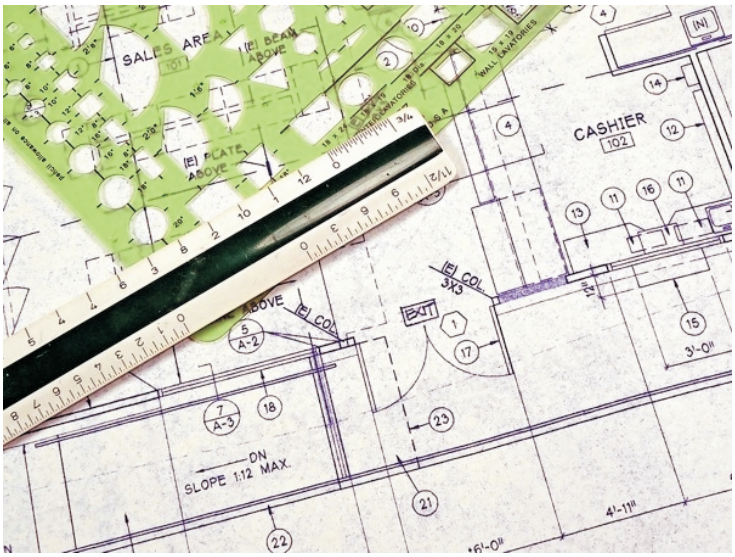


**FIGURE 4. Templates can save much manual drafting time.**

# FURTHER EXPLORATION...

### ONLINE CONNECTION: Using the Architect's Scale

Learning how to use a scale ruler can be difficult. The architect's scale, in particular, can be confusing. A civil engineer's scale and a metric scale are usually easier to comprehend because they are based on our numeric system and have equal ratios based on 10. An architect's scale, however, is much different because there are 12 inches in 1 foot and an inch can be divided many times. This can be rather confusing, and mastering the architect's scale requires practice.

To learn more about how to use an architect's scale ruler, visit the link below:

http://secure.mycart.net/catalogs/store.asp?pid=180082

## IRREGULAR CURVES

An **irregular curve**, or French curve, is a device used for the mechanical drawing of curved lines. Usually a French curve is in the form of a template with many variations of a curving line that can be traced. Several different forms and sizes are available, including radius curves, ship's curves, and flexible curves.

## SCALES

Although there are different styles of scales, there are basically only three different types of scales.

First is the triangular **civil engineer's scale**. It is made up of six scales, two on each of its sides. Calibrated in multiples of 10, it is used in engineering.

Second is the triangular **architect's scale**. It consists of 11 scales. On 10 of these scales, 1 inch is subdivided into different amounts, each representing a foot. For example, one scale is a $^1/_2$-inch scale, so each $^1/_2$ inch equals 1 foot. The eleventh scale is the full scale. The inch is divided into 16 parts, with each part equaling $^1/_{16}$ inch. It is primarily used by architects and designers.

Third is a triangular **metric scale**. It is usually made up of six scales. It is used where the metric system is the standard for linear measurement. An advantage of the metric scales is that any scale is a multiple of 10, the same way the metric system is organized. This makes any reduction or enlargement easy to calculate.

## Summary:

Manual drafting, also known as hand drafting, is done by hand with pencil or ink. It requires the aid of drafting instruments on a medium. Manual drafting pencils hold different grades of lead. They range from soft to hard. There are also technical pens for ink and special tools for erasing lines.

Drafting tables come in a range of sizes, with a variety of added features to aid in drafting. The drafting chair is also an important piece of equipment. It should be comfortable and adjustable.

There is a full range of drafting instruments to aid in drawing. Each performs a certain task. Drafting instruments are used to create straight and perpendicular lines, circles and arcs, irregular curves, and angled lines. Some tools are used for exact measurements and for the division of distances, and some are used to easily recreate standard symbols and shapes.

## Checking Your Knowledge:

1. What are the three categories of lead grades?
2. Besides erasers, what are two important instruments to have when erasing?
3. What are two important features in a drafting chair?
4. For what is a compass used?
5. How many different scales are on an architect's scale?

## Expanding Your Knowledge:

Most art stores have a large selection of types and qualities for different drafting instruments. Much can be learned by physically seeing all the variations and styles. The sales clerk can also be of great help in providing information. Plan a trip to your local art store to learn more about drafting instruments.

## Web Links:

**Galileo's Compass: History of an Invention**
http://brunelleschi.imss.fi.it/esplora/compasso/dswmedia/storia/estoria1.html

**Using Engineer's and Architect's Scales**
http://www.usfa.dhs.gov/downloads/pdf/nfa/engineer-architect-scales.pdf