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CHAPTER 12

Measuring, Marking, and Laying Out Materials

Objectives

After studying this chapter, you should be able to:

- Distinguish between measuring, marking, and layout tools.
- Lay out lines and geometric shapes.
- Transfer shapes to working material.
- Maintain measurement and layout tools.

Technical Terms

angle divider
arcs
bench square
brace measure table
caliper
centering rule
combination square
detail pattern
flexible rule
framing square
half pattern
hermaphrodite caliper
inside caliper
layout rod
layout tools
marking gauge
measuring tools
octagon scale
outside caliper
profile gauge
rigid folding rule
shop measurement standard
slide caliper
sliding T-bevel
square
square grid pattern
squareness
story pole
tape measure
template
trammel points
try square

Accurate measurement and layout is essential for high quality cabinetmaking. You must be able to transfer the shapes of your design onto your materials. With skillful measuring, you can mark, cut, and assemble parts with precision.

Much of cabinetmaking relies on square edges and joints. ***Squareness*** simply means that all corners join at a 90° angle. See Figure 12-1. When a piece is not cut square, or two pieces are not assembled square, the entire cabinet is affected.

This chapter describes how to mark accurate geometric shapes on your materials. A number of tools are used by cabinetmakers to complete layouts. These include marking, measuring, and layout tools.

12.1 Marking Tools

Most cabinetmakers mark with pencil. A sharp pencil will make an accurate line. Remove pencil marks with an eraser before sanding. A knife or

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Figure 12-1. The manufacture of high quality products requires materials that are accurately measured, laid out, and cut.

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scratch awl (scriber) will also mark the wood. See Figure 12-2. A light cut makes a visible reference line for sawing or other work. A knife is often used when the mark is needed to locate a tool, such as a saw or chisel. A scratch awl can indent the wood to help center a drill. See Figure 12-3. Avoid ink because it bleeds into wood cells.

12.1.1 Marking Gauge

Traditionally, cabinetmakers used a marking gauge to layout their cuts. The ***marking gauge*** is designed to make parallel lines. It has an adjustable head and a steel pin or cutting wheel, Figure 12-4. It is used to mark parallel lines on wood, plastic, and metal.

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Figure 12-2. Knives and scratch awls make precise marks. A variety of styles are used.

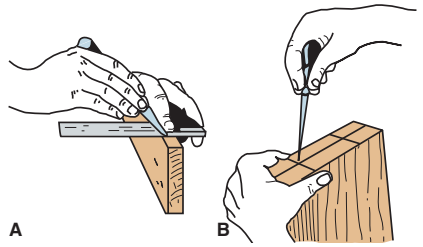

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Figure 12-3. Marking. A—Marking a line with a knife. B—Marking a drill center point with an awl.

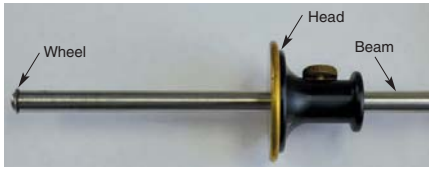

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Figure 12-4. Components of a marking gauge.

Procedure

Using a Marking Gauge

To use the gauge:

1. Adjust the head to the appropriate width from the edge of the board to the line, using the scale printed on the beam. See Figure 12-5A.
2. Place the gauge flat on the material. The steel point should face sideways, without touching the wood.
3. Roll the gauge toward the stock until the pin or cutter touches the surface.
4. Push the gauge away from you. Keep the head against the edge of the work. The point or cutter will make a visible score line, Figure 12-5B.

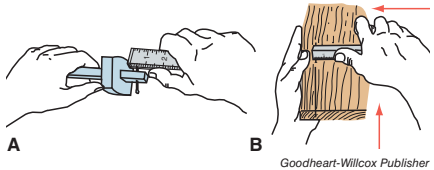

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Figure 12-5. A—Setting the marking gauge. B—Marking a parallel line.

You can also use a marking gauge to transfer dimensions. Set the marking gauge to the size of part you wish to copy. Then mark the new workpiece. This is helpful when duplicating parts.

12.2 Measuring Tools

Measuring tools are instruments used to determine lengths and angles. They follow two systems. They are the US customary system and the International System (SI), commonly referred to as metric. US customary rulers and scales measure feet and inches. Smaller units are measured in fractions of an inch. See Figure 12-6A. To find the fractional distance you need, count the spaces across the board. This becomes the numerator (top number). Count the spaces in one inch on the rule. This is the denominator (bottom number).

Metric rulers and scales measure in millimeters. They are typically numbered every 10 mm. See the metric rule in Figure 12-6B. A metric rule may be further divided into 0.5 mm. Both systems may appear on the same measuring tool, as shown in Figure 12-6C.

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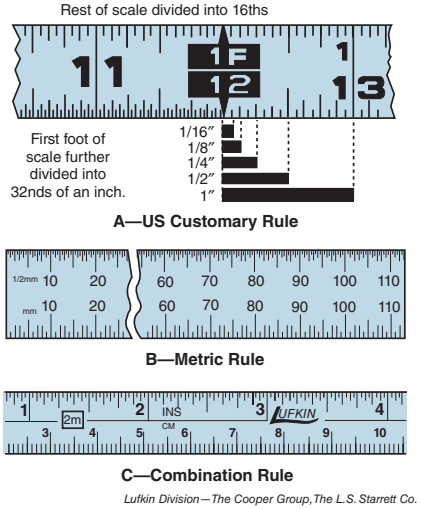

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Figure 12-6. Rule measuring units. Use the system designated on the working drawings. A—US customary. B—Metric. C—Combination of both units.

The measuring system you choose depends on the working drawings. The title block will indicate what system is used. It will also provide the scale of the drawing. If the scale reads 1″ = 1′-0″, then each inch on the drawing will be 1′ on the layout.

Green Note

The old adage, "measure twice cut once" is good advice. Mistakes will happen. Taking your time to make sure you have correct measurements will help you avoid material waste and spending extra time fixing your mistake.

12.2.1 Rule

The rule you select depends on the accuracy you need and which style you prefer. Rules may be flat, flexible, or folding types. They are made of wood, fiberglass, plastic, metal, or cloth. Sometimes both customary and metric measurements are found on the same rule.

Flat rules are typically metal, wood, or plastic. They may be 12″ to 48″ long. High quality wood rules have brass ends. The brass ends are not damaged as easily as wood. Rules may also be steel or aluminum.

Special purpose rules include a ***centering rule***, with the measuring units extending both directions from the center zero point. This reduces the chances for error with many centering tasks.

Rigid folding rules are usually 6′ long. Metric folding rules are 2 meters long. Some have an extension rule at one end for measuring inside distances and depths. See **Figure 12-7**.

A ***flexible rule***, or ***tape measure***, is very convenient and will measure both straight lengths and curves. See **Figure 12-8**. It can also be used to measure inside distances, such as a doorway. To account for the size of the tape case, add the distance indicated on the side of the case to your measurement. Most tape cases will be printed with the amount you must add (usually 2″–3″). Some tape measures have a window on the top to read the inside distance.

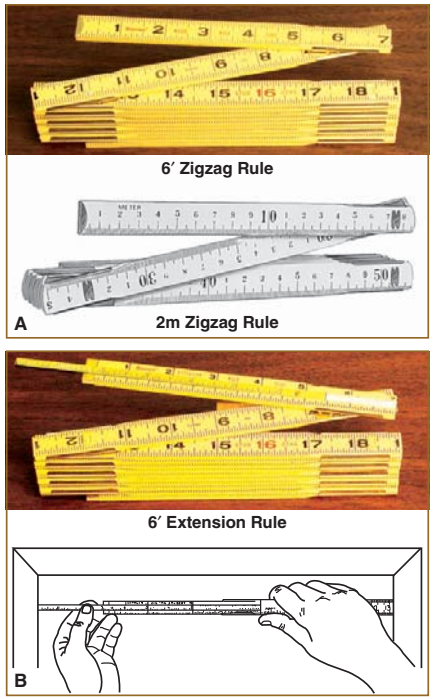

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Figure 12-7. A—Rigid folding rules extend to measure distances. B—Using the extension to measure inside distances.

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Figure 12-8. Two types of tape measures. The bottom tape measure is extra flexible to allow for measuring curved surfaces.

Tape measure lengths commonly used by cabinetmakers range from 12′ to 30′ (4 m to 9 m). Tape lengths may be up to 200′ (61 m). Both US customary and metric measurements may be printed on the tape.

12.2.2 Slide Calipers

Slide calipers are used to measure outside and inside distances, as well as depth. They come in various types. See **Figure 12-9**. A vernier scale provides the most accurate measurement but is the most difficult to read. Dial calipers have precision gears, but wood shavings can cause problems if they get into the gears. Digital calipers have become popular in recent years, especially because they can be quickly switched from inches to millimeters. Outside dimensions are measured using the large jaws. Inside dimensions are measured with the smaller, pointed jaws. Depth measurements can be taken using either the main jaw or depth probe. See **Figure 12-10**.

12.2.3 Squares

There are a number of different kinds of ***squares***. They are used for several purposes, such as:

- Checking that corners form a 90° angle (squareness).
- Serving as a straightedge.
- Measuring distances and angles.

Framing and Bench Squares

Framing and bench squares are flat steel or aluminum. A ***framing square*** has a 24″ (610 mm) body

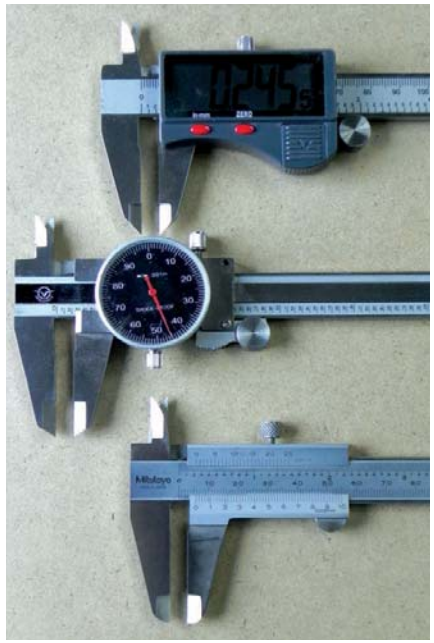

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Figure 12-9. Slide calipers are available in various styles.

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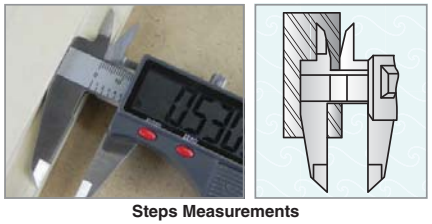

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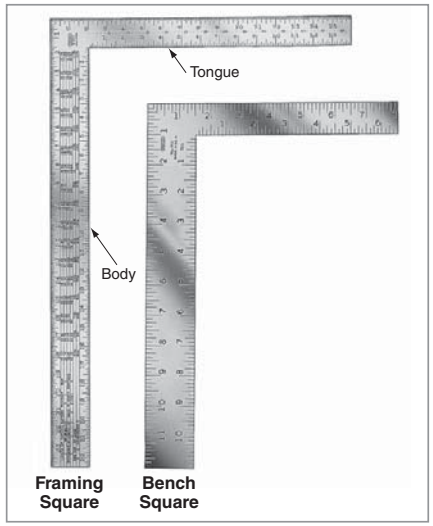
Figure 12-10. Four ways calipers can be used to take measurements.

and a 16″ (406 mm) tongue that form a 90° angle (right angle). A ***bench square*** is smaller. See **Figure 12-11**. The face of the square is seen when the body is held in the left hand and the tongue in the right hand. The back is the other side of the square. The face and back of both squares have measurement scales and most framing squares also have tables.



Stanley Tools

Figure 12-11. Framing squares are larger than bench squares. The framing square may also have a list of scales and tables printed on it.

Try Square

Try squares have a steel blade and a steel or wood handle. Some have a 45° angle cut into the handle. Try squares are the most reliable of all squares for accuracy. Use them for making layouts, checking squareness, or setting up machinery. See **Figure 12-12**.

Combination Square

A ***combination square*** is more versatile than a try square. It consists of a grooved blade that slides through the handle. It can also be equipped with a protractor and a center head. See **Figure 12-13**. You can use a combination square for a number of purposes:

- Measure distances and depths.
- Lay out 45° and 90° angles.
- Draw parallel lines.
- Locate centers.

To lay out a parallel line, adjust the blade to the intended distance. Place a marking device such as a pencil, scratch awl (from the handle on some squares), or knife point against the end of the blade. While holding the marking device against the blade, slide the square down the material. See **Figure 12-14A**.

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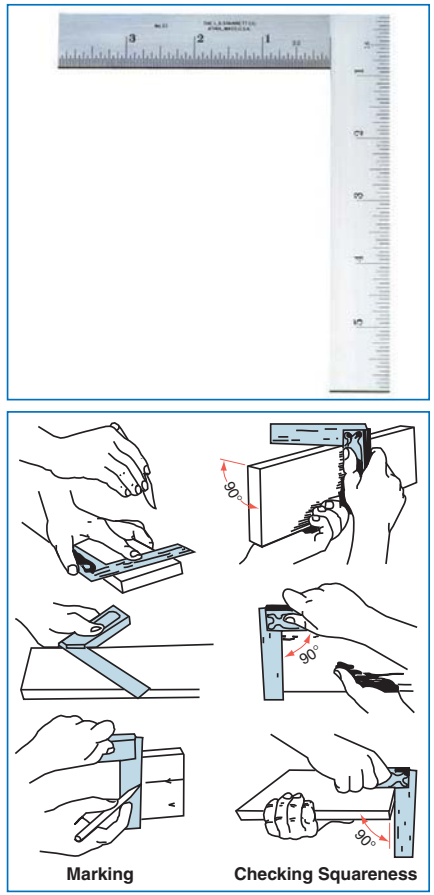

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Figure 12-12. Try squares are for both marking and checking squareness.

Many combination squares have a center head. Hold it against any circular or curved surface. The blade's edge will point directly through the center of a circle, **Figure 12-14B**.

The protractor head adjusts for any angle. You may wish to remove the handle and center head when using the protractor head. See **Figure 12-14C**.

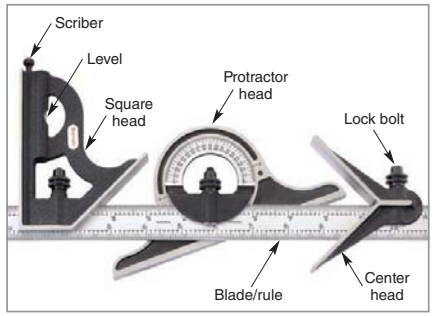

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Figure 12-13. Parts of a combination square.

12.2.4 Tables

Tables provide helpful information for commonly used measurements. Two such tables are the brace measure table and the octagon, or eight-square scale.

The ***brace measure table*** gives diagonal measurements that show the length needed for a diagonal piece, such as a brace, to support a shelf. The measurements are on the tongue of most framing squares, **Figure 12-15**. For example, suppose you have a 22″ wide shelf and you wish to brace it at a point 18″ from the wall and 24″ below the shelf. Find the measurement on the table marked 18/24. You will find the number 30 next to it. This is the proper length of the brace.

Procedure

Using an Octagon Scale

The ***octagon scale*** helps you identify critical measurements for laying out octagons. Suppose you wanted to create an octagon tabletop 28″ across, **Figure 12-16**. To produce this tabletop, proceed as follows:

1. Cut a piece of material 28″ square.
2. Draw centerlines AB and CD.
3. Set a compass or divider for 28 dots along the octagon scale.
4. Mark the distance on each side of the centerlines along the four edges of the board.
5. Connect the newly marked locations to form the eight sides.

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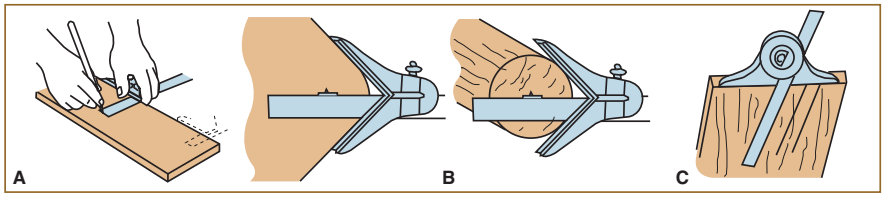

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Figure 12-14. Use the combination square to complete these tasks. A—Mark parallel lines. B—Find centers. C—Mark angles.

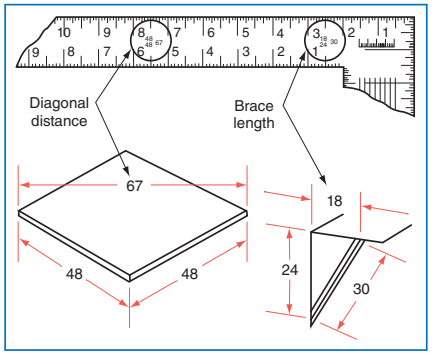

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Figure 12-15. The brace measure table shows brace lengths.

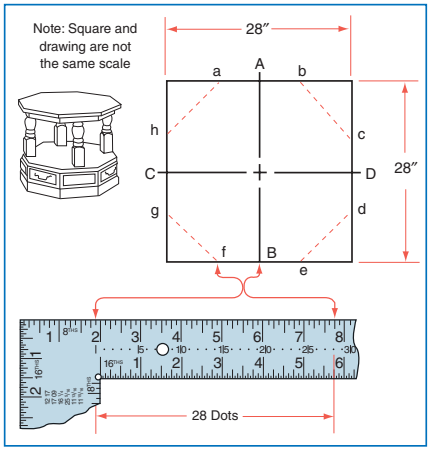

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Figure 12-16. The octagon scale, found on some framing squares, is a row of numbered dots for laying out octagons.

12.2.5 Scales

The scales refer to customary and metric measurements. This makes the square useful as a rule. Once a measurement is marked, the square can be used to draw a perpendicular line. See Figure 12-17. It can also be used to check the squareness of an assembly.

12.3 Layout Tools

Layout tools transfer distances, angles, and contours. Most lack scales for measuring distances and angles. These are set with a measuring tool. The following descriptions cover common layout tools.

12.3.1 Sliding T-Bevel

The ***sliding T-bevel*** is used to lay out and transfer angles, Figure 12-18. Set the angle of the T-bevel with a protractor. Loosen the locking device on the handle to move the blade. After setting the proper angle, tighten the locking device.

Besides layout, T-bevels can set the angles for table saw blades, jointer fences, and drill press tables. If you are setting 90° angles, use a try square. T-bevels are not as accurate as a square.

12.3.2 Angle Divider

An ***angle divider*** is a layout tool consisting of two blades that move outward at an equal rate from the body. It is used to bisect angles. The blades move apart from 0° to 90°. If the blades are adjusted to an angle or a corner, the body bisects the angle. This angle helps when cutting miter joints. See Figure 12-19A.

Angle dividers have numbers on the body and an index mark on the adjusting nut. The numbers on the side of the nut are 30°, 45°, and 60°. Accurately aligning the index mark along these numbers sets the blades to that angle. The numbers on the other side of the nut are 4, 5, 6, 8, 10, and 0. These indicate settings for polygons. Aligning the index nut at 6 will set the angle of the blades for a hexagon (a six-sided polygon). The angle between the blades will be 120°. The body will bisect the angle at 60°. When the index mark is set at 0, the blades form a straight line with the body.

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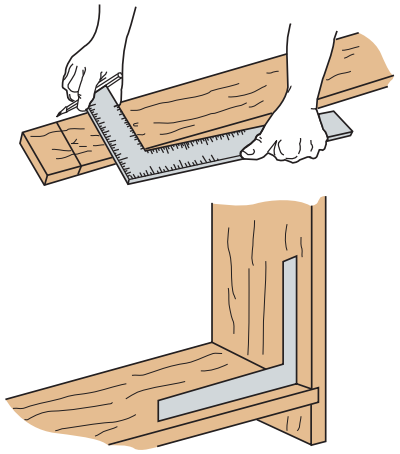

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Figure 12-17. Framing and bench squares are used for measuring, marking, and checking squareness.

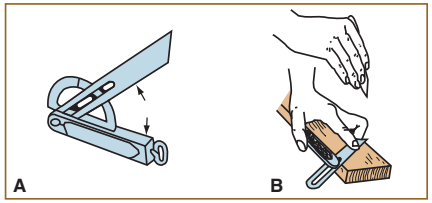

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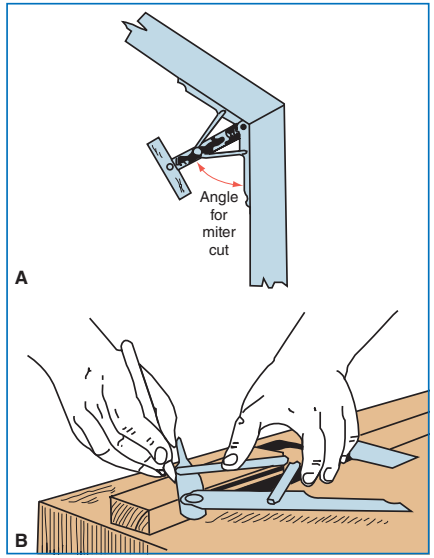
Figure 12-18. The T-bevel has a body, blade, and locking device. A—Setting the angle with a protractor. B—Marking the wood.

Procedure

Laying Out an Octagon Picture Frame

To lay out an octagon picture frame, proceed as follows:

1. Set the index mark even with the 8.
2. Hold the body of the angle divider against the edge of the frame material.
3. Mark the mitering angle and saw the workpiece on that line. See Figure 12-19B.



General Hardware

Figure 12-19. Angle dividers are helpful when setting angles for cutting miter joints.

12.3.3 Calipers

Calipers are used to transfer dimensions. The three types of calipers are outside, inside, and hermaphrodite. See Figure 12-20. Some are assembled with a firm (friction) joint. Others have a bow spring with an adjusting screw and nut. Firm-joint calipers are quicker to adjust, but bow-spring calipers maintain greater accuracy during use.

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Figure 12-20. Calipers are used to transfer outside and inside measurements and parallel lines. A—Firm-joint outside calipers. B—Bow-spring outside calipers. C—Firm-joint inside calipers. D—Bow-spring inside calipers. E—Hermaphrodite calipers.

Calipers are used most often when wood turning. When the lathe is stopped, you can check or transfer thicknesses and distances.

Outside Caliper

An ***outside caliper*** checks outside diameters on turnings. See Figure 12-21. First, set the caliper with a rule. Then turn the material until the caliper slips over it. When making duplicate parts, set the caliper by the workpiece being copied.

Inside Caliper

An ***inside caliper*** checks inside diameters. Preset the caliper with a scale. Then turn the work until the diameter is reached, Figure 12-22.

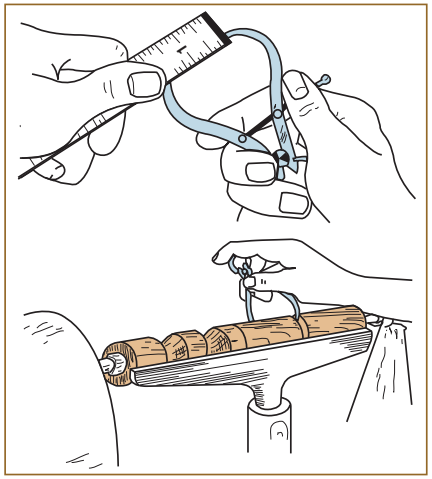

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Figure 12-21. Set and use the outside caliper to check diameter measurements.

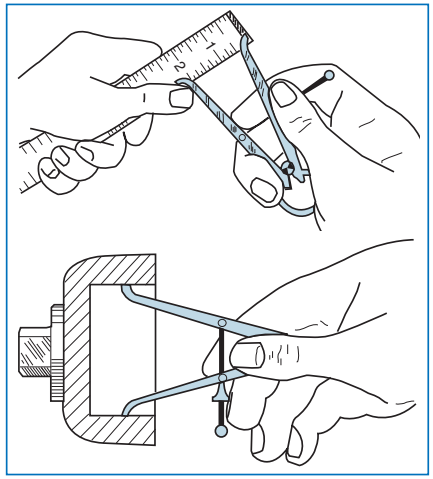

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Figure 12-22. The inside caliper is set and used to check dimensions on the inside of round material.

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Hermaphrodite Caliper

The ***hermaphrodite caliper*** is a firm-joint tool that has one caliper-like leg and one needle-like point. The hermaphrodite caliper is used to:

- Locate outside and inside centers by scribing three or four arcs, Figure 12-23A.
- Mark a parallel line on flat or round stock, Figure 12-23B.
- Copy a contour, which is often called coping, Figure 12-23C.

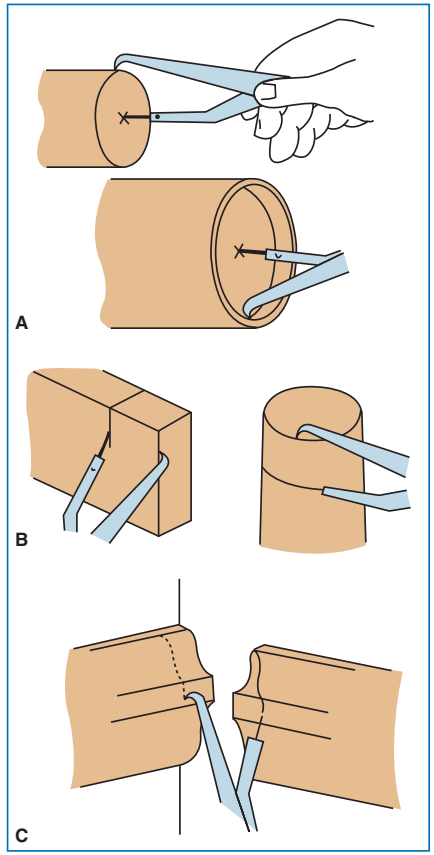

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Figure 12-23. Locate centers and mark parallel lines with the hermaphrodite caliper.

The tools described thus far measure and mark distances, lines, and angles. You will also need to lay out circles, arcs, and curves. Tools used for these purposes include compasses, dividers, irregular curves, and profile gauges.

12.3.4 Compass and Divider

Compasses and dividers are similar layout tools. Both have two legs. However, a compass has a pencil point on one leg instead of a steel point. See Figure 12-24. Use compasses and dividers to:

- Step off distances.
- Bisect lines, angles, and arcs.
- Construct lines and arcs tangent to each other.
- Scribe circles, ellipses, and arcs.
- Lay out polygons.
- Cope contours, such as for fitting moulding.

Marking with a compass requires some hand coordination. Place one hand on or near the top (joint) of the compass or divider. See Figure 12-25A. The other hand sets the pivot location of the steel point.

Use compasses and dividers as you would when drafting. Adjust the compass or divider to the proper measurement when transferring distances, Figure 12-25B. Then mark the material. You can also duplicate parts by setting the dividers to the size of the original part and use them to mark the new material.

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Figure 12-24. Compasses have a pencil and steel point. Dividers have two steel points.

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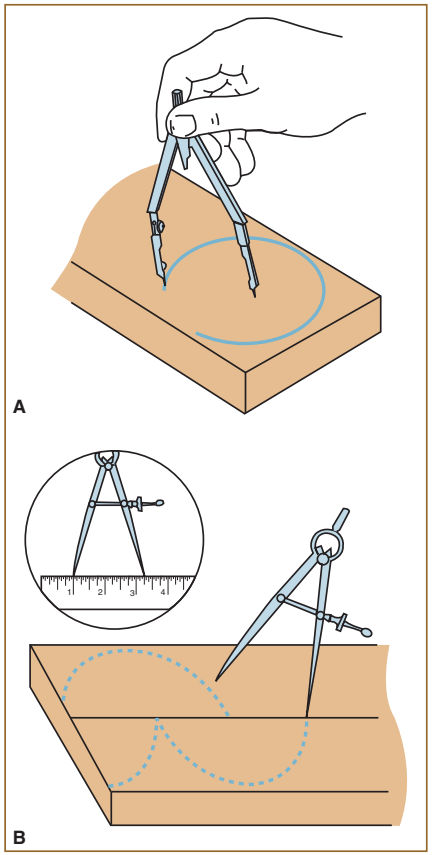

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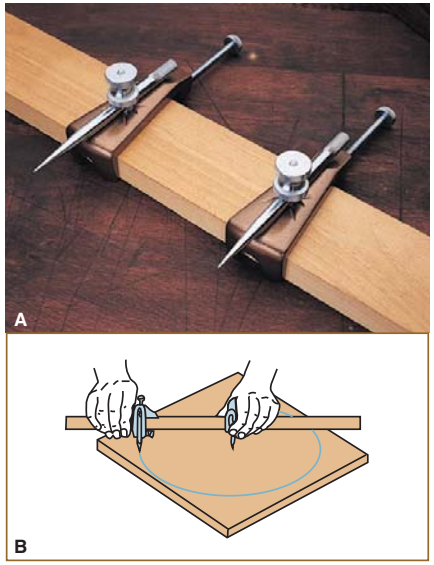
Figure 12-25. A—Place and swing the compass on the center point of the circle or arc. B—Use the divider to step off measurements.

12.3.5 Trammel Points

Trammel points are used for making large circles and arcs. Two steel points are clamped on a rectangular piece of lumber. See **Figure 12-26A**. Some have a point that can be replaced with a pencil. This allows you to mark the wood with either a pencil mark or a scratch.

The size of the circle is limited only by the length of wood you choose for the points to slide on.



The Fine Tool Shops; Goodheart-Willcox Publisher

Figure 12-26. A—Clamp trammel points to a piece of wood. B—Use to lay out circles larger than are possible with a compass.

Procedure

Laying Out a Circle with Trammel Points

To lay out a circle with trammel points:

1. Adjust the points to the desired radius with a rule.
2. Hold one steel point of the trammel at the center of the circle.
3. Swing the other trammel point in an arc to mark the circle on the material, **Figure 12-26B**.

12.3.6 Profile Gauge

A ***profile gauge*** is used to copy irregular shapes. See **Figure 12-27**. Press it against a curved surface. This causes individual pieces of wire or plastic to slide. Once shaped, the contour can be transferred to a pattern, paper, or the material to be cut.

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The Fine Tool Shops

Figure 12-27. A profile gauge conforms to the shape of the piece to be copied.

12.4 Layout Practices

Layout must be done with accuracy. Although layout tools can be used many ways, select the tool that is best suited to your work.

12.4.1 Marking Points

When marking a distance, the best pencil mark to make is an arrow or V. See **Figure 12-28**. The point of the arrow shows the proper location. A pencil dot may be lost among the scratches or blemishes in the wood. A short line does not tell which end of the line is the proper measurement. When making the mark, do not press hard. Remember, any pencil marks, dents, or scratches you make during layout must be removed later. Erase all unnecessary pencil marks.

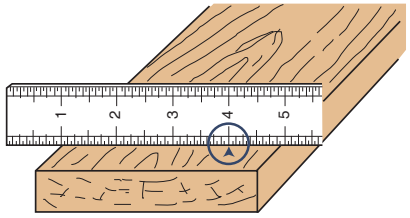

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Figure 12-28. Points are most accurately marked with an arrow or a V.

Be sure that the rule you use is in good shape. The end should not have dents. If a corner is damaged, begin measuring from the 10″ mark. For example, to lay out a distance of 3″, measure from the rule's 10″ mark to the 13″ mark. Remember to account for starting away from the end of the rule.

When using a tape, make a habit of frequently inspecting the hook for damage. If the hook has been bent, your measurements will be incorrect. It is a good practice to have a ***shop measurement standard***, an object of known dimension that can be used to check the accuracy of all tape measures. Select a material that won't change dimension significantly due to changes in temperature or moisture. For example, solid wood is not a good choice.

12.4.2 Lines

Most lines are made using a rule or square. For lines that must be parallel to the edge, use a marking gauge, combination square, or hermaphrodite caliper.

12.4.3 Circles and Arcs

Compasses, dividers, and trammel points make accurate circles and arcs. To set them, place one leg on the 1″ or 10 mm mark of a rule. Adjust the other leg according to the desired measurement. Again, be sure to account for starting away from the end of the rule.

Arcs are partial circles. The arc has a center point and radius. Set the layout tool for the radius of the arc. Then locate the point of the tool at the arc's center and swing the desired arc.

12.4.4 Polygons

Common polygons include triangles, squares, rectangles, hexagons, and octagons. Polygon shapes are used for a variety of items including tabletops, mirror and picture frames, and clock faces.

Two common tools used to lay out polygons are the framing square and protractor. Set angles on the framing square using two pieces of wood and the measurements on the tongue and body. See **Figure 12-29**.

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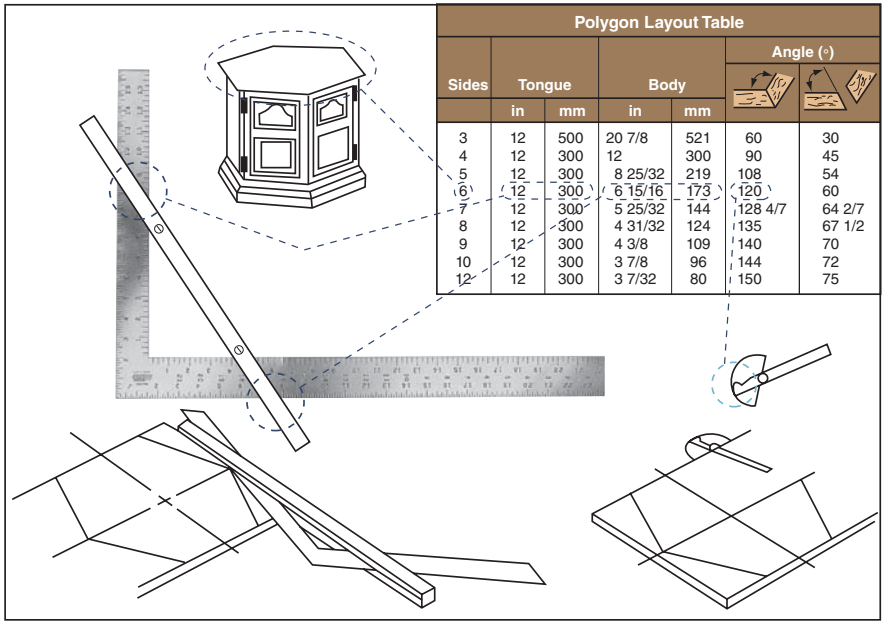

Polygon Layout Table

Sides	Tongue		Body		Angle (°)	
	in	mm	in	mm		
3	12	500	20 7/8	521	60	30
4	12	300	12	300	90	45
5	12	300	8 25/32	219	108	54
6	12	300	6 15/16	173	120	60
7	12	300	5 25/32	144	128 4/7	64 2/7
8	12	300	4 31/32	124	135	67 1/2
9	12	300	4 3/8	109	140	70
10	12	300	3 7/8	96	144	72
12	12	300	3 7/32	80	150	75

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Figure 12-29. A protractor or framing square and straightedge may be used for polygon layouts.

Procedure

Drawing a Hexagon Using a Compass

Some polygons can be easily laid out with a compass. Two examples are hexagons (six sides) and octagons (eight sides). To draw a hexagon, proceed as follows:

1. Draw a circle with the radius equal to one side of the hexagon, Figure 12-30.
2. Keep the same setting of the compass after drawing the circle.
3. Start at any point on the circle and draw an arc that intersects the circle.
4. Move the compass to where the arc intersected the circle and construct another arc. Work your way around until you divide the circle into six parts.
5. Connect the six intersections with lines to complete the hexagon.

Procedure

Drawing a Octagon Using a Compass

To draw an octagon, proceed as follows:

1. Draw a square the size of the octagon, Figure 12-31.
2. Draw diagonals across the corners of the square.
3. Set the compass to the distance from a corner of the square to the intersection of the diagonals.
4. Place the compass point on each corner of the square and construct arcs.
5. Connect the points where the arcs intersect the edges of the square.

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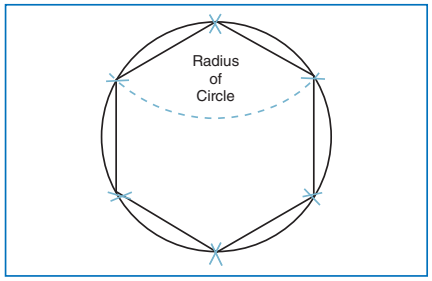

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Figure 12-30. Hexagon layout made by striking arcs with a pair of dividers.

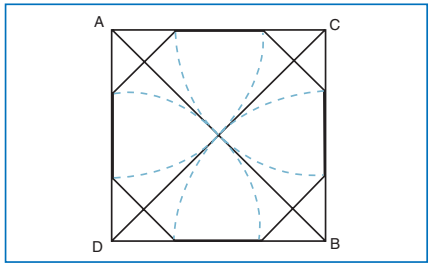

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Figure 12-31. Octagon layout using a divider or compass.

Procedure

Laying Out an Ellipses with a String

An ellipse (oval) can be laid out easily with a string, Figure 12-32. Select a string that will not stretch, and proceed as follows:

1. Cut out a rectangle the desired size of the ellipse.
2. Make centerlines EF and GH.
3. Make an arc using point B as the pivot and line BC as the radius.
4. Measure the length of line AD.
5. Divide that distance by two. (AD/2)
6. Measure this distance on each side of O to locate points I and J.
7. Put thumbtacks or small nails at points E, I, and J.
8. Tie a string tightly around the thumbtacks.
9. Remove the thumbtack at point E.
10. Place a pencil inside the string loop and pull the loop tight. Move the pencil to create the ellipse. For accuracy, keep the string at the same point on the pencil while moving about the ellipse.

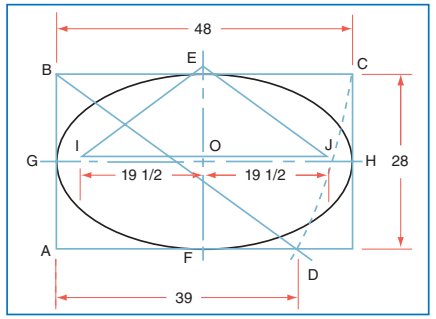

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Figure 12-32. An ellipse for an oval tabletop can be easily laid out within a rectangle.

12.4.5 Irregular Shapes

Some cabinet styles have irregularly shaped parts. For example, Early American furniture has many curves. Working drawings usually include patterns that show how to lay out the shape.

Patterns

Drawings may provide full, half, or detail patterns, Figure 12-33. A ***half pattern*** shows detail on one side of a centerline. You mark around the pattern, then turn it over and mark again. A ***detail pattern*** may be necessary for more complex shaped parts.

A ***square grid pattern*** is a way to transfer complex designs from working drawings to material. Make two square grid patterns. One pattern is traced over the working drawing and the other is a full-size pattern. The size of grids should correspond to the scale of the working drawing. If the scale is 1/4″ equals 1″, use a 1/4″ grid sheet. The full-size transfer pattern will be 1″ squares.

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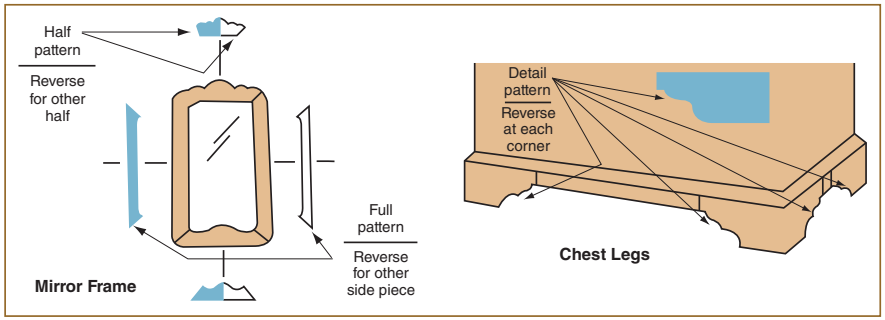

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Figure 12-33. Full, half, and detail patterns are valuable layout devices.

Make the grid on tracing paper placed over your working drawings. Then trace the shape from the working drawing, **Figure 12-34A**.

Cut a sheet of heavy wrapping paper for the full-size pattern. Lay out the proper size squares on the paper. Place a dot on the pattern grid where the design crosses it. See **Figure 12-34B**. Connect the dots to complete the full-size pattern. Cut out the pattern with scissors. Then lay the pattern on the wood and trace around it.

Templates

A ***template*** is a permanent full size pattern used for guiding a tool. For example, you may lay a template over material to guide a router bit to cut out a shape. It may be made of cardboard, hardboard, or thin sheet metal. Make a template when you intend to use the shape several times. When duplicating irregular curves, use a profile gauge. Refer again to **Figure 12-27**. This is much simpler than trying to measure the original part to make the pattern.

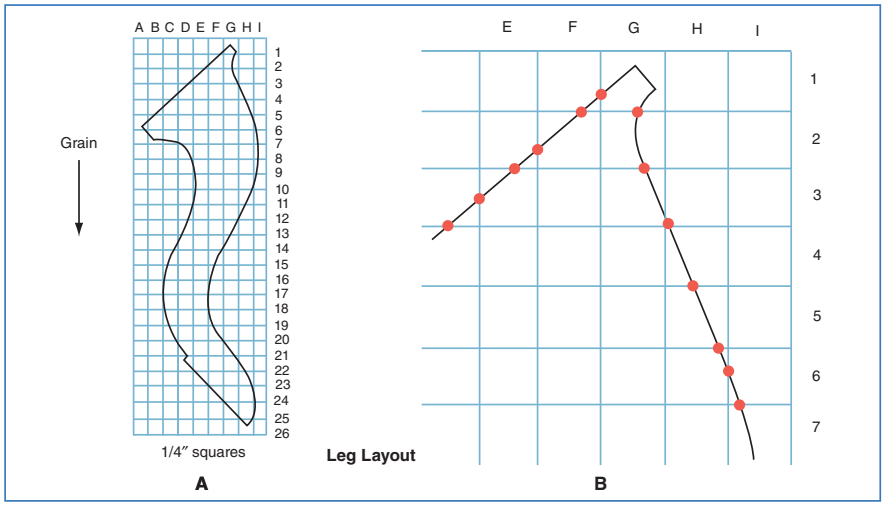

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Figure 12-34. Transfer lines in individual squares from the square grid pattern to the layout.

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12.4.6 Layout Rod

A ***layout rod*** is a record of often-used distances. Plan to make one for standard cabinets you produce. It eliminates the need to measure repeatedly with a rule. A layout rod can also help with machine setups.

The rod is marked with important cabinet dimensions, **Figure 12-35**. These may be the location of shelves, doors, and joints. Measurements are marked full size. Make the rod slightly longer than the greatest dimension of the cabinet. The rod can be used for height, width, and depth measurements.

A rod is made of 1×1 or 1×2 lumber. It is surfaced on all four sides. One side may contain width measurements. A second side may contain height measurements. Other sides are used for depth and other important dimensions.

12.4.7 Story Pole

Similar to a layout rod, a ***story pole*** is used to mark the exact locations of items found in a room. It is usually made of 1×3 lumber and is as long as necessary (up to the room width). A second pole is made equal to the height of the room, or the top of the highest cabinet. In addition to marking cabinet locations on the story pole, mark all other items in the room, such as electrical outlets, switches, doors, windows, vents, radiators, plumbing, and light fixtures.

12.5 Digital Measuring Devices

There are many digital measuring devices available. Lasers are now commonly used on jobsites for measurement. They can be used to quickly and accurately record the dimensions of a space. Electronic calipers can switch from inch to metric with the push of a button. See **Figure 12-36**. Machine accuracy and repeatability is now so precise that cabinetmakers frequently measure to within thousandths of an inch.

As parts are created, they must be measured to ensure accuracy so assemblies will fit together properly. Some digital measuring devices have the ability to send data to a computer for collection. See **Figure 12-37**. This record of parts in production can help resolve any machining issues that may occur.

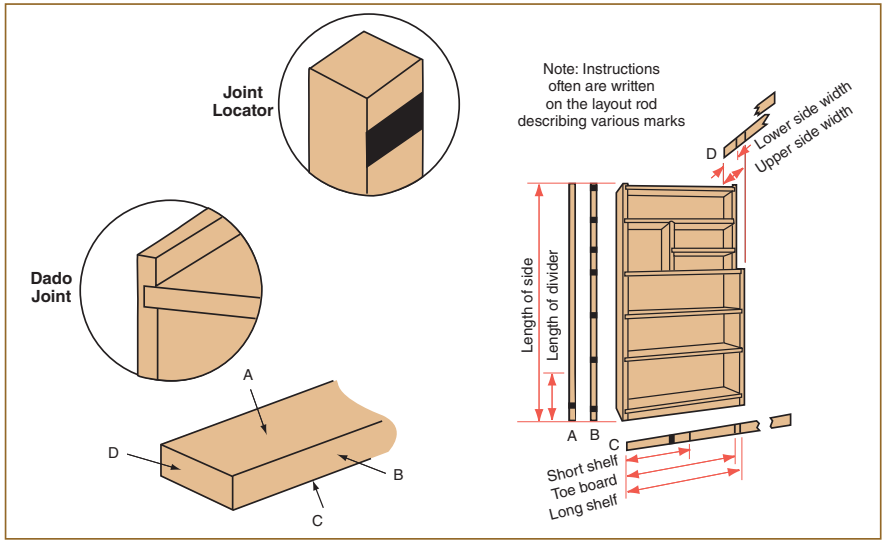

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Figure 12-35. Layout rods become permanent references for a particular cabinet.

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Accurate Technologies

Figure 12-36. Digital measuring tools are capable of recording inside, outside, diagonal, hole-edge and hole-hole dimensional measurements.

Accurate Technologies

Figure 12-37. This measurement table is used to check and record panel measurements. These can be uploaded to a computer.

12.6 Measuring and Layout Tool Maintenance

Measuring and layout tools need very little maintenance. There are few moving parts. However, care is needed during handling and storage of the tool.

Some measuring tools, such as framing and try squares, have scales stamped on them. They may become difficult to read over time. If so, wipe across them with a cloth pad containing white paint. Then remove the excess from the surface of the tool with steel wool. The measurements should be readable again.

Many tools are plated or painted to prevent rust. If rust does occur, such as on the blade of a try square, remove it with steel wool. Then rub the blade with paste wax. Oil should be used sparingly with woodworking tools because it can stain wood.

Moving joints should be rubbed with paste wax for lubrication. However, be careful when lubricating firm-joint tools, such as calipers. This might cause the joint to move too freely.

Knives and awls require sharpening. Refer to Chapter 39 for tips on sharpening. The points on dividers, compasses, trammel points, and marking gauges may need to be touched up occasionally.

Safety in Action

Measuring and Laying Out Workpieces

When measuring and laying out workpieces:

- Hold sharp points of tools away from you when carrying them.
- Cover sharp tool points if you must have them in your pocket.

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Summary

- Quality cabinetmaking relies on square edges and joints, in which all corners join at 90° angles.
- Marking tools include pencils, knives, or scratch awls. These marks are visible reference lines for sawing or other work.
- Measuring tools are based on either the US customary system of measurement or the International System (SI) of measurement.
- The title block on the working drawing indicates what measurement system is used for the product.
- Measuring tools include rules, slide calipers, squares, scales, and table. Many of these are also used as layout tools.
- Common rules include centering, rigid folding, and flexible (also known as a tape measure).
- Layout tools transfer distances, angles, and contours. Those without measurements on them must be preset with a measuring tool.
- Layout tools include T-bevels, angle dividers, calipers, compasses, dividers, trammel points, and profile gauges.
- Accurate layout is critical. Select the tool that is best suited to the work.
- Mark distances with a pencil mark in the shape of an arrow or a *V*. This indicates a precise point.
- Create lines using a rule or square.
- Create circles and arc using compasses, dividers, and trammel points.
- Tools commonly used to create polygons include the framing square and protractor, and in some cases, a compass.
- Create irregular shapes using patterns and templates.
- A layout rod is a record of often-used distances. A story pole is used to mark the exact locations of items in a room.
- Digital measuring devices can be used to quickly and accurately record dimensions.
- Carefully handle and store measuring and layout tools. They have few moving parts but are still susceptible to wear and tear. Points may need to be sharpened occasionally.

Test Your Knowledge

Answer the following questions using the information provided in this chapter.

1. _____ means that all corners join at a 90° angle.
2. Name three types of marking tools.
3. The US customary system measures in _____.
   A. millimeters
   B. liters
   C. feet and inches
   D. None of the above.
4. What rule would you select when laying out a tall curio cabinet?
5. Slide calipers are used to measure _____.
   A. outside distance
   B. inside distance
   C. depth
   D. All of the above.
6. *True or False?* A square can be used to measure distances and angles.
7. Brace lengths can be found on the framing square's _____.
8. Parts of a(n) _____ square include a blade, center head, and protractor head.
9. Set the angle of a sliding T-bevel with a(n) _____.
10. A(n) _____ has two blades and is used to bisect angles.
11. Describe three types of calipers and their uses.
12. Name four tasks that can be done using a compass or divider.
13. The most accurate way to mark a workpiece is to draw a(n) _____.
    A. arrow
    B. dot
    C. line
    D. None of the above.
14. What is a shop measurement standard?
15. Name three tools you can use to lay out circles.
16. Name two tools commonly used to lay out polygons.
17. When copying an irregular shape, use a(n) _____.
18. What should be used to remove rust on a measuring tool?

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Suggested Activities

1. Make a list of measuring tools and machines with measuring scales in your shop. List the units these tools and scales have (US customary, metric or a combination of both). Are there times when one measurement system is preferable to the other? Share this list with your instructor.
2. Lay out an octagon using the octagon scale on a framing square. Show your construction to your instructor.
3. Using an angle divider or T-bevel, divide a 90° angle into 15° increments. Share your drawing with your instructor.
4. Following steps listed in this chapter, lay out a hexagon and an octagon using a compass. Show your finished construction to your instructor.
5. Use the grid method to enlarge a 1/4 scale irregular layout to actual size. Share the finished drawing with your instructor.

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