EVALUATING
ACADEMIC READINESS
FOR APPRENTICESHIP TRAINING

Revised for

ACCESS TO APPRENTICESHIP

COMMUNICATIONS SKILLS
INTERPRETATION OF DIAGRAMS

AN ACADEMIC SKILLS MANUAL
for
The Construction Trades (Structures)

This trade group includes the following trades:
Drywall & Acoustical Applicator, General Carpenter,
Mason (Brick & Stone and Restoration), Reinforcing Rod Worker, Roofer,
Terrazzo, Tile & Marble Mechanic

Workplace Support Services Branch
Ontario Ministry of Training, Colleges and Universities

Revised 2011

In preparing these Academic Skills Manuals we have used passages, diagrams and questions similar to those an apprentice might find in a text, guide or trade manual.

This trade related material is not intended to instruct you in your trade. It is used only to demonstrate how understanding an academic skill will help you find and use the information you need.

COMMUNICATIONS SKILLS
INTERPRETATION OF DIAGRAMS

An academic skill required for the study of the Construction Trades (Structures)

INTRODUCTION

You've probably heard this expression: "A picture is worth a thousand words." It means that something you can see would take a thousand words to explain. The purpose of graphic material (diagrams, charts, pictures) is to make information about your trade easy to see. The correct ***interpretation of diagrams*** is part of finishing a job in the construction trades accurately and efficiently.

The information in a diagram might illustrate a new concept, show the correct order of the steps of a procedure or give the requirements and measurements for framing a garage. You need to be able to interpret scale drawings and identify symbols on blueprints. Clearly, *interpretation of diagrams* is an essential skill for your technical reading toolbox.

In the construction trades, accuracy is essential. When you don't have access to hidden structures, you need to rely on diagrams to provide the background information needed to work precisely. Diagrams can provide you with details about areas that you can't see or touch.

Other graphics such as charts and tables list details such as measurements in a way that makes it easy to find the correct component needed for a specific situation. Pictures can give you an idea of the end result or they can show differences in related items.

Interpreting graphics correctly is an important skill to develop as you master the knowledge and techniques of your trade. In this skill sheet, we look at:

- Standard symbols and diagrams.
- Symbols and diagrams as visual language.
- Diagram and text that interpret information.
- Information in text and diagrams that match.

PART I
STANDARD SYMBOLS AND DIAGRAMS

Graphics

The term ***graphics*** refers to the various types of technical drawings and charts used in your trade. Graphics are a means of communicating complex ideas in a small space. They serve many purposes: they illustrate concepts, show relationships, compare information and illustrate how something works, how to do something, or where something is.

Symbols

As you learn your trade, you will be introduced to many symbols. Symbols are a shortened form of language. An object, process, relationship or number can be converted into a symbol. Many symbols are international. When you come across a symbol in your reading or on the job, you need to learn what term the symbol stands for and you also need to know what that term means.

Example: These three international symbols demonstrate this:

×	multiplication symbol	Multiplication is indicated by the symbol **x**. The **x** symbol immediately identifies a process. It also tells you what to do.
CO_2	carbon dioxide symbol	The relationship between a carbon molecule and an oxygen molecule can be stated symbolically. The symbol **CO_2** stands for or represents carbon dioxide. The **C** stands for a carbon molecule; the **O** stands for an oxygen molecule; the **$_2$** tells you there are two oxygen molecules. Glance back over this explanation on **CO_2**. "A symbol is worth a thousand words".
M	number symbol for million	Many numerical amounts are represented by symbols. **M** is the first letter of the Greek word mega (great) and it is used to represent the number million.

While many symbols, such as the ones shown above, are international, some countries and some agencies have their own symbols. The International Standards Organization (ISO), the Canadian Standards Association (CSA) and the American National Standards Institute (ANSI) are different accredited groups that use their own symbols. The following extract from a table of hydraulic and pneumatic symbols tells you that *ISO* has published these symbols.

Example:

Table 1: Basic Hydraulic and Pneumatic Symbols

ISO Symbols	Definitions
▼	Hydraulic Flow
△	Pneumatic flow
↗	Indication of variability

Symbols in text

Symbols are routinely used in technical writing as well as in drawings. The paragraph below shows how symbols can be used in writing to pass along specific information about an aspect of your trade − *heat loss coefficients:*

Example: Thermal properties of common building and insulation materials can be accurately measured. Heat transmission through any combination of these materials can be calculated using the following formula:

$$R = \frac{1}{k} \text{ or } \frac{1}{C}$$

(k and C are both measured in Btu's)

Your ability to correctly use information like this depends on understanding the meaning of R, k, C and Btu. If the symbols used in the text or diagrams are unclear, you need to look them up. We have listed the meanings of these symbols below:

R = Represents resistance to the flow of heat (which is the opposite of conductivity or conductance)
k = Coefficient of thermal conductivity (the amount of heat transferred in one hour through 1 square foot of a given material that is 1 inch thick and has a temperature difference between its surfaces of 1°F)
C = Conductance of a material, regardless of its thickness
Btu = British thermal unit (the amount of heat needed to raise the temperature of 1 lb of water 1°F)

As you learn your trade, you will encounter many symbols – some will be familiar and others will be new. It is your job to learn what they mean to add to your understanding of the concepts, principles, and "language" of your trade.

Which way is up?
Symbols help explain information.

Example: Objects shown at right angles can be viewed from different positions. The symbols in Figure 1 indicate the angle at which you view an object. They show whether you are viewing from left to right (**first-angle**) or from right to left (**third-angle**).

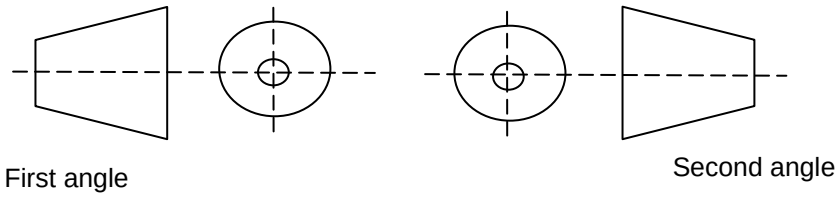


FIGURE 1: ISO symbols for the first- and third- angle projections

Symbols are shorthand for something. You need to know how to unlock the meaning presented by a symbol in a text or drawing. Each symbol transfers information to you efficiently, but you need to know precisely what it stands for. The difference between 30^{o} and 30" is significant.

Purpose
Your purpose in learning symbols is to learn to read and speak the language of your trade. You need to interpret both written material *and* any graphic material found in the text to understand and use the information presented.

PART II
SYMBOLS AND DIAGRAMS AS VISUAL LANGUAGE

Once you learn the meanings of trade symbols, you can recognize their meaning when you come across them in later sentences. This is the next sentence in the paragraph about heat loss coefficients.

> A good insulation material will have a high R-value. Calculate the R-value if C is 0.53 Btu.

You already know what *R-value, C and Btu* stand for, so you can carry out the calculation.

Lines mean something

Lines used in technical drawings convey meaning. Lines can be *thick* or *thin*; broken, with equal spacing; broken with long/short spacing and so on. Lines provide you with information. As with symbols, *standards apply to these lines and define their meaning* in the construction trades.

> **Example:** Canadian Standards define line thicknesses as *thick* or *thin*: *thick* is at least twice the thickness of *thin*. It is essential that you recognize what each line stands for in a chart or diagram. Figure 2 contains some samples to illustrate this:

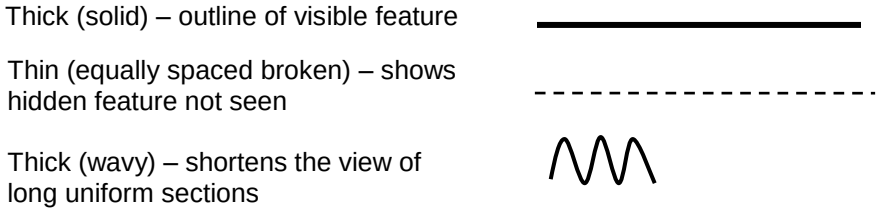


Figure 2: Examples Of Lines In Technical Drawings

What does this mean?

A diagram that contains lines and shapes is abstract – it represents something real but doesn't look like the real thing. Working diagrams usually are abstract.

> **Example:** A diagram of an automatic bleed-down circuit.

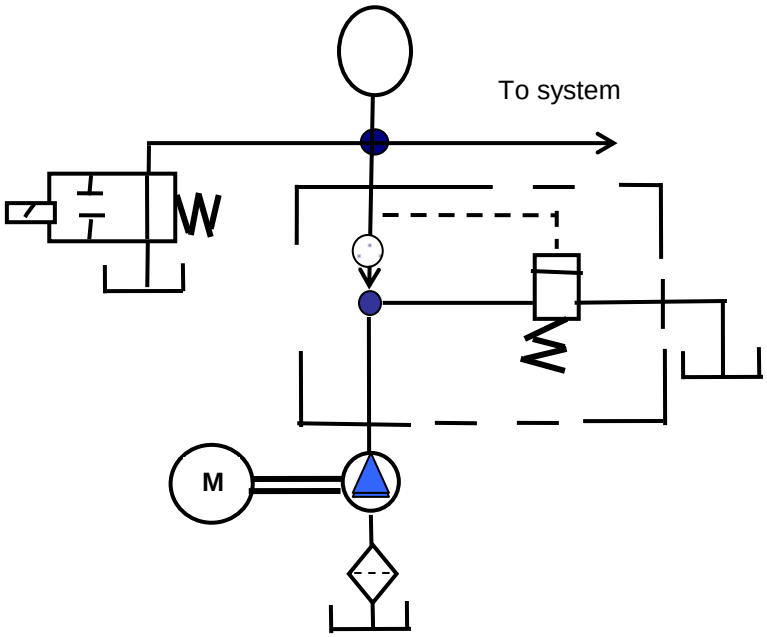


Figure 3: Automatic Bleed-Down Circuit

Working diagrams usually don't look like what they represent. In the diagram of an automatic bleed-down circuit, the circle with **M** in the middle stands for motor. This certainly doesn't look like a motor but, when you know M represents a motor and you see it in the diagram, you know the diagram includes a motor.

Each symbol you can interpret increases your ability to understand and use information presented in diagrams. Lines in drawings provide exact information about an object or a process. Figure 3 uses lines and symbols to show a series of relationships. It is a stripped down, but concise, visual language. Each part of this diagram conveys information about the placement of the following in an automatic bleed-down circuit:

- flow lines
- springs
- motor

Road maps

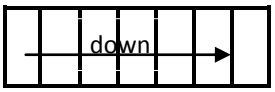
Compare Figure 3 to a road map. A road map gives you an overview of a whole system: compass directions, routes, distances, names of places. From it, you can calculate distance and travelling time, determine stopping points, plan routes. A figure with each of its symbols is like a map to use as a guide to essential trade information.

PART III
DIAGRAMS AND TEXT INTERPRET INFORMATION

Diagrams

Diagrams relate to something real. They show you how to do something, what something looks like, or the things that you can't see such as the flow of liquids or electrons. Some diagrams look

like the real thing (such as the drawing of a tool); some represent but do not look like, the real thing, such as this drawing/symbol below that indicates the presence and direction of stairs.



STAIR INDICATOR

Figures
When you are reading, you might be directed to a graphic, which is usually labeled as a Figure with a number. The reference to the graphic may be in parentheses like this (Figure 2-10). Or, the text may tell what the graphic will show you.

> **Example:** Laminated veneer lumber (LVL), as shown in figure 12-5, consists of select veneers bonded together with waterproof adhesives. It has all the capabilities of solid lumber without defects such as knots and warp.

Read everything
Knowing the purpose of a graphic helps you interpret what is being conveyed. It's important to get all the information available from a graphic. The information is there to help you develop a clear understanding of the principles and concepts required by your trade.

Labels and headings
Headings, titles and labels add to the information available in diagrams and help you interpret the information. Be sure to read all titles and headings. The labels or descriptions in a diagram identify what you are looking at; they may contain directions or point you to an important aspect of the diagram.

Use all the information provided by labels and written descriptions within the diagram to get the complete picture.

To interpret a diagram, start by reading the label. A label offers important information. It may

- identify the diagram,
- describe how to follow the information on the diagram,
- refer you to the text for clarification,
- highlight important points.

Diagram labels provide a focus for the information presented. Here are some samples of labels attached to diagrams. Each label gives more information than the one before it and each label relates to the graphic *and* text.

> **Figure 1** Combination Square
> **Figure 2** Measuring with a combination square
> **Figure 3** Using a combination square to scribe a line at a right angle to a surface.

Using Text and Diagram Together

Figures 4 and 5 provide key information about footing design. The text, diagram and chart are important and useful on their own, but together, they give a more complete picture concerning how footings should be laid out.

Passage 1
Footing Design

Footings must be wide enough to spread the load over an area that will adequately support it. Different soil types will have different load bearing capacities. See Figure 4 for a comparison of this capacity.

Type of Soil	Capacity in tons per square feet
soft clay	1
wet sand or firm clay	2
fine, dry sand	3
hard, dry clay or coarse sand	4
gravel	6

Figure 4: Load Bearing Capacities Of Soils. Different widths of footings are used for different types of soils and slopes.

For construction of residential and smaller buildings, a general rule is to make the footing twice as wide as the foundation wall. See Figure 5. The average thickness of a footing is about 8 inches.

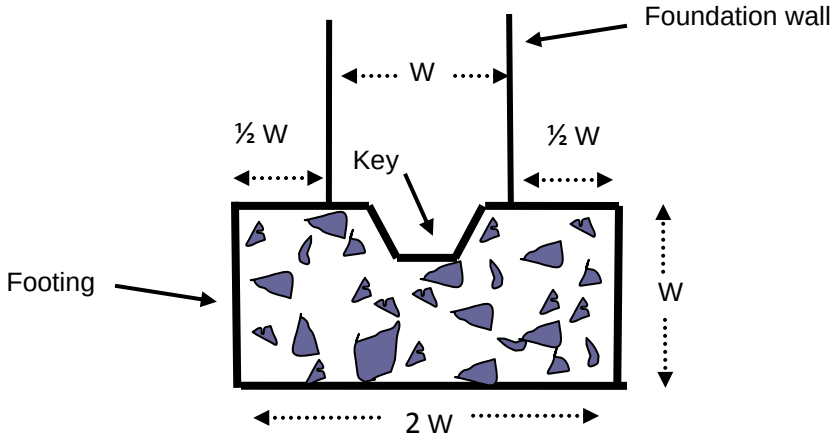


Figure 5: Standard Footing Design For Residential Construction. The footing is twice the width of the foundation.

Footings under columns and posts carry heavy loads and these loads are concentrated. The footings are usually from 2 to 3 feet square. The thickness should be about 1½ times the distance from the face of the column to the edge of the footing.

The chart and diagram give a clear picture of what is involved in choosing the width of a footing. They are labeled so you can identify and easily retrieve information. They are simplified so you can see the layout and the key details. Used with the text, they help you clearly understand this aspect of building foundations.

The text provides explanations and directions not found in the diagram.In this example, the text explains:

- why a footing needs to be wide enough,
- the different load bearing capacities of different soil types,
- footing widths for construction of residential and smaller buildings,
- average thickness of a footing under columns and posts,
- thickness of a footing supporting a column.

The diagram provides a clear picture of the footing and all the dimensions. The chart lets you easily compare the load bearing capacity of different soils. Together, they explain:

- types of soils and their load bearing capacities;
- what a foundation wall looks like;
- what the footing looks like;
- dimensions of the footing compared to the foundation wall .

The descriptions combine with the diagram and the chart to tell you a lot about footings. Clearly, the chart, diagram and text differ, yet ***they work together*** to describe an important concept in construction. Together they provide a mental and visual picture of the process of constructing a footing.

How not to . . .

Technical drawings often show you how to do something. The text describes actions to be done and explains the reasons for doing them, while the drawings show you how to perform those actions. Examining both the text and drawings helps you to accurately follow directions and avoid problems.

In the next example, the text describes how to clamp to a drill-press table in a correct and then an incorrect way. The diagrams illustrate both ways.

Passage 2
Drill Press Table

The work piece must be held securely for any drill-press operation. The clamps, bolts, and packing blocks must be located properly and the work clamped securely enough to prevent movement, but not tight enough to spring or distort the work. The correct clamping procedure is illustrated in Fig. 5A. Note that the step or packing block is slightly higher than the work and the bolt is located close to the work

piece so that the main pressure is applied to the work.

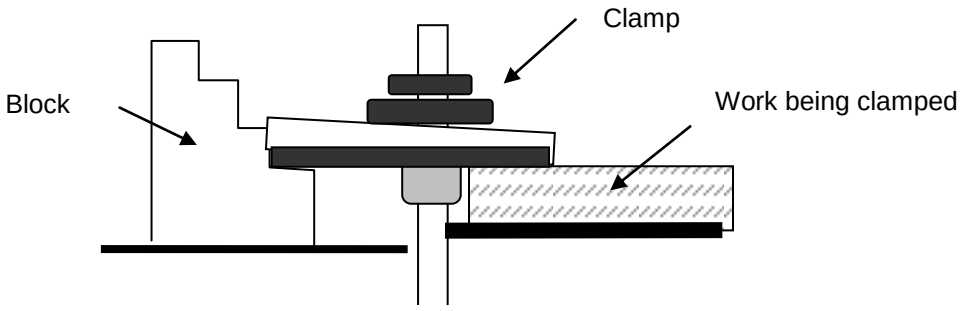


Figure 5A: Correct Clamping Procedure. Block is higher than piece being clamped

Figure 5B illustrates an incorrect clamping procedure in which most of the pressure is applied to the step or packing block. Incorrect clamping occurs whenever the step or packing block is lower than the part being clamped, or when the bolt is closer to the block than to the work.

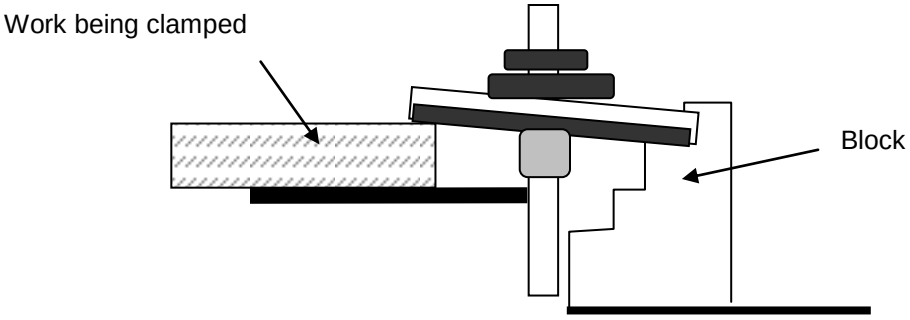


Figure 5B: Incorrect Clamping Procedure. Block is lower than piece being clamped

Read it all

When we look at diagrams, charts or tables, we need to refer back to *the guidance of the text*. The text tells us when to refer to the diagram and directs us to specific aspects of a drawing; it may repeat or emphasize important points.
The text in Passage 2 directs you to Figure 5A in the third sentence. Next, the text directs your attention to a point on the diagram:

> Note that the step or packing block is slightly higher than the work and the bolt is located close to the work piece.

Make sure you find the corresponding spot on the diagram. It is illustrated so that you can see it and understand it. You need to be sure that you are seeing exactly what you are supposed to see.

The rest of the sentence gives you a reason for the placement described:

> . . . so that the main pressure is applied to the work.

Figure 5B shows you incorrect clamping. After comparing correct and incorrect methods, you should be able to apply these directions. Further, the visual information should help you remember how to do this and why it's important to do it right.

Test yourself
Assess how well you are interpreting diagrams. If we removed the references to the figures in the text in Passage 2 (e.g. Figure 5A, Figure 5B), could you do the following?

1. Match the text and diagrams correctly.
2. Identify which method of clamping is correct and which is incorrect.
3. Explain why the two methods differ? If it is not clear, read and then reread. Match diagram to text and text to diagram as you go. Find relevant spots on the diagram the way you would pick out points on a map.
4. Compare the two diagrams while referring to the text.
5. Piece together possible consequences of incorrect clamping from information contained in the text and diagrams.

If you can answer yes to the questions above, you have correctly interpreted the information.

PART IV
INFORMATION IN TEXT AND DIAGRAMS

Stop and read the diagram
A diagram relates to something real, whether it is a hydraulic circuit or the symbol for ducting on a blueprint. You need to be able to convert the information into language and later into actions.

The first step is to understand what is being depicted by the diagram. Try to describe to yourself in words what the diagram represents. If you don't recognize certain symbols, look them up.

Read Passage 3 below and identify places or points on the diagram that correspond to the main text. The text explains what is happening; the diagram converts this into something visual. You can *see* the individual rooms to be floored. You can also see the chalk line, starting point, direction to lay in and the location of the splined grooves.
Both the text and diagram in this example move from left to right, although in the diagram we can see the circular nature of the process. Once you have followed the information flow, you ***interpret*** what is happening at different stages.

Passage 3
Multiroom Layout

When a flooring installation is carried throughout the major part of a building, study the floor plan to determine the most efficient procedure to follow. Figure 7 shows a typical residential floor plan with a method for the installation of strip flooring. A setup line (chalk line) is first laid out two flooring widths (plus ½ in) from the partition as shown. The starter courses are aligned with the setup line before face nailing. Installation is continued across the living room, across the hall, into and through bedrooms No. 1 and No. 2. A spline line is set in the groove of the starter strip and the floor is laid from this point into the dining room and bedroom No. 3. In bedroom No. 2, a splined groove is also used to lay the floor

back into the closet. In small closet areas, such as shown in bedroom No. 1, it is usually impractical to reverse the direction of laying with a splined groove and the pieces are simply face nailed in place.

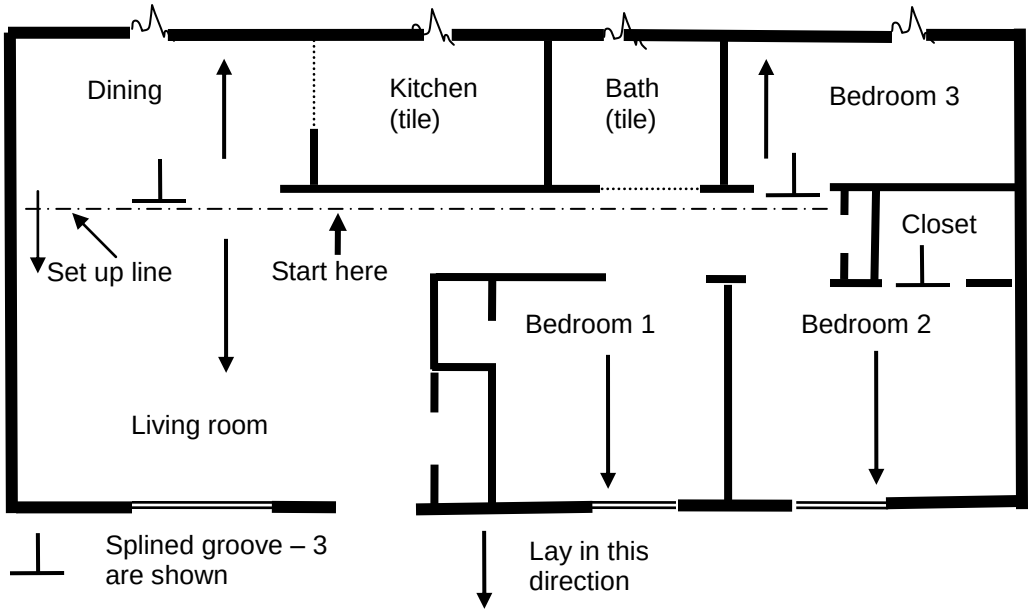


FIGURE 7: Floor plan shows correct procedure for laying strip flooring throughout a number of rooms

The last strip along the wall of a room will usually need to be ripped so it will have the required clearance (½ in minimum). The last several strips must be face nailed. Do not use ripped strips where they might detract from the appearance. It is recommended that full-length strips always be used around entrances and across doorways. In general, plank flooring is installed by following the same procedures used for strip flooring. In addition to the regular blind nailing, screws are set and concealed in the face of wide boards.

Answer the questions below. Answers are at the end of this skills manual.

1. Which sequence of information is correct, **A** or **B**?

   A. a) set up chalk line,
   b) align starter course with set up line,
   c) face nail starter course and set up splined grooves in dining room and bedrooms 2 and 3,
   d) proceed counter clockwise beginning in living room and ending with the dining room.

   B. a) set up chalk line,
   b) face nail starter course after aligning it with set up line,
   c) begin by laying the living room and work from right to left into the second bedroom,
   d) set a spline line in groove of starter strip, and lay dining room and the third bedroom.

2. Which of the following describes the correct procedure when laying floor in Bedroom No. 1?

   a) The room is laid after the hallway and the strips are laid working from the hallway toward the opposite wall.
   b) The strips are laid in the direction from the hallway to the opposite wall and a splined grove is necessary to reverse the direction of laying in the closet.

3. Which of the following describes the most likely procedure for laying flooring in the kitchen or bathroom?

    a) Lay kitchen flooring after completion of dining room and the bathroom after completion of the hallway.
    b) Lay the flooring of kitchen and bathroom in the same direction as adjacent rooms.
    c) There are no directions because they are tiled and the procedure for laying tile may differ from the procedure for laying strip flooring.

CONCLUSION

The text that accompanies a diagram is directly related to it. They are partners. Usually the main text explains in words the information you see in a diagram. It also directs you at the appropriate time to study the diagram. It tells you what you should look for in the diagram.

When you use the information from both text and graphics, you develop a clearer understanding of a principle, a procedure or a type of equipment. Use text and diagrams together to enrich your learning.

When the text describes steps in a process and the diagram illustrates it, you can follow the information flow, Your eyes can move in all directions. You can *see* the information from different points in the process. You can interpret what is happening at different stages.

Technical diagrams and symbols transfer information. Provided you read carefully and interpret correctly, graphics can do any of the following in little space and at a glance:

- show relationships.
- make abstract ideas easier to understand.
- show you something invisible or hidden
- focus on and emphasize important aspects on information.

Summary

1. ***Symbols* are a form of shorthand.** Understand what symbols represent to understand the language of your trade. Note any differences between countries.

2. ***Lines* convey information**. Lines and symbols can show relationships, objects and processes.

3. **Diagrams (graphics) use a visual approach** to make technical information more meaningful.

4. **Diagrams are labelled** to identify parts and their relationships.

5. **The text and diagram relate to each other** and work as partners. Always use them together.

6. **Always read the description that accompanies each diagram**. Text tells you what you are looking at and what to look for.

7. **Diagrams and symbols relate to something you need to know**. Interpret and connect them to achieve understanding.

Answer Page

PART IV, Multiroom Layout,

1. Which sequence of information is correct, **A** or **B**?

   B.
   a) set up chalk line,
   b) face nail starter course after aligning it with set up line,
   c) begin by laying the living room and work from right to left into the second bedroom,
   d) set a spline line in groove of starter strip, and lay dining room and the third bedroom.

   The diagram and text work together to clearly describe this sequence. Sequence **A** is incorrect because it omits the step of setting the splined line and assumes we work in a circle. In this case, the text is essential in finding the correct sequence. Make sure you read it carefully and refer to the diagram for verification and better understanding.

2. Which of the following describes the correct procedure when laying floor in Bedroom No. 1?

   a) The room is laid after the hallway and the strips are laid working from the hallway toward the opposite wall.

   If you read the passage carefully, you will see that in this case, a spline grove is ***not*** necessary because this closet is small. In this situation, the flooring will be face nailed in place, so Answer **b)** is incorrect. Answer **a)** provides us with the correct information.

3. Which of the following describes the most likely procedure for laying flooring in the kitchen or bathroom?

   c) There are no directions because they are tiled and the procedure for laying tile will differ from the procedure for laying strip flooring.

   The passage contains no directions for laying flooring in the kitchen or bathroom. The diagram labels both of these rooms with the word (tile) in parentheses. This tells us that these rooms will be floored with tile. Therefore, the instructions for strip flooring that apply to the rest of the floor won't apply in these two rooms. Answer **c)** is the best answer.