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CHAPTER 1
MEASURING and MARKING

Chapter 1, Section 1:

Woodworking involves lots of measuring and there are two very different ways to do it. The first and more common method is to determine the length or size of something according to a fixed scale such as a ruler or tape measure scaled in feet and inches or meters and millimeters. In this method you use the ruler to reference a distance on a length of wood or you may use a tape measure to determine the length and width of a longer item.

The other method is to match or compare an unmeasured piece against a known object. In this method you don't actually need to know the precise numerical measurement. What is important, however, is that you carefully compare and mark one piece to exactly match another. The importance of this method and the frequency of its use cannot be overstated. Any time you transfer a dimension directly, without converting it into numbers, you avoid a primary source of error. Use this comparison method whenever you are carefully fitting pieces into a project, for instance, taking a strip of molding and matching it to fit precisely along the length of a table apron that runs between two offset table legs or fitting a tray to fit inside of a box, marking the mortise for a butt hinge, marking the pin portion of a dovetail directly from the tail portion or setting a stop block for cutting identical pieces. If small enough to handle, the existing piece itself can also be used as a template to set a cut line.

Both methods are used frequently in woodworking. The first method requires a set of measuring tools and the second method requires only a marking tool such as a pencil or knife. Both methods can result in the setting of a stop block or fence on a tablesaw, router, drill press, etc. Very often the two methods are used in conjunction with each other. First, a measurement is made and then subsequent parts are marked to match the original that becomes the reference item. The more accurate the measurement in the hands of the woodworker, the better the finished product.

Standard measuring tools. Most woodworkers have a set of rulers in various lengths, such as six inches, twelve inches and maybe eighteen or twenty-four inches, a steel straight edge, a retractable tape measure and maybe a folding rule. The need to rely on printed or incised lines or gradations on the ruler means it is difficult to be precise in very small increments such as one-thirty-second inch. For finer measurements, particularly of thicknesses, the woodworker relies on calipers, either vernier or digital, and micrometers that can measure to thousandths of an inch. Calipers and micrometers are more typical of machinist's work but now are found frequently in woodshops for limited uses. Calipers are limited by size usually to about six inches while micrometers are even more limited in their range.

For measuring angles, protractors are used including the traditional plastic school model, more sophisticated larger metal protractors as well as digital angle protractors. A sliding or adjustable bevel can be used to copy angles from the protractor.

Standard rulers and protractors can be adapted with raised dots. There are also specialty gauges and measuring blocks available such as 1-2-3 blocks, set-up blocks, stepped set-up gauges, dovetail templates and the like.

Sources for these tools can be found in the separate section at the end of this chapter.

Specialized measuring tools developed for blind woodworkers. To achieve the accuracy required in woodworking, two important measuring devices have been developed specifically for blind or visually impaired woodworkers—the Rotomatic rule and the Click Rule. These instruments are used to make both actual numeric measurements as well as transferring non-numeric distances. Of the two devices, the Rotomatic is the more accurate and versatile while the Click Rule is somewhat easier to use. The Rotomatic appears to have been invented about 1950 by Frederick Sigafoos of the Overbrook School for the Blind in Philadelphia where he trained a number of students both in its use and in its manufacture. The devices do not seem to be patented and are made by a few different manufacturers so there may be slight differences in operations of various models.

The Rotomatic. The Rotomatic consists of a six and a half-inch long threaded steel rod with a large rotating rectangular measuring nut or fence that can be moved precisely along the threads and locked in place with a hexagonal locking nut. The dimensions of the rectangular measuring nut are five-eighths inches wide by fifteen-sixteenths inches long and exactly one-quarter inch thick. There is a scored line or notch on the side of the measuring nut. When that notch points up, the nut is at a measurement that is an exact multiple of one-sixteenth inch, either zero, one-sixteenth, one-eighth, three-sixteenths, one-quarter, five-sixteenths, three-eighths, etc. The three-eighths inch diameter threaded rod has raised threads at every half-inch interval to tactually determine the half-inch increments. The Rotomatic threads are machined precisely one-sixteenth inch apart so that a full turn of the measuring nut moves it one-sixteenth inch, a half turn moves it one-thirty-second inch, a quarter turn moves it one-sixty-fourth inch and a lesser turn moves it proportionately even a shorter distance. The Rotomatic can measure with an accuracy of one-sixty-fourth-inch and it can be used to transfer any non-numeric distance.

There also are three smooth extension rods of 6 inches, 12 inches and 18 inches that screw into the Rotomatic threaded steel rod as well as into each other. These extension rods precisely extend the length of the threaded rod. Extension rods come in steel as well as aluminum depending on manufacturer. The Rotomatic uses a10-24 thread for extension connections.

The Rotomatic measures from the outside end of the threaded rod to the inside face of the measuring nut. Remember this carefully while reading the following descriptions of how to use the Rotomatic.

To learn how to use the Rotomatic, begin by zeroing it out. Note the hole in the end-face of one end of the threaded rod that is the attachment point for screwing in the extensions. This end is the starting point for all measurements. Rotate the large rectangular measuring nut to that end so that it is flush with the end face with the screw hole and the notch on the nut is face up along with the raised threads marking the half-inch positions. This is the zero point. All measurements are made from this end. For all uses, the raised threads on the rod must be facing up. The notch in the rectangular measuring nut will face up for all even inches and for all multiples of one-sixteenth inch including eighths, quarters and halves but the notch will face down or to the sides for measurements of thirty-seconds and sixty-fourths.

Measurements up to 6 inches with the Rotomatic are made using only the threaded rod. Measurements longer than that are made with the appropriate extension rod screwed in place so that the total measurement is the length of the extension rod plus the measurement along the threaded rod to the inside face of the rectangular nut. Measurements up to 12 inches are made with only the 6-inch extension screwed into the threaded rod. Measurements up to 18 inches use only the 12-inch extension, up to 24 inches use only the 18-inch extension. To make longer measurements use a combination of extension rods.

Now, let’s make a test measurement with the Rotomatic. To measure two inches exactly, turn or spin the rectangular nut until it lines up evenly with the fourth raised thread mark and both the notch in the rectangular nut and the raised threads are facing up. Use your fingernail to see if you can feel the fourth raised thread mark. If you can, then your measurement is greater than exactly two inches, so turn the rectangular nut back until you can no longer feel the raised thread. That position will be two inches exactly. If you were going to use this measurement you would then turn the 6-sided hexagonal locking nut tight against the rectangular nut to hold it securely and exactly in position. For even inches and half-inches the raised thread on the rod must be flush with the face of the rectangular nut or fence.

Now let’s try a more difficult measurement. To measure three and nine-sixty-fourth inches for instance, turn or spin the rectangular measuring nut until it lines up flush with the sixth raised thread mark that represents the 3-inch measurement. Once again, the notch on the rectangular nut and the raised threads must be facing up. Now turn the measuring nut another 2 full turns to get to three and one-eighth inches that is also the same as three and eight-sixty-fourths. Now turn a final quarter turn to move the measuring nut to three and nine-sixty-fourths inches. Note carefully that the raised threads on the rod are facing up but the notch on the rectangular nut is on the side and not facing up. Hold that position carefully while turning the 6-sided locking nut tight against the larger rectangular measuring nut.

To measure a longer distance, first screw in the appropriate extension onto the threaded rod and follow the same procedure. When you screw in the appropriate extension, move the measuring nut to the starting position at the end of the threaded rod. That position would be the zeroed out position if using only the threaded rod, but now becomes the 6-inch mark if using the 6-inch extension, or the 12-inch mark if using the 12-inch extension, etc. Turn the measuring nut or fence the necessary turns away from this point to get the additional measurement you need beyond the 6-inch or 12-inch, etc. starting point. As an example, to measure 7 inches exactly, screw in the 6-inch extension, and rotate the rectangular measuring nut until it is flush with the second raised thread. That is the 1-inch position on the threaded rod or the 7-inch mark after taking into account the 6-inch extension.

Cautionary Note: When an extension rod is screwed onto the raised thread rod, the rectangular nut may be able to be turned slightly past the end of the rod so that it registers a bit less than the zero position. If that is the case with your Rotomatic, be sure that you position the rectangular nut or fence so the notch faces up along with the raised threads on the rod. Only then will you be in the proper zero starting position.

Helpful Tip: For each measurement, you don't actually have to start at zero and count each and every revolution. You can quickly position the measurement by using the raised half-inch marks to get close. Position the rectangular nut or fence on the closest raised thread and then count the additional rotations from that raised thread mark to "dial in" your measurement precisely.

Inside Measurements with the Rotomatic: Inside measurements are made by positioning the end of the threaded rod or extensions against one inside face and turning the square measuring nut until its inside face is flush with the other inside edge of the material being measured. Alternatively, the backside of the measuring nut can be used to fit flush against an inside face and the resulting measurement on the threaded rod must then be increased by exactly one-quarter inch to account for the thickness of the nut.

To make an inside measurement of the width of a small box or drawer, for instance, position the Rotomatic so that the end with the hole in the threaded rod fits just inside the face of the box. Turn the measuring nut as necessary keeping track of the rotations until the outside or the back face of the measuring nut fits snugly against the opposite inside face of the box. To account for the thickness of the measuring nut, be sure to add one-quarter inch to the measurement noted on the Rotomatic.

<u>Outside measurements with the Rotomatic</u>: To measure the length of a board or to make an outside measurement of a box, it is helpful to clamp a block of wood to the outside face of the box or to butt the end of the board against a fence or other stationary piece. The block acts as a fence and the end of the threaded rod can be butted against this block or fence to facilitate the measurement.

Turn the measuring nut as necessary until the inside or the front face of the measuring nut or fence fits snugly against the opposite end of the board or against the opposite outside face of the box. Probably you will have to set the Rotomatic to a rough measurement and then carefully position the tool against the fixed fence and adjust the measurement until you get it exact.

The Rotomatic procedure does require some practice before you develop enough familiarity to be able to take accurate measurements. Practice taking all kinds of measurements until you develop the necessary skill to be able to comfortably count the raised threads and revolutions of the measuring nut. With this practice you will become adept feeling the raised threads and counting the additional turns needed for a measurement.

Chapter 1, Section 2:
The Click Rule. The Click Rule is a metal tubular device seven and nine-sixteenths-inches long that houses a threaded steel rod that clicks at every one-sixteenth inch as it is moved to new settings. The threaded rod has raised threads every half-inch. The metal tube has two flat rectangular stops or fences mounted on it. One stop or fence is located precisely at the open end of the tube and the raised thread rod protrudes through it. The other stop or fence is positioned exactly six inches along the tube from the stop at the open end of the tube. The front fence at the end of the tube is exactly one-quarter inch thick and it is five-eighths inch wide by one and three-eighths inches long. This fence lays on its long edge. The back fence is seventeen-sixty-fourths inch thick by three-quarters inch wide by fifteen-sixteenths of an inch long. This fence is fitted around most of the tube and stands vertically on its width.

A seven-inch piece of the threaded rod is inserted into the tube and a knurled locking knob is screwed into the top of the threaded rod through a long slot that has been machined into the tube. The threaded rod can be extended from or retracted into the tube by sliding the knurled knob with the rod attached. A small BB with a spring has been milled into the stop at the very end of the tube so that as the BB rides over the threads, a clicking sound is heard and felt. Each click corresponds to one-sixteenth inch. The Click Rule is accurate to one-sixteenth inch.

The Click Rule comes with three 12-inch extension rods that screw into the end of the Click Rule raised thread rod and into each other. The Click Rule uses a 10-32 connection thread. As mentioned earlier, the Rotomatic uses a 10-24 thread for extension connections. Mickey Fixsen who uses both tools has modified his Click Rule and its extensions to use a 10-24 thread so that all extensions are interchangeable with each tool. He has made additional extensions and used 10-24 threads for those as well.

The Click Rule measures from the end of the protruding threaded rod to the nearest face of the rectangular stop positioned at the end of the tube. Remember this carefully while reading the following descriptions of how to use the Click Rule. Both the Click Rule and the Rotomatic follow the same principle in measuring from the end of the rod to the inside face of the measuring stop or fence.

Helpful Tip: In practice, instead of having to count clicks for every sixteenth of an inch, the raised threads at half-inch intervals can be counted to position the fence close to a measurement, and then the final clicks can be counted to fine-tune the exact measurement. Therefore, the user can count the number of raised half-inch marks on the threaded rod protruding from the end of the tube and count the extra clicks in sixteenths of an inch to determine the measurement. Remember that with the Click Rule, the raised thread must be positioned just outside of the fence so that it can be felt with your fingernail.

It’s time now for a test measurement. To use the Click Rule to measure exactly two inches, loosen the knurled knob and push the knob to move the threaded rod out of the tube. Push the rod out until four of the raised half-inch threads can be felt. The fourth raised half-inch mark will be just a fingernail away from the stop or fence. Now you are exactly at the two-inch mark so tighten the knurled knob to lock the rod in place.

Important Difference. Note that this procedure is slightly different from the Rotomatic. For the Click Rule you must be able to feel the raised thread outside of the fence. In this test measurement it is the fourth raised thread outside of the fence that measures exactly two inches. For the Rotomatic, that last raised thread would have been flush with the fence.

Now let’s do a more difficult measurement. To use the Click Rule to measure four and three-sixteenths inches for example, loosen the knurled knob and push the knob to move the threaded rod out of the tube. Push the rod out until eight of the raised half-inch threads can be felt and the eighth mark is just a fingernail away from the stop or fence. Now you are exactly at the four-inch mark. Next, slide the threaded rod an additional 3 clicks to set it for the additional three-sixteenths inch. Now tighten the knurled knob to lock the rod in place.

If the distance to be measured is between six and twelve inches, then simply measure from the end of the rod to the inside face of the second metal stop and add six inches to your measurement. This precisely placed second stop in the Click Rule eliminates the need for a six-inch extension piece.

<u>Outside measurements with the Click Rule</u>. Outside measurements can be determined easily with the Click Rule. To measure the length of a board, it is helpful to butt the end of the board against a fence or other stationary piece. Slide out the threaded rod as necessary until the end of the threaded rod butts against the stationary piece and the inside of the stop or fence at the end of the tube fits snugly over and against the opposite end of the board. Probably you will have to set the Click Rule to a rough measurement and then carefully position the tool against the stationary piece and adjust the measurement until you get it exactly.

Once again, if the measurement will be between six and twelve inches then measure to the inside face of the second fence.

Remember to add six inches to the noted or "clicked" measurement.

To measure the outside measurements of a box it is helpful to clamp a block or piece of wood to one outside face of the box. Slide out the threaded rod as necessary until the end of the threaded rod butts against the block and the inside of the Click Rule stop or fence fits snugly over and against the opposite outside face of the box.

Approximating measurements to one-thirty-second of an inch. Remember that the Click Rule measures only to the nearest one-sixteenth inch. If the Click Rule fence fits only loosely against the opposite outside face of a box or the end of a board, then the actual length of the board probably is roughly one-thirty-second inch less than the measurement shown on the Click Rule.

Inside Measurements with the Click Rule. With some practice, accurate inside measurements can be taken. Remember, the length of the Click Rule is seven and nine-sixteenths inches. To make an inside measurement of a small box or drawer or door opening inside a face frame, for instance, position the Click Rule so that the threaded rod fits against the inside face of the box and the backside of the Click Rule fence fits snugly against the opposite inside face of the box. To account for the thickness of the first fence, be sure to add one-quarter inch to the Click Rule measurement noted. But if the measurement is between six and twelve inches so that you are measuring to the backside of the second fence, then you will have to add an extra seventeen-sixty-fourths inch to the measurement, that is, an extra one-sixty-fourth more than the extra quarter inch to account for the slightly thicker size of the second fence.

Extending the length of the Click Rule. You can extend the length of the Click Rule by adding threaded rods that screw into the Click

Rule. The extension rods will accommodate longer measurements.

Again remember that the Click Rule measures only to the nearest one-sixteenth inch. If the Click Rule fence fits only loosely against the opposite inside face, then the actual measurement probably is roughly one-thirty-second inch greater than the noted or “clicked” measurement.

<u>Measuring inside a cabinet with face frame:</u> A cabinet opening with a face frame or other obstruction makes it difficult to use either the Rotomatic or the Click Rule. It may be easier to take two straight narrow boards that fit easily within the cabinet opening. Overlap the boards and position the end of one board against the left side of the cabinet and position the end of the other board against the right side of the cabinet. Pinch the boards against each other and either clamp or tape the boards to maintain the position and measurement. Now use the Rotomatic or Click Rule to measure the length of the boards. That length will equal the distance between the cabinet sides.

<u>Comparison of Rotomatic and Click Rule:</u> For the blind or visually impaired woodworker, the Click Rule and Rotomatic are very important measuring devices that can make actual numeric measurements as well as measuring and transferring non-numeric lengths. There are some differences between the two devices.

The raised threads at every half-inch interval on the Click Rule differ slightly from the Rotomatic. The Click Rule raised thread protrudes slightly beyond the fence or stop so that the woodworker’s fingernail can be inserted between the raised thread and the stop. When measuring three inches with the Click Rule, for instance, you will be able to feel six raised threads, whereas on the Rotomatic you would only be able to feel five raised threads and the sixth would be exactly flush with the measuring nut.

This difference can be explained by the way each threaded rod is milled. Go to the very end of the Click Rule rod and count the small one-sixteenth inch threads with your fingernail on the side of the rod. You will be able to count seven threads on the Click Rule before coming to the raised eighth thread. That is the reason why the Click Rule raised thread must be one notch outside of the fence to be able to measure one-half inch. On the Rotomatic you will be able to count eight threads on the side before coming to the raised thread that is the ninth thread. That is the reason why the Rotomatic measurement is made with the raised thread flush with the fence. The two manufacturing approaches differ slightly, but both devices can be used to make accurate measurements.

The Click Rule enables the woodworker to achieve accuracy to one-sixteenth-inch fairly quickly. The Rotomatic enables the woodworker to achieve more precise accuracy to one-sixty-fourth-inch although it takes a bit longer. The Rotomatic has the added advantage of being able to lie flat on the workpiece giving slightly greater accuracy.

How to use these measuring devices in the shop to set machines, fences and stops to cut wood to specific lengths and widths will be covered in later chapters dealing with each particular machine and function.

Chapter 1, Section 3:
Other Measuring Devices

Shop-made Adjustable Length Gauges: Gil Johnson uses a shop-made length gauge that he first made in high school shop class. The length gauge consists of three small pieces of wood each roughly three-eighths inch thick and one inch wide. The top piece is about four inches long and has a long one-quarter inch wide slot routed throughout most of its length. A small block about an inch square is glued to one end of the top piece. The third piece is about three inches long and has a three-sixteenth inch counter sunk hole drilled near one end to accommodate a three-sixteenths inch flat head bolt. This bolt and a wing nut secure the two pieces together. The shorter piece can be moved along and locked into position at any desired length. This length gauge can then be used to set a cut line on a board or to set a stop block on a saw. Gil has made a series of these gauges from 4 inches long to four feet in length. He finds it a quick and handy way to transfer precise distances from one piece to another without the need for any numerical measurement. It is particularly useful for making inside measurements.

Bar gauges. Armando Del Gobbo finds simple bar gauges to be very helpful. Bar gauges consist of thin boards overlapped to take or compare inside measurements. He uses the specially designed head clamp from Lee Valley-Veritas to fit over two thin measuring sticks with an easy-to-use knurled knob for tightening them into position.

Measuring or Set-Up Blocks: Other very useful devices include measuring or set-up blocks. A simple 1-2-3 block is a piece of wood or metal that measures 1 inch thick by 2 inches wide by 3 inches long. The 1-2-3 block can be used in multiples and in conjunction with fractional set-up or measuring blocks to measure various distances. Gordon Mitchell uses set-up blocks that are square brass bars about 2 inches long and exactly square in cross section. Set-up blocks come in sets with bars one-eighth-inch, three-sixteenths-inch, one quarter-inch, three-eighths-inch and one half-inch square. Some sets have blocks 4 inches long with the same square cross-sections. The woodworker can know these sizes by feel particularly if the set is kept together for comparison. Bill Reynolds uses steel key stock that is available in one-eighth inch square increments from one-eighth to a full one inch square. Key stock is available at local hardware stores and is used to secure pulleys to shafts.

A wide variety of measurements can be made by using the 1-2-3 block in conjunction with the necessary combination of the fractional set-up bars. To measure three and fifteen-sixteenths inches, for instance, use the 3-inch side of the 1-2-3 block with the three-sixteenths-inch, the one-quarter-inch and the one-half-inch set-up bars. To measure three and one-sixteenth inches, use the 2-inch side of the 1-2-3 block with the one-half-inch, three-eighths-inch and three-sixteenths-inch set-up bars.

Gordon also uses small steel angle blocks as set-up pieces. The blocks are precision machined to an accuracy of 0.0001 inch per inch. Each block is 3 inches long, hardened and lightly magnetized for better holding ability. The set includes angles from 1 degree to 5 degrees in one-degree increments, and 10 degrees to 30 degrees in five-degree increments.

Mickey Fixsen has made large angle guides out of medium density fiberboard (MDF) or tempered hardboard. These larger gauges are very useful in setting miter gauges because they are stable and have longer edges to match against a tablesaw blade when setting a miter gauge.

When working in confined spaces or setting fences for the tablesaw or router to smaller dimensions, the fractional set-up blocks and the 1-2-3 block often can be used much more easily than larger measuring devices such as the Click Rule and Rotomatic. All of these devices play an important role for the blind woodworker. With these devices, the blind woodworker can achieve the accuracy needed to do fine woodworking.

Braille and Talking Measuring Tools: Rulers and tape measures with scales in Braille or other tactile markings to be read by touch are readily available. Bob Kennedy sometimes uses Braille micrometers, talking calipers and audible levels. These tools are available through a maker of scientific instruments although these tools are considerably more expensive.

Braille rulers and tape measures simplify making rough measurements but generally cannot be read any finer than about one-eighth inch because of the need to be able to feel the marked scale. Often these measuring instruments are not accurate enough for the close tolerance work sometimes required in woodworking.

The Braille micrometers and talking calipers have a greater degree of accuracy but are limited to specialized types of measuring.

Talking Tape Measure. A welcome addition to measuring devices for the blind is the talking tape measure. Talking tape measures speak out the measurements. This device allows easy outside or inside measurements accurate to within a sixteenth of an inch. Simply, press any of the 5 buttons to activate the voice, but preferably the zero button, and pull out the tape to the extent necessary and place the edge of the tape measure housing on one end of the object to be measured and the end of the tape on the other, and the tape measure will announce the measurement. For inside measurements, be sure to place the tape measure housing back against the inside wall or back to be measured, extend the tape to the other side and again, the measurement will be announced. This device will give measurements in millimeters, centimeters, meters, feet and inches, or inches. It also has a memory capability and a way to add measurements to memory. It is produced in different languages as well.

Sources for the various measuring tools discussed above are listed in a separate section at the end of this chapter

Chapter 1, Section 4:

Marking. Measuring is only half the task. Marking or recording or somehow duplicating a measurement is just as important.

Woodworkers measure a board, make a mark at the appropriate measurement, and then use a try square or other device to draw that mark into a line that will be used to set up a cut or to position another piece of wood, or for some other function. The accuracy of the line depends on the accuracy of making the original mark, of extending that mark into a line, and on the thickness of the pencil lead used to draw the line. Each of these steps is a possible source of error. Taking a second piece of wood, again measuring the same distance, then marking it off into a pencil line often results in two pieces of wood marked with slightly different cut lines.

There is a more precise way. Using a knife to mark the position and to incise the line reduces the margin of error. Marking with a knife severs wood fibers along the line and helps preserve a clean edge when sawing to the line. A marking knife is beveled on one side of the blade. Use the bevel side of the knife on the waste side of the line and always run the blade’s flat side against the steel ruler, straight edge or try square.

The blind woodworker needs a slightly different method, however. Theoretically, the knife mark will provide an incised line that can be felt by the blind woodworker. Too often of course, it’s difficult for the woodworker to find the incised line later on in the process. Masking tape placed close to the line is a useful way of quickly finding the general location by feeling the tape and then carefully feeling for the incised line. Using double-faced tape to hold a wood block or stop in position exactly on or near the incised line also may help. To position the stop block, first place the edge of the knife in the incised line, then carefully slide the stop block up to the knife to position it exactly. This may be difficult to do when there is double-faced tape on the bottom of the block causing it to stick prematurely as you try to position it exactly next to the knife.

If you have first incised a mark on a workpiece and you want to mark a second piece of wood at the same length, insert the tip of the knife into the incised line, carefully position the second piece of wood against the knife blade and then mark off the length at the opposite end of the piece, or even clamp the two pieces together and use the first as a template and cut right at the end of that piece.

Since many woodworkers are not able to readily feel a thin, knifed line with their fingers, they may prefer a line scratched with a sharply pointed awl (spelled a-w-l) or a line scratched with a scribe (also called a scratch awl) because it makes a deeper and more prominent line. Unfortunately, it also makes a wider line. If you use an awl you can develop the habit as Bob Kennedy has done of always positioning the scratched line to be on the waste side of the cut. This will remove any unsightly scratch from the finished project.

Chapter 1, Section 5:
Other Marking Techniques

Mark the Reference Face of All Boards. While on the subject of marking, it is very helpful at the beginning of a project to mark a reference face on each piece of the stock. Usually, the reference face is the show face so that all measurements are made from the show face. This means that even when there are slight variations in the thicknesses of workpieces, all offsets, all thicknesses of tenons, positions of mortises, etc. match up exactly and any variation due to differences in thickness are visible only from the hidden sides of a piece. It's important to remember to mark the face sides at the beginning of a project.

Cabinetmaker's Triangle. When using multiple pieces which are to be edge-joined, once you establish the order of the pieces, it's very helpful to use a cabinetmaker's triangle to mark the pieces. The sighted woodworker would use a pencil, a carpenter's crayon, or chalk to draw a large triangle over all of the pieces placed edge-to-edge in their final position. The blind woodworker accomplishes the same thing with the use of tape to mark the triangle. The uppermost or outside piece of wood will have only the V-shaped point of the triangle on it, while middle pieces of wood will have only parts of the two diverging sides of the triangle and the bottommost and opposite outside piece of wood will have the ends of the tape sides where they join the base of the triangle. Once the triangle has been taped, a knife should be used to slice apart the tape at the edges of each board. Once the pieces are tape marked with a cabinetmaker's triangle the pieces can be shuffled in any random order and you will always have a means of re-establishing their original position simply by feeling and re-assembling the tape-marked triangle.

Keeping Organized. Of course with tape being used to mark the face side of each piece and tape being used to mark the carpenter's triangle you will need to establish some system to keep your tape marks understandable so that they don't mislead you later on. You may use a small square piece of tape in a corner of the workpiece to indicate the face side or you may use any of a variety of available raised dots to indicate this. Tape positioned on other parts of the piece could mean something else. Size of the pieces of tape, configuration of the piece of tape, placement of the tape, etc. all could convey different items of important information.

David Albrektson uses Braille ‘n Speak, a portable notetaker device, to keep track of important information and points to remember. Dean Tuttle has used sticky dots and Dymotape with Braille notes. Some woodworkers use Braille labels, Braille numerical markings, push tacks, small screws, notches, tap in very small brads or drill small reference or registration holes in a waste portion of the workpiece that will be cut off later. Whatever method is used, be sure that it will not show on the finished project and that it will not get in the way of future woodworking operations. Establish some form of consistency in applying marks or labels. Above all, it’s very important to keep all of your wood pieces in an organized fashion while you work. A dedicated parts rack helps with organizing.

Other Marking Tools. There are a number of other basic marking tools available from woodworking stores and catalogs, as well as from hardware stores and home centers. Marking tools from woodworking stores and catalogs tend to be of better quality than the carpentry-type items carried by hardware stores and home centers.

Try Squares. The try square is an important specialized woodworker’s tool with a machined blade with exactly parallel sides fixed to a handle at precisely 90 degrees. It is used to check the accuracy of 90-degree square corners and for marking lines at right angles to an edge of a board. The thicker handle overlaps the thinner blade to form a fence or stop so that the handle can rest against an edge of the workpiece while the blade lays flat on the face of the workpiece. Try squares come in a variety of styles from inexpensive plastic handled squares to handles of rosewood and brass.

Machinist’s Squares. Machinist’s squares are steel and are very useful as try squares, particularly because they are available in a variety of sizes and tend to be less expensive. The most common try squares have blades about 6 inches long but the smaller variety of machinist's squares or engineer's squares with a 3-inch or 4-inch blade are extremely handy because they are lighter, easier to use and fit nicely in a pocket where it's easier to find the try square when it's needed.

Combination Squares. There are adjustable or combination squares consisting of a grooved ruler used as the blade that slides along a tab in a thicker handle with a lock to hold it in position. Bob Kennedy's Braille form combination square is marked on the edge of the ruler portion with raised dots every one-eighth inch. Combination squares have a variety of uses. The primary use is as a large size try square. Because the adjustable ruler can be set at any measurement, running a pencil along the end of the ruler or blade in the combination square is a useful way of drawing lines parallel to an edge or end of a board. Simply set the ruler to the desired measurement, lock it in place and then run the square against the edge while holding a marking tool against the end of the ruler. In similar fashion, the ruler can be set at a measurement and used to set depth of cut on either a table saw blade or router bit.

Checking a Try-Square for Squareness. Try squares and machinist's squares should be checked periodically for squareness. Rough handling and dropping any square can easily knock it out of square. To test for squareness, take a length of wood with an edge jointed straight. Place the handle of the try square or machinist's square along the jointed edge and the blade at a right angle on the face of the board. Lightly incise a line along the blade. Now carefully flip the handle over so the handle is pointing in the opposite direction and again position it against the edge. Insert the tip of the knife into the incised line near the edge and slide the blade of the square up against the knife to line up the blade with the incised line. Once positioned exactly, lightly incise a new line along the edge. Be particularly careful when incising the second line and be sure that the knife stays against the blade of the square and isn't captured by the first incised line. If the try square is truly square, the second line will run exactly within the first incised line. If the lines diverge, the tool is out of square. The greater the divergence, the more it is out of square. In any event, if out of square it's time to invest in a new machinist's square.

Incising Lines With a Knife. A word is in order about incising lines. The sharp blade of the marking knife will want to follow the grain of the wood and that grain usually runs anything but straight. To avoid this problem, be sure to lightly incise the line for the first few passes. Subsequent passes can be done with slightly more pressure to deepen the line and to make it more prominent so that it is easily felt.

Speed Square. A speed square is a rougher, construction grade tool with uses similar to a try square but it is constructed differently. Speed squares are simply a metal right triangle with two equal legs and a diagonal hypotenuse at forty-five degrees. Speed squares come in a variety of sizes. There are slots or detents along the hypotenuse so that accurate angles can be measured. One side of the triangle will have a raised lip that can be used as a fence to butt against the edge or end of a board. The triangular metal configuration of the tool gives it rigidity so the square is more difficult to knock out of square. Generally however, the squareness is not machined as precisely as a try square or machinist's square.

Miter Squares. Miter squares have a blade passing all the way through both sides of the handle so that it registers 45 degrees to the handle on one side and 135 degrees on the other. The miter square is used for measuring or marking inner or outer miters.

Sliding Bevels. The sliding or adjustable bevel is an extremely useful tool. The sliding or adjustable bevel has a blade that rotates within a handle and can be adjusted to any angle and locked in place either with a thumb-screw, wing nut or lever. The tool is used to transfer an angle from an existing piece to another board or to measure that angle against a protractor. The tool can also be set to a particular angle using a protractor or angle blocks.

Measuring Stock. At the beginning of a project when the stock is still rough the woodworker needs to layout and measure the individual pieces. Each piece should be measured slightly oversized. When measuring length, allow about an extra inch. When measuring width, allow about an extra half-inch. This approach allows leeway for changes to the wood that might come about during the process of milling the wood flat and square. It also permits some adjustment in sizes as the project proceeds.

Often this step of oversizing can be skipped if larger pieces of wood are first milled square. If the wood has been fully milled and has had time to adjust, individual pieces can then be cut to final length and width.

Cutting multiple pieces the same size: When cutting multiple pieces to the same dimensions, carefully measure to cut only the first piece. Then use that piece as a template guide to mark and cut subsequent pieces. Better yet, set a stop on the saw so that you can butt up the stock against the stop and cut accurately without measuring or marking. This method is the most reliable way for any woodworker to get accurate results so that each piece exactly matches every other piece.

Setting fences and stop blocks: The Rotomatic and Click Rule are often first used to measure a workpiece but an even better use of those devices is in setting fences and stop blocks. This results in exact repeatability. Variations on how to mark and cut wood will be covered in later chapters dealing with each particular shop machine and function.

Miter gauges: Generally, woodworkers find it very difficult to set standard miter gauges on tablesaws to precise angles. The exception is the Incra line of miter gauges. Incra has several miter gauges available with varying levels of angle settings and price. Detents for angle marks are notched along the outside perimeter of the base and a pivoting pawl rotates into the notches to accurately position the gauge. The woodworker can count and feel the notches to determine an angle. Incra miter gauges are expensive but highly accurate.

Summary. When done with care, measuring and marking can be extremely accurate. The blind woodworker has available the necessary tools to accomplish manually exactly what the sighted woodworker can do visually. It takes a bit more time and practice but everyday, blind woodworkers produce extremely accurate measurements. And, we don’t need to add that accurate measurements are extremely important.

Joints and other pieces will fit tightly without gaps only if the measuring was accurate. So spend a lot of time working with your Rotomatic or Click Rule and a set of measuring blocks to develop the necessary skill to measure accurately. You’ll be well rewarded for the effort.

Chapter 1, Section 6:
SOURCES FOR MEASURING TOOLS

1. The National Federation of the Blind maintains a valuable website at nfb.org. The link to measuring devices offered for sale by them is:

http://secure.nfb.org/ecommerce/asp/prodtype.asp?prodtype=9

From the NFB homepage, navigate your way to Measuring Devices by first clicking on Products & Technology, then click on Product Catalog, then click on Measuring Devices and a page will come up with the Click Rule, Rotomatic, various rulers, micrometers and a talking tape measure.

The following is a list of products offered:

BRAILLE METERSTICK
Plastic Meterstick
A black plastic ruler with raised lines every centimeter with Braille every other centimeter and it has thick raised lines for decimeters
BRAILLE METERSTICK AID57M $15.00

CLICK RULE
6-inch device with three extensions of 12 inches each with tactile markings every half-inch. Tighten screw for easy and accurate measurement.
CLICK RULE AID01R $65.00

METAL FOLDING RULER
12 inches, aluminum with tactile markings every quarter-inch and folds in half.
RULER-FOLDING AID02R $6.00

METAL RULER
12 inches, aluminum with tactile markings every quarter-inch.
RULER-12 INCH AID00R $6.00

ROTOMATIC
6-inch device with three (3) extensions (6, 12, and 18 inches) and a nut which moves on a threaded rod with threads that are one-sixteenth-inch apart. Quarter turn of the nut equals one-sixty-fourth inch measurement (also includes lock nut).
ROTOMATIC AID04R $50.00

STARRETT INSIDE MICROMETER
Brailled and accurate from .200 - 1.200 inches. Instructions included.
MICROMETER AID54M $240.00

STARRETT INSIDE MICROMETER
Brailled and accurate from 0 to 3 inches. Instructions included.
MICROMETER, 0-3 AID53M $210.00

STARRETT INSIDE MICROMETER
Brailled and accurate from 1 to 2 inches. Instructions included.
MICROMETER, INS AID55M $240.00

STARRETT OUTSIDE MICROMETER
Brailled and accurate from 1 to 2 inches. Instructions included.
MICROMETER, 1-2 AID51M $200.00

STARRETT OUTSIDE MICROMETER
Brailled and accurate from 2 to 3 inches. Instructions included.
MICROMETER, 2-3 AID52M $200.00

TALKING TAPE MEASURE
16 foot, in case. Print instructions and uses one 9-Volt battery (included).
TAPE MEASURE-TALKING AID06T @99.00

2. Some measuring tools are available from the following websites:

maxiaids.com
aidsforindependentliving.com
resourcedigest.com
abledata.com
aph.org

3. The Rockler Woodworking catalog on-line at rockler.com, or telephone 800-279-4441

search for “brass set-up bars” or go to:
http://www.rockler.com/search_results.cfm?filter=brass+set-up+bars&submit.x=10&submit.y=10

Machined solid brass setup bars to accurately set depth of cut, fence to cutter distance, material thickness and more without using calipers or tape measure. Set includes six two and a half-inch long bars measuring one-eighth-inch, three-sixteenths-inch, one-quarter-inch, five-sixteenths-inch, three-eighths-inch and half-inch square. Bars can be combined for additional heights. Comes in foam-padded divided plastic tray

Item No. 36918 for $16.99

search for “router depth gauge” or go to:
http://www.rockler.com/product.cfm?page=5707&filter=16346

Stepped Set-up Gauge for the Router – Easy and accurate depth adjustments from one-sixteenth-inch to one and a half-inches. Determine settings in one-sixteenth-inch increments. Heavy-duty aluminum construction.

Item No. 16346 for $5.89

4. The Woodcraft catalog on-line at woodcraft.com or telephone at 800-225-1153.

WHITESIDE Brass Set-up Gauges. Search for “brass set-up gauges” or go to:
http://woodcraft.com/family.aspx?familyid=4854

Whiteside offers precision machined brass set-up gauges for a variety of purposes, from setting depth of cut on a plunge router to setting bit height or fence depth on the router table as well as many other uses. Stack them together to combine measurements from one-eighth-inch to one and seven-sixteenths-inch. Brass gauges will not damage tool or bit edges. Set includes: five two and a half-inch long bars, measuring one-eighth-inch, three-sixteenths-inch, quarter-inch, three-eighths-inch, and half-inch square.

Item No. 144932 for $13.99

Router and Saw Depth Gauges. Search for Router Depth Gauge or go to: http://woodcraft.com/family.aspx?familyid=4439

These aluminum gauges make saw or router set up fast and easy. Just set the gauge across your blade or cutter and adjust to the required setting. Both are clearly marked in inches (both fractional and decimal) and millimeters. The Router Depth Gauge is designed for setting cutter depths from one-sixteenth-inch to one and one-half inches in one-sixteenth-inch increments. The Saw Depth Gauge can be used to set blades on radial arm, hand held circular and table saws from one-eighth-inch to two inches in one-eighth-inch increments.

Router Depth Gauge #143294 Price: $8.50
Saw Depth Guide #143295 Price: $8.50
Router and Saw Depth Gauge Set of 2 #03K17 Price:$13.99

5. The Lee Valley and Veritas catalog on-line at leevalley.com or telephone 800-871-8158

Angle Blocks. Go to
http://www.leevalley.com/wood/page.aspx?c=1&cat=1,43513,51657,32524&p=32524

Set any angle from1 degree to 90 degrees with a set 10 hardened steel blocks, each 3 inches long and machined to 0.0001 inches per inch. Set includes angle from 1 degree to 5 degrees in 1 degree increments and 10 degrees to 30 degrees in 5 degree increments. Each block is lightly magnetized for better holding ability. Comes in a protective case.
88N82.01 Angle Blocks, set of 10 $35.50

Bar Gauge Heads. Go to
http://www.leevalley.com/wood/page.aspx?c=1&cat=1,43513,43553,32585&p=32585

Bar Gauge Heads are made of brass and ABS plastic with openings of one-half inch by three-quarters inch. Rip one-quarter inch slices off standard three-quarters inch lumber to make bars of any length you want (wood is not included). Two brass pins are included for transferring inside or outside measurements smaller than the length of the sticks or for transferring outside measurements without making hook tips.
05N31.01 Bar Gauge Heads $12.95

6. The Captek Adaptive Technology for the Blind catalog on-line at www.captek.net or telephone 800-888-7400. The talking calipers are available from captek.net along with a wide range of shop and carpentry tools.

Go to: http://captek.net/office_classroom.htm#tools

From the Captek homepage, click on Office/Classroom, Shop, and Medical Aids in the left column, then click on Shop and

Carpenters’ Tools in the main center column which will take you to the following information:

The Digi-Voice Tool Module is the essential basic unit that speaks the values shown in the digital tool display. Etched tools have a combination of enhanced fingernail markings and raised dots. Carpenter tools are read by tone and null.

#1155 TALKING TOOL MODULE $695.00 S/H $20.00

A full line of digital measuring tools are used efficiently by people with severe visual limitation/total blindness. Two tools may be plugged into the module at the same time with readout selected at the tool.

Digital Tools include: (Prices subject to change, please call for a quote)

#2701 6" VERNIER CALIPER $210.00 S/H $11.95

#2702 8" VERNIER CALIPER $245.00 S/H $11.95

#2703 0-12" VERNIER CALIPER $595.00 S/H $11.95

#2706 0-24" VERNIER CALIPER $705.00 S/H $11.95

#2709 CABLE FOR CALIPER $49.95 S/H $7.95

#2710 0-1" DIGITAL MICROMETER $225.00 S/H $11.95

#2711 1-2" DIGITAL MICROMETER $245.00 S/H $11.95

#2712 2-3" DIGITAL MICROMETER $305.00 S/H $11.95

#2713 3-4" DIGITAL MICROMETER $325.00 S/H $11.95

#2716 0-6" DIGITAL MICROMETER $645.00 S/H $11.95

#2718 MICROMETER STAND $94.95 S/H $11.95

#2719 CABLE FOR MICROMETER $49.95 S/H $7.95

Note: Shipping grouped on multiple items in same order.

Other tools such as Height and Depth Gauges, Dial Indicators and Digital Torque Wrenches are also available. Contact us for more information.

Etched tools have epoxy dots and grooves for reading by touch:

#1650 0-1" ETCHED MICROMETER $139.95 S/H $11.95

#1651 1-2" ETCHED MICROMETER $159.95 S/H $11.95

#1652 2-3" ETCHED MICROMETER $179.95 S/H $11.95

#1653 3-4" ETCHED MICROMETER $224.95 S/H $11.95

#1654 4-5" ETCHED MICROMETER $239.95 S/H $11.95

#1655 5-6" ETCHED MICROMETER $249.95 S/H $11.95

#1656 6 ETCHED MICROMETERS w/box $999.00 S/H $11.95

#1700 200-Inch/lb TORQUE WRENCH $365.00 S/H $11.95

#1705 200-Foot/lb TORQUE WRENCH $435.00 S/H $11.95

#2774 AUDIBLE CARPENTER'S LEVEL 2' $89.95 S/H $11.95

#2775 AUDIBLE CARPENTER'S LEVEL 10" $39.95 S/H $7.95

#2776 AUDIBLE STUD SENSOR $34.95 S/H $7.95

7. The combination square is available at most places adaptive equipment is sold. Replacement markings are available from the American Printing House for the Blind, Louisville, KY. Their web site is www.aph.org.

8. The Incra line of miter gauges is available through a number of woodworking catalogs. Details on Incra's various miter gauges can be found at Incra's website, www.incra.biz.