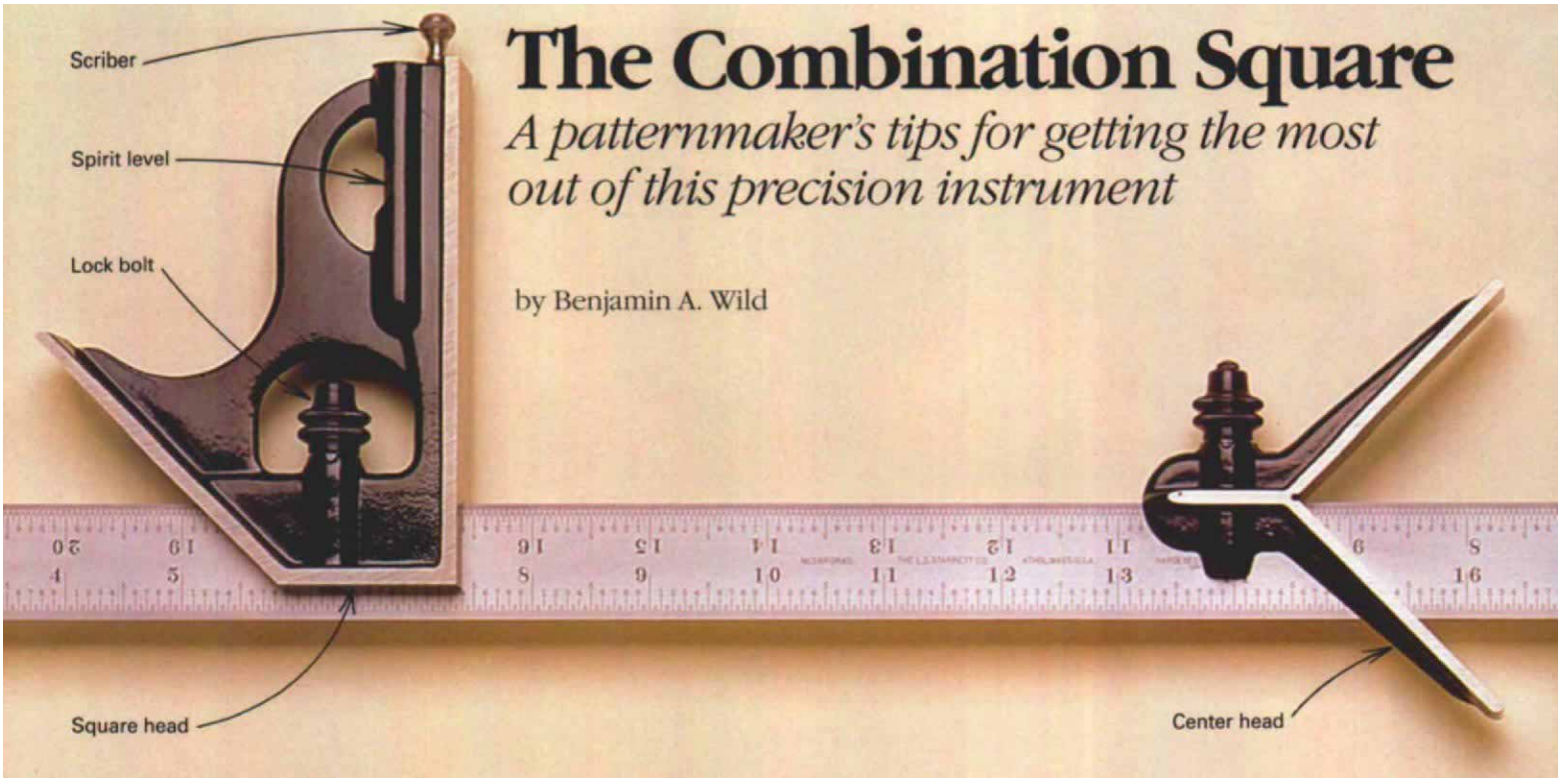


The Combination Square

A patternmaker's tips for getting the most out of this precision instrument

by Benjamin A. Wild

When I started my patternmaking apprenticeship 16 years ago, I was told to show up for work with a hammer and a combination square. I understood the need for a hammer, but I wondered why the square was so important. Besides the obvious use of laying out square and 45° miter lines, I soon found the combination square indispensable for accurately setting up and checking out machines as well as other layout work. Because a combination square is adjustable, it works quite well as a marking gauge and a height, depth and thickness gauge. It also transfers lengths of preset measure. Accessories, such as a protractor head for laying out angles and a center head for finding the center of round and square stock, extend the tool's usefulness. In addition to these techniques, I'll discuss some of the basic considerations for buying and using one of these versatile instruments.

Buy quality

When the boss saw the shiny, new, bargain-basement square that I bought, he threw it into the garbage. He then took me to the store and bought a Starrett square, protractor and center head set for me and deducted the cost from my first paycheck (L. S. Starrett Co., 121 Crescent St., Athol, Mass. 01331; 508-249-3551).

That Starrett square has fallen off benches, scaffolds and boats. The level vial is smashed, the scriber is lost and the paint is chipped. Recently, I put a 24-in. blade into it, set it on a surface plate (a precision ground granite table) and put it up against a 24-in. machinist's try square. I couldn't see light between the blades anywhere. After 16 years of hard use, it's as good as the day it was made. The cheap square, which I secretly retrieved from the garbage, went out of square and was thrown into Dad's toolbox years ago.

Quality materials and precision machining set the Starrett and other good squares, such as Brown and Sharpe's (Brown and Sharpe Manufacturing Co., Precision Park, 200 Frenchtown Road, North Kingstown, R.I. 02852-1700; 401-886-2000), apart from run-of-the-mill squares. The heads are forged and hardened; the rule blades are made of hardened steel and are available in a polished or satin-chrome-plated finish. I recommend the satin-chrome finish because it reduces reflection and glare, making the rule much easier to read. As a bonus, the chrome plating protects the blade from rust and wears exceptionally well.

Starrett squares also have what the manufacturer refers to as "quick reading graduations," which are staggered graduations with the inch subdivisions numbered as well as the inches, as shown in the photo above. A variety of graduation schemes are available, from all fractional, decimal or metric to some combination of these divisions. The decimal graduations, because of their predominant use in the aerospace industry, have become known as aircraft scales. These scales are handy if you use a calculator for determining layout dimensions because you can measure directly in decimals without converting to fractions.

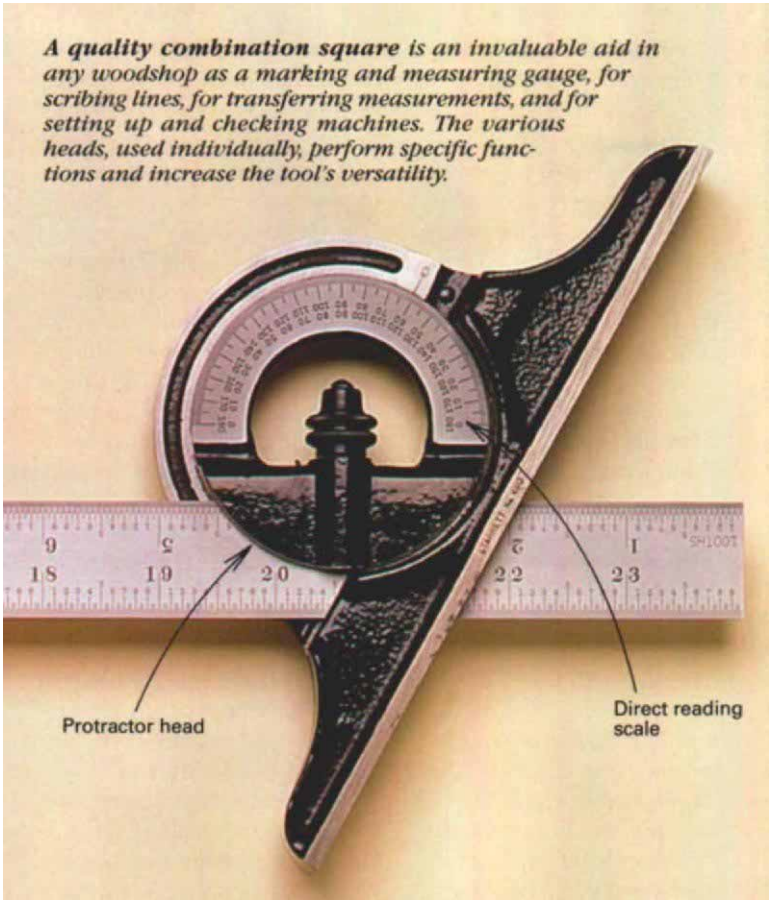
My personal preference for a square is Starrett's catalog number C33HC-12-16R. This unit has a square head and a center head, and the 12-in.-long, satin-chrome blade has quick reading 32nds and 64ths on one side and aircraft quick reading 50ths and l00ths on the other side. A 24-in.-long blade is convenient for many applications, but the 12-in.-long blade does the job 90 percent of the time.

The center head makes quick work of finding the center of round or square work. Simply butt the edges of the stock against the V of the head, with the rule extended across the end of the stock, and scribe a line. Rotate the tool approximately 90° and scribe another line. The intersection of these lines marks the center of the piece. A protractor head is a useful, optional accessory for machine setups and for transferring angles.

Care and maintenance of the square

With proper use and care, a good square can be passed on for generations, so I've developed some techniques to maintain the quality and accuracy of my square. When sliding the blade back and forth or taking it out of the head, I push on the lock bolt to re-

Photo: Susan Kahn



***A quality combination square** is an invaluable aid in any woodshop as a marking and measuring gauge, for scribing lines, for transferring measurements, and for setting up and checking machines. The various heads, used individually, perform specific functions and increase the tool's versatility.*

lieve the tension of the spring. This makes it easier to get the blade in and out of the head and prevents wear on the lock bolt and the head contact surface. To lubricate the blade, I use paraffin because it doesn't attract dust as oil will.

It's also a good idea to check the square's alignment every so often, especially after the square has been dropped or otherwise abused. Hold the square head against a jointed straight edge of a board with the rule extended across the surface of the board. Mark a line along the rule on the board's surface; then flip the square over so that the head is against the same straight edge, but the rule is on the opposite side of the line. Any gap between the rule and line will be double the amount that the square is off.

If the square is out of alignment, check the blade to see if it is straight and doesn't have any dings or burrs that might interfere with proper seating in the head. Burrs can easily be smoothed out by rubbing lightly with a flat sharpening stone. For more serious problems, contact the manufacturer for reconditioning.

Using the combination square

I learned one of the most important tricks for using a square from an old Southern craftsman, named Wes, while working at a Virginia boatyard. Pete, a young apprentice, was having trouble with out-of-square cuts and approached Wes for advice. Wes drawled out a couple of inquiries, "Did you mark the line straight? Did you cut directly on the line?" When Pete quickly responded "yes," Wes asked, "Pete, can you see straight?"

From that interchange, I learned to look at what I'm doing. I look to be sure the head of the square is tight to the edge of the workpiece. After marking a line, I look at it. If it looks wrong, I check it. I've avoided many mistakes with this simple procedure, and as I've gotten better as a woodworker, I've learned to trust my eye and recheck anything that doesn't look right.

When using a square, a bump or defect as small as 1/32 in. along the edge of the board, can cause the blade to be more than 1/8 in. out of square. To avoid errors, the combination square's head must be held tightly to the workpiece. I wrap my thumb around the curved part of the head with my palm pushing the head down and in against the edge of the workpiece. My index finger pushes down on the blade as far away from the head as I can comfortably reach. With this grip, I can slide the square along the board while keeping the head of the square pressed firmly against the edge. For the most accurate line, I place my knife or pencil on my mark, slide the square up to the marking instrument and then draw or scribe the line. (See the sidebar below for a discussion on marking lines with a knife vs. a pencil.)

The square as a marking gauge

The square can be used as a marking gauge by setting the desired length from the end of the blade to the perpendicular face of the head. Then, while holding a marking instrument against the end of the blade, slide the square's head along the edge of the board, as shown in the top left photo on the following page. This technique requires some dexterity and practice for best results. Because the wood's grain has a tendency to throw off the marking instrument, I only use this method for quick parallel lines when the layout is not critical. For more exact lines, I use a marking gauge.

The square as a thickness, depth and height gauge

My first rule of measuring is "don't, if you can avoid it" The ability to slide and lock the blade of a square lets me establish a consistent frame of reference that helps me avoid measuring in several different situations. Rather than measure the thickness of a board to plane another board to the same dimension, I use the square as a thickness gauge. I place the reference board on a flat table and

Accurate layout depends on a fine line

In any operation that requires handwork, the results are predicted by how clearly and accurately the line is marked. The clearest and most precise lines are made with a sharp knife that cuts the wood fibers. Lines scratched with an awl tend to be fuzzy, particularly across the grain. And a pencil line (no matter how sharp the point) is a lot wider than a carefully scribed line. The wide pencil line can lead to confusion about whether to work to the near side, far side or middle of the line.

To help make a scribed line more visible, I run a hard lead (4H) drafting pencil with the tip sharpened to a chisel shape along the score line. This darkens the line without affecting its accuracy. Sand paper (180-grit) glued to a piece of wood works well for sharpening the pencil.

My favorite layout knife is the X-Acto model with a large plastic handle, as shown in the top left photo on the following page. The thin X-Acto blades produce very clean lines. The thicker the blade and the deeper the cuts, the less accurate the line will be. And, if you make a mistake, a thin, lightly scored line is easier to sand away.

When scribing, make sure that your finger doesn't hang over the edge of the rule; I've found that most patternmakers have at least one scar as a result of having made this mistake. —*B.W.*

***The combination square** also can serve as a marking gauge. Simply hold a knife or pencil against the end of the blade while drawing the square's head along the edge of the stock.*

***As a depth gauge,** the combination square can be used to check the thickness of planed stock, as shown here. The square also can check mortise and dado depths and the lengths of tenons and tongues.*

***Lay out evenly spaced divisions** with the combination square by first setting the square to the desired increment. Then align the rule's end with the starting point, and score a mark at the square's head. Without lifting the knife, move the square along the board, butting the rule's end to the knife blade, and make the next mark at the square's head, as shown here.*

***With a set of parallel uprights and a story stick,** you can accurately lay out and transfer measurements from irregularly shaped objects. Mark the top edge of the story stick to be sure that it is properly oriented when transferring measurements.*

hold the head of the square vertically on the board with the blade hanging over the board's edge, as shown in the near left pholo. I then extend the blade to the tabletop and lock it in place. That set measurement can be used as a "feeler" gauge to judge the thickness of the board I'm planing. I've found that my sense of touch is much more accurate than trying to measure in these situations.

The height of a tablesaw blade or router bit can be set using this same technique. I set the square to the desired depth of cut using the comparative technique described above whenever possible or the rule's scale. Then, with the end of the blade resting on the saw table or router base, I adjust the blade or bit to the square's head. Again, feeling when the bit or blade just contacts the square's head provides a more accurate setting than trying to see the adjustment.

I've also used the square in this manner to check and compare tenon lengths to mortise depths and the tongue lengths on shelf ends to dado depths in carcase sides.

The square as a spacer

The square, set for a specific dimension, can be used to evenly space elements in a project, such as pickets in a fence, slats in a crib or dividers in a set of pigeonholes. I generally use a calculator when determining element spacing, and this is where the Starrett's decimal graduations come in handy. I can set the square directly from the calculator readout without the need to convert back to fractions thus eliminating another possible source of error.

Using this technique of laying out an element by referencing from the previous element or layout mark does introduce the possibility of cumulative error—an insidious mistake that quickly grows as the number of elements increases. However, in this situation, cumulative error can be minimized by aligning the blade end of the square with the reference surface and scribing along the perpendicular square head with a knife blade. After scribing the line, but before lifting the knife, I move the square down and butt the end of the blade against the side of the knife blade. I then scribe the next line against the perpendicular square head, as shown in the photo at left. I continue to leap frog the square and knife down the board until I get near the opposite end. Then I determine the amount of cumulative error and divide it among the last few increments to make the error all but undetectable.

Transferring points with a square

Lines or points are easily transferred from one side of a board to the other or even from piece to piece by setting the blade to the desired length. The key to accurate transfers is to establish datum surfaces that are straight, flat and square to each other and then always to measure from these datum surfaces.

This technique works fine for square projects, but what about curved surfaces? For irregular surfaces, machine shops have a coordinate measuring machine—a device that rides on a track above the part and measures the distance between points. For our purposes, however, a combination square, a story stick and a set of parallel blocks will accomplish the same thing. The story stick is held over the object by the parallel blocks and becomes the datum surface for measuring all the features of the object. Using the square, as shown in the photo at left, I transfer all the desired points from the object to the story stick. Marking a datum surface on the stick helps keep the stick from getting turned around. I can then transfer these dimensions from the story stick to create another piece or to make a drawing. □

Ben Wild, a former patternmaker, runs an apprenticeship program and teaches vocational training for the Rochester, N.Y., school district.

Photos: Charley Robinson