

John R. Walker

Exploring metric drafting

basic fundamentals



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by

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INTRODUCTION

EXPLORING METRIC DRAFTING is a first course which teaches Drafting Fundamentals and Basic Constructions. As you proceed, you will become familiar with methods and processes used by industry. You will make many of the Drafter's skills your own. A course in metric drafting will help you to develop the capacity to plan in an orderly fashion, to interpret the ideas of others, and to express in an understandable manner.

EXPLORING METRIC DRAFTING is the metric version of EXPLORING DRAFTING, also published by Goodheart-Willcox. This metricated text contains metric dimensioned drawings. It will be revised as new drafting standards are finalized and adopted.

The problems presented in this text are similar to the problems contained in the original EXPLORING DRAFTING. They have been metricated to take advantage of standardized metric stock sizes. They are not problems where the original inch dimensions were simply converted to metric units. Metric drafting is much more than that.

For the best learning situation, avoid converting the metric units to inches and fractions and making your measurements in these units. Use a metric scale. Do not even think in inches. Otherwise, confusion may result and mistakes will be made.

Drafting is the "Language of Industry." It offers many opportunities for a lifetime of challenging and personally rewarding careers. Will you accept that challenge?

John R. Walker

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Typical industry photo. Hundreds of drawings were required to plan and build the hotel in which this 21.3 metre long truss was used. (Bethlehem Steel Corp.)

Unit 1

WHY STUDY METRIC BASE DRAFTING

DRAFTING is the part of industry concerned with the preparation of drawings needed to develop and manufacture modern products.

Drawings often are the best means available to explain or show our ideas, Fig. 1-1. Drafting frequently is called a “universal language” because it communicates ideas in graphic or picture form. Like other languages, symbols (lines and figures) that have special and specific meanings are used to accurately

describe the shape, size, type of material, finish and fabrication of an object. The symbols have been standardized over most of the world, making it possible to interpret and understand drawings made in other countries. See Fig. 1-2.

Drafting also is the “language of industry.” It is a precise language because drawings provide the craftworker with the information needed to produce the product the designer had in mind, Fig. 1-3. It involves

Fig. 1-1. Drawings are the best way to show how to construct something as complex as this helicopter. Can you imagine trying to explain how to make a helicopter using words only? (Sikorsky Aircraft)

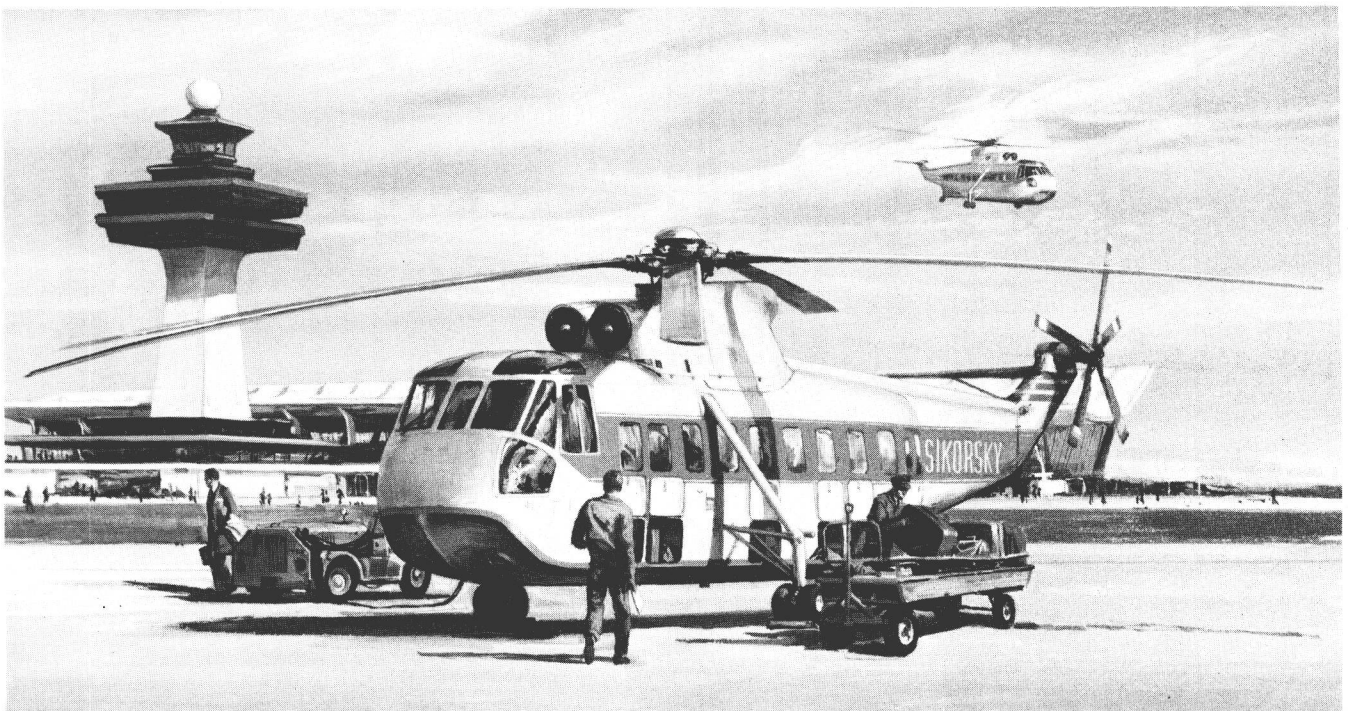




Fig. 1-2. Although the written instructions are in Japanese, it would be possible for you to use this plan to construct this radio controlled model airplane, if you understand drawings and the metric system.

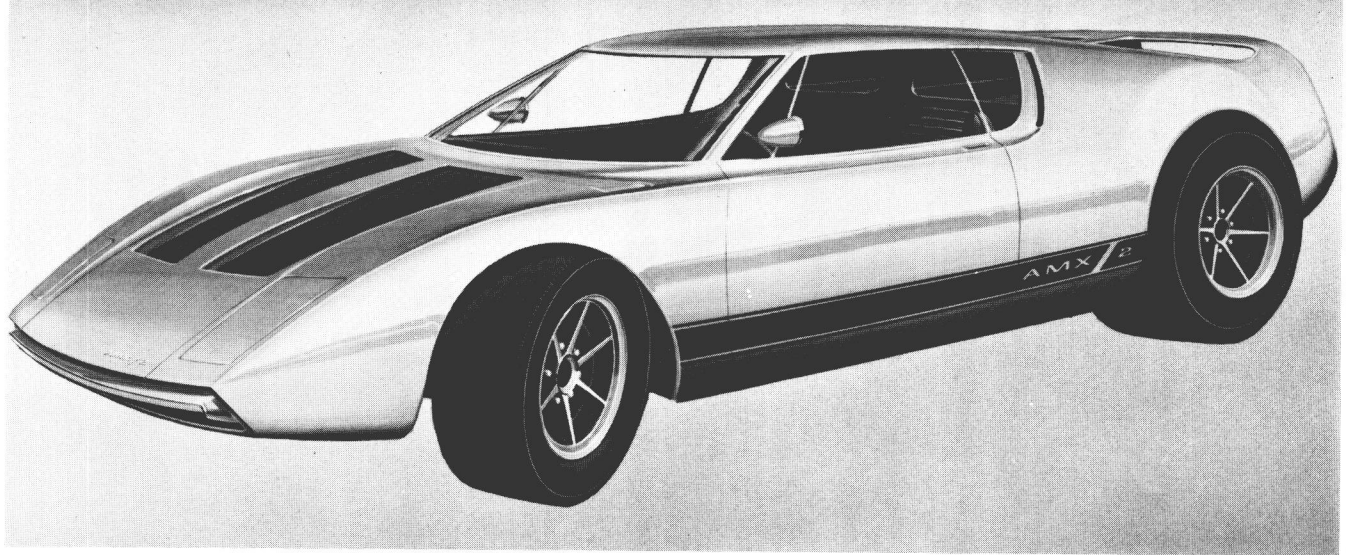


Fig. 1-3. Drafting is the "language of industry." Drawings show craftworkers what the designer had in mind. (American Motors)

the recording of necessary production information on paper, film or tape, Fig. 1-4.

Drafting is very important to our modern world. It would be difficult to name an occupation that does not require the ability to read and understand drawings.

It is quite obvious that the craftworkers who build our homes, make our cars or produce our TV sets must use drawings. YOU use drawings when you assemble a model, Fig. 1-5.

Many specialized fields of drafting have been developed: aerospace, architectural, automotive styl-

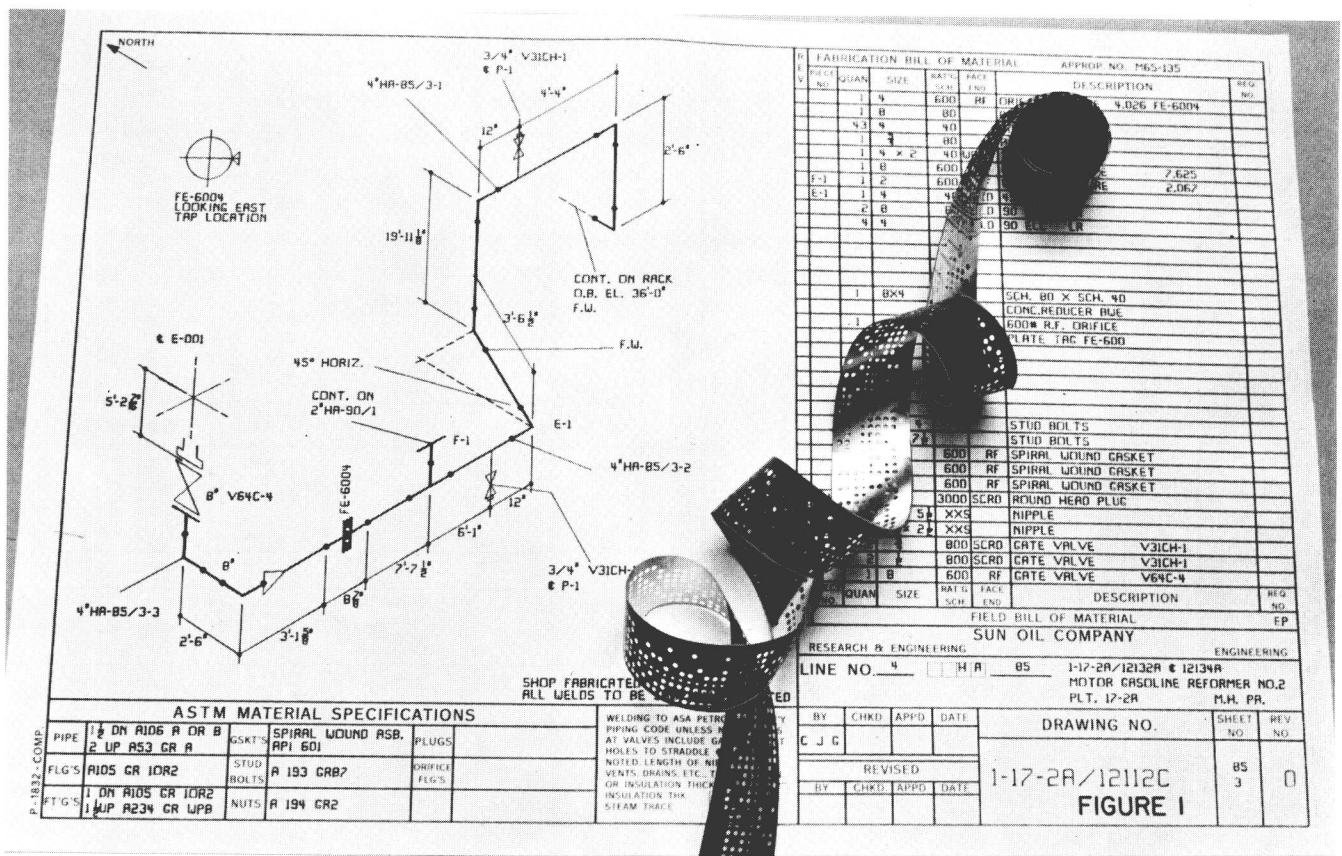


Fig. 1-4. Some specialized drafting can be done by machine. The required information is "punched" into a plastic tape. The tape is fed into a computer-like machine which interprets the hole sequence in the tape and prints it on a sheet of paper. This drawing of a piping diagram in an oil refinery was made in this manner. (Sun Oil Co.)

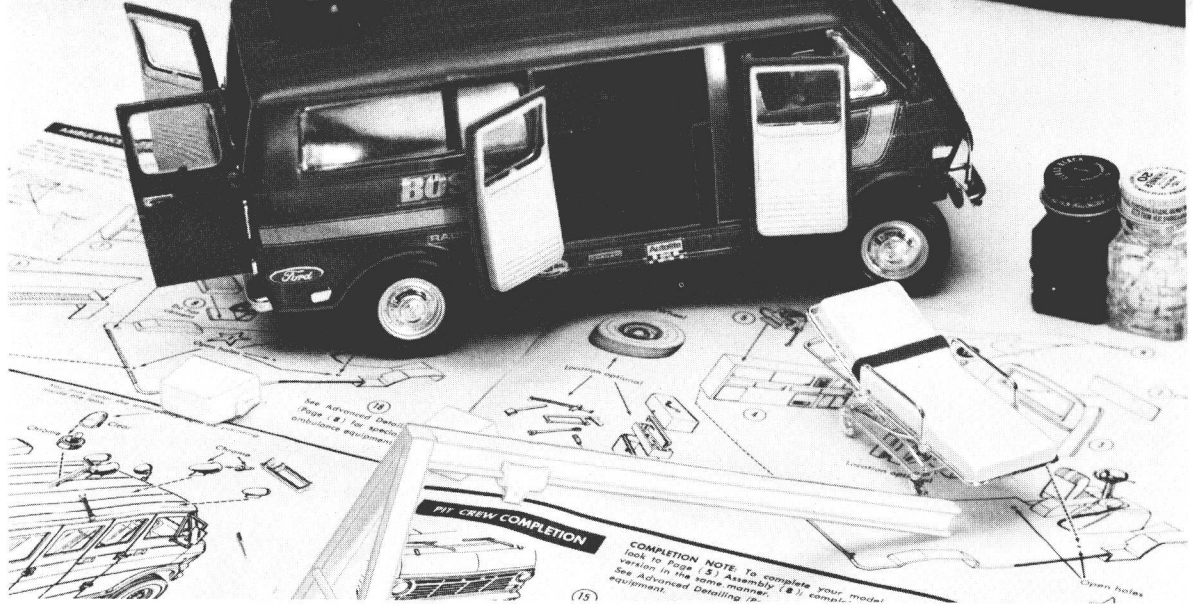


Fig. 1-5. You use drawings when you construct a model.

ing, electronic and electrical drafting, structural drafting, engineering graphics, technical drawing and topographical drafting.

Basically, they use the same drafting equipment and employ similar drafting techniques. However, the type of work done varies greatly.

But why study metric base drafting? For that matter, what metric units of measure will you use and how will you use them?

To answer the first question, the United States is "going metric." Drafting will play a very important role in our conversion to the metric system of measure.

As to the metric units of measure you will use, the full conversion to metrics by the United States will take a very long time. No specific time schedule has been established. For the present, your knowing and understanding the following metric units will be a big step towards full understanding of the metric system. The chart in Fig. 1-6 will make the learning easier.

ISO, SI AND ANSI

In the process of learning metrics, you will find references to the terms ISO, SI and ANSI. These terms have the following meaning:

ISO is the International Organization for Standardization. This international specialized agency for standardization is composed of the national standards bodies of 80 countries. They are concerned with the

terminology, dimensions and test methods (includes safety and quality) for international standards.

STANDARDS define and allow measurement of length, volume, weight, time and other values. They are independent of environmental conditions such as temperature and pressure.

SI stands for the Systeme International d'Unites and refers to the metric system in its most modern and perfected form. There is only one SI unit for each physical quantity. See Fig. 1-7. The system is simple. Multiples and submultiples of an SI unit are related to the unit by powers of 10. There is also a consistent set of prefixes for naming the multiples and submultiples of the unit.

TO MEASURE	METRIC UNIT USED	COMPARES TO THIS
Length	millimetre (mm) centimetre (cm) metre (m) kilometre (km)	Thickness of paper clip Width of paper clip About 39 1/2 inches About 6/10 mile
Area	hectare (ha)	About 2 1/2 acres
Weight	gram (g) kilogram (kg) metric ton (t)	Weight of paper clip About 2.2 pounds 2240 pounds
Volume	litre (L) millilitre (ml)	1 quart, 2 ounces 1/5 teaspoon
Temperature	degree Celsius (°C)	Water freezes at 0°C, boils at 100°C. To convert to Fahrenheit roughly: double °C and add 30

Fig. 1-6. How metric units roughly compare with English measure and familiar household items.

kilometre (km)	=	1 000 metres (thousands)
hectometre (hm)	=	100 metres (hundreds)
dekametre (dam)	=	10 metres (tens)
metre (m)	=	1 metre (unit of linear measure)
decimetre (dm)	=	0.1 metre (tenths)
centimetre (cm)	=	0.01 metre (hundredths)
millimetre (mm)	=	0.001 metre (thousandths)
micrometre (μ m)	=	0.000 001 metre (millionths)

Fig. 1-7. The most common linear units in the metric system.

ANSI is the American National Standards Institute. This is the organization that represents the United States in the International Organization for Standardization. It approves and distributes the ISO standards in the United States.

TEST YOUR KNOWLEDGE - UNIT 1

(Write answers on a separate sheet of paper.)

1. What does the term drafting mean?
2. Drawings are often used because:
 - a. They are easy to make.
 - b. They are the best means available to explain or

show many ideas.

- c. People who cannot read can understand them.
 - d. All of the above.
 - e. None of the above.
3. Drafting is also called:
 - a. A universal language.
 - b. The language of industry.
 - c. A picture language.
 - d. All of the above.
 - e. None of the above.
 4. In addition to the craftworkers who make the things we use every day, list several other people who make use of drawings.
 5. List five specialized fields of drafting.
 6. With reference to the metric system, what is the meaning of each of the following terms:
 ISO _____ .
 SI _____ .
 ANSI _____ .
 7. _____ is the unit of linear measure in the metric system.
 8. What is the metric equivalent for the term Fahrenheit?

OUTSIDE ACTIVITIES

1. Secure samples of drawings used by the following industries:
 - a. Aerospace.
 - b. Architecture.
 - c. Automotive styling.
 - d. Electrical and electronic.
 - e. Structural.
 - f. Manufacturing (technical drawings).
 - g. Map making.
2. Make a collection of pictures (magazine clippings, photographs, etc.) that show products made by industries listed in No. 1.
3. Obtain copies of drawings made in a foreign country.
4. Visit a local architect who designs residences. After discussing a project in work, prepare a report on the steps normally followed when designing a home for a client. Prepare your questions carefully before your visit.
5. Visit a local surveyor and make a report on this type of work. Borrow sample surveys for a bulletin board display.



The architectural drafter must have the technical knowledge required to carry out the ideas of the architect. (Prestressed Concrete Institute)



The fabrication and erection of steel structures like the Lamoille River (Vt.) Bridge requires many drawings. With drawings the drafter conveys, in technical language, all the information required to fabricate the many structural members. (Bethlehem Steel)

Unit 2

SHOP SKETCHING

SHOP SKETCHING is one of many drafting techniques. It is a convenient and rapid way of putting ideas into visual form. See Fig. 2-1.

A good sketch shows the shape of the object, and provides dimensions and special instructions on how the object is to be made and finished.

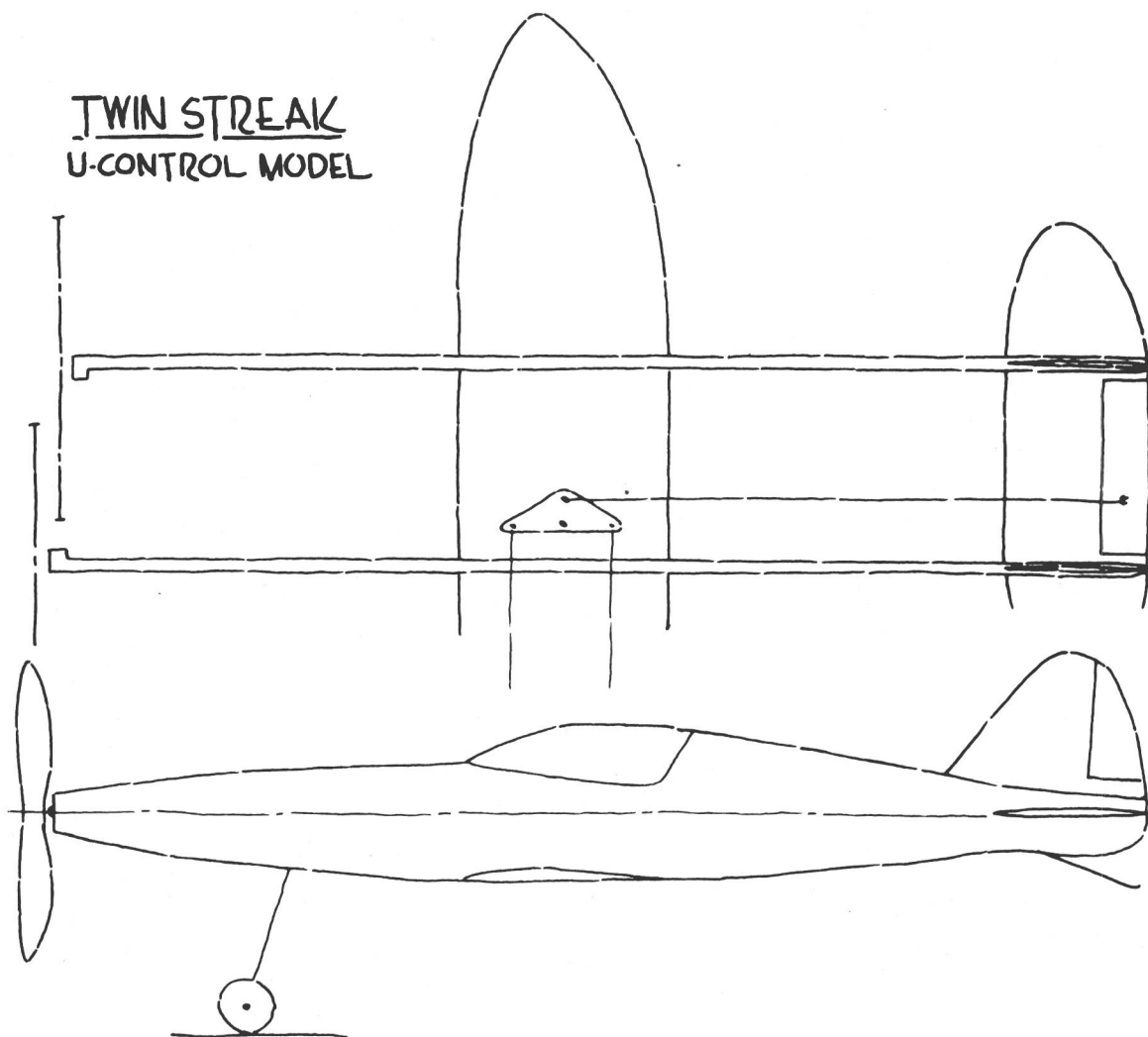


Fig. 2-1. Sketch of a model plane design. Sketching is a convenient and rapid way of putting ideas into visual form.

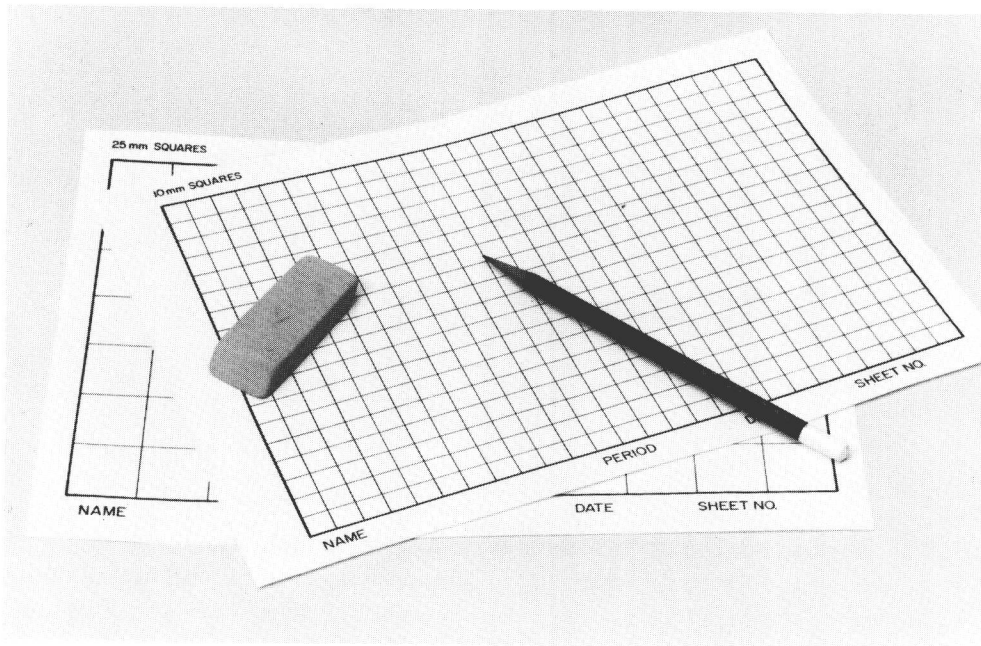


Fig. 2-2. Graph paper is useful in sketching. A good eraser is also a necessity.

Sketching does not require a great deal of equipment. Properly sharpened F, 2H or HB grade pencils and sheets of standard 8 1/2 x 11 in. (210 x 297 mm) letter size paper are well suited for this purpose. See Fig. 2-2. The paper can be plain or cross sectioned (graph or squares). A good eraser is also needed.

In sketching, a line is drawn by making a series of short strokes, Fig. 2-3. Draw light (thin) construction lines first—corrections are easier to make. Horizontal lines are drawn from left to right; vertical lines are drawn from the top down.

The instructions that follow tell and show how to sketch basic geometric shapes. You will find that even the most complex drawings are made up of a combination of these basic geometric shapes.

ALPHABET OF LINES (SKETCHED)

A drafter uses lines of various weights (thickness) to make a drawing. Each line has a special meaning, Fig. 2-4. Contrast between the various line weights or thicknesses helps to make a drawing easier to read. It is essential that you learn this ALPHABET OF LINES:

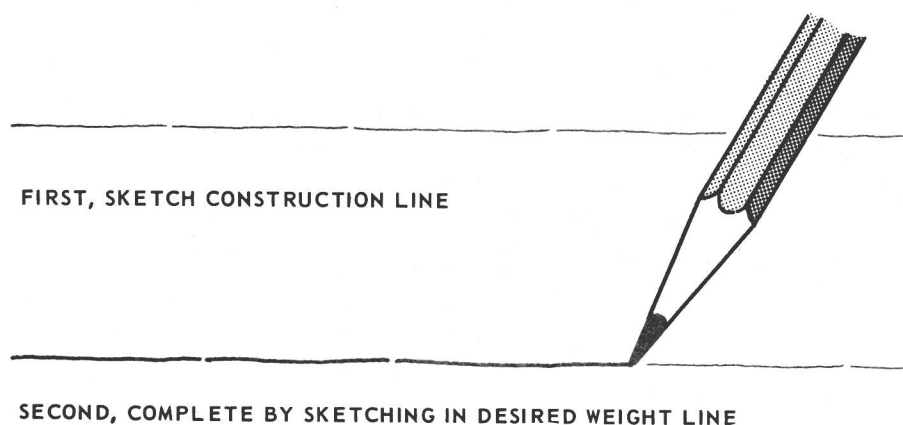


Fig. 2-3. When sketching, a line is drawn by making a series of short strokes.

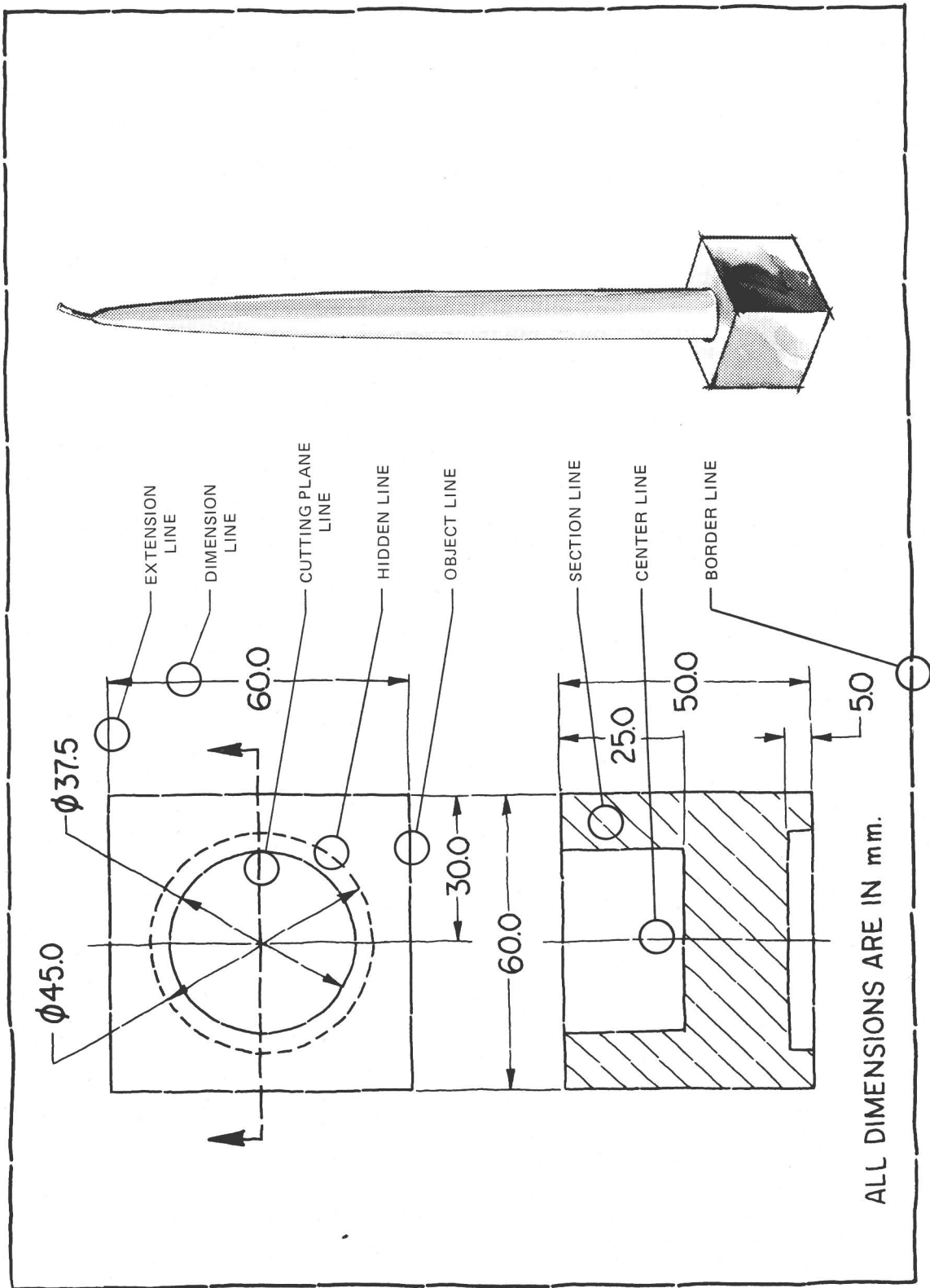


Fig. 2-4. ALPHABET OF LINES as used in sketching a project.

CONSTRUCTION AND GUIDE LINE

CONSTRUCTION LINES are used to lay out drawings. GUIDE LINES are used when lettering to help you keep the lettering uniform in height. These lines are drawn lightly, using a pencil with the lead sharpened to a long conical point.

BORDER LINE

The BORDER LINE is the heaviest (thickest) line used in sketching. First, draw light construction lines as a guide, then go over them using a pencil with a heavy rounded point to provide the border lines.

OBJECT LINE

The OBJECT LINE is a heavy line, but slightly less in thickness than the border line. The object line indicates visible edges. In sketching object lines, use a pencil with a medium lead and a rounded point.

HIDDEN LINE

HIDDEN LINES are used to indicate or show hidden features of a part. The hidden line is made up of broken lines with dashes about 4.0 mm long with about 1.0 mm spaces. It is medium weight and less prominent than the visible line.

EXTENSION LINE

EXTENSION LINES are the same weight as dimension lines. These lines indicate points from which the dimensions are given. The extension line begins 1.5 mm away from the view and extends about 1.5 mm past the last dimension line.

DIMENSION LINE

DIMENSION LINES generally terminate in arrowheads (about 3.0 mm long) at the ends. Generally, they are placed between two extension lines. A break is made, usually in the center, to place the dimension. A dimension line is placed a minimum of 10 mm away from the drawing. It is a fine line and is drawn with a pencil sharpened to a long conical point.

CENTER LINE

CENTER LINES are made up of alternate long dashes (10 to 40 mm long) and short dashes and spaces (about 3.0 mm and 1.5 mm respectively). Center lines are drawn about the same weight as dimension and extension lines. They are used to locate centers of symmetrical objects.

CUTTING PLANE LINE

CUTTING PLANE LINES indicate where an object has been cut to show internal features. Two types are acceptable. However, a cutting plane line made of 6.5 mm dashes with 1.0 mm spacing is recommended. The second type uses a long dash (15-40 mm) and short 3.0 mm dashes with 1.0 mm spacing. A cutting plane line is slightly heavier than an object line and is drawn using a pencil with a rounded point.

SECTION LINE

SECTION LINES are used when drawing inside features of an object to indicate the surfaces exposed by the cutting plane line. Section lines are also used to indicate general classifications of materials. These lines, light in weight, are drawn with a pencil sharpened to a long conical point.

