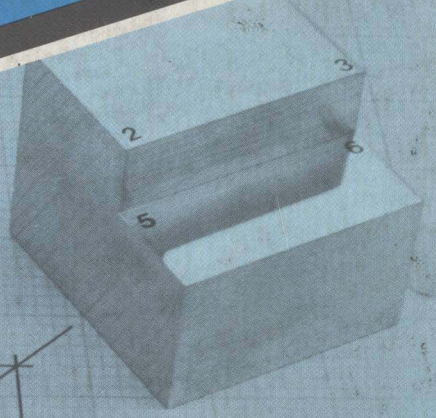
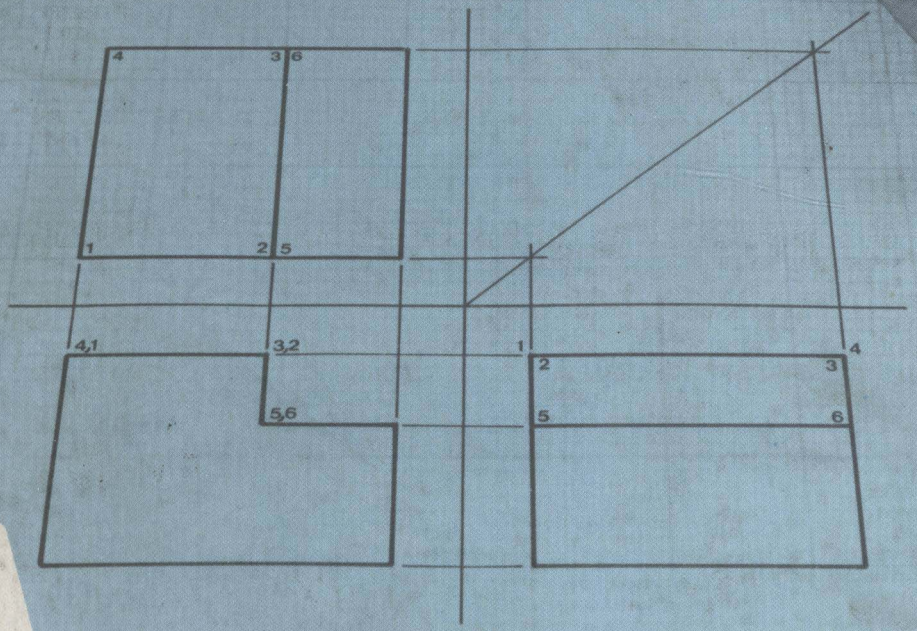
ESSENTIALS OF DRAFTING

James D. Bethune





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PREFACE

This book has been written for the student who is taking drafting either to satisfy a curriculum requirement or as an elective, but who is not a drafting major. This student usually wishes to gain a basic working knowledge of drafting fundamentals so that he can apply it to other courses, but he is often hindered in obtaining this knowledge by a combination of limited class time (basic drafting is normally a one semester course) and large class enrollments. This situation forces the student to rely heavily on the instructor's lectures and on his own ability to read and understand the text.

To make it easier for the student to learn from this text, the material is presented using a step-by-step problem-solving format accompanied by many illustrations. The written portion of the text may be described as a "how to" approach. The idea is to present not only drafting theory, but also the procedures and conventions used to apply the theory. This will enable the student to work directly from the text to the board while doing his class and homework drawings.

The scope of the material presented has been limited to those subjects most often needed to prepare technical drawings, with heavy emphasis on orthographic views (including sectional views and auxiliary views) and dimensioning. Fasteners, oblique, isometric and development drawings are also covered. Although limited in scope, the material is presented in depth. Four chapters, for example, discuss how to draw three views of an object.

Special care was taken in choosi exercise problems for each chapter. The problems are directly related to the subject of the chapter, and are, for the most part, presented in isometric form to help the student learn visualization. Many are presented on grid background in order to force the student to create all his own dimensions without any hints or leads from dimensions used to state the problem. The problems which are dimensioned are done so using decimals and the unidirectional system, although most of the decimals are convenient fractional equivalences.

The text also includes metrics. Chapter 13 is entirely devoted to linear metric measurements (as used on technical drawings) and first angle projection. All other chapters contain at least one exercise problem done in metrics.

Several people deserve my special thanks for their contributions to this book. My wife, Kendra, not only did all the typing but also did the initial editing for grammar and spelling errors. Chris Duncombe

contributed his photographic skills to create interesting an magina-tive photographs. George Cushman, my colleague at Wentworti stitute, was always willing to argue and discuss a method or teaching roach. And Cary Baker and Stu Horton of Prentice-Hall always ans red all my questions promptly and clearly. Thanks to you all.

Finally, I would like to make a request of you, the reader. Please send me your comments. A formal letter isn't necessary—just a marked up xerox copy of the sections in question would be fine. Being a teacher myself, I'm well aware that every text has certain sentences or illustrations which, although not wrong, consistently cause confusion. I would sincerely appreciate your pointing these out to me.

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CONTENTS

DRAFTING TOOLS AND THEIR USE 1

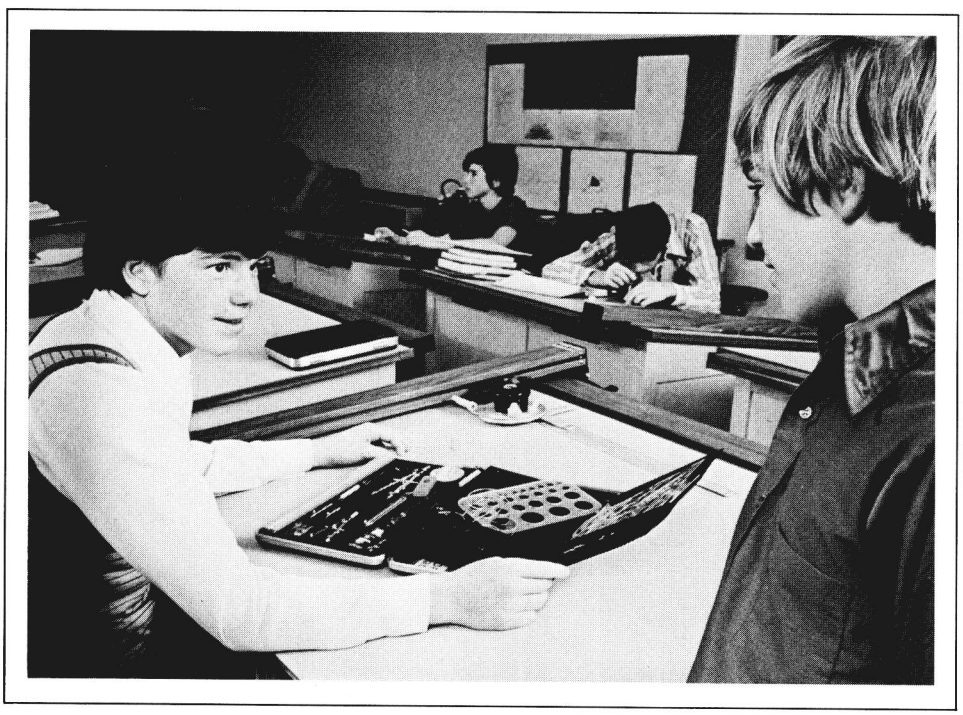


Figure 1-0 Illustration courtesy of Teledyne Post, Des Plaines, Illinois 60016.

1-1 INTRODUCTION

This chapter explains and demonstrates how to use basic drafting tools. Most sections in the chapter are followed by exercises especially designed to help you develop skill with the particular tool being presented. Try each tool immediately after reading about it by doing the appropriate exercises. As you work, try to learn the capabilities and usage requirements of each tool, because it is important that you know how to use each tool with technical accuracy, skill, and creativity.

1-2 PENCILS, LEADHOLDERS, AND ERASERS

Figure 1-1 shows several different pencils and leadholders. Most draftsmen prefer to draw with leadholders instead of pencils because leadholders maintain a constant weight and balance during use which makes it easier to draw uniform lines.

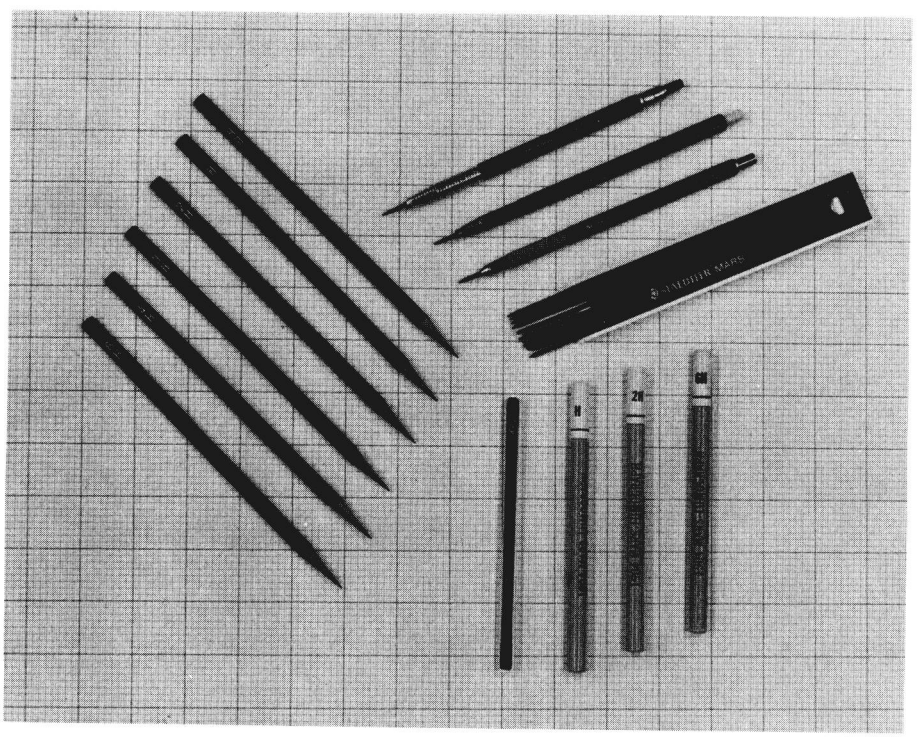


Figure 1-1 Pencils and lead holders.

Regardless of whether a leadholder or pencil is used, its lead must be kept sharp with a tapered, conical point like the one shown in Figure 1-2. Figure 1-3 shows several different lead sharpeners and Figure 1-4 shows how to sharpen a lead by using a sandpaper block.

When sharpening a lead, care should be taken to keep the graphite droppings away from the drawing. Most draftsmen keep a cloth or piece of clay handy to wipe the excess graphite from a newly sharpened lead.

Leads come in various degrees of hardness, graded H to 9H. The higher the number, the harder the lead. Light layout and projection lines are usually drawn with the harder leads; darker lines, used for detailing and lettering, are drawn with the softer leads.

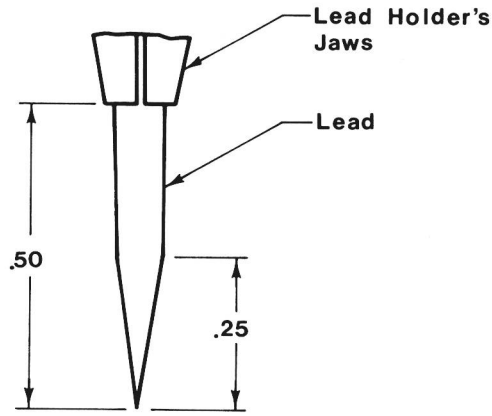


Figure 1-2 The shape of a properly sharpened lead.

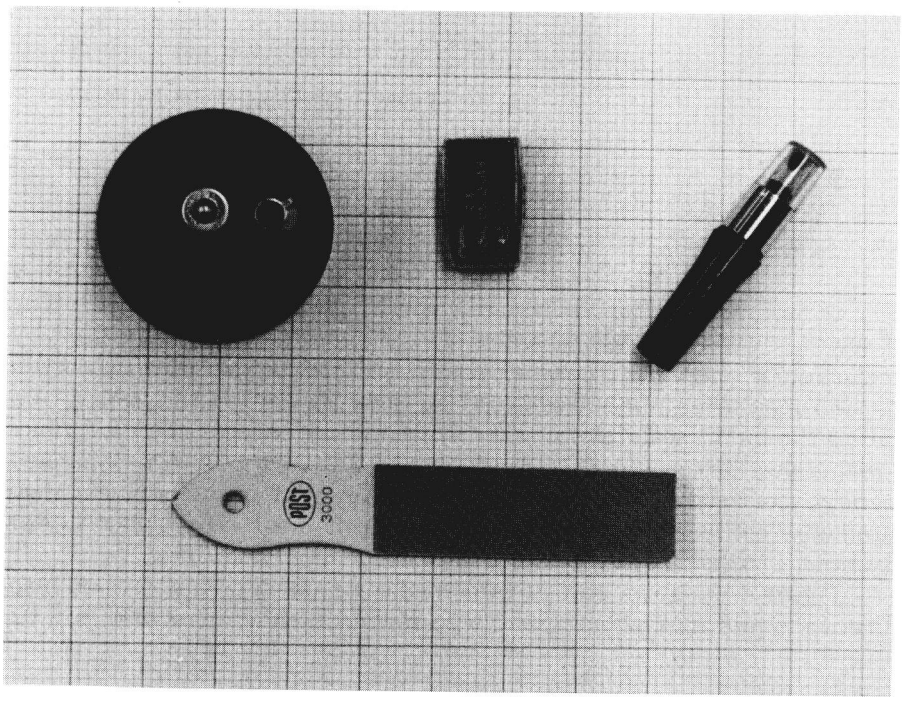


Figure 1-3 Lead sharpeners.

Figure 1-5 shows several different kinds of erasers and an erasing shield. The harder erasers are used for removing ink lines and the softer ones are used for removing pencil lines. Gum erasers (very soft) are used when large amounts of light erasing are required.

An erasing shield enables a draftsman to erase specific areas of a drawing and thereby prevents excessive redrawing of lines that might otherwise have been erased. To use an erasing shield, place it on the drawing so that the area to be removed is exposed through one of the cutouts. (The various cutouts are shaped to match common drawing configurations.) Hold the shield down firmly and rub an eraser into the aligned cutout until the desired area is removed. When the erasing is finished, the excess eraser particles should be brushed off. Figure 1-6 demonstrates the above method.

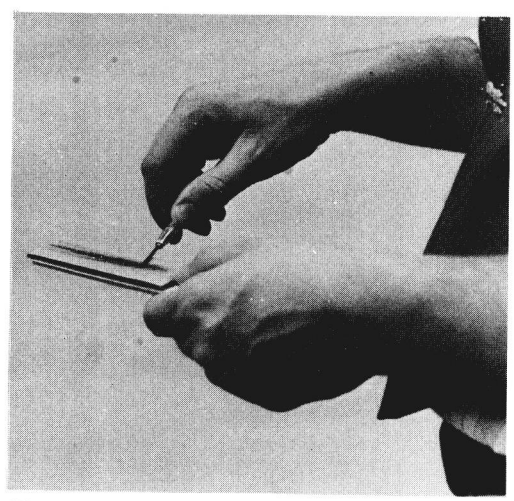


Figure 1-4 Sharpening a lead using a sandpaper block.

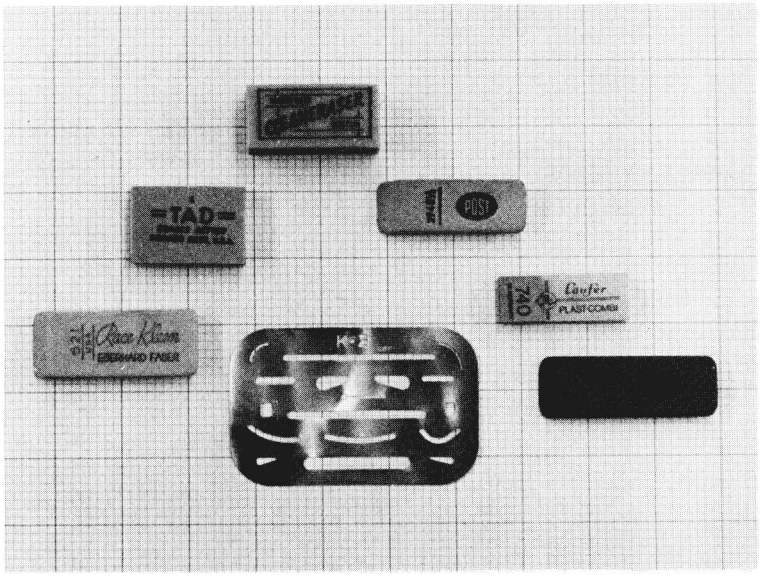


Figure 1-5 Erasers and an erasing shield.

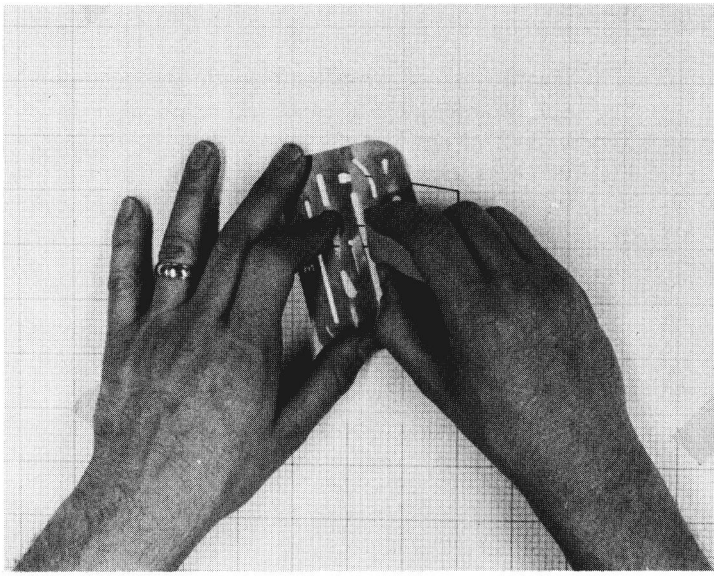


Figure 1-6 Using an erasing shield.

1-3 SCALES

Scales are used for linear measuring. Figure 1-7 shows a grouping of several different kinds of scales. The scale most commonly used by draftsmen is one with its inches graduated into 16 divisions with each division measuring one-sixteenth of an inch. Figure 1-8 shows part of a "16-to-the-inch" scale along with some sample measurements. Unlike a real scale, the scale in Figure 1-8 has the first inch completely labeled to help you become familiar with the different fractional values. Measurements more accurate than one-sixteenth must be estimated. For example, 1/32 is halfway between the 0 and the 1/16 marks.

Figure 1-9 shows part of a decimal scale. Each inch is divided into 50 equal parts making it possible to make measurements within 0.01

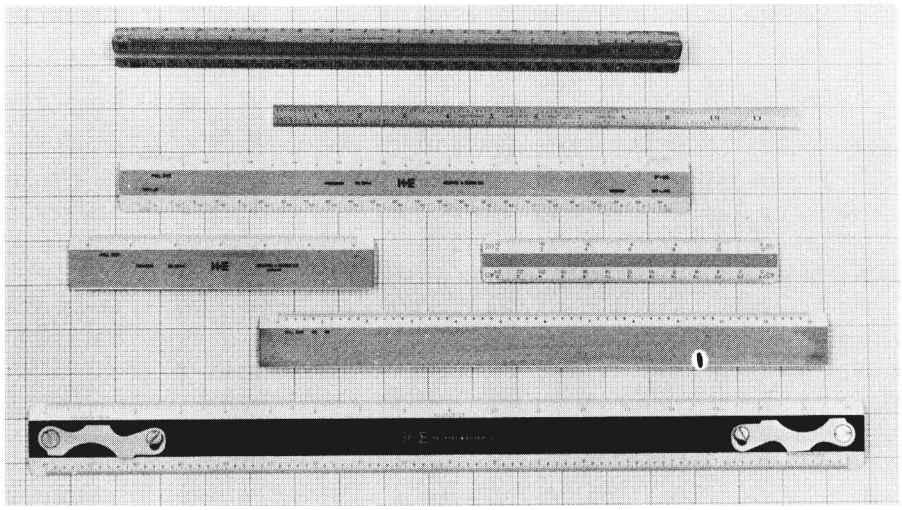


Figure 1-7 Scales.

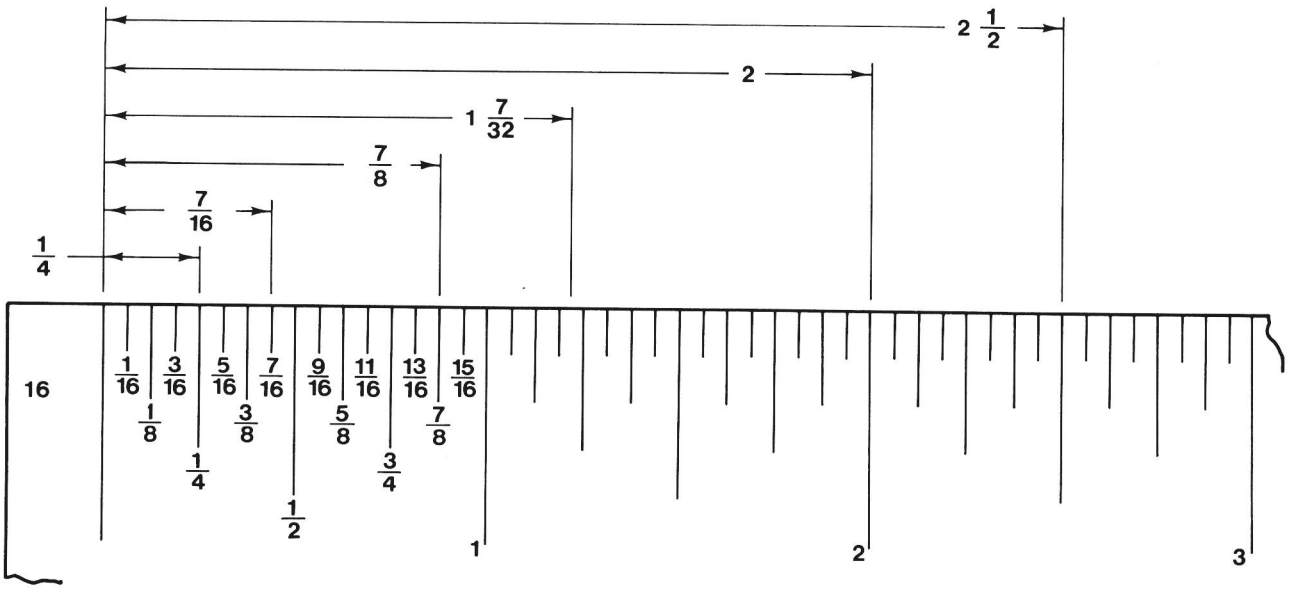


Figure 1-8 A 16-to-the-inch scale with some sample measurements.

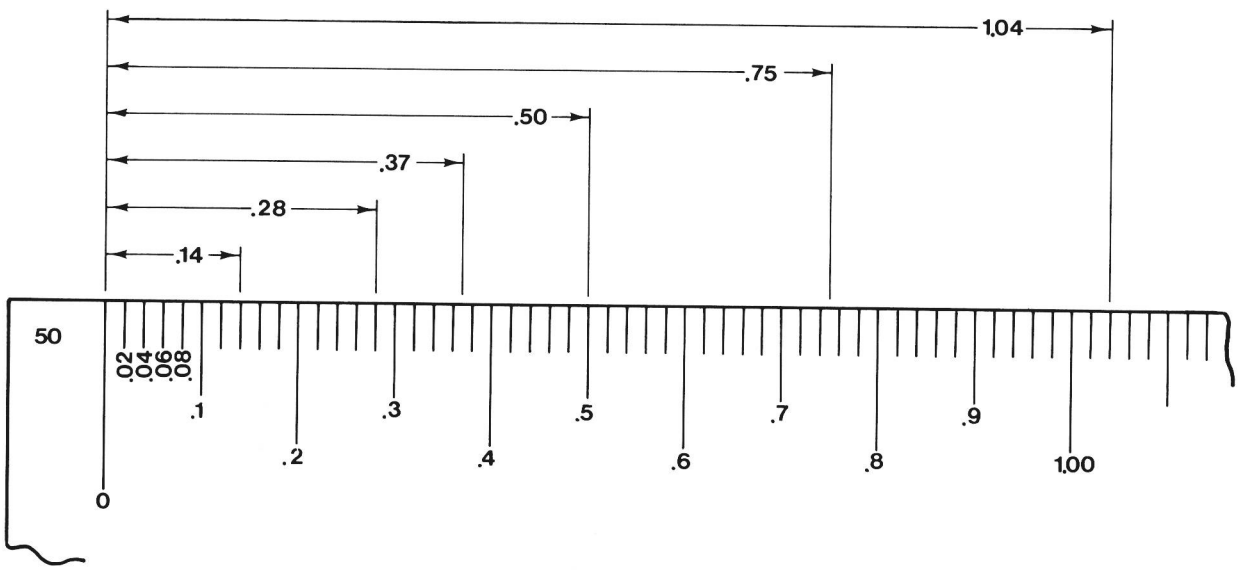


Figure 1-9 A decimal scale with some sample measurements.

inch (hundredth of an inch) accuracy. Several sample readings have been included and the first 0.10, unlike a real decimal scale, has each graduation mark labeled.

Many scales are set up for other than full-sized drawing. For example, the ½ scale enables a half-sized drawing to be made directly without having to divide each dimensional value by 2. Three-quarter scales enable direct ¾-sized drawings to be made, and so on.

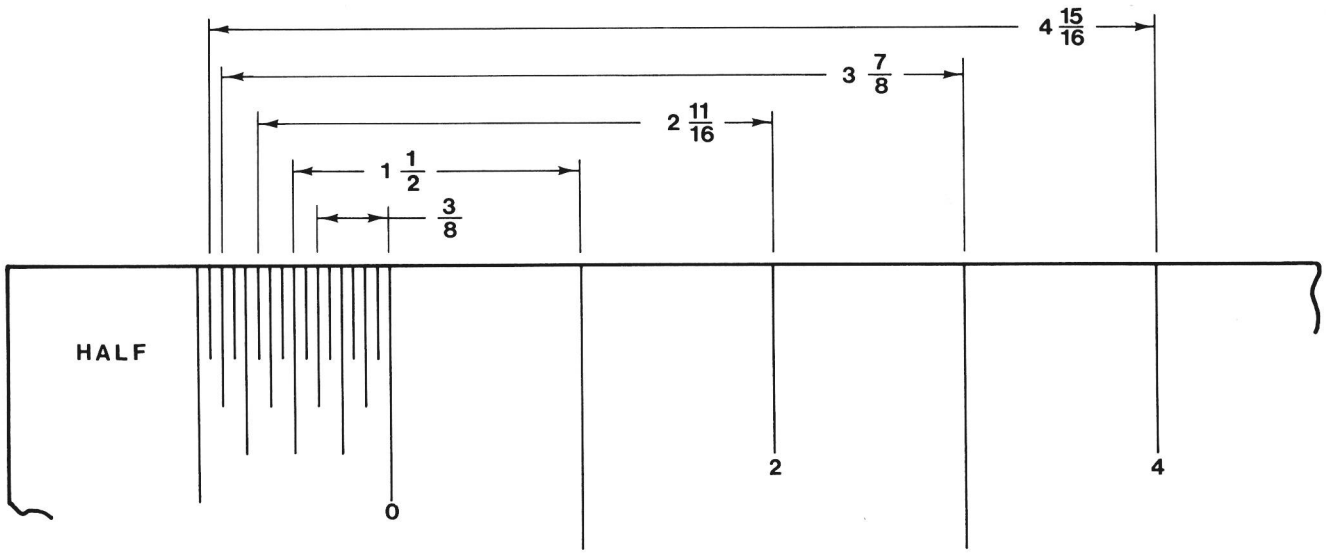


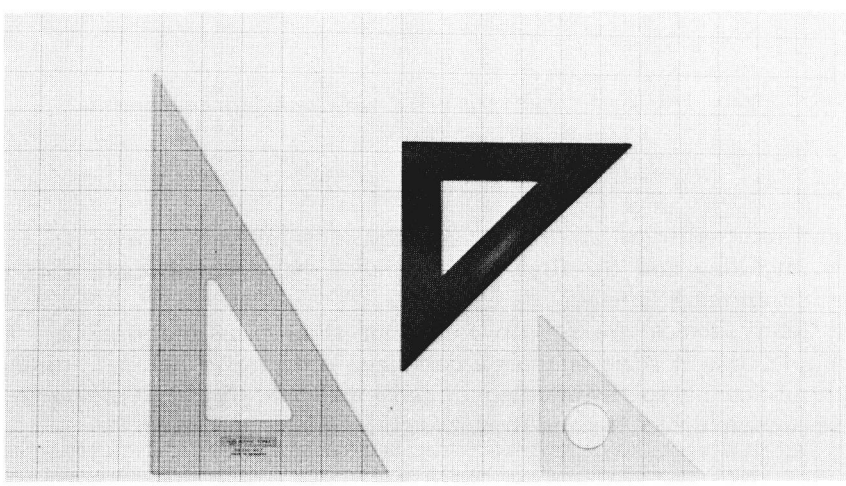
Figure 1-10 A half scale with some sample measurements.

All fractional scales are read as shown in Figure 1-10. Only one of the sections representing an inch is graduated into fractional parts. This graduated section is located to the left of the "0" mark. When making a reading (for example, 3-7/8) on a fractional scale, read the whole (3) part of the number to the right of the "0" and the fractional part (7/8) to the left. See Figure 1-10 for an example of a 3-7/8 reading on a half scale.

1-4 T-SQUARE AND TRIANGLES

A T-square is used as a guide for drawing horizontal lines and as a support for triangles which, in turn, are used as guides for drawing vertical and inclined lines. Figure 1-11 shows a T-square and several different sizes and types of triangles, including an antique wooden one.

Figure 1-11 T-square and triangles.



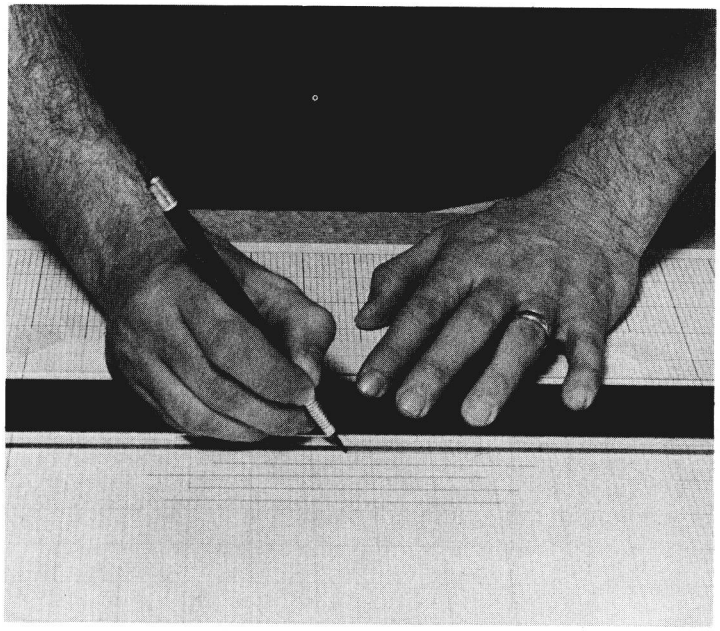


Figure 1-12(a) Drawing a horizontal line using a T-square as a guide.

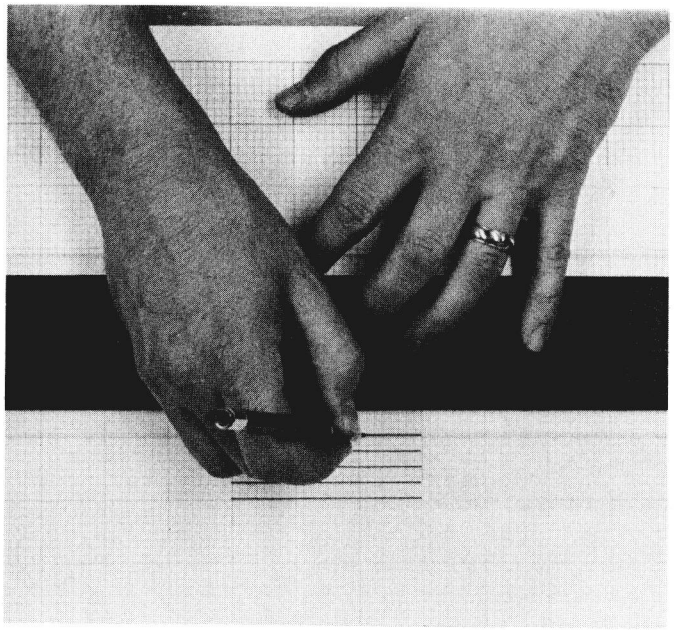


Figure 1-12(b) Drawing a horizontal line using a T-square as a guide.

To use a T-square or triangle as a guide for drawing lines, hold the pencil as shown in Figures 1-12(a) and 1-12(b) and pull the pencil along the edge of the straight edge from left to right. (These instructions are for right-handed people. Left-handed people should reverse these directions.) Rotate the pencil as you draw so that a flat spot will not form on the lead. Flat spots cause wide, fuzzy lines of uneven width. Always remember to keep your drawing lead sharp.

When using a T-square, hold the head (top of the T) firmly and flat against the edge of the drawing board. Use your left hand to hold the T-square still and in place while you draw. When you move the T-square, always check to see that the head is snug against the edge of the drawing board before you start to draw again.

When a T-square and a triangle are used together to create a guide for drawing, the left hand must not only hold the T-square in place; it must also hold the edge of the triangle firmly and flat against the edge of the T-square. To accomplish this, use the heel of your hand to hold the T-square in place and your fingers to keep the triangle against the T-square (see Figure 1-13).

It is important that all your tools be accurate. A T-square, for example, must have a perfectly straight edge. If it does not, you will draw wavy lines and inaccurate angles with the triangles. To check a T-square for accuracy, draw a long line by using the T-square as a guide. Then flip the T-square over, as shown in Figure 1-14, and, using the same edge you just used as a guide, see if the T-square edge (now upside-down) matches the line. If it does not, the T-square is not accurate.

Triangles should be checked for straightness in the same manner used to check a T-square, but, in addition, they must be checked for "squareness." To check a triangle for squareness, align the triangle against the T-square and draw a line by using the edge of the triangle which forms a 90°-angle to the T-square as a guide. Holding the T-square in place, flip the triangle over, as shown in Figure 1-15, and see if the triangle edge matches the line. If it does not, the triangle is not