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PREVIEW  
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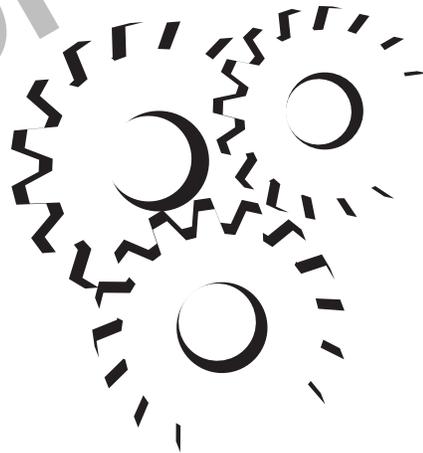
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***A MAINTENANCE TRAINEE'S INTRODUCTION  
TO CARPENTRY***

***Lesson One***

***Layout and  
Hand Tools***



36101

***TPC Training Systems***

**Lesson*****Layout and Hand Tools*****TOPICS**

**Introduction**  
**Dressing for Carpentry Work**  
**Safety Accessories and Equipment**  
**Layout Tools**  
**Straightedge**  
**Marking Gauge**  
**T-Bevel and Protractor**

**Framing Square**  
**Testing a Framing Square**  
**Chalk Box and Line**  
**Work-Holding Vises and Clamps**  
**Hand Tools**  
**Your Toolbox**

**OBJECTIVES**

**After studying this lesson, you should be able to...**

- Identify the safety equipment that a carpenter should wear to protect his eyes, hands, and feet.
- List the twelve common layout tools mentioned in this lesson.
- Describe how to check the accuracy of a framing square.
- Tell how you would acquire the hand tools you need as a carpenter trainee.
- Point out the features that you'd look for when buying your own toolbox.

**KEY TECHNICAL TERMS**

**Hazard** 1.03 something that can cause you harm if you're not dressed or equipped to deal with it  
**Safety code** 1.15 set of state or local laws regulating the safety of your workplace

**Straightedge** 1.19, 1.20 strip that has an accurate edge for drawing straight lines and checking construction  
**Framing square** 1.24 large square with tables printed on it for pitching roofs and laying out stairs

Carpentry, like other trades involved in today's building technology, includes a variety of tasks. These tasks range from the rough framing of a building's wood skeleton to the finishing of its interior paneling and trim. Sometimes, one carpenter will do all of the tasks. Often, however, a team of carpenters with special skills will each perform just one task on a series of buildings.

Some carpenters specialize in a certain phase of building: roofing, flooring, siding, or drywall installation, etc. Although each carpenter is a specialist, he must have a good overall knowledge of carpentry so he can complete his work in a way that makes it easier for other craftsmen to do their jobs.

This course acquaints you with the elements of carpentry: hand and power tools, lumber and materials, plans and drawings, and the planning of carpentry tasks. It will make you, as a maintenance carpenter, familiar with the basics of the trade. Then you can continue with the next courses, which explain the framing and finishing operations of carpentry.

## Introduction

1.01 As broad as the field of carpentry is, there are still only a few basic rules for successfully completing any task. These rules are: 1) plan carefully, 2) be accurate, 3) build for strength, 4) be neat, and 5) work safely. Carpentry tools are of three general classes:

- layout tools, for accurately laying out and measuring a project
- hand tools, for doing the shaping and/or erecting
- portable power tools.

This lesson covers both layout and hand tools.

1.02 Before picking up a tool to do any task, you should have the knowledge and means to protect yourself from on-the-job accidents and injuries. Like all industrial occupations, carpentry has its safety hazards. You need to know how to dress properly for work and how to use the various safety equipment provided for your protection.

1.03 Job safety is a combination of knowing how to use tools and an awareness of the hazards that exist. You can learn to use tools, but you need the right attitude to develop awareness of hazards. Being aware of dangers on the job will help protect you and your co-workers from injury.

## Dressing for Carpentry Work

1.04 As a general rule, clothing worn on the job should be protective and comfortable. The carpenter in Fig. 1-1 is dressed correctly. He's wearing a hat and a long-sleeved shirt of heavy material. Avoid all kinds of loose clothing, because it can be dangerous. The descriptions on the following page will help you to recognize and acquire suitable clothing.

1.05 **Coveralls.** Wear well-fitting coveralls with a lot of pockets and loops for carrying tools. You can save time by carrying frequently-used tools around the job site with you. If you don't like coveralls, wear

**Fig. 1-1. A carpenter properly dressed for work**



pants without cuffs (so they don't catch on anything and trip you). If you're wearing pants, add at least a hammer holster on your belt, and a nail apron.

**1.06 Shirt.** In good weather, roll your sleeves tightly above your elbows. Do not wear loose cuffs or a necktie that may get caught in machinery. In cold weather, button or zip up your jacket.

**1.07 Shoes.** Thick-soled work shoes give good protection against nails and other sharp objects. Wear shoes with safety toes if necessary. Always wear rubber boots in damp areas. Never wear sneakers, sandals, or old dress shoes.

**1.08 Gloves.** A carpenter's hands are more important than his tools. Protect your hands from rough surfaces and sharp edges with good quality gloves, especially when unloading and moving materials.

**1.09 Hat or cap.** Wear a head covering to keep your hair away from rotating equipment. If the job requires a hard hat, wear one. In some cases, hard hats are required by law.

**1.10 Eye protection.** When sawing or chipping, protect your eyes from sawdust and chips. Wear goggles or glasses with shatterproof lenses, such as the ones shown in Fig. 1-2.

**1.11** Don't wear jewelry on the job. Rings, neck chains, and wristwatches can snag on work and get caught in machinery. Rings cause blisters if you wear one while using hand tools for long periods. Vibrating machinery can damage wristwatches. Keep your nails trimmed short to prevent painful accidents. And, if you have long hair, tie it back out of your sight.

**Fig. 1-2. Safety glasses for eye protection**



### Safety Accessories and Equipment

**1.12** Like any other trade in the construction industry, carpentry has its occupational risks. You can protect yourself against serious injury and disability by using common sense—and by equipping yourself with a few basic safety items. In addition to the hard hat and goggles already mentioned, ear plugs and dust masks are often useful. Ear plugs protect your hearing from the damaging high-level noise produced by some power tools. A dust mask protects your lungs when sawing or sanding, and especially during dirty demolition operations. Glasses or goggles will protect your eyes from dust and dirt raised by demolition.

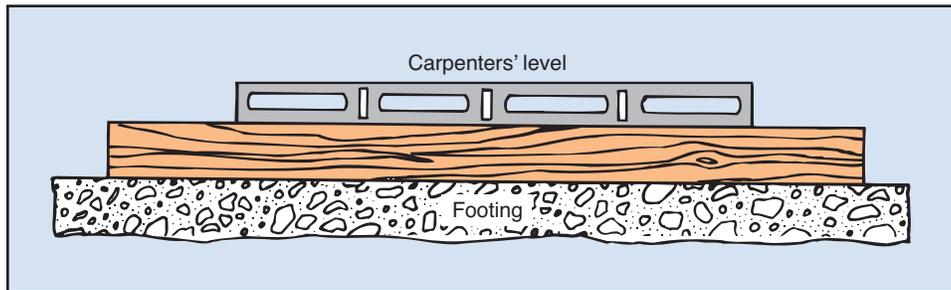
**1.13** You should also have a first aid kit, complete with disinfectant and bandages, on the job at all times. Adhesive bandages carried in your wallet often come in handy. They prevent minor cuts from becoming infected, and they enable you to continue working when you cover minor blisters with them. Be a professional. Get the best possible safety accessories and use them regularly. Forgetting to use safety accessories can make a hazardous situation even more dangerous.

**1.14** Carpenters use a great variety of equipment in the course of a day's work. Every manufacturer has his own "safe operating instructions" for his tool or product. Portable power tools have one type of instructions; hand tools have another type. You'll be learning how to use tools such as chisels, hammers, planes, routers, saws, and wrenches, to name a few. There are very specific instructions for the proper use of ladders, scaffolding, welding equipment, and even fire-fighting apparatus. Whenever you are in doubt about the way to use any of these, ask your supervisor.

**1.15** State and local safety codes, to which building contractors must conform, assure you, the carpenter, safe surroundings in which to work. But you must work in a safe manner. You must use tools safely. You must read the instruction plates and warning labels on all equipment. You should also report defective equipment to your supervisor without delay. In short, your safety education must become just as important in your daily training as the development of your technical and manual skills.

### Layout Tools

**1.16** Carpentry consists of building, and building consists of making joints—many types of joints. All

**Fig. 1-3. Proper use of a carpenters' straightedge**

joints must be made with care. The joined parts require accurate measurement and precise cutting. All materials must be cut straight, and to the proper length. In order to assure accurate work, you must first carefully lay out the joints, using accurate layout tools that you can read quickly and correctly.

1.17 Good tools are a necessity in any trade. In carpentry, especially, you need good layout tools. No matter how fine the hand tools you use for cutting and shaping, you cannot make correctly fitting joints unless you first lay them out accurately with dependable tools. It is important that you be sure to select your layout tools carefully. Buy tools made by recognized manufacturers at reputable stores. It pays to buy tools of good quality. Bargain tools do not usually turn out to be bargains.

1.18 The layout tools that a carpenter usually uses include most or all of the following:

- scribe
- combination square\*
- folding rule\*
- T-bevel and protractor
- measuring tape\*
- framing square

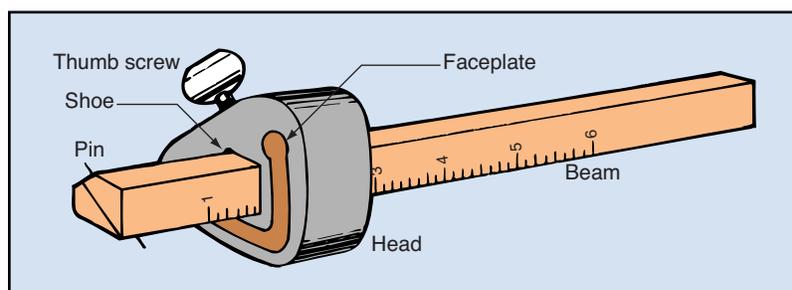
- straightedge
- carpenter's level\*
- marking gauge
- try square\*
- plumb bob\*
- chalk box and line
- work-holding tools.

The starred (\*) tools listed above are already covered in detail in TPC Training Book 107 Hand Tools. The others are described in the following paragraphs.

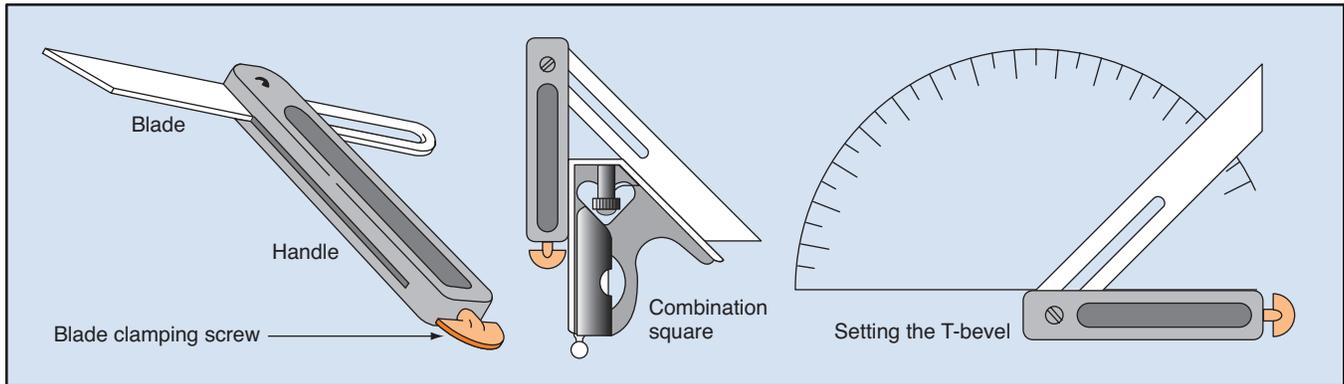
### Straightedge

1.19 Use a straightedge to guide a pencil or scribe in marking a straight line or to test a faced surface—for example, to check the straightness of the edge of a board. Actually, you can use the edge of anything that you know is straight, such as the edge of a steel square. However, a standard metal straightedge is still the best tool for the job. Use a straightedge to plumb, or level, your construction when you find that the length to be checked is longer than your level (Fig. 1-3).

1.20 A straightedge for carpentry work may be of either wood or metal. It may be a few inches long, or several feet in length. For ordinary work, you can make

**Fig. 1-4. A typical single-bar marking gauge**

**Fig. 1-5. A T-bevel can be set at any angle**



a fairly accurate straightedge from a strip of good, straight-grained wood, such as a strip 4 in. wide ripped from a sheet of plywood  $\frac{1}{2}$  or  $\frac{3}{4}$  in. thick. However, wood tends to warp out of shape, so you should use only a steel edge for accurate work. To hold a straightedge steady while scribing a straight line, press down firmly on its center area with your fingers spread apart.

### Marking Gauge

1.21 A single-bar marking gauge, shown in Fig. 1-4 on the previous page, has many uses. It is quite simple, and is made of either wood or metal. Most frequently, it is used to make a single mark for cutting off a board to a desired length. A single-bar marking gauge consists of a small beam with a graduated scale on it, along which slides a movable head that has a lockscrew.

1.22 Simply use the screw to set the required dimension between the sliding head and the scribing pin in the end of the beam. Transfer the dimension to the workpiece by pressing the face of the head against the edge of the board, then pushing the gauge away from

you (with slight downward pressure) so the pin scribes a line parallel to the edge or end of the board.

### T-Bevel and Protractor

1.23 The T-bevel is much like a try square. The only difference is that it has an adjustable handle that pivots on a special bolt with a wing nut. The handle can be set at any angle (Fig. 1-5). With the handle loose, you can press the T-bevel into an odd-angled corner, then tighten the nut so you can retain the angle on the T-bevel. Then it's easy to transfer the angle from the job or project to the workpiece you're making. You can also use a protractor to set the T-bevel at any desired angle. Position the pivot over the center of the protractor and adjust the handle to the correct number of degrees.

**The Programmed Exercises on the following page will tell you how well you understand the material you have just read. Before starting the exercises, remove the REVEAL KEY from the back of your book. Read the instructions printed on the Reveal Key. Follow these instructions as you work through the Programmed Exercises.**

<p>1-1. The general classes of carpentry tools are layout tools, hand tools, and portable _____.</p>	<p>1-1. POWER TOOLS Ref: 1.01</p>
<p>1-2. Job safety is a combination of knowing how to use tools and an awareness of the _____ that exist.</p>	<p>1-2. HAZARDS Ref: 1.03</p>
<p>1-3. If you wear trousers, also wear a nail apron and a _____ holster.</p>	<p>1-3. HAMMER Ref: 1.05</p>
<p>1-4. If you are working in a damp area, always wear _____.</p>	<p>1-4. RUBBER BOOTS Ref: 1.07</p>
<p>1-5. You can protect your lungs during dirty demolition operations by wearing a _____.</p>	<p>1-5. DUST MASK Ref: 1.12</p>
<p>1-6. Carpentry consists of building and building consists of making many types of _____.</p>	<p>1-6. JOINTS Ref: 1.16</p>
<p>1-7. To mark a board for cutting off to length, mark the cut with a _____.</p>	<p>17. MARKING GAUGE Ref: 1.21, Fig. 1-4</p>
<p>1-8. To transfer an angle from a structure to a workpiece, set the angle on a _____.</p>	<p>1-8. T-BEVEL Ref: 1.23, Fig. 1-5</p>

## Framing Square

1.24 The framing square, shown in Fig. 1-6, is sometimes known as the carpenter's steel square. It is a multipurpose tool. As a larger version of the try square (it's 24×16 in.) you can use it for drawing layout lines at right angles and for checking doors and door openings for squareness. It's more accurate than other squares because it has longer legs.

1.25 A framing square has several dimensional scales. An inch is usually divided into various fractions: eighths and sixteenths on the face side, and tenths, twelfths, and thirty-seconds on the reverse side. In addition, the square is imprinted with several tables (rafter, Essex, brace, etc.) to help you lay out stairs and roof rafters with great accuracy. These tables will be studied in detail in a later course on Framing Operations.

1.26 You can obtain a framing square with either a blued, polished, nicked, or copper finish. The blued one, with dimensions and scales in white, is the easiest to read. Because the framing square is so accurate, it is useful in places where the common combination square just isn't good enough to do the job. A good framing square is just as important to a carpenter as a good level. No modern carpenter should be without one.

### Testing a Framing Square

1.27 To test the square, select a sheet of plywood or similar material that has a factory-straight edge.

Place the square on top of the plywood with the blade extending to the left and the tongue at right angles to the edge of the plywood. Hold the square firmly in position, with the entire blade length aligned with the wood's edge and the tongue extending away from you across the board.

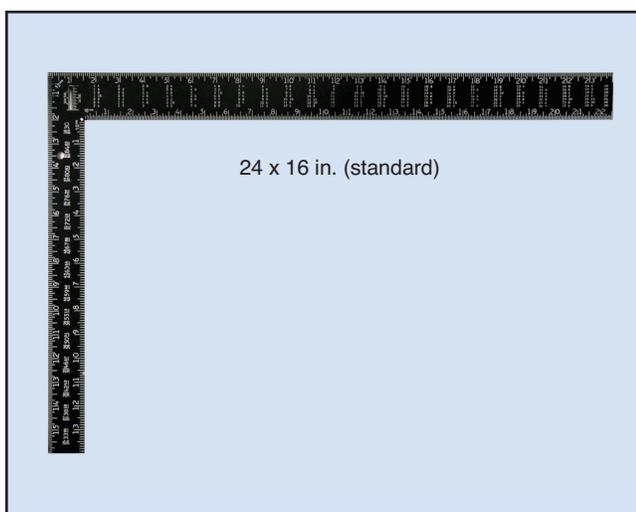
1.28 While holding the square in this position, draw a line across the board (against the tongue of the square) with a penknife or sharp-pointed pencil. Then turn the square over with the blade extending to the right along the wood's edge. At the same time be sure to keep the heel (outer corner of the square) right on the line you've drawn across the board.

1.29 Now compare the position of the tongue with the mark across the board. If the edge of the tongue is exactly on the mark, or if a new mark made against the edge of the tongue in its new position coincides with the first mark you drew, your square is truly square. If the angle of the square is more or less than 90°, the square is defective. Replace the square with a new one. Always check out a new one by the above process before you purchase it.

### Chalk Box and Line

1.30 The chalk box and line, shown in Fig. 1-7, is a handy device for marking long straight lines between two points that are too far apart to use a square or a straightedge. The plastic or aluminum box contains white or colored powdered chalk. As you pull the

**Fig. 1-6.** Carpenters' framing square



**Fig. 1-7.** A common type of chalk line and box



lightweight cord or twine from a reel in the box, the chalk sticks to the cord. All you do is stretch the cord between the points, draw it tight, and snap it against the work surface with your finger. This produces a highly visible line of chalk for your guidance.

1.31 When preparing to snap the line, it is important to pull it at right angles to the work surface before letting it snap back. This assures printing a straight line. If you pull it even a little bit to one side, you will produce a faulty, curved line. For clear lines, keep the box filled with chalk. Also, reel in the cord carefully after each use so it doesn't get tangled (the cord can be up to 100 ft long). Be sure that the ring at the end of the cord is secure so the cord can't disappear into the box.

### Work-Holding Vises and Clamps

1.32 To ensure accurate woodwork, workpieces must be held tightly on the bench so they don't slip when you cut them. A woodworking vise, shown in Fig. 1-8, is a valuable tool for this purpose. A vise must first of all be rigid and heavy. It must also be strong to resist the force of your tools. It is usually fitted to the top of your workbench.

1.33 To get the best service from a vise, always try to clamp the workpiece somewhere near its center. Don't allow clamped work to overhang excessively from the vise. Always clamp work so that the faces of the vise jaws bear equally upon it. Hardened jaws can break if the bearing load isn't uniform. By all means,

keep the vise screw and nut well lubricated. Take the front jaw off and turn it over each time you lubricate the screw.

1.34 You will often have to press glued pieces of wood together until the glue sets. If you're using the vise for another task, use clamps, like the ones shown in Fig. 1-9, to hold the glued pieces together. A single-screw C-clamp is the most common type of clamp. Another type of clamp, the handy double-screw clamp, is made of wood. It is a good tool, but you must use some models with great care, because even their screws are made of wood.

### Hand Tools

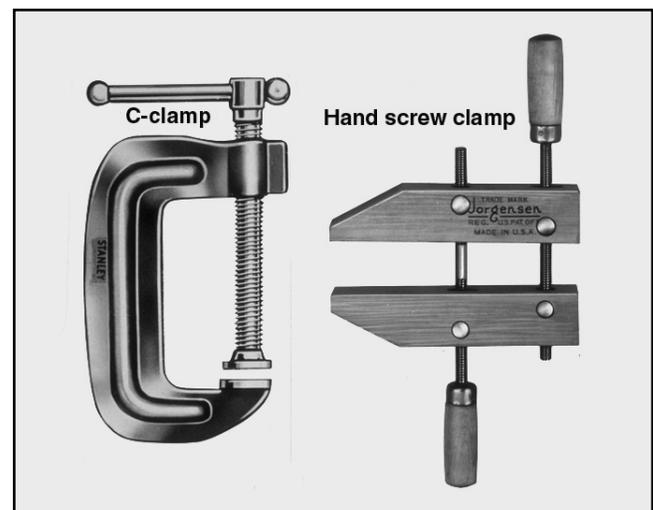
1.35 There are literally hundreds of hand tools available to the carpenter. However, only a few of them are needed to do most tasks. Carpentry tools are nowhere near as costly as those for some other building trades, but they will last a long time if you care for them properly. The best way to build a collection of tools is to buy only the ones that you need—tools to help you do the job right. Select tools of a size and weight that are comfortable for you to use.

1.36 Many basic tools are designed for more than one use or purpose. Read the operating instructions for such tools so you understand their multiple-use features. (This may save you from buying two tools when one will do.) Avoid using a tool for a task that it's not designed to do. Chances are that you'll ruin the work, break the tool, and perhaps injure yourself.

Fig. 1-8. Woodworking vise for benchwork



Fig. 1-9. Two common types of clamps



**Fig. 1-10. Open toolbox**

1.37 While opinions may vary slightly, most carpenters agree on the basic tools that a trainee should have. They include the following, all of which are described in detail in Course 107, Hand Tools:

- hammer
- screwdriver
- drills
- crosscut saw
- jack plane
- putty knife
- ripsaw
- chisels
- scraper
- hacksaw
- wrenches
- metal snips

**Fig. 1-11. Closed toolbox**

- compass saw
- pliers
- nail sets.

### Your Toolbox

1.38 Your toolbox should be of sturdy, lightweight construction. It should be just big enough to carry what you need. An open box like the one shown in Fig. 1-10 is perhaps the most useful type on the job because it provides ready access to your tools. A closed box, shown in Fig. 1-11, is the best type for storing tools. Be sure it has strong hinges and a good latch and lock.

1.39 **Identification.** Identify your tools clearly. Etch your name into the metal. Mark each tool with colored tape or some other means to make it easy to recognize when you're on the job. Color marking will help you to locate your tools quickly at the end of the day if someone else has been using them.

1.40 **Protection.** Protect your tools at all times. When you leave the job at the end of the day, take your toolbox with you or leave it under the lock-and-key protection of the night watchman. Your tools, along with your ability to use them, are your means of livelihood. You lose money whenever you don't have your tools readily available!

1.41 This lesson covers only a fraction of the tools available to the carpenter. Yet it does cover the essentials that he needs for most maintenance tasks. It is important to be prepared for any task. However, you don't need to spend a lot of money and overburden yourself with tools.

1.42 Professional carpenters tell a long-standing story about apprentices with little know-how who have toolboxes that are too heavy to move around. Don't let this happen to you. Learn to use the basic tools described in this lesson. Then add more tools according to your specific needs and work habits. The following 20 tools will help you perform at least 95 percent of the tasks you may be assigned.

1.43 These tools (which you can buy for a couple hundred dollars), plus a few power tools, are all that you will really need to start:

- tape or folding rule
- floor chisel

- combination square
- crowbar
- framing square
- jack plane
- carpenter's level
- crosscut saw
- plumb bob
- compass saw
- chalk line
- putty knife
- claw hammer
- mat knife
- wood chisels
- open-end wrenches
- standard screwdriver
  - medium size
- vise-grip pliers
  - medium size
- Phillips screwdriver
  - medium size
- metal snips
  - medium size.

PREVIEW  
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## 14 Programmed Exercises

1-9. You can check the squareness of doors and door openings with a _____ square.	1-9. FRAMING Ref: 1.25
1-10. To test a framing square, use a sheet of material that has a _____ edge.	1-10. FACTORY-STRAIGHT Ref: 1.27
1-11. The proper tool for marking a straight line between two distant points is a _____.	1-11, CHALK BOX AND LINE Ref: 1.30, Fig. 1-7
1-12. When using a woodworking vise, always clamp a workpiece near its _____.	1-12. CENTER Ref: 1.33
1-13. To press glued pieces together, use a double-screw clamp or a _____.	1-13. C-CLAMP (SINGLE-SCREW CLAMP) Ref: 1.34, Fig. 1-9
1-14. The best way to build a collection of tools is to buy only the tools that you need. True or False?	1-14. TRUE Ref: 1.35
1-15. You need about _____ tools to perform 95 percent of all carpentry work.	1-15. 20 Ref: 1.39
1-16. The best type of box for storing tools is the _____ box.	1-16. CLOSED Ref: 1.41

Answer the following questions by marking an "X" in the box next to the best answer.

- 1-1. The three classes of carpentry tools are
- a. erecting, cutting, and layout
  - b. cutting, layout, and portable power
  - c. layout, hand, and portable power
  - d. hand, cutting, and erecting
- 1-2. As a general rule, clothing worn on the job should be
- a. snug and warm
  - b. protective and comfortable
  - c. loose and baggy
  - d. water resistant
- 1-3. Which of the following articles of clothing is safe for a carpenter to wear?
- a. Wristwatch
  - b. Shirt with sleeves rolled up tightly
  - c. Pants with cuffs
  - d. All of the above
- 1-4. A useful safety appliance to wear during demolition operations is a
- a. dust mask
  - b. nail apron
  - c. set of cuff guards
  - d. heavy belt
- 1-5. To be considered a safe carpenter, which of the following must you do?
- a. Use tools safely
  - b. Read instruction plates
  - c. Report defective equipment
  - d. All of the above
- 1-6. If you don't have a good straightedge, what can you use in place of it?
- a. A string with weighted ends
  - b. A strip of straight-grained wood
  - c. A length of pipe
  - d. A chalk line
- 1-7. What tool is used most often to mark a board for cutting off to length?
- a. Straightedge
  - b. Marking gauge
  - c. T-bevel
  - d. Trammel points
- 1-8. A carpenter's steel square for checking doors and door openings is also called a(n)
- a. try square
  - b. utility square
  - c. framing square
  - d. combination square
- 1-9. When a common combination square isn't accurate enough to do a job, you should use a
- a. framing square
  - b. T-bevel
  - c. try square
  - d. marking gauge
- 1-10. When you are shaping a piece of wood on your workbench, hold it steady with a
- a. C-clamp
  - b. double-screw clamp
  - c. woodworking vise
  - d. all of the above

## SUMMARY

You may have the best hand tools on the market for shaping and assembling carpentry projects, but you won't be able to do accurate work with them unless you have good layout tools. Using layout tools correctly will help you measure accurately, draw a straight line, and properly locate the centers of holes, etc. As a general maintenance carpenter, you must begin all your projects with accurate layouts.

As shown in the latter part of this Lesson, a tool kit for a trainee like yourself need not consist of more than 20 tools. About half of these are for laying out and half for shaping. Pick your tools care-

fully from the stocks of reputable stores. The basic layout tools that you'll need include: a scribe, straightedge, folding rule or steel tape, level, plumb bob, chalk line, and a couple of squares (combination and framing).

Along with your hand tools, keep your layout tools in a convenient toolbox. Learn to use the basic 20 tools well before you think about adding more tools to your kit. Be sure your toolbox is light and strong and has special protective mountings for the tools. Mark the tools with your name or an identifying color, and keep them under lock and key when not in use.

## Answers to Self-Check Quiz

- |      |    |                                                 |       |    |                                                       |
|------|----|-------------------------------------------------|-------|----|-------------------------------------------------------|
| 1-1. | c. | Layout, hand, and portable power. Ref: 1.01     | 1-6.  | b. | A strip of straight-grained wood. Ref: 1.20, Fig. 1-3 |
| 1-2. | b. | Protective and comfortable. Ref: 1.04           | 1-7.  | b. | Marking gauge. Ref: 1.21, Fig. 1-4                    |
| 1-3. | b. | Shirt with sleeves rolled up tightly. Ref: 1.06 | 1-8.  | c. | Framing square. Ref: 1.24                             |
| 1-4. | a. | Dust mask. Ref: 1.12                            | 1-9.  | a. | Framing square. Ref: 1.26                             |
| 1-5. | d. | All of the above. Ref: 1.15                     | 1-10. | c. | Woodworking vise. Ref: 1.32, Fig. 1-8                 |

Contributions from the following sources are appreciated:

- |              |                                                                   |
|--------------|-------------------------------------------------------------------|
| Figure 1-1.  | Bob Brandt Photograph                                             |
| Figure 1-2.  | Aearo                                                             |
| Figure 1-6.  | Swanson Tools                                                     |
| Figure 1-7.  | Ridgid Tools                                                      |
| Figure 1-8.  | Ridgid Tools                                                      |
| Figure 1-9.  | Stanley Tools (left),<br>Adjustable Clamp Company—Chicago (right) |
| Figure 1-10. | Ridgid Tools                                                      |
| Figure 1-11. | Ridgid Tools                                                      |