

THE **16** LAYOUT TOOLS EVERY SHOP NEEDS

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POPULAR Woodworking

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OCTOBER 2008 #171

New Workbench Design Holds it All

On Guard! Tame Your Table Saw

7 Tricks Conquer Nasty Tear-out

1 Sander Leaves 9 Others in the Dust

The Shocking Craftsmanship Of Greene & Greene



— OCTOBER 2008 —

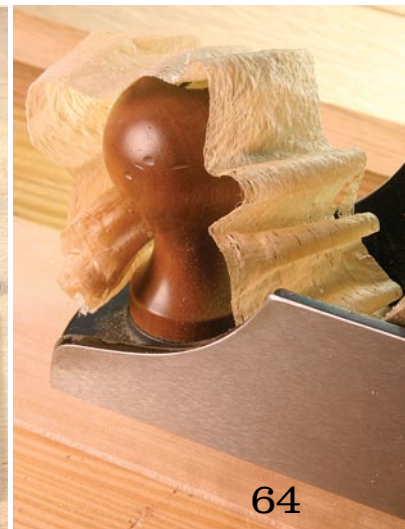
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We ran 10 random-orbit sanders through the testing gauntlet to see what model removed the most material, which was the most comfortable to use and, simply, which one we liked the most. See how the dust settled.

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It's the little things that truly distinguish the iconic Greene & Greene design. In this second of a three-part series, you'll get a close-up look at some famous furniture details and a taste of craftsmanship that is on a higher plane than most things made today.

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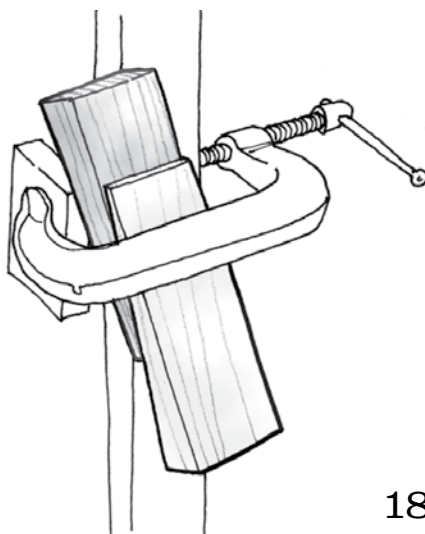
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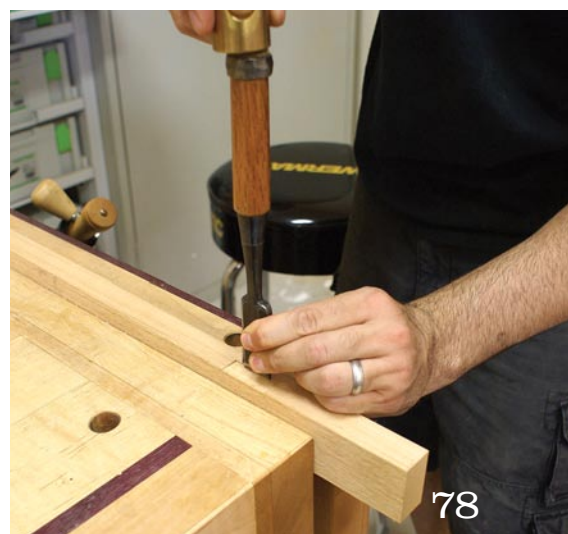
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The Veritas twin screw on Senior Editor Robert W. Lang's knockdown workbench is just one of many workholding devices you'll find on this intriguing new bench design.

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Workbench Workhorse

Senior Editor Robert W. Lang's new workbench combines the best workholding devices and ideas from historic benches, along with a few design twists of his own. In this video, Bob shows you how to secure just about any type of workpiece on this bench, whether you use power tools or hand tools.

popularwoodworking.com/video

The Wood Whisperer

While power tools are popular in most shops these days, they don't often leave a surface that's ready to be jointed or finished. Here, Marc Spagnuolo shows you how to clean up your power-tool cuts using a variety of hand tools, from smoothing out the inevitable variation from a dado stack to trimming dowels and pegs flush to perfectly sizing a tenon.

popularwoodworking.com/video

On the Blogs

How We Make the Cover

To shoot the cover of this magazine, Senior Editor Robert W. Lang had to haul his bench to Glen D. Huey's professional shop so we could get a pretty picture. Our videographer tagged along and caught the shenanigans on tape for your viewing enjoyment.

popularwoodworking.com/blogs

Project Plans

Table Saw Safety Rules

Download a list of Marc Adams's basic principles of table saw safety that will reinforce this issue's article on the topic – you can hang them in your shop above your bench.

popularwoodworking.com/oct08

\$175 Workbench

One of the most popular free projects on our web site is our plans for the \$175 Workbench. With some pine, nuts and bolts from the home center, you can build an inexpensive bench that is as stout as a mule. Our original version, now more than eight years old, is still in service and is holding up nicely. You can download the article for free from our site.

popularwoodworking.com/bargainbench

New This Month:


Greene & Greene Furniture Details: Incredible Intricacy

This downloadable slide show gives you an up-close look at some of the almost unfathomable design details craftsmen Peter and John Hall executed in their furniture for Charles and Henry Greene.

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And More!

Visit popularwoodworking.com/oct08 to find a complete list of all the online resources for this issue – including videos, additional drawings and photos.

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Marc Adams is the founder of the Marc Adams School of Woodworking in Franklin, Ind. In this issue, he writes about table saw safety (page 45).

Anyone who's attended Marc's school knows about his affection for all things Disney. So in between classes, he's been working on a "Beauty and the Beast" bed for his daughter's room, based solely on illustrations from the film. It's made of poplar, and painted white with an undertone of blue (those cartoon colors can be quite a challenge to match in reality!).

Marc describes the bed as "curvy and swirly," with myriad elaborate hand-



carved details. And it's big. So big, in fact, that it doesn't quite fit. The bed is 1" too tall for the room, an issue he plans to get around by cutting the carpet and pad.

Christopher Schwarz, editor of this magazine, is wrapping up his latest book project: "Mechanick Exercises: The Art of Joinery." That title no doubt sounds familiar – "Mechanick Exercises," by Joseph Moxon, was the first woodworking book written in English. Originally published in the mid-17th century, Moxon's work describes the things you would find if you walked into a 17th-century joiners shop – and hand tools haven't changed much during the last three centuries.

What has changed is the English language. So to make the book more accessible, Christopher has modernized spelling, grammar and sentence structure. In addition, he's added photographs to help illustrate Moxon's words, and



commentary on how 17th-century tools and techniques can be used effectively in the modern-day shop.

"Mechanick Exercises: The Art of Joinery" will be available this fall from Lostartpress.com.

Glen D. Huey This month, Glen celebrates his two-year anniversary as senior editor at *Popular Woodworking* and *Woodworking Magazine*. He does, however, still build custom furniture on the side – a not-so-carefully veiled excuse to keep his professional shop with its wide-belt sander. In fact, we shot the cover picture for this issue there. Somehow, Glen finds time to write books, too. His latest, which includes a DVD with how-to video demonstrations, is "Trim Carpentry for the Homeowner" (Popular Woodworking Books).

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Abandon Ship— Before it Sinks

One of the biggest frustrations with woodworking comes with designing furniture. There are thousands of people who will teach you how to cut a joint or apply a finish, but there is almost no one who will tell you that a design of yours stinks.

You can't trust your family. They will like whatever you build. And when they rave about a project, you should interpret "Wow! I love it!" as "Wow! It's not falling apart!"

You can't trust fellow woodworkers. Of all the critiques I've sat through, I've found that most woodworkers are loathe to take a brother or sister down a notch when it comes to design. Some woodworkers feel unqualified to comment on a project's aesthetics. Other woodworkers hesitate to criticize because they know that their turn in the box is coming.

Heck, you can't even trust the Internet. Even on the anonymous messageboards, it's really rare for one woodworker to offer anything but the mildest commentary on a project built by another. Stuff that looks like it should be hauled away in a dumpster usually gets kudos along the lines of: "That's some nice red oak!"

So who can you trust? Until you can afford a personal design guru, you are going to have to trust your educated gut.

When I say "educated," I mean that you have to treat design like any other woodworking skill. You need to study it by browsing books on great furniture from your library. You need to read about antique and

contemporary work like you read about the latest dovetail-cutting gizmo. After reading enough books on fine furniture, your gut will twitch approvingly whenever you see an excellent form.

And most of all, you need to practice. That means sketching a project several times before committing to it. There are several ways to do this. Draw stuff out full-size so you can see how the parts relate to one another. Build it out of foam-core insulation to see how the project looks in three-dimensional space. Build a mock-up out of cheap wood so you can alter moulding profiles and work out the details of the joinery.

Why am I writing about this? Because I'm just about to do the absolute most important thing when designing a piece of furniture: Be fearless when it comes to abandoning your efforts to design furniture. I would rather have 10 pieces of awkward furniture in my wastebasket than one in my house.

I have an end table design that made it to the wooden prototype stage, and it's just not working for me. I tried everything I know to save it (lightening the look, creating harmonizing details, trying to create one dominant theme for the piece). But nothing helped.

And though I'm irritated that I used up several hours of shop time, that's better than the sinking feeling I'd get every time I saw my complete but not-quite-there design. **PW**



Christopher Schwarz

PHOTO BY THE AUTHOR

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Safety Note

Safety is your responsibility. Manufacturers place safety devices on their equipment for a reason. In many photos you see in *Popular Woodworking*, these have been removed to provide clarity. In some cases we'll use an awkward body position so you can better see what's being demonstrated. Don't copy us. Think about each procedure you're going to perform beforehand.

Tenons Wider than 6" Should be Split into Two

I am making an Arts & Crafts dining table with a stretcher that's 12" wide x 48" long. It connects to the end rails with a mortise and tenon. The tenon is 8" wide. I have two questions:

1) Should I make the mortise wider than the tenon to allow for wood movement or size it to fit?

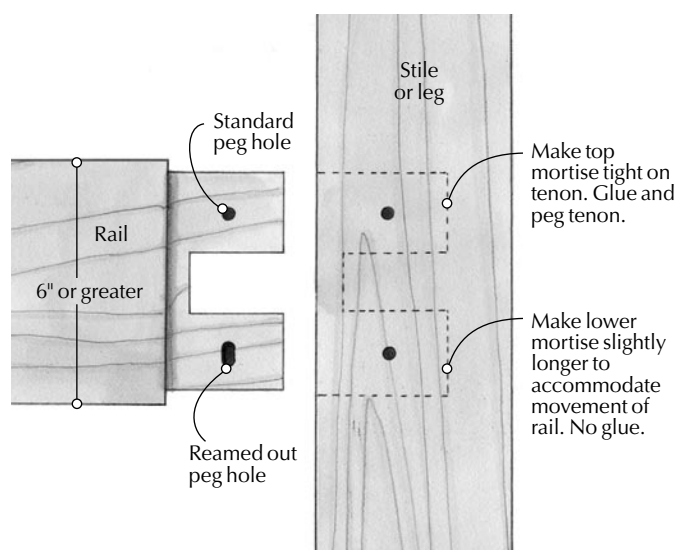
2) How should the tenon be fastened to the mortise—glued, dowel pins only or both?

—Jerry Draper, Smithville, Tennessee

You should split tenons into two that are wider than 6". So make two tenons. Make the top mortise tight. Glue and pin it.

Make the bottom mortise a tad longer. Use no glue. Pin the tenon and ream out the hole a bit in the tenon only to allow movement. That will fix you for life.

—Christopher Schwarz, editor



#1,000-Grit Stone Isn't 'Coarse'

I enjoy *Popular Woodworking* (and *Woodworking Magazine*) primarily because it offers a lot of insight into the overall ways we work, offering guiding principles and much better insight into safety issues than similar magazines. I'm also a fan of Christopher Schwarz. However, his answer to a question on sharpening in the June Letters section (Issue #169) misses the mark on a basic philosophical idea I've seen stated frequently in your magazine.

It shows up on page 74 of that same issue: "Always start with the coarsest tool possible." Thus, when Christopher advised spending 15 minutes lapping the back of a chisel with a #1,000-grit waterstone, I snorted.

Long before I took up woodworking, I made custom knives. The very same principle applies to abrasive grits. The letter writer had a #220-grit stone; that was the place to start. I'd even be tempted to go to #60-grit abrasive if the back was far out of flat; just glue some sandpaper to a piece of glass.

Another key trick essential to a good finish (which matters far more on a custom knife than on a chisel, but it's useful to know, especially near the edge) is to change the angle of the cutting motion when you change grits. For example, make the new scratches at a 60° to 90° angle from the last grit. This contrast clearly shows when you've removed the previous grit's scratches. A little ink on the surface using either a felt-tip pen or blue metal marking compound like Dykem can also be a help. Each grit should lead to the next in fairly short order for something as small as a chisel. There's no way I'd want to spend 15 minutes on one grit, so thinking of #1,000 grit as "coarse" is a part of the problem. You can go #60-#220-#400 before hitting the #1,000 and #8,000 grit. Those inexpensive carborundum stones every hardware store sells have their places as an alternative to the sandpaper/glass approach. You can even use them with water if you don't want to mess with oil (though glycerine/water is much bet-

ter)—they're wonderful when you've nicked something if you don't have a grinder or it's not suitable for the job.

—Tim Corcoran, Claremont, California

How to Build a Bench When You Don't Have a Bench? Look East

My current workbench doesn't cut it any more (it's too small, not flat, etc.) and I'm doing more and more work with hand tools. So I'm planning to build a new, 8'-long workbench as soon as possible. I'm leaning strongly toward Southern yellow pine as the material. Based on your magazine's advice, I like the idea of using 2x10s and ripping them in half, then laminating the pieces into a single, solid slab about 4" thick.

I assume I need to get the faces flat and smooth in preparation for glue-up. It would seem that using it straight from the big box lumber rack would leave gaps that would show and reduce overall strength.

CONTINUED ON PAGE 16

ILLUSTRATION BY HAYES SHANESY

So my question is: If I need to plane each face of each piece, how can I do this without a bench as long as the lumber (i.e., 8')? I use handplanes. I do not have a power jointer or planer. My current thinking is to build a long, narrow torsion box out of plywood for the sole purpose of planing the pine. Any suggestions – besides buying a power jointer?

— Norbert Janiszski, San Antonio, Texas

It's a good question: How do you build a bench without a bench?

Rather than buying a commercial bench or making something akin to a torsion box, you might consider making something like a Japanese planing beam.

This can be as simple as a couple of your flattest 2x12s screwed face-to-face. I'd screw them together so they are offset at the ends by about 24". Then you can put the beam on some sawhorses, brace one layer of your 2x12s against the wall of your shop and handplane your other benchtop pieces.

The principle is demonstrated in this post on WoodCentral.woodcentral.com/cgi-bin/hand-tools.pl?read=124615#124615.

— Christopher Schwarz, editor

Half-lap joints on Tea Table Beading Are for Strength

The tea table in the June 2008 issue is tempting to build, but I'll change the slipper feet to pad feet. I'm also a big fan of tiger maple!

I do have some questions:

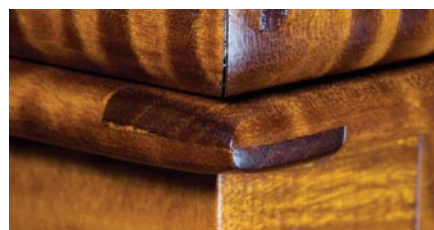
1. According to the cutting diagram for the candlesticks, when the front is attached there should be $\frac{1}{4}$ " of the front above the top face of the slide, and $\frac{1}{16}$ " of the front below the bottom face of the slide – right? The slide front is not attached like the front of a lipped drawer would be, which is flush to the bottom, correct?

2. Why is the beaded frame joined at the corners with half-lap joints? Why not miter them? To me, the half-laps leave a bit of end-grain at each corner, and when finish is applied it becomes quite visible; a mitered joint would show a clean corner.

— Fred L. Miller, Charlotte, North Carolina

I like to have the candlestick sit just below the slot to hide the area when the slide is closed. So, you are correct in your assessment.

The beaded frame was half-lapped for strength. If the main top is a bit snug in the opening and begins to push the frame as it swells, a half-lapped



frame won't give as easily as it would if the corners were simply mitered. Also, holding the corners together if mitered would present a problem unless you attach the frame to the base a piece at a time. The end grain is visible, but I think it enhances the look (at least that's my rationalization).

— Glen D. Huey, senior editor

Sometimes Simple is Best – And Most Useful to Readers

Thank you for writing the article “50-cent Band Saw Fence” (April 2008, issue #168).

I'm a beginning woodworker without a great deal of interest in power tools, but I've come to realize that the band saw is a great tool (I'm tempted to say an essential tool).

I mainly appreciated the article because I perceived that it was the voice of experience on how to use a band saw and what to expect from one. Although your comments might be regarded by some as too simple for print, I always find such advice to be useful. It gives me information that I need in order to use a tool with confidence. **PW**

— Dave Raeside, via e-mail

Question? Comment? We want to hear from you.

Popular Woodworking welcomes comments from readers about the magazine or woodworking in general, as well as questions on all areas of woodworking. We are more than happy to share our woodworking experience with you by answering your questions or adding some clarity to whatever aspect of the craft you are unsure about, and if you have a complaint, we want to address it whenever possible.

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Letters
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THE WINNER:

Shop-made Beam Compass

In my work I often need to draw large-radii curves, for which I use this long beam compass. Built from scrap wood and a dowel center, it's cheap and easy to make in any length. It can be quickly adjusted and doesn't need locking clamps or screws to hold its setting.

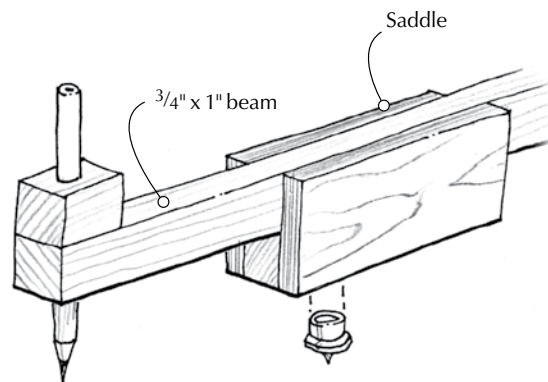
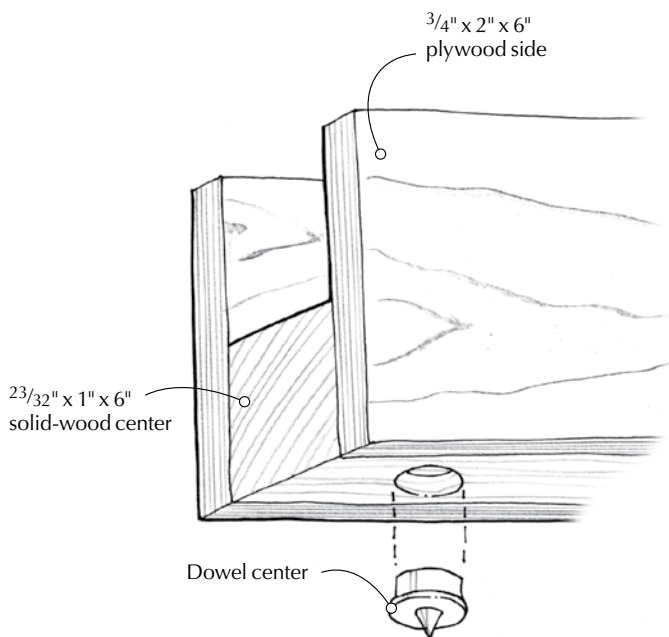
The compass consists of a beam with an inverted friction-fit saddle. A dowel center inserted into the underside of the saddle serves as a pivot point. Make the beam from $\frac{3}{4}$ " x 1" stock, and glue a small block onto the end to help hold the pencil. Drill through the block and beam

to create a hole that will grip a pencil with a press fit. (I use a round rather than faceted pencil.) Make the 6"-long saddle from a piece of solid wood glued between two pieces of $\frac{1}{4}$ "-thick plywood. Cut the center piece about $\frac{1}{32}$ " narrower than the beam to ensure a friction fit that allows you to adjust the saddle position but that holds its setting without clamping. Drill a hole in the underside of the saddle to accept a dowel center, which is sold for aligning mating dowel holes.

To use the compass, adjust the distance between the pencil's point and the dowel-center tip to match the desired radius. Use an awl to poke the center point of your circle or arc into your workpiece, register the dowel-center point tip in the divot, and swing the compass to make your mark.

— Larry LaBeau, Temperance, Michigan

CONTINUED ON PAGE 20



Cash and prizes for your tricks and tips!

Each issue we publish useful woodworking tips from our readers. Next issue's winner receives a \$250 gift certificate from Lee Valley Tools, good for any item in the catalog or on the web site (leevalley.com). (The tools pictured at right are for illustration only, and are not part of the prize.)

Runners-up each receive a check for \$50 to \$100. When submitting a trick (either by mail or e-mail) you must include your complete mailing address and a daytime phone number. If your trick is selected for publication, an editor will need to contact you. All entries become the property of *Popular Woodworking*. You can send your trick by e-mail to popwoodtricks@fwpubs.com, or mail it to Tricks of the Trade, *Popular Woodworking*, 4700 E. Galbraith Road, Cincinnati, OH 45236.

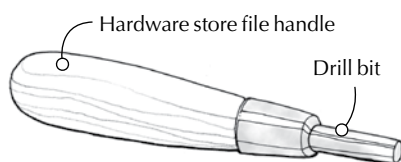


Quick, Slick Burnisher

A nice scraper burnisher can be made quickly for little or no cost. All you need is a cheap wooden file handle (available at hardware stores) and an old drill bit. You simply drill into the handle, then leave the bit in its hole with about 1½" of the unfluted end projecting. A ¼"- or 5/16"-diameter bit fitted into a 4"-long handle works well for the job.

For a burnisher to work properly, it must be smooth, so use a bit on which the shank isn't galled or pitted. If necessary, you can polish the shank before assembly by chucking it upside down in your drill press and buffing it with wet/dry sandpaper held against it like a shoeshine cloth. Use the finest grit possible to clean up any rough areas.

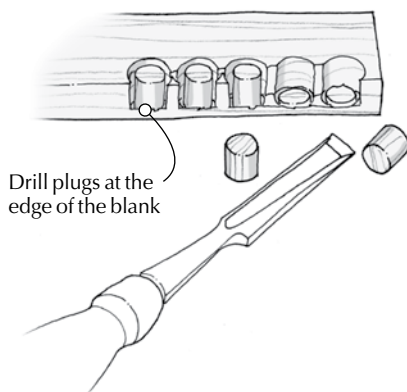
— John Griffin-Wiesner,
Golden Valley, Minnesota



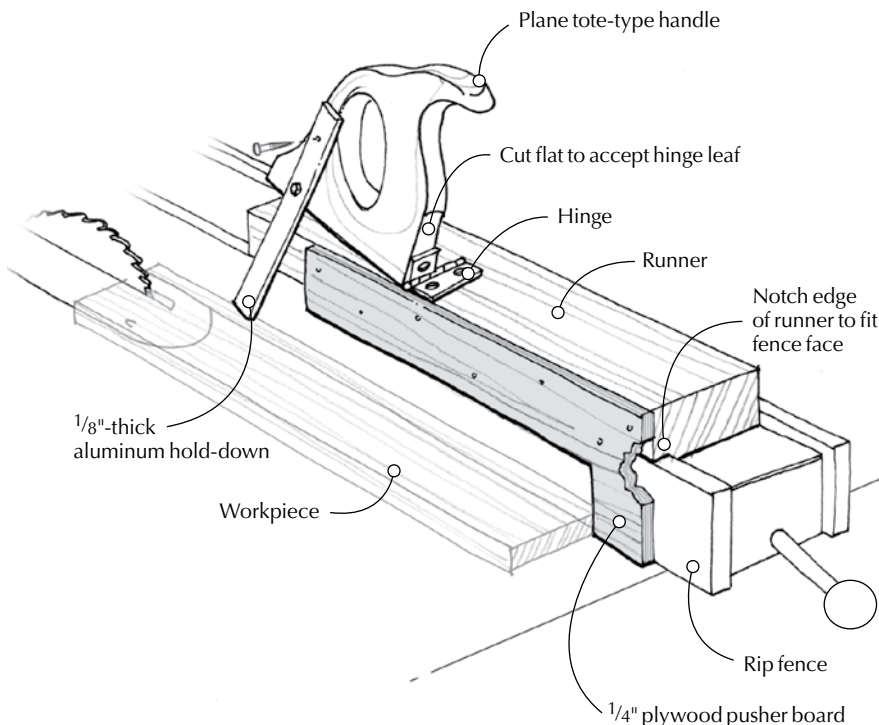
Popping Plugs

After cutting out plugs on the drill press, I used to saw them from their blank using the table saw. Unfortunately, this would often send the freed plugs flying across the shop, forcing me to hunt for them afterward. I recently discovered a much better approach. I drill the plugs right at the edge of the blank, which exposes one side of the plugs, allowing me to easily pop them free with a chisel.

— Otis Greenwell, Memphis, Tennessee



Safer Ripping of Short Stock



Ripping very narrow stock on the table saw can be a bit dicey because your push stick runs so close to the blade. If you're not careful to keep it against the rip fence, it can tip into the spinning blade. And cutting short, narrow pieces is particularly difficult because the blade's rising rear teeth tend to push the stock upward.

I cobbled up this little jig to help with the job of cutting short, narrow pieces. It consists of four pieces: a top runner board, a side pusher board, a wooden handle and an aluminum hold-down bar. I made the jig to suit my Biesemeyer-style fence, but it could be modified to fit any similar fence. The advantage to this jig is that the hold-down remains snug against the fence while your hand is well above the blade.

My jig is about 12" long, but you can make yours any length you like. Just keep in mind

that the minimum length of stock you can cut will be determined by the distance between the hold-down and the pusher heel. Begin by making the runner board from thick stock, rabbeting its edge to create a guide channel to follow the fence's attached face. The left-hand edge of the runner should be flush to the face of the fence. Make the L-shaped pusher board and screw or nail it to the runner. Hinge a handle (I used a plane tote replacement) to the runner, with the side of the handle aligned to the edge of the runner. Then fasten the hold-down to the handle with at least two screws, making sure that the hold-down will reach to the saw table. When using the jig, make sure that the workpiece is firmly against the fence, seated against the heel, and under firm pressure from the hold-down.

— Carl Bilderback, La Porte, Indiana

Cleaner Erasing

Let's face it, we all make layout mistakes and have to erase errant pencil lines. You have probably discovered that a typical rubber eraser tends to smear pencil lines on wood and other materials. There's a much better tool for the job: a plastic eraser. Available at

art-supply stores for about a buck, a plastic eraser gets rid of pencil lines cleanly without leaving streaks that might lead to other layout errors or finishing problems.

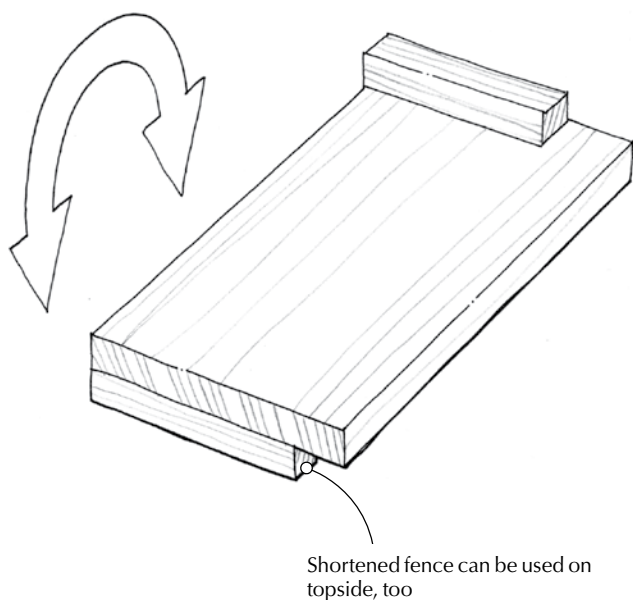
— George Macon, Tucson, Arizona

CONTINUED ON PAGE 22

Reversible Bench Hook

Like many woodworkers, I use a bench hook to support small pieces on the bench for handsawing. A typical bench hook is just a small panel with a shortened topside fence at one end for supporting the workpiece and a full-length underside fence on the opposite end that “hooks” against the edge of the workbench. The topside fence stops short of the panel edge to create a landing for the saw teeth at the end of the cut. Eventually, of course, the panel gets too scarred to use. My trick is simply to stop the underside fence short of the end, just like the topside fence. That way, the bench hook can be used with either face up, doubling its life.

— Peter Giolitto, Surrey, England



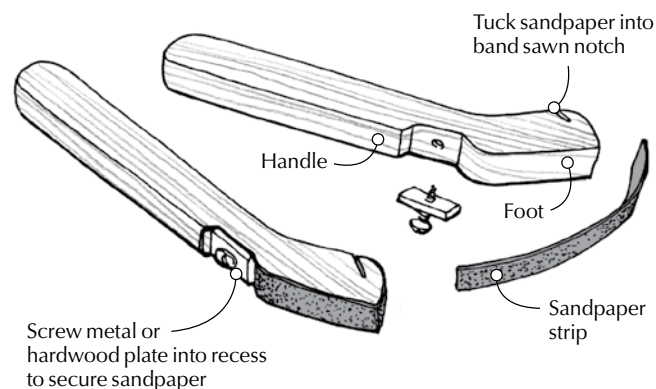
Offset Detail Sander

When doing repair work, I often have to inlay small patches of wood into a finished surface. To help level the patch afterward without marring the adjacent surface, I made up several of these little detail sanders, band sawing them from $\frac{3}{4}$ "-thick hardwood scraps.

A strip of sandpaper wraps around the foot, with one end tucked into a notch on top and the other end clamped under a small metal plate that's screwed into a recess under the handle. The angled handle (offset by about 30° to the foot) allows a good grip and firm downward force on the foot. You can also invert the sander and use the rounded top of the foot for aggressively sanding a small area.

I find that a 4"-long handle with a rounded end is comfortable and provides good leverage. You can make the foot any size you like (mine are about $1\frac{1}{2}$ " long); just make sure to sand the bottom truly flat. I have six of these and each is outfitted with its own grit, which is marked on the tool.

— Sarah Dieterichs, Hellertown, Pennsylvania

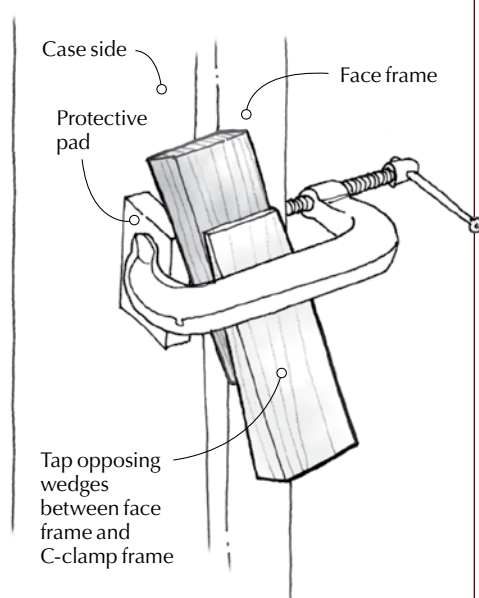


Clamping Edges with Wedges

I made a built-in bookcase for my daughter that required attaching the face frame after installing the case. I didn't want to mar the face frame with nail holes, but I don't have any special-purpose edge clamps and didn't want to buy a bunch for this single application. I remembered seeing wedges used for various clamping purposes, and decided to put them to work here along with standard C-clamps.

I found that by squeezing the clamps against the case sides (with protective pads underneath), I could tap opposing wedges under the clamp frame to apply pressure against the face frame. Packs of wedges are available at home-supply centers, or you can make your own on the band saw using scrap wood.

— Steve McDaniel, Humboldt, Tennessee



Power Sandpaper In a Pinch

In the middle of a job, I ran out of hook-and-loop sandpaper for my detail sander. With no time to get more, I was faced with hand-sanding—not exactly my favorite job. As an alternative, I grabbed some stock sheet sandpaper, cut it to the shape of my sander pad, then fixed it to a piece of worn hook-and-loop paper using hot-melt glue. It works great! I found that laying a thin bead of glue at each corner of the new sheet, then pressing it in place did the trick. Just don't apply it too thick, or you risk creating lumps under the sheet. **PW**

— Richard Zegers, Bellingham, Washington

A Joynt Forme

This 17th-century seating piece is good practice for what came after.

I'm going to take a step back in time this month to explore the ubiquitous seating of the 17th century. I think you'll find this to be a fruitful journey as my series about period chairmaking continues.

History

Seventeenth-century estate inventories often include: 4 *joynt stools*, 2 *formes*. This combination of pieces appears with sufficient frequency to suggest this was a typical suite of seating furniture.

The term “joynt” (probably the verb “joined,” not the noun “joint”) describes the method of construction. Joined stools were assembled with mortise-and-tenon joints. The mortise and tenon was the essential structural joint of the Joiners' Guilds. Joiners made a wide range of products with this joint. You're probably familiar with all of them. The basic “frame and panel” is a mortise-and-tenoned picture frame-like structure with an inset floating panel. It was used to make doors, and paneling (sometimes called wainscoting), but also

what we would call blanket chests and other pieces of furniture. The cope-and-stick sashed window is a variation of this same structure, with glass replacing the wooden panels.

The term “joined,” spelled many different ways in the period, was used to differentiate mortise-and-tenon construction from probably more common “boarded” or nailed structures, or the turned post-and-rung structures. Generally speaking, only members of the Joiners' Guild were permitted to use mortise-and-tenon construction for furni-



Otherwise known as ... This piece of furniture was called a *forme*. *Forme* was a 17th-century word for what we today call a bench. People sat on *formes* and did their woodworking on benches. Built carefully, joined stools and *formes* can be strong, elegant and surprisingly useful.

ture and architectural interiors. Carpenters were allowed to sell furniture as long as it wasn't mortise and tenoned. Turners alone were permitted to make post-and-rung type furniture. Outside of London, however, these rules rarely held up.

Joined stools are thus small stools for sitting on, assembled using mortise-and-tenon joints. A "forme" is a joint stool long enough to accommodate several people.

Stock Preparation

Pitsaws, used for sawing logs into lumber, were common in 17th-century Colonial America. But sawn stock wasn't always needed to make useful items. The relatively short, narrow pieces required to make joined items could be easily split from straight-grained woods.

I was lucky to get a 3'-long red oak log that was straight as an arrow. Red oak is easy to split, especially when wet. The split pieces can be worked wet and assembled into usable furniture quickly and easily. I painted the end grain with a commercial end-grain sealer shortly after the tree was felled. When I began working with this log a few weeks later, it was still very wet.

I used steel wedges and my dogwood gluts to split the log into the various parts I needed: 2" x 2" pieces for legs, 1" x 2" pieces for stretchers, and 1" x 2½" pieces for aprons. If my log were longer, I would have tried to split out a board wide enough for the top. As it is, I had to use sawn lumber for that. I suspect this was not uncommon.

Hoping to capture a 17th-century feel, I squared up my stock without using my hand saws. The pieces were quickly hewn to shape using my hatchet, froe and drawknife. For this sort of work, you have to put aside some of your notions of preparing sawn stock. For example; I worked the narrow sides first. I didn't want to spend the time flattening the wide face if I was going to rive half of it away later. It was difficult just to get the stock to sit on the bench. I often sat on the stock to hold it steady. With two edges trued up, I went to work on the face. From the rough-split or drawknifed surface I used my fore plane. I finished each face with my long try plane.

I didn't four-square every piece of stock, though. The aprons were left a bit pie-shaped. This allowed use of the stock near the pith. I don't know if this was done in the period or not. I'd be surprised to hear this was never done. It's a savings of both wood and time.



Preplaning. For the 2" wide x 3' long stretchers, I thought it was easier to snap a line (here darkened with *ye olde Sharpie*) and shave to it before working the broad 2" face with my plane.



Go green. Planing green, riven oak is a treat. There's no tear-out, and the plane cuts as if the blade is super sharp. Burying my bench in shavings took very little time or effort.



Uniformity not required. For some parts, the triangular shape of riven wood will suffice. The moulded piece at the top is a finished 2½"-wide apron. Its lack of uniformity of thickness will have no effect on the finished stool.

Turnings

Green wood is easy to turn and forgiving of mistakes. This is a golden opportunity to try spring-pole turning or perfect your technique with the skew. If you are an accomplished turner, perhaps you could try making the legs very quickly or doing the entire job with a single 1" skew chisel. Professional turners in the 18th century could do a very fine job making crisp, uniform parts. But professional



Profiles in time. I've chosen a 19th-century sash ovolo for the bottom edge of the apron. I'm not sure this is an accurate 17th-century profile. You might try just using a simple hollow plane and seeing what you come up with.

furniture makers who were less experienced turners, such as Philadelphia joiner John Head, didn't always do a great job. Though elegantly shaped, Head's turnings lack uniformity. I think it's fine to focus on making something beautiful and not worry too much about identical parts.

Joinery

I began the joinery with the ends of the forme. On the end pieces, the legs are closer together at the top than at the bottom. I established that angle by eye and drew it on my workbench top. Bevel gauges can move in use so it's good to have an unmoving reference mark to check against. Using the lines on my bench, I established the length of the apron and stretcher, and the upper and lower rails of my mortise-and-tenoned frame.

Locating the mortises was the next step. I knew that my stock wasn't perfectly square. It wasn't perfectly square two days ago when I planed it, and it is likely less square today. Not only isn't it square, it's not 2". Now I could go back and plane everything down to 1.90". And that might be a wise thing to do. But that's not what I did. I chose instead to deal with

whatever inconsistencies I have in my stock, pushing errors to less conspicuous areas.

I chose the faces with the mortises in them as reference faces. This allowed me to saw all the aprons and stretchers alike. But this would make it harder to have all the exterior

faces flush. So just to be clear, if you want flush legs and stretchers, you must use the outside (flush) face as a reference and custom-cut the aprons and stretchers to account for any inconsistencies in stock prep. I've done it both ways. For this project, I'm planning on

CONTINUED ON PAGE 28



Mortise width. To keep the apron pieces alike, I located the mortises from the inside faces. The outside faces can be cleaned up later if necessary. Just a single line is all that is required to locate the mortise. The chisel determines the width of the mortise.



Location, location, location. I positioned the mortises vertically from the bottom of the foot. I located the turned features from the same face.



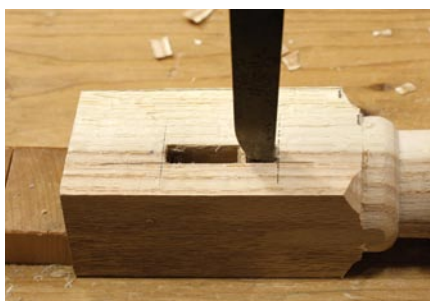
Good enough. I'm not a great turner. But neither were many 17th-century joiners. These legs are not uniform, and good turners past and present could do much better. But they are good enough and fairly typical. I chose this shape to match the table this piece will accompany. Wallace Nutting's "Furniture Treasury" has many examples of joined stools and formes, and an appendix with line diagrams of legs that you can use for inspiration.



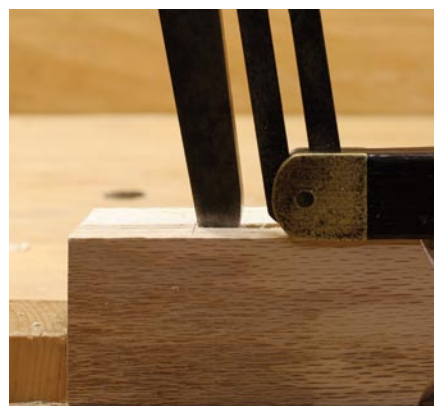
Small bites. Holding the chisel between my fingers and pushing the tool with my shoulder, I make a series of small paring cuts.



Bigger bites. Once the sides of the mortise are established, I can begin making more aggressive cuts, easily paring out thick pieces of wood.



Paring. I pare down into one corner of the mortise. Paring down across the grain is easy on me and easy on the chisel. I have 28 of these to do. Working from the opposite direction, I can quickly pare out the remaining material. This technique is limited by the length and depth of the mortise. A short, deep mortise can't be done this way.



Right-angle finish. I didn't work all the way to the end lines. I save that work for last. With the help of my trusty bevel gauge, a few mallet blows at the correct angle finishes the job.

a small step between the legs and the aprons and stretchers. Gauging from the mating faces will make my work easier.

Mortising

There are various mortising techniques. Period craftsmen may have chosen to drill and pare. Carpenters certainly did this. I believe there is some evidence of this technique in some fine furniture including chairs, but that's just guesswork on my part. Some craftsmen prefer to chop mortises using stout joiner's mortise chisels. The technique I use is based on a paragraph in Moxon's "Mechanick Exercises" titled "Of the Paring Chisel." It probably is not how period craftsmen cut mortises, but it works so well, and the other methods are so well-known, that I feel it's worth showing here.

Tenons

I don't have any special technique for cutting tenons but I do have a few special tools. I made myself a fixed-pin mortising gauge similar to the one in the surviving 18th-century tool chest that belonged to Benjamin Seaton. I filed the pins flat on the inside, which makes marking tenons a snap. The arm has four sets of pins, each sized precisely to a mortise chisel in my set. I use two long backsaws (one rip,



Custom gauge. My mortising gauge has sets of pins filed for four of my most often used mortise chisels. I set my gauge to create a small offset between the leg and the apron.

one crosscut) to saw the cheeks and shoulders. One tool I don't have or use is a shoulder plane. I much prefer a chisel for this job. The errors I make sawing are rarely uniform enough for a plane to be helpful.

Assembly

Furniture like this is always pegged. Making the pegs is the next step. You want bone dry, riven (split) hardwood stock. If a peg breaks while you are driving it, it can be very difficult to remove. I drawbored all of my joints. I used a piece of walnut for the top to match the table this goes with. The tops of these were typically fastened to the legs with angled pegs.

Conclusion

I know this probably isn't the sort of item that excites would-be period woodworkers. To make matters worse, I think I spent a week of hard work building this thing. But believe it or not, this is a really useful piece of furniture for a big family or folks who love to



Bottoms up. I know I'll have to plane the tops of the aprons, so I used the bottom as the reference face. Unfortunately, the moulding prevented me from accessing this face directly. But sticking moulding after you've cut the angled tenons on the end can be a drag. So I'm using my straight-edge to help.



Not too shabby. The finished joint looks surprisingly good to me.

entertain and share meals with lots of their friends. Most important, it's a fantastic way to get in touch with the craft of 17th-century joiners. Their tools, skills, joints and guild became building blocks of the 18th-century baroque movement that produced some of the finest furniture yet made. **PW**

Visit Adam's blog at artsandmysteries.com for more discussion of traditional woodworking techniques.



An old favorite. You've seen this finish work before. It's linseed oil and shoe polish over milk paint. Joined stools and formes were often painted. The paint would have been oil-based lead paint. Less lead or advanced wear would make that sort of paint look a bit more like this. I think the red cast in the black walnut top complements and contrasts with the green paint.



Well, I like it. My woodworking buddies probably won't slap me on the back for this project, but it was fun and the finished forme with its attending (and easier to build) refectory table isn't without its own elegance.

Steel City Granite-top Tools

These surfaces are truly flat, have less vibration, are easier to set up and no rust – ever .

At the last AWFS show in Las Vegas, the big news was the introduction of granite tops as a replacement for cast iron by Steel City Tool Works. We've had three of these machines in the shop for a few months, and I used them to build the workbench featured on the cover of this issue.

We've been impressed with Steel City's products, and these new arrivals are of the same caliber. This review will focus on the addition of granite to already good machines.

The Same But Not the Same

On paper, this is the same hybrid table saw that we reviewed in our February 2007 issue (#160). The specifications are the same, but the addition of a riving knife, as well as the granite top, led to a redesigned trunnion assembly.

It's still a beefy casting, but it now moves straight up and down to keep the riving knife positioned at the top of the blade. In traditional

table saw design, the arbor swings in an arc.

Height adjustments are smooth, and the riving knife or traditional guard can be removed or replaced in a matter of seconds. The granite top is 1³/₄" thick throughout, but it is relieved near the insert, allowing full-depth cuts without any loss of strength in the top.

The extension tables slide on steel bars mounted to the saw's main top. This allows

Steel City Granite-top Tools

Steel City Tool Works ■ 877-724-8665
or steelcitytoolworks.com

Street price:

Band Saw 50100G ■ \$799.99

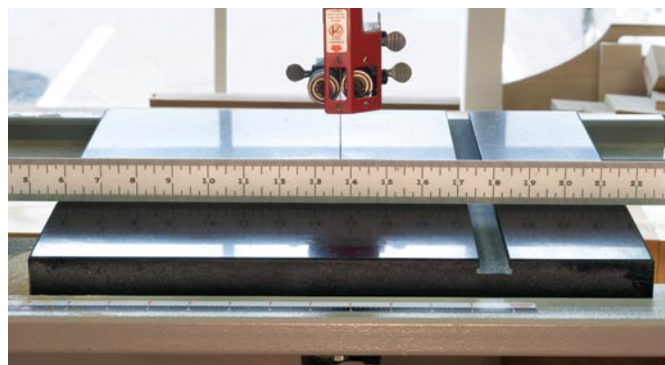
Table Saw 35900G ■ \$1,299.99

Jointer 40615G ■ \$819.99

For more information, circle #152 on Free Information Card.



Table saw #35900G. The thick granite of this saw's top reduces vibration and will not rust in humid conditions. The granite around the insert is relieved to allow for full-cut capacity.



Band saw 50100G. No worries here about a band saw tabletop showing a crown in the middle or even a disparity in surfaces at the blade slot. Steel City has this granite top dead-flat.

dard saw, and the flatter, smoother surface was a subtle but noticeable improvement.

Jointer Fence a Huge Improvement

The most noticeable, and likely most significant, improvement that we saw in performance was in the jointer. The tables are still cast iron, but the granite fence makes this jointer what a jointer ought to be.

Cast iron jointer fences are notorious for being warped, and having a straight fence made a profound improvement in both setting the fence square to the table and in milling stock.

Smooth Operating Band Saw

Band saw cuts are all about maintaining control, and the flat surface with less vibration is a nice improvement. It isn't a dramatic change, but it is better. Other features of the saw – the guides, adjustments and components – are all top-notch, reminiscent of older American-made machines.

Overall, granite is an idea that works well. If you're a perfectionist, you'll appreciate the flat surfaces. Cast iron comes close to perfection, but there are always slight deviations to deal with. Granite isn't fragile, and holds up well under normal use. And if your shop is in an area where humidity makes rust an issue, you will want to make the change.

—Robert W. Lang



Jointer 40615G. A straight, dead-flat fence on a jointer translates into accurate fence adjustments and perfect 90° cuts.

Festool Router: Innovative in Every Detail

If you look at the price of this new Festool router before reading this review, you're going to miss the details of an extremely innovative tool. So resist that urge. I think many router manufacturers will copy features of the Festool OF2200 for many years.

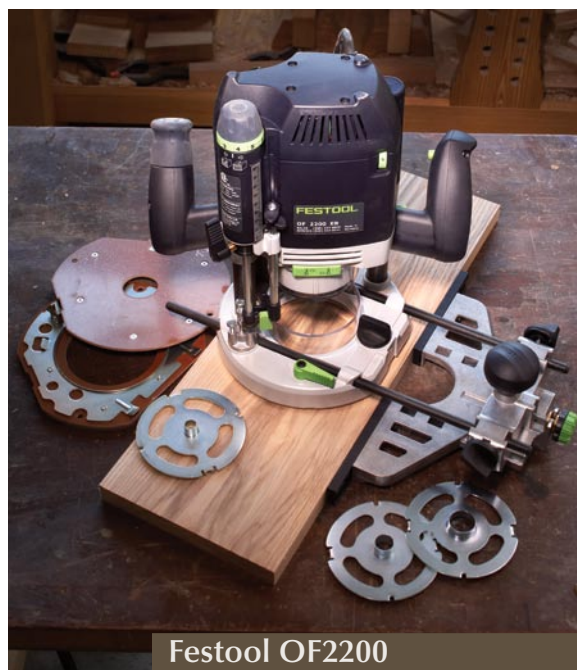
When I say extremely innovative, it's still an understatement. Let me begin with a feature that every router user will appreciate: changing router bits. This task is no longer a knuckle-busting event. Festool incorporated a single-tool ratchet action for changing bits. Depress the rocker-style spindle lock (one direction to tighten, the other direction to loosen), then use the wrench in a ratcheting motion to do the work.

Another innovation is the clip-on base plates. This router comes with a single base plate that clips to the tool (the 3³/₈" opening is large enough for most router bits). Flip a spring-loaded lever to remove the plate; to attach a different plate, simply insert the two tabs into the slots and push the plate tight to the tool until it snaps into position.

What makes this feature worthwhile besides providing easy access to the collet? Two things stand out. First, Festool has introduced magnets to the template guides – there's another innovative idea. Small magnets hold the guides, which are positioned into keyed sockets, to the routers. The guides self-center and are given additional support by the clip-on base.

The second reason for the newly designed base is improved dust collection. Keep the base-plate opening close to the router bit size and dust collection is more efficient. That's a big deal at Festool. So, the company offers an accessory kit with four additional base plates and four various-sized template guides, along with a parallel edge guide and dust-extraction hood.

Another dust-collection accessory is a retractable, spring-loaded dust shroud. With a flip of a lever, a 360° shroud springs from



Festool OF2200

Festool USA ■ 888-337-8600 or
Festoolusa.com

Street price:

Router ■ \$800

Accessory Kit ■ \$310

For more information, circle #153 on Free Information Card.

the motor housing to encase the router-bit area and further increase dust collection. Plunge the router to full depth to retract the shroud, or retract it manually.

If you're looking for negatives about this router, the only apparent downside is the mass of the tool. The Festool OF2200 weighs in at just more than 17 pounds. That's quite a bit when you're running an edge profile without an offset base. But, it's just heavy enough to sit perfectly still until you move it when you're routing for inlay.

Now take a look at the price. It's worth every dollar. Or euro. —Glen D. Huey



Interchangeable plates. Clip-on base plates allow you access to the router bits for fast changes, as well as increased dust collection.

Blum Bench Planes Offer Precise Control

Anyone who dabbles in the history of hand-planes can tell you this: There are no new designs out there. However, after trying the new Blum planes, I'm not sure I agree.

They have a lightweight wooden body, which gives them a traditional feel. But the blade adjuster is far more precise than what you'll find on a traditional metal plane. It's a unique combination of traits that appeals to a wide variety of woodworkers, which I discovered at a recent event we had in our shop.

Despite the unfamiliar controls, most woodworkers quickly took to the Blum planes and easily produced wispy shavings. Because the controls that regulate the blade are unusual, let's take a look at them.

Two brass knobs on top regulate the depth of your cut. One controls the right corner of the blade; the other controls the left. You turn each knob counterclockwise to increase your cut until it's even on both sides of the mouth. This system is infinitely more precise than the lateral-adjustment lever on an old Bailey-style plane. The only disadvantage is that

you have to make two adjustments every time you change the blade's position.

Three knobs at the rear of the plane control the mouth of the tool. You slightly loosen the big knob then close or open the mouth using the little knobs.

The other unique aspect of these tools is that they use a very short cutter that is mounted in the tool from below at a 50° pitch. You remove three screws to remove the blade, hone it and then return it to the tool.

The fit and finish of these tools is superb, and they function flawlessly. Once I understood the controls (a 5-minute process) the Blum tools worked like a charm.

Because the planes are unusual, the maker (Gary Blum) has posted videos and detailed information on these tools on his web site (blumtoolco.com). Check out the site to see



Blum Tool Bench Planes

Blum Tool ■ 800-521-5458 or
blumtoolco.com

Street price ■ \$199 to \$295

For more information, circle #154 on Free Information Card.

how they work. The tools are available in four sizes, from a smoothing plane to a jointer plane. Prices begin at \$199.

—Christopher Schwarz

Ashley Iles Chisels Just for Dovetailing

You don't have to have a specialty set of chisels to make hand-cut dovetails, but it sure does make parts of the process easier.

When dovetailing, chisels are used for three jobs: Chopping out the bulk of the waste, paring the remaining waste back to your base-lines and cleaning up the acute corners of the dovetail sockets when cutting half-blind dovetails.

English toolmaker Ashley Iles has created a set of six chisels that handle two of these jobs with great aplomb. Four of the chisels are specially designed for paring out the waste between the tails or pins. The tops of the chisels have an oval profile that terminates in a knife-like edge along the length of the blade. This special shape allows you to sneak between the tail section of the joint to pare out the waste. Many modern chisels have chunky long edges that will bruise the joint.

These four chisels come in different sizes: 1/8", 1/4", 3/8" and 1". They are supposedly stout enough for light chopping, though I found that the three smaller ones flexed more than I liked when striking them (even gently) with a mallet. I recommend you drive these three

smaller chisels with your hands and use them for paring your waste only.

The other two chisels are left- and right-hand skew chisels. These tools excel at cleaning out the waste in the corners of your half-blind dovetail joints. With standard bench chisels with a 90° front edge you have to engage in some gymnastics to tease the waste away (such as turning the tool on its side and twisting it). Skew chisels dive right in, grab the offending waste and pull it right out. They're a nice luxury.

Like all Ashley Iles chisels, these are made by hand in the English tradition with bubinga handles. I have found the company's tools to be properly heat-treated and well-ground. These tang-style high-carbon chisels were easy to set up and sharpen, and they kept their edges for a long time.



Ashley Iles Dovetail Chisels

Tools for Working Wood ■ 800-426-4613
or toolsforworkingwood.com

Street price ■ \$150/set of six

For more information, circle #155 on Free Information Card.

Many woodworkers prefer to make their own chisels for dovetailing by grinding an old set to shape. If you are a maestro at the grinder, this is no big deal. But if you'd rather skip the metalworking and get on with the woodworking, I think you'll be well served by this excellent set of specialty tools. **PW**

—CS

This hybrid design holds work any which way you want to.

BY ROBERT W. LANG

Good design is little more than selective thievery. This workbench is a good example of that. A combination of features from several historic forms, ranging from the Roubo to the Workmate, becomes a new form, suited to being the center of a modern woodworking shop.

I've never seen a workbench that I was entirely happy with. I have love/hate relationships with many common features. I like tool trays, but hate the way shavings and other detritus collects in them. I want to be able to clamp work quickly, but speed means nothing if the clamping isn't solid

and secure. Good design is also the art of compromise, finding the happy medium between extremes.

This bench began with the idea of building a reproduction of an English Nicholson bench. The Nicholson was popular in Colonial America, and variations of it appeared in woodworking books until the 1920s. The dominant feature on the Nicholson is a wide front apron, which allows work to be secured to the front of the bench as well as to the top.

The drawback to the extended apron is that it limits the ability to clamp down to the

Old ideas, new combination. Elements of several historic benches are combined in an easy to assemble, solid work-holding fixture.

21st-Century

top of the bench from the edge. I narrowed and lowered the apron so I could clamp work to the bench in two directions. I was also intrigued by the knock-down joinery on some of the historic Nicholson benches. While I don't plan on moving my bench very often, I decided to make it in manageable chunks, to ease the process of making it and assembling it.

The design is based on function in the completed bench, and also on the process of making, moving and maintaining it. The tools I used to make it are basic home-shop equipment—a 10" hybrid table saw, a 6"-inch

jointer and a 12" "lunchbox" planer. And I didn't need a bench to build my bench. I made the top first, then placed that on a pair of horses.

Getting it Straight, One Part at a Time

The best reason for assembling the top of the bench first is that when it is complete, it can be put to work to fabricate and assemble all the other parts. It's almost as good as having a place to sit down when you're halfway through building a chair.

I began with rough 8/4 ash lumber, and

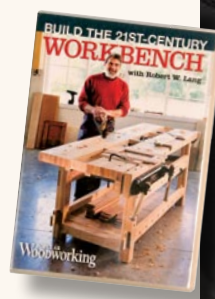
picked through my stock for the straightest pieces to use for the top. After running one edge over the jointer, I ripped each piece to a rough width of 3 1/4". Then I dressed one face of each piece flat on the jointer. When I had 14 pieces ready, I moved to the planer.

I wanted the stock to be at least 1 7/8" thick, but stopped milling when I had two clean faces. Each half of the top consists of six pieces glued face to face, and leaving the parts as thick as possible allowed me to maximize the width. If the stock had ended up thinner than planned, I would have added a seventh piece. The goal was



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Workbench

to have the halves of the top finish at least 11½" wide, but less than 12".

The length of the bench was also a variable. I wanted a minimum length of 84", but I was able to get clean lengths of 90" from the 8'-long rough material. After all the parts were milled, I let them sit over a weekend to be sure the wood wasn't going to move or warp.

I began laminating the top boards in pairs glued face to face. To keep them flat, I clamped them together on the strongest, straightest surface available: an I-beam made of ¾"-thick plywood. I let each pair sit in the clamps for at least four hours, and let them all sit for 24 hours to allow the glue to dry.

Back to Milling, then Serious Gluing

I ran the edges of each glued pair over the jointer to get a straight, square edge on each lamination. I then ran the boards on edge through the planer. Once again, I stopped when I had two clean surfaces rather than taking the boards to a specific thickness.

The cleaned-up pairs were slightly over my planned 3" thickness, but I would still need to remove some material after gluing up each top

section. How much to remove would depend on how well these pieces went together.

I set two long boards between my horses, and placed square boards across them, about a foot apart. This gave me a nice level surface

to work on, and provided the ability to reach around, over or under the tops as I was setting the clamps. A test-stacking of three pairs of boards gave me the confidence to glue each half-top section in one go.



Spread with speed. A disposable paint roller applies an even coat of yellow glue quickly. Apply the glue to one side of the lamination only. Doing both sides wastes time and glue.



Sum of its parts. The flatness of the finished benchtop depends on the quality of its component parts. Milling the pieces as true as possible and gluing them together on a flat surface is crucial.



Practice makes perfect. Taking time to set up a level and accessible surface for gluing, and making a dry run, makes the final glue-up stress-free and yields good results.



Power lunch. This bench was designed around available machinery. After cleaning one surface with a handplane, the opposite surface is planed on a portable machine.



It just fits. Trimming the top halves to final length is within the capacity of this 12" sliding compound miter saw.

With nearly every clamp in the shop standing by, I spread yellow glue on one face of two of the parts with a 3"-wide paint roller. With an even coat of glue applied, I turned the parts 90° and starting tightening the clamps, working from the center out to the ends.

Wooden handscrews across the ends of the glue joints prevented the parts from sliding out of place. I removed any glue squeeze-out with a wet rag and a scraper, and let the pieces sit in the clamps overnight.

Because I had carefully milled the parts before gluing, and glued carefully on a flat surface, the tops were in good shape coming out of the clamps. I knocked down the high spots with a handplane to get a flat surface, and ran the assembled tops through the portable thickness planer.

Leaving the top halves less than 12" wide allowed me to use this small machine for surfacing. At some point in the future I may need to resurface the top, and the little planer will always be an option. This strategy also allowed me to cut each top half to length with my sliding compound miter saw.

The Structure Down Below

Joinery on a bench is on a different scale than joinery for furniture. The parts are larger, and the emphasis is more on function and strength than appearance. The legs are two pieces glued face to face, and each pair of legs is connected with an upper and a lower stretcher with mortise-and-tenon joints.

The legs and stretchers are assembled into units, and the two ends are connected



Minimize the layout. After laying out the tenon locations on the stretchers, lines are transferred to mark the matching mortises on the inner parts of the legs.

with rails running the length of the bench. The large scale of the components made it possible to locate joints for the knock-down connections in the outer halves of the legs, and these joints were cut before the legs were laminated together.

In furniture I use through-tenons to show off, but in this bench I used them to make life easier. The mortises are only cut in the inner half of each leg. After laying out the joints, I removed most of the waste at the drill press with a 3/4"-diameter Forstner bit.

Working on my new benchtops placed on horses, I used a chisel to square the mortises to the layout lines. I then cut the tenons to fit the mortises. I cut most of the shoulders by hand, but also cut some on the table saw to compare techniques.



Wasting away. A 3/4" Forstner bit in the drill press is used to remove most of the material from the through-mortises in the inner legs.

Online EXTRAS

Videos, plans and text about building and using the 21st-century bench are available on the *Popular Woodworking* Editor's blog: popularwoodworking.com/oct08

A full-length video of the construction of this bench is available on DVD for \$19.99. In addition to the video content, the DVD contains additional detail drawings and photos. For more information and to order, visit:

popularwoodworking.com/bench



Chop for an easy fit. A bit of chisel work cleans up the mortises to the layout lines at top and bottom. Widening the sides allows an easier fit and stronger joint with the addition of wedges.



Shoulders by hand. I think it's faster to cut the shoulders by hand and avoid exacting setups on a machine. It's just a matter of cutting to the lines.

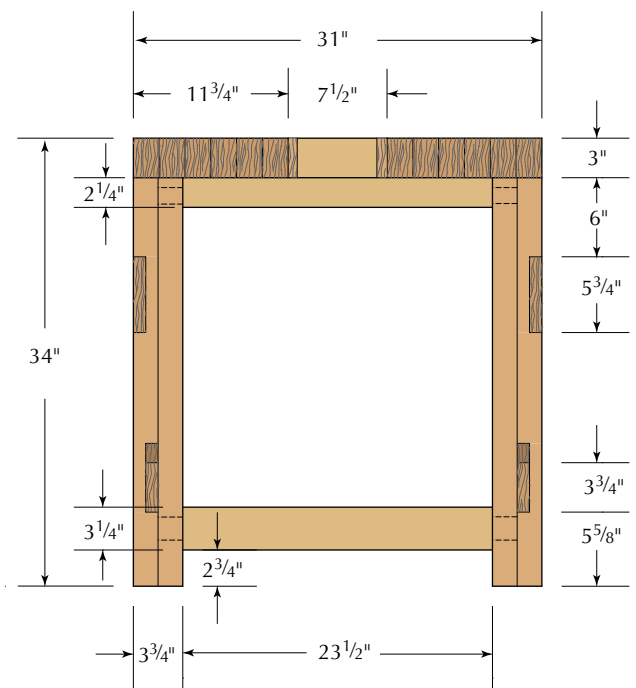
The hand-cut shoulders were a bit neater, and didn't take much longer to make. After cutting the shoulders, I removed the waste around the tenons at the table saw, using the miter gauge to guide the boards across a stack-dado set.

With a shoulder plane and rasp, I fine-tuned the fit of the joints. After tweaking a couple to a perfect fit, I realized I could make the tenons narrow in width, widen the outside of the mortises with a quick chisel cut, then secure the joints from outside with wedges.

This saved time, and gave stronger joints. With the tenons wedged, they can't pull out of the mortises. After letting the glue dry, I trimmed the wedges with a flush-cutting saw, followed by a block plane.



Tenons, plan B. The tenons can also be cut on the table saw, but the machine must be adjusted several times to hit the layout lines precisely.



PROFILE

Great Big Dovetails

It's easy to think of dovetails as decorative joints, but there are many practical reasons for using this joint to hold the ends of the bench together. Most of the stress on a bench in use is end to end, and the wedged shape of the rail-to-leg joints can't be pulled apart. In fact, if you push the base of this bench from the end, the joints tighten rather than loosen.

The dovetails also serve to positively locate and align the parts during final assembly. As the joints come together, they fit where they fit; it isn't possible to put them together in the wrong place.

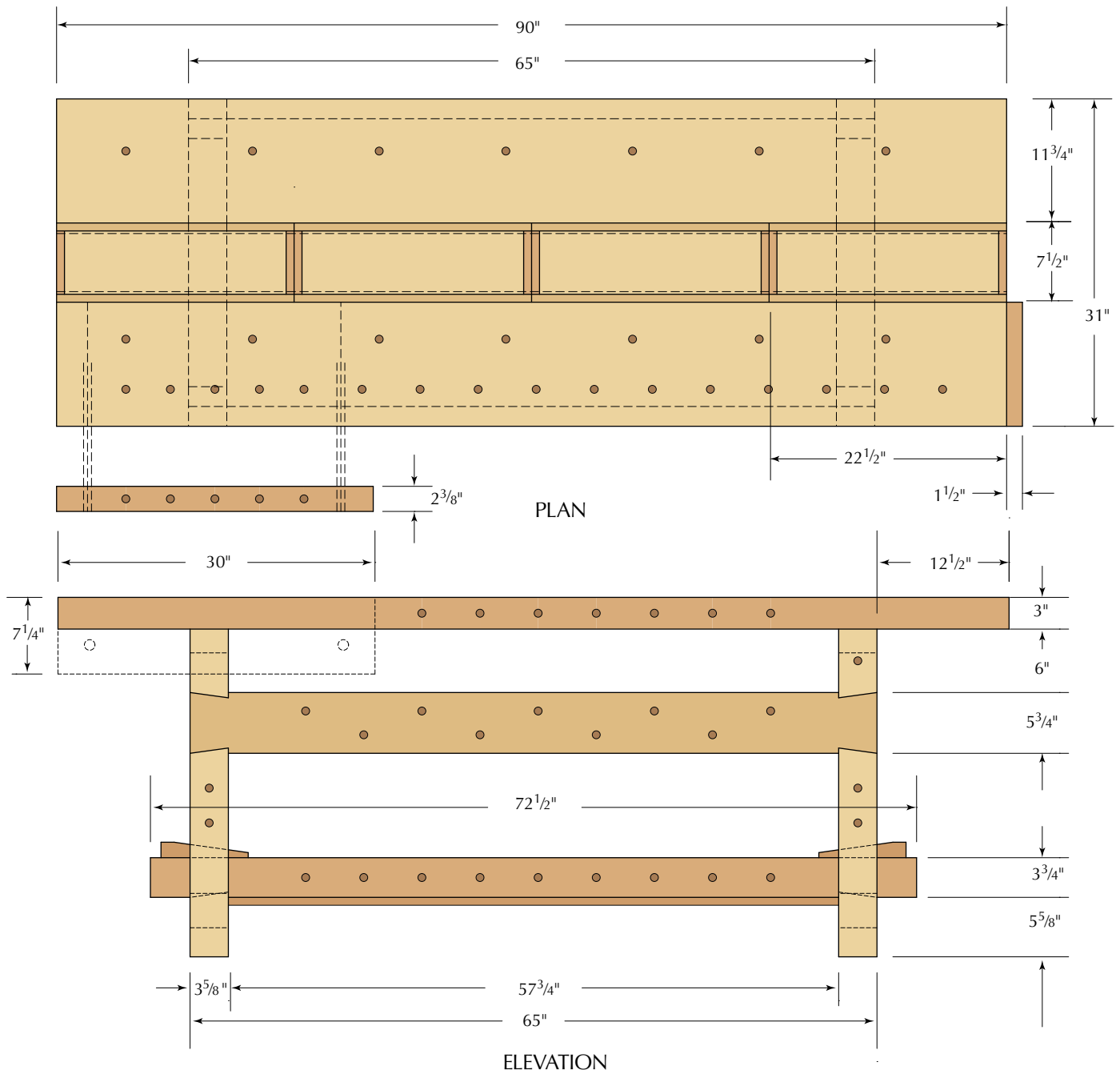
Both upper and lower dovetail joints are half-lapped with the outer portion of the leg. The lower joint is on the inside of the leg and is a half dovetail; the other half of the joint is a removable wedge. The upper joint is on the outside of the leg and secured by a lag bolt.

After cutting the shoulders by hand, I removed the waste with the stack dado on the table saw, and used a roller stand to support the long workpieces. The angled cuts were made with a jigsaw.

I smoothed out the waste left by the dado cutters with a chisel, shoulder plane and rasp, then marked the locations of the sockets on



Together forever. After assembling the leg and stretcher joints, wedges are glued and driven in the joint from the outside to lock it permanently.



the outer legs directly from the tails. I cut the angled ends of the sockets with a backsaw, and removed most of the waste in between at the table saw.

The remaining waste was removed with a chisel, followed by a shoulder plane. Then I used a plane maker's float to achieve a flat bottom on these joints. The upper joints need to be equal in thickness so that the outer surfaces of the legs and rails will be flush when the bench is assembled.

Down at the lower rail, the tail needs to

be thinner than the socket so that the end of the rail can easily pass through the socket in the leg. The socket also needs to be wide enough to allow the square end of the rail to enter the narrow portion of the joint, then drop down into place.

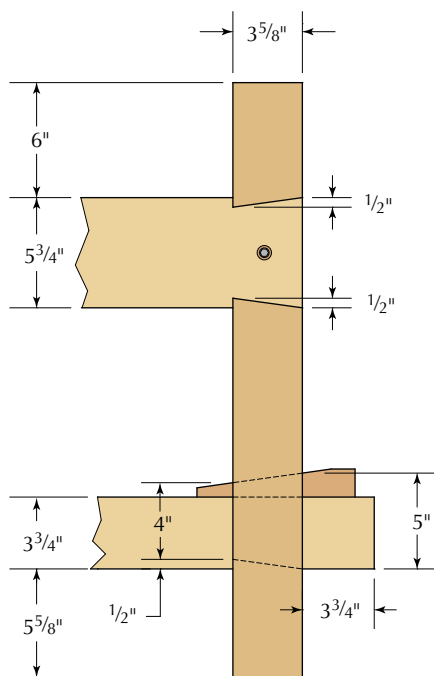
This requires some fussing, but because the outer half of the leg is loose at this point, it's easy to see what is going on while adjusting the joint. After fitting the lower portion of the tail, I cut and fit the removable wedges.

With the joinery complete, I spread glue

on the inside surface, and glued the outer legs to the previously assembled inner legs and stretchers, taking care to keep the parts aligned. After letting the glue dry overnight, I was anxious to see the completed bench.

Screws, Wedges and the Hole Story

I set the completed end units on the floor, and inserted the two lower rails into one end, knocked in the wedges then slid the rails into the other end. The upper rails were knocked into place, and after marking the centers of the



LEG DETAIL



Halfway gone. The dovetails on the ends of the horizontal rails are half-lapped. I removed most of the material with a stack dado set on the table saw. An adjustable roller stand supports the other end of the long parts.



Real-time layout. After making the male part of the joint, the socket is laid out directly from the finished part. Simply lay the rail in position, line up the top and knife in the angled line.



Fit the joint, then the wedge. After fitting the dovetail for the lower rail, a matching wedge is cut and fit. Thanks to working on only half the leg, this process is entirely visible.



A little skinny. The end of the rail will need to easily pass through the assembled leg. The square is set to half the thickness, and the space below the blade tells the story.



Careful now. The legs are permanently assembled by gluing. Judicious placement of glue to keep it out of the joint, and a clamp across the bottom to keep the parts from sliding, make the process painless.

tails, I made a $\frac{3}{4}$ "-diameter counterbore deep enough to leave the head of a lag screw about $\frac{1}{8}$ " below the surface. Then I drilled a pilot hole and drove in a $\frac{1}{4}$ " x 2" lag screw.

I set the tops in place on the assembled base, with the edges even with the outside of the legs and a consistent distance in between.

I drilled $\frac{3}{8}$ "-diameter through holes in the upper stretchers, and $\frac{1}{4}$ "-diameter pilot holes in the bottom surface of the tops. Four $\frac{5}{16}$ " x $3\frac{1}{2}$ " lag screws secure each top section to the base. After admiring the assembly for a while, I laid the bench on its side, and flushed the joints to each other.

The front of the bench is really a working work-holding surface, so I took care to level all the parts to be in the same plane. While I was at it, I used my block plane to bring the ends of the tails even with the edges of the legs.

Setting the bench back on its feet, I laid out the locations of the vises, as well as the $\frac{3}{4}$ "-diameter holes in the top, front rails and front legs. A Veritas twin-screw vise straddles the left-front leg, and a small quick-release vise is in the tail-vise position. I routed out

a recess in the end of the benchtop for the tail vise, and glued two 2"-thick x $4\frac{1}{4}$ "-wide blocks to the bottom to hold the screws for the larger, twin-screw vise.

There is a line of holes in the top, centered on the dog location in the end vise. I drew a line the length of the bench at this distance, then marked a hole to just miss each side of the right hand leg. I set a pair of dividers at this distance and stepped off the center-to-center marks for this line of holes.

I carried these marks down to the front rails using a framing square. The holes in the lower rail are centered vertically, and the ones in the upper rail alternate high and low, $1\frac{3}{4}$ " in from the edges. The holes in the rails don't need to line up with the holes in the top, but it seemed a reasonable spacing. It was easier to transfer the existing layout than to think about a new one. The holes in the front will be used with a surface clamp, or a simple dog to support work from below.

On the inside edge of the top, I marked out locations for holdfast holes on 12" centers, 3" in from the back edge on the front half. On the back half is another row of holdfast holes,



A short side trip. After assembling the rails and top halves, the bench is turned on its side to level the front surfaces.

also on 12" centers. I wanted these roughly in the middle of the top, but didn't want to drill into the glue line, so I centered them in the middle of the board beyond the center of the rear top.

There are five holes in the front jaw of the vise, lining up with the holes in the top, roughly in the center and near each end of the jaw. Each of the front legs also has holes, two in the left, equally spaced between the upper and lower rails. The holes in the right leg match, with an additional hole in the space between the upper rail and the benchtop.

Because the parts of the bench are relatively manageable components, I took the bench apart and drilled all of the holes at the drill press using a $\frac{3}{4}$ "-diameter brad point bit at a low speed, about 500 rpm. I used my roller stand to support the long parts that hung off the drill press table.

Where Will the Hamsters Sleep?

Between the two lower rails is a shelf that is supported by 2"-wide cleats nailed to the bottom of the rails. The shelf boards are random widths of $\frac{4}{4}$ material, with opposing rabbets on the long edges. The boards at each end have a rabbet on only one edge, and butt against the inside edge of the lower stretchers.

The shelf boards and cleats were left as thick as possible, and cleats were also nailed to the underside of each inside edge of the top sections to support the removable tool trays. The trays are open-topped boxes, made from $\frac{3}{4}$ "-thick solid wood. The corners are held together with simple rabbet-in-groove joints. The bottom is rabbeted to fit in a $\frac{1}{4}$ "-wide groove, with the face of the bottom even with the bottom edges of the box sides.

The tool trays can be turned upside down if desired to make the entire bench, or just

portions of it, one wide flat surface. Or they can be removed to allow clamping to the middle of the benchtop. They can also be easily carried to return tools to their homes, or to the trash can to remove the inevitable accumulation of shavings and other trash.

I don't believe that a bench needs a fine finish. After planing all the surfaces, I knocked off the sharp corners of the edges, and applied a coat of Danish oil.

With a few holdfasts and holddowns, along with some F-style clamps, I can hold work securely in almost any position. That's what a good bench is for. It is the tool that makes the work of all the other tools easier and more efficient. **PW**

Robert is senior editor of this magazine and author of several books about furniture of the Arts & Crafts movement. Information on his books is available at his web site: craftsmanplans.com.

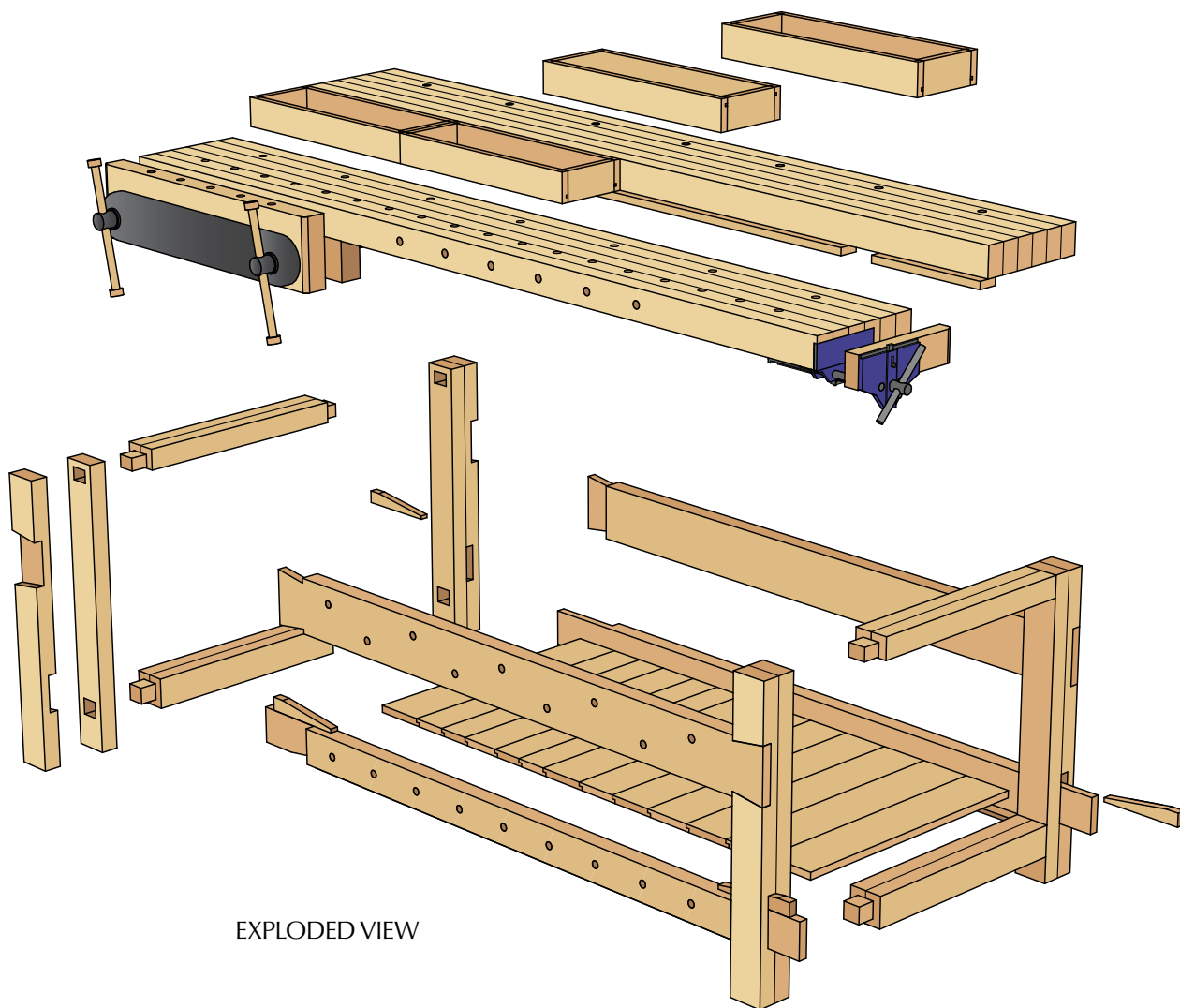


Fine-tuning. The lag bolts that secure the upper rails are counterbored to keep the heads well below the surface. The faces of the rails are made flush to the legs.

Even ends. The ends of the tails are also trimmed flush. The lag bolts that hold the top on are visible behind the block plane.



The boring part. The top halves are heavy, but with the aid of a stand they can be brought to the drill press for boring the dog and holdfast holes.



EXPLODED VIEW

21st-Century Workbench

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL	COMMENTS
		T	W	L		
12	Top laminates	1 ¹⁵ / ₁₆	3	90	Ash	Mill TAP*, 6 per half
4	Inner legs	1 ¹⁵ / ₁₆	3 ³ / ₄	31	Ash	Mill TAP*, 1 ³ / ₄ " minimum
4	Outer legs	1 ¹⁵ / ₁₆	3 ³ / ₄	31	Ash	Mill TAP*, 1 ³ / ₄ " minimum
4	Upper stretchers	1 ¹⁵ / ₁₆	2 ¹ / ₄	31	Ash	Mill TAP*, 1 ³ / ₄ " minimum
4	Lower stretchers	1 ¹⁵ / ₁₆	3 ¹ / ₄	31	Ash	Mill TAP*, 1 ³ / ₄ " minimum
2	Upper rails	1 ¹⁵ / ₁₆	6	65	Ash	Mill TAP*, 1 ³ / ₄ " minimum
2	Lower rails	1 ¹⁵ / ₁₆	3 ³ / ₄	72 ¹ / ₂	Ash	Mill TAP*, 1 ³ / ₄ " minimum
4	Wedges	7 ⁷ / ₈	1 ³ / ₈	8 ⁵ / ₈	Ash	Mill TAP*, 1 ³ / ₄ " minimum
4	Cleats	1 ¹³ / ₁₆	2	90	Ash	Cut to fit between ends
8	Box sides	3 ³ / ₄	3	22 ¹ / ₂	Ash	
8	Box ends	3 ³ / ₄	3	6 ³ / ₄	Ash	
4	Box bottoms	3 ³ / ₄	6 ³ / ₄	20 ¹ / ₂	Ash	
1	Shelf	3 ³ / ₄	22 ³ / ₈	58	Ash	Random width shiplapped boards
1	Face vise blocks	2	4 ¹ / ₄	30	Ash	Total length, trim for each side of leg
1	Face vise chop	2 ¹ / ₄	7 ¹ / ₄	30	Ash	Laminated from 3 pcs.
1	Tail vise chop	1 ¹ / ₂	3	11 ⁵ / ₈	Ash	

*TAP=Thick as possible

Supplies

Lee Valley

800-871-8158 or
leevalley.com

1 ■ Veritas twin-screw vise, 24" center
#05G12.22, \$225

1 ■ quick-release bench vise, 7"
#10G04.11, \$99

2 ■ Veritas surface clamp
#05G19.01, \$67 each

2 pr. ■ 4³/₈" bench dogs
#05G04.02, \$26.50 pair

Tools For Working Wood

800-426-4613 or
toolsforworkingwood.com

2 pr. ■ Gramercy holdfasts
#MS-HOLDFAST.XX, \$29.95 pair

Prices correct at time of publication.

Table Saws

by Marc Adams

It is estimated that nearly 80 percent of all woodworking requires some type of sawing. The power, accuracy and control of the table saw has made the process of sawing wood a lot more productive and a lot less physical. It's arguable as to who first invented the circular saw, but one thing is certain – it has revolutionized our craft. I've often wondered if plywood as we know it today would have ever been invented if we didn't have a way to productively cut it. I also think about the skill shifts of the traditional apprenticeships. At one time it took years of practice and great skill to handsaw wood accurately. The table saw changed that process to an almost rudimentary procedure.

Table saws can make myriad cuts including rip cuts, crosscuts, coves, mouldings, dados, kerfs, rabbets, miters and bevels. It is a precision-cutting tool that requires that the machine be set up

On guard. If you cannot do an operation without the stock guard or an effective shop-made one, you should use another machine.



PHOTOS BY AL PARRISH

A Better Way to Work • Part 7

WOODWORKING Essentials



Good posture. Good table saw technique begins with your stance. Always stand to the left of the blade and gain additional support by bracing yourself against the saw.

accurately, maintained properly and be used competently. Small problems can have huge consequences. R.J. DeCristoforo summarized using a table saw better than anyone when he said, “measure twice, saw once” and “think twice before sawing.”

My goal with this article is not to review the different types of saws available today, or discuss their characteristics. I’m not going to explain the difference between blades or how to make fixtures to cut tapers or tips and tricks or troubleshooting or maintenance schedules, and I don’t want to compare European to American saws. All that information already exists in myriad books and articles.

I have decided to stay away from the topic of dust control because we all know the dangers of dust and the importance of controlling it and, again, there are volumes of books and maga-

zine articles on the subject. My intentions with this article are to focus on the techniques, methods and mechanics of safely using the table saw. After all, it is very well documented that more accidents occur on table saws than any other machine in the shop.

In Ian Kirby’s book “The Accurate Table Saw,” there is a brief introduction written by Les Winter who is a forensic engineer. He explains the essence of danger by defining two components: hazard and exposure. A hazard has the potential to cause injury. Exposure is the likelihood of coming into contact with the hazard. It is the combination of hazard and exposure that make something dangerous. If you can reduce the exposure then the hazard becomes less dangerous. In my very first article in this series, “Learn the Skills to be Safe” (November 2007, issue #165). I set the stage for the rules

that apply to using all power equipment by defining control, exposure and limitation. These three factors are exactly what the user needs to know to reduce the hazards of a table saw.

Control

At the table saw, you must always be in control of the work. Control occurs through a combination of sequences and involves both managing the material and understanding how the machine is designed to give the user as much support as possible through the point of contact. The following is a list of six factors that are important to gaining better control at the saw.

First, you as the operator must have a firm stance at the machine. Your starting position will vary depending on the size of material and type of cut being made. I definitely recommend that you stand to the left of the blade with a pushing vector toward the fence and away from the back of the blade. I like to firm up my stance by placing my hip against the saw itself; this gives me better support.

Never stand directly in front of the blade or in direct line of potential kickbacks. It is not uncommon to see both novice and experienced woodworkers standing to the right of the fence. Although this does protect you from being in the direct line of a kickback, it causes you to have to reach over the fence, which could put you off balance. The natural tendency when pushing wood is to push it in the direction that you are leaning. Leaning toward the blade from the fence side could cause the pushing motion to be directed more toward the back of the blade, and nothing good comes from the wood making contact with the back of the blade. Plus, your hand position for pushing from this side of the fence is awkward.

Second is how to maintain control while pushing the stock through the saw. Never cut freehand on a table saw. A freehand cut can deprive you of most of the protection a table saw affords. For most of us, pushing wood through a table saw is instinctive. However, there are real mechanics to the pushing process. The wood must remain flat on the table and tight against the control



Hand position. Notice how my right hand has fingers lipped onto the fence. This registers my hand in relation to the blade. Also notice the push stick positioned for use to finish my cut.

surfaces, such as the fence or miter gauge.

When ripping wood, I dedicate my hands so that my right hand provides the forward push and my left hand pushes the wood against the fence – make sure to maintain 3" of clearance from the guard with both hands. When ripping wood, I also like to hook a finger or two on the top edge of the fence to keep my right hand from accidentally being thrust toward the guard. It is OK to stop feeding a board during the middle of the cut to reposition your right hand or to pick up a push stick – but you must never let go of the stock with your left hand during this transition. Once the cut is complete you need to make it a rule and habit to not reach over the saw blade to pick up and bring the stock back to the front of the saw – even with the guard in place. Never clear scraps away with your fingers while the blade is rotating; always let the blade come to a complete stop first. Make sure that you always push the stock that is between the blade and the fence so it is beyond the back of the blade; always use good follow-through after the cut.

Third is maintaining good eye contact. Learn to keep your eyes in tune with the fence and the guard (instead of the blade). Most people want to stare down the blade as it's cutting the wood, but with the guard

over the blade the cut is obscured and will tell you very little. As long as you keep pushing the wood the cut will take place. You must be aware of the entire work area; be alert and keep your eyes moving over the entire table but concentrate mostly on the control between the work and the fence. Visualize where the 3" rule is and develop a good awareness of this zone. Be aware of where your hands are at all times; watch to make sure your fingers stay way beyond this zone.

Fourth is how to control oversized material. Large and heavy wood can have a tendency to tip or fall off the machine. It's very hard to control large and awkward stock. I know most shops are limited on space, but it sure is nice to have extra table surfaces around the sides and especially the back of the saw. If you have someone helping you with large stock, make sure you practice first and make sure you are in control of the cut. The helper should just act as a table extension. It does not work to have two people trying to steer a piece of wood through the saw at the same time. If a helper is not available, use a roller support to help support long stock as it is being ripped.

The fifth factor of control on a table

saw is the feed rate. The rate you feed the stock in the cut can be affected by many factors including the differences between ripping and crosscutting, the type of blade being used and its sharpness, the type of material being cut, and the power of the saw. Sometimes just listening to the cut will tell you more than anything else. You should never force the cut to the point where the blade stalls. If you notice the edge of the board is burning, that's a pretty good indication that you are feeding too slowly, that your blade is dull or that the fence is misaligned – or possibly all three. If the edges of your boards are showing signs of burning, try to speed up the feed rate a bit. If that doesn't improve the burning then the blade is probably getting dull or needs a good cleaning. Verify that the fence is parallel to the blade.

And finally, the sixth factor of control is built into the saw itself. On a 10" table saw the blade is rotating at approximately 4,000 rpm. As wood makes initial contact with the blade there is little kicking force because the cutting force is straight down toward the table, just like with a band saw. As the wood continues in the cut to a point where the stock is about halfway



Support. Stationary tables to both the left and right of my table saw make this area more user friendly, but nothing increases safety more than a proper outfeed table.

past the blade, the wood will start to encounter a forward vector of force that in turn will cause the wood to react by moving in the direction of the rotating blade or toward the operator (the action of kickback will be explained in my next article). To counter these forces, engineers have built in “control” as a way to manage the undesirable effects of the wood when it contacts the blade. The table itself, the fence, a miter gauge, standard guarding, specialty devices such as push sticks, featherboards and hold-down devices, are all great ways to control the stock as it meets the point of contact on a rotating blade. A well-designed machine provides or has available some type of “control” to counter the kicking and grabbing forces that naturally take place with rotating cutters and provides the user with a clear range of motion through the entire process.

Three Kinds of Exposure

Going back to Winters’ explanation of hazard and exposure, he says that by reducing the exposure, you will reduce the danger level. Less exposure means less danger; more exposure means more danger. It almost doesn’t get easier than that – and that should be the golden rule of operating all power equipment in the shop safely. Exposure at a table saw can have three meanings: blade height when there is no guard being used, blade height with the guard and repetitiveness. (For the sake of argument let’s just say that these rules apply to all blade types.)

Blade Height when No Guard is Used

Let’s face it: No matter what rules we establish for the table saw when it comes to using your guard, most woodworkers, both professional and novice, will at some time remove the guard(s) to make certain types of cuts. Nothing good comes by removing a guard. If you violate my rules about never running a table saw without a

guard, then you must set some kind of rule as to how much blade exposure you will allow. With unguarded and exposed through cuts the best rule to use is “minimize, not maximize.” Like the late Dr. Roger Cliffe used to say, “How high the blade should be above your work is a definition of terms: the difference between amputation and laceration.” And if the blade is unguarded you might as well plan on both kickback and blade contact as a part of your future.

It is recommended that when you are making unguarded through-cuts that the blade be set about $\frac{1}{8}$ " to $\frac{1}{4}$ " above the stock. However, keep this in mind: At a lower blade setting there are a considerable number of teeth in the cut that are moving in a substantially forward direction. Kickback forces can be transferred into the wood most efficiently with a low blade, and with a lower blade there is a greater distance between the rear of the blade and the splitter. Plus more teeth means more friction, which in turn heats the blade and increases the risk of burning the wood.

Let’s just make this whole issue simple: Always find a way to guard the blade; never use a table saw without the guard. The point of the two photos above right is to demonstrate that at the low blade exposure, the blade will have three teeth in the work at the rear of the blade. At full exposure, only two rear teeth are in the work. The trajectory at the low setting will have the teeth of the blade leaning 60° off vertical, directed at the operator while at full exposure, the trajectory of the teeth is only 30° off vertical.

Blade Height when Guard is Used

This may take you by surprise but a higher blade height helps the blade to run cooler. At the same time, it helps the motor to run more efficiently while using less power. I’ve been told that if the saw is adjusted just right, you will also get a cleaner cut with a higher blade. This is why at trade shows you always see the “pitch man” running the blade as high as possible when demonstrating his blades. Why don’t they use their guards – bunch of dummies!?

Think of this as well: With fewer



Tooth trajectory. In the top photo you can easily see the trajectory of the blade’s teeth and the closeness of the blade to the splitter. Above, the teeth trajectory is forward, toward the operator and the distance between the blade and the splitter has widened.

teeth in the cut, the transfer of forward energy is less efficient and a higher blade presents less of a gap between itself and the splitter. All of a sudden, it sounds like I’m recommending that you run your blade as high as possible, but that’s not the case. Keep in mind that a higher blade setting produces more exposure and a greater danger level – only if the guard is not in place. And this discussion is about blade height with the guards in place. With a guard acting like a barrier, the likelihood of the blade contacting your hand(s) from any direction, except straight in, is low. No pivoted or aftermarket guard can prevent you from sliding your hand straight into the blade. So what’s the answer? The answer is that a well-guarded blade can be set slightly higher than an unguarded blade.

Repetitiveness

The second type of exposure is in terms of repetitiveness. Each time you

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make multiple cuts or passes you could be putting yourself at more risk. For example, there is no sense in making several passes over a table saw blade to make a wide cut when you could have done it in one pass with a dado blade. As you present yourself to extra passes or multiple moves, you expose yourself to more risk.

Limitation

There are two types of limitations to consider. The first are common-sense items such as your physical limitations and the limitations of your shop space. Everyone has difficulties handling a sheet of plywood or cutting heavy or long wood. And small shop space can sometimes require a lot of planning and strategy before making a cut. As I mentioned earlier there is nothing wrong with asking for help.

The other type of limitation, which is definitely the most important factor in understanding any machine, is to know when that machine is not capable of safely performing an operation. At some point you have to determine when the table saw has reached its limits. My rule is simple: I use the guard as my determining factor. If the guard on my saw will not permit me to make the cut that I desire or if I can't effectively make or obtain a guard that will work, then the table saw is not the machine for that operation. There is nothing wrong with walking away from the table saw when it's the wrong machine. Actually, I find the challenge of figuring out a second approach to be a great learning experience and believe it has made me a better woodworker – not to mention it's helped to keep me out of the emergency room.

Understanding Guarding and How it Relates to Through and Non-through Cuts

Guarding simply is the act of positioning barriers or other safety methods so that hazards are inaccessible to the user. I'm probably going to take a hit for this next statement, but I think that most table saw manufacturers make guards that are inefficient and not very user-friendly. Yes, they do meet the provisional requirements by OSHA (1917.151 (c) (1,2,3)) for having

an enclosure, splitter and anti-kick-back fingers, but they lack real design ingenuity.

What makes a table saw so versatile is it can make both through and non-through cuts. Standard “off-the-show-room-floor” guarding doesn't make it easy to move between these two actions and worse yet, most manufacturers have attached all three guards together to act as one unit. If you remove one, then you've removed all three. It can be a lot of work to remove a guard – followed by a lot of work to put it back on. After doing this a time or two, frustration sets in and it won't be long before it becomes a habit to just leave the guard off altogether.

Ask any woodworkers today if they still use their guard and watch how quickly they look at the top of their loafers and say, “... uh, no.” Then ask them if they even know where their table saw guards are and they usually don't know that either.

I truly believe that everyone who uses an American-made table saw today would use their guard system, no questions, if the guard systems were user-friendly. This is why aftermarket guarding is becoming so popular today. Aftermarket guards separate the enclosure from the splitter, which allows you to remove one and leave the other in place.

Plus, most aftermarket guards have a degree of adjustability, which gives

them a better range of protection and they can be taken off and put back on in a matter of a few seconds. But even with that, aftermarket guards can't accommodate every possible cutting action on a table saw – but they sure are better, and I definitely recommend that you look at upgrading your standard guarding.

Every table saw that I've owned over the last 15 years has had the standard guard replaced by aftermarket guarding systems. Make sure the aftermarket guard you purchase has at least the blade enclosure and a splitter. More than likely the splitter will come with anti-kickback fingers attached to it.

In order to fully understand guarding on the table saw you have to understand the differences between the three guards, their purposes and how they function during through and non-through cuts.

Blade Enclosures

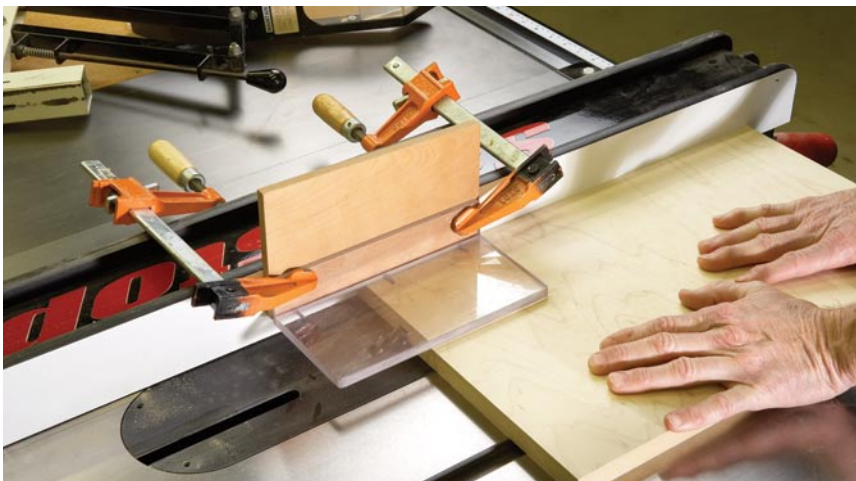
The blade enclosure, which is sometimes referred to as a shield, hood or top guard, is the most visible part of the guarding system on a table saw. A good enclosure should either rest on top of the wood or be set as close to the wood as possible. It should not allow your fingers to get between it and the wood or near the blade and should not have pinching forces. Enclosures that do not pivot act to a small degree as a way to help hold the wood in control and to



Clear view. It's important that a guard be clear and not distort the view of the blade as the cut is being completed.

limit any potential lifting of the stock just in case it grabs or catches on something. It should provide good coverage on all four sides of the blade.

I use the enclosure as a starting point for my 3" rule (see *Popular Woodworking* November 2007, issue #165). A good enclosure should not obstruct your view through the point of contact and must aid in deflecting chips away from the user and direct them toward the dust collector, or at least down toward the table. One of the biggest drawbacks to conventional or standard enclosures is that they are not adjustable from side to side or front to back, which can cause problems when trying to rip narrow or short stock. Although aftermarket guards do allow some adjustability, they also have limits before the guard obstructs the path of motion. If the cut requires that the enclosure be removed, remember my simple rule: If the guard on my saw will not permit me to make the cut or if I can't effectively make or obtain a guard that will work, then the table saw is not the right machine for that operation.



Limit contact. A blade guard can be as simple as a piece of Lexan attached to a scrap. When clamped to your fence, it provides safety by limiting potential contact with the blade.

When making non-through cuts, enclosures or top guards can sometimes be more of a hindrance than asset. They can limit the motion, restrict control and create binding. Non-through cuts will require creative ways to protect yourself from unnecessary exposure to the blade.

Splitter

The second guard on a table saw is not quite as obvious as the enclosure or top guard but is the most important part of the guarding system. The splitter, sometimes referred to as a spreader or riving knife, is directly behind the blade and is used for through cuts. Splitters are most effective when they are the exact width as the kerf of the blade and are in perfect alignment with it. The splitter separates and prevents material that is being cut from coming in contact with the back of the blade. That minimizes the chance of pinching and kicking back. Typical American-made splitters will not work for non-through cuts, which will require that they be removed. It is important to realize that even with a splitter properly installed, kickback can occur if through some circumstance the wood should make contact with the back or top of the blade and just before the splitter. Be aware that the closer the splitter is to the blade, the more effective it will be. Splitters should be used for both ripping and crosscutting.

There are two types of splitters – static and dynamic. Today nearly all American-made contractor and cabinet saws have static splitters (though that is changing). These are the typical top guard/splitter/anti-kickback-finger combination-guard system that comes with most new saws. This combination guard system is attached just behind the blade arbor and just to the back of the



Less-than-stellar design. Due to typical American-style splitters extending above the top of the blade, making any cut except for a cut completely through your stock is not possible.



Dangerous gap. Standard splitters do not follow the blade as it raises or lowers. Therefore, the gap between the two can be wide. This opening is an area where pinching and kickback can develop.



Better design. Riving knives add a great deal of safety to any standard blade cut. The knife travels with the blade to maintain a close fit to the blade and reduce the possibility of pinching.



Capture the cutoff. A cutoff of nearly 6" is not captured by a traditional splitter or anti-kickback fingers, but a riving knife positioned close to the blade would keep the cutoff away from the back of the spinning blade.

saw table. They do not move once they are installed. Standard splitter/guard systems can vary in how close the splitter is located to the blade, but can be as far back as 2" or more. The larger the gap between the splitter and the blade, the more potential there is for a piece of stock to come in contact with the back of the blade. Be mindful that with a static splitter, the gap will vary as the blade is raised and lowered. Static splitters must also be removed when making non-through cuts.

A better type of splitter is one that is not connected to the enclosure or top guard, but is connected to the arbor casting itself. On European saws this type of splitter is called a riving knife. It is located just barely behind the blade and will raise and lower with the blade. The gap between the two never changes and is typically as close as 1/4". A good riving knife is set just a little lower in height than the arc of the blade. This allows you to make both through and non-through cuts, which makes you safer and more productive. Riving knives should not be used with dado or moulding-head cutters. For the record, I would much rather have a riving-knife type of splitter on my saw.

Anti-kickback fingers

Anti-kickback fingers are sometimes referred to as non-kickback fingers, dogs or pawls. Their job is to oppose the tendency of the saw to pick up material and throw it toward the oper-

ator. Overall, I'm all for any thing that can make a saw safer. From an engineering point of view, anti-kickback fingers seem to be a good concept but they come with quite a bit of controversy as to their effectiveness. European saw manufacturers don't use them at all because they deem them to be virtually ineffective with little positive gain. As a matter of fact, European saws can't have anti-kickback fingers because of the dynamics of a riving knife. Anti-kickback fingers can sometimes get in the way. For example they can limit and even interfere when ripping narrow stock. I've had on numerous occasions the anti-kickback finger limit the motion and even obstruct my push stick.

A splitter is a nice safety addition to a crosscut sled. However, you will have to remove your anti-kickback fingers if you use a splitter with your crosscut sled because they will create a hang up when you pull the sled back after the cut. Although anti-kickback fingers do work when using a miter gauge for crosscutting, they are virtually useless with stock less than 6" wide. Remember: A standard guard/splitter combination is set back from the blade, which causes the anti-kickback fingers to be positioned even farther from the back of the blade. When crosscutting, the cut is completed when the trailing edge of the board clears the front of the teeth. This will leave the unsupported cut-off board right next to the back portion of the blade and just before the anti-kickback fingers. Because anti-kickback fingers are attached to the splitter, they follow the same rule for through and non-through cut applications as the splitter.

In the next issue I'll be discussing in detail one of the most serious safety problems with table saws: kickback. And I'll discuss how you can prevent it. **PW**

Marc is the founder and owner of the Marc Adams School of Woodworking, the largest woodworking school in North America. For more information on the school and its excellent curriculum, visit marcadams.com or 317-535-4013. You can download a list of safety rules for the table saw by visiting popularwoodworking.com/oct08.

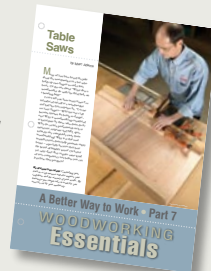
Work with More Accuracy (and Safety) in your Woodshop

The best way to use your machines is rarely explained in the manual. Find out how to operate machines to get accurate results without sacrificing safety.

• Part 7

Table Saws

The fundamental skills to get good (and safe) results with the most important woodworking machines.

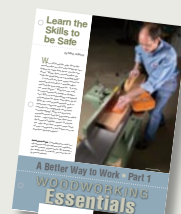


IN PAST ISSUES

• Part 1

Learn the Skills to be Safe

The groundwork for a lifetime of accurate woodworking is to understand your tools.



• Part 2

Practical Safety Devices

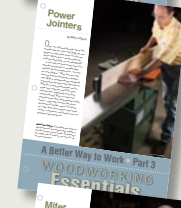
Choose the right guards, push sticks and hold-downs to work safely.



• Part 3

Power Jointers

Most people use their jointers wrong, resulting in warped stock and unsafe operations.



• Part 4

Miter Saws

Stock miter saws are neither accurate or safe. Here's how to fix both problems.



• Part 5

Band Saws

Band saws are safe if used correctly; however it's easy to step over the line and get bit.



• Part 6

Planers

Powered planers seem like safe machines until you start testing their limits.



Layout tools are woodworking's widows and orphans. The work they do seems pretty mundane, so we woodworkers tend to focus our attention and our expenditures on the fancy stuff. The shift in focus from hand work and hand joinery to woodworking machines played a part in the demotion of layout tools, as a lot of layout is now built into the fences and guides on machines.

Just as no shop doing quality woodworking will ever get completely away from hand work, we are unlikely to ever eliminate the need for layout tools. If you are a woodworker you do need to own and know how to use layout tools. Fortunately, they are not hard to figure out. They are just a bit foreign for some of us.

Layout tools usually come into play early in the furniture-making process. Generally, the only work you do before layout is stock preparation. Before any joining or shaping is done, your stock will have to be laid out.

There are two broad categories of woodworking: joinery and shaping. Likewise, there are two broad categories of layout tools: those used for laying out joints and those that lay out shapes. However, there is some overlap between the two types and frequently, more than one tool is used in a single operation.

I counsel against skimping when buying tools. Quality tools cost money. Inexpensive tools do not work well – if at all. However, layout tools are exceptions. Some companies make very pretty and very expensive layout tools. Some companies make very accurate and precise layout tools. But, woodworking is not done to three decimal places. If you want to work with really pretty or extremely accurate layout tools, that is your choice. You'll pay more and your woodworking won't be any better for it. Often, the basic equivalents available in a hardware store, in woodworking catalogs, or at home centers will work fine.

That said, I do prefer my layout tools to have some features, and other features I avoid. Rather than appearance and cost, my criteria are ease of set up and fine adjustment. As I discuss these tools, I will mention these features and explain why I prefer some over others.

Marking Lines

All layout involves making lines that you can follow as you work. The quality of your

work is dependent on being able to see and follow these lines. So, dark heavy lines are best. Right?

Nope. Remember the definition of a point and a line from high-school geometry? A point has no dimensions; it is a concept. A line is an infinite series of points, so while it has length, it has no width. That would be the ideal in woodworking; but what we can imagine we cannot always create. Any line we make has width. Cut slightly to one side of a line in one place and to the other side in another, and you can be off by the width of that line. This may not seem like a lot, but a shoulder or dovetail with a gap that wide is pretty obvious.

A pencil draws a line and no matter how sharp the pencil, its line has width. For this reason, woodworkers usually rely on scored, rather than drawn, layout lines. In woodworking, scoring these lines is commonly referred

LAY



Whether you do hand or machine work, these layout tools are indispensable.

BY MICHAEL DUNBAR

to as scribing, and the lines are referred to as scribe lines. Some layout tools scribe their own lines. Others require a separate tool, one that is referred to as a striking knife.

Tools that Scribe

A striking knife has a flat-backed, usually V-shaped blade with a suitable handle. The critical feature is the blade. It is ground on only one side rather than on both, as your pocket knife would be. If rather than flat the blade is ground on both sides like a knife, the scribe line would be offset by up to half the thickness of the striking knife's blade.

So in use, the flat side of the blade is run against the layout tool. The tip of the blade is often V-shaped to allow the knife to be used in either direction and by left- and right-handed woodworkers.

It is important to keep your striking knife sharp, as a dull knife will crush and tear wood fibers, rather than scribe cleanly. A scribe line made with a striking knife can be faint, but readily visible if you work with light coming

slightly from the side. Its shadow makes the line easy to see.

If you have trouble seeing the scribe line, run a pencil lightly along it to leave behind a little graphite. It does not make the scribe line wider like a pencil line, just easier to see.

Layout lines are usually very fine and are easily planed, scraped or sanded away. As an aside, woodworkers in the past did not usually bother. One feature that helps determine whether a piece of furniture is a genuine antique are the layout lines. I like these layout lines because through them the long-dead furniture maker is telling me how he worked.

Begin with the Basics

Most layout tools will require that you first establish a straight and true edge on a piece of wood. For that reason, the straightedge is the most basic layout tool. A straightedge is different from a ruler or a yardstick. Its purpose is to provide what its name implies – a straight edge. While some straightedges are graduated for use in measuring, their primary purpose is to guarantee a straight line. You can measure with a ruler, but a ruler does not necessarily provide the precision you want when checking a straight edge or a flat surface.



Striking knife. To use a striking knife, hold the flat side firmly against your guide and draw the knife toward you to scribe a line.

A straightedge is usually made of steel and is thus much heavier than a ruler. They also cost a lot more. Because straightedges have a lot more uses in a shop than just making straight lines, they are worth the expense. You will not often need one more than 24" long.

Sometimes in woodworking you have to saw or plane to a line longer than you can trace. While it may seem an unlikely candidate for inclusion with other layout tools, long layout lines are best made with a chalk line. This technique is ancient. A string is covered with a very fine colored powder (nowadays either red or blue chalk) and when drawn tight and snapped, the string leaves a perfectly straight line of powder for you to follow.

All you need to do is locate the point at one end of the line you wish to make and a corresponding point at the other end. The chalk line has a hooked tab that will secure it over the end of a board (but a third hand can also be useful). The tab has a triangular opening in it so you can make sure the tab is perfectly aligned with your beginning mark. Simply be sure the mark is in the point of the triangle.



LAYOUT TOOLS

Unwind the string as much as you need to extend over the other mark on the far end. Pull taut. Now, reach inward along the string's length and lift slightly. Let go, and the string snaps down on the wood, leaving a perfect line. It is important to lift neither too much nor too little. Too little, and the line is faint and hard to see. Too much and the string snaps back with so much force, that a cloud of powder will shoot out laterally. The result is a blurry line.

A chalk line definitely has width, so when cutting stay in the center. However, a cut long enough to require a chalk line does not generally require the same precision as joinery.

Joinery

Furniture is made by connecting pieces of wood together. This is the part of the craft we today call joinery. Several centuries ago, joinery meant making furniture and the practitioner of the craft was called a "joiner." The term changed to "cabinetmaker" during the 18th century.

When woodworkers examine each other's work and make judgments about the other guy's or gal's ability, they usually examine the joinery. Precise, tight and neat is good. Gaps, wobble and sloppy is bad. While cutting good joints requires skill, the work is never going to be good unless it is first well laid out.

Much of woodworking involves joining pieces at a right angle to one another. Thus, 90° is the most common angle in the craft. The parts we join together are also most often square or rectangular. This reliance on right angles is why a try square is the woodworker's close friend and companion.

Try squares are made in a wide range of sizes from miniature squares with blades only a couple inches long to large squares with 12"



Chalk line. While a chalk line leaves a wide mark in comparison to a pencil, it's unlikely that precision will be paramount in a line that's too long to mark using a straightedge.

blades. For most furniture making, a 9" try square is adequate for layout.

The important thing about a square is that it be square. Testing is very easy. Place your square on a proven straight edge (this is a good job for your new straightedge). Scribe a line. Flip the square so the handle is pointing the opposite direction and be sure the tool confirms the line. If the blade is not square, buy a new tool.

Some woodworkers use framing squares or combination squares. While I own these tools, I do not use them for layout. A framing square is too unwieldy and I feel the combination square is not accurate enough.

Miter Squares

While 90° is the angle we work with most often, 45° is a close second. This 45° layout is

done with a miter square. These come in a variety of forms. The most traditional is similar to the try square, consisting of a wooden handle secured at 45° to a blade. I am particularly fond of my Japanese miter square, which has a slightly different form. It has a raised foot that fits over the edge of a board. The blade is 45° on both ends.

Angles other than 90° and 45° require an adjustable layout tool that can be set to whatever angle you need. The tool for this is the bevel square. I can't think of a tool with as many names as this one. Some woodworkers call them an adjustable bevel, a T-bevel or a sliding T-bevel.

The most basic version of a bevel square is a blade mounted in a handle. The handle has a wing nut that can be loosened to adjust the tool and tightened to lock the blade in position. There is a slot in the blade that allows the blade to slide. This way it can be set for an angle and its complement.

The wing nut is the problem I have with this most basic and inexpensive type of bevel square I just described. Bevel squares are often placed against a part, or are used to measure two angles to confirm they are the same. I find the wing nut often gets in the way. I prefer a bevel square with a locking lever that is out of the way below the surface of the handle. Another option is a bevel square with the locking nut in the end of the handle.

Bevel squares are very handy. They are good for laying out an angle, but you can also use them to measure an unknown angle. This is an important capability when making a copy of an original piece of furniture. However, you sometimes need to take an angle from a drawing or a photo. Other times, you need to fit your woodworking to an odd-shaped space. The bevel square will measure the space's odd angles.

Setting or measuring a bevel square requires another tool. You can use a protractor. However, I prefer an adjustable triangle, a tool that can be purchased at an art-supply store. We rely a lot on bevel squares in Windsor chairmaking, as each part in a Windsor is at an angle. Our sack back is the chair we teach most often. So, when making this chair we use a bevel board (which is simply a board with lines drawn at the necessary angles) to set the angles we need. Our bevel board has only the angles used in a sack back chair. We find a lot fewer mistakes get made if the only angles on the board are the nine angles in this particular chair. A bevel board is great



Try square. An easy test to see if your square is indeed square is to place it on a proven straight edge and draw a line. Now flip the square so the handle is pointing in the opposite direction, and see if the tool confirms the line. If it doesn't, buy a new square.



Miter squares. Traditional miter squares resemble try squares, with a wooden handle secured at a 45° angle to the blade. A Japanese miter square has a raised foot that fits over the edge of a board, and a 45° blade at both ends.



Bevel squares. There are several types of bevel squares, all of which are handy for laying out angles, but also for measuring unknown angles.

for setting an angle, but would be impractical for reading an angle.

Here are a couple tips for using a bevel square. If you place the tool on its handle so as to measure an upright angle, be sure the end of the blade is not projecting from the handle. While you may have set the tool to the desired angle, the projection will lift the handle off the work surface and you will get an erroneous reading.

The bevel square's blade is adjustable and held in place by a locking mechanism. However, that mechanism does not create a positive lock. It only pinches the blade. Be aware that the blade can slip. If you bump the blade or drop the tool, always recheck it. The tool may very well have lost its setting.

We teach our students to collapse a bevel square when they are done with it. We call that position "the only safe bevel square." A bevel square still set to the last angle you used invites you to pick it up and use it in the wrong place.

Finally, be careful when using a bevel square. The ends of their blades are pointed and can you stab yourself if you are careless. I have witnessed some nasty puncture wounds made by a bevel square.

Marking Gauges

"Marking gauges" is actually a category of tools, which contains a number of slightly different tools that all look very similar. These gauges all consist of a bar with a sliding fence. In the end are one or two points for scribing. These points can be a small pointed steel rod, shaped like a sharpened pencil. They can also be a wheel, a double-sided knife, or a single knife with an end like a miniature striking knife.

The marking gauge is the simplest tool of this form. It has only one scribe in the end of its bar. Its purpose is to scribe a line at a uniform distance from another edge. That edge can be straight or curved. In joinery, a marking gauge is often for laying out the baseline for dovetails or tenon shoulders.

In shaping work a marking gauge is used to make a chamfer. "Chamfer" is a woodworking word for a bevel on the edge of a surface, such as the underside of a tabletop. To lay out a chamfer, run the gauge on the part's edge and on a wide surface. The wood between the two lines is removed and a uniform chamfer results. If you use the same setting for both lines, you will achieve a 45° chamfer.

A mortise gauge is a slightly different tool in that it has two scribing points. The one closest to the fence is adjustable. This can be accomplished in a number of ways, depending on the tool. I prefer one with an adjustment screw in the opposite end of the bar.

Some mortise gauges are adjusted by sliding a bar, which is then secured with a set screw. I do not find these easy to set up accurately.

A mortise gauge's purpose is just what its name implies. It is used for laying out the long edges of mortises, which are parallel. Although not mentioned in its name, the tool also lays out tenons. Laying out mortises and tenons is important whether you are cutting your joints by hand or by machine.

In using a mortise gauge, the setting between the scribes is the width of the mortise's opening. When cutting mortises by hand, I set this distance directly from the mortise chisel. I simply place the cutting edge against the fixed point and bring the adjustable point into contact with the other side of the blade.

If you are using a drill press or hollow chisels in a mortising machine, you can measure the setting with a small ruler, for example, 1/4", 3/8", etc.

The next step in setting up a mortise gauge is to adjust the fence. If your mortise is centered, this is easy. Subtract the width of the

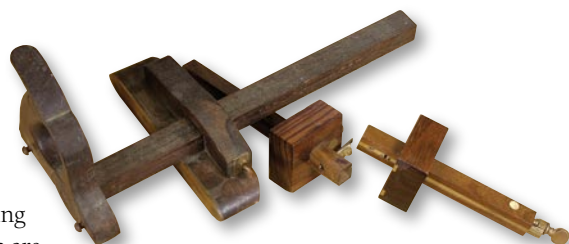
mortise from the thickness of the stock and divide by two. Use as an example a 1/4" mortise in 3/4" stock. The remaining 1/2", divided by two equals 1/4". Set the fence so there is 1/4" between it and the adjustable scribe. This will center your mortise on the stock.

If your mortise is offset, you have to determine the amount of offset and set your fence for the thicker wall, or the narrower one.

When laying out mortise-and-tenon joinery, use the same mortise-gauge setting for both parts of the joint. It is a good habit to always place the fence on the same side of the stock throughout the entire operation. Consider the example of making a table. Always run the fence on the outside edge of the apron and the outside surface of the leg. You can also use the inside edge. It does not matter which you choose – just be consistent. No matter how careful you are when setting up a marking gauge, you may be just a hair off. If you jump back and forth between surfaces, your work will be off by that difference.

To test the reasoning behind this advice, set your gauge and scribe a mortise on a test edge. Now, fence the gauge on the other side and scribe the mortise a second time. You will see the amount of offset.

While a mortise gauge will lay out the width of a mortise and the thickness of the



Marking gauges. Marking gauges all consist of a bar with a sliding fence, and have one or two points at the end for scribing.



Mortise gauge. If you hand cut mortises, a good trick is to set your mortise gauge to the width of your mortise chisel.



Slitting gauge. Although the slitting gauge looks a lot like a marking gauge, this gauge has a small knife mounted in the end of the bar.

accompanying tenon, completing the job will also require a try square, and perhaps a marking gauge for laying out the shoulders.

While I do not scribe the shoulders with a marking gauge, I do ensure uniformity by using a marking gauge to measure the tenon's length. I make a mark with the marking gauge and complete the shoulder with a try square.

A slitting gauge looks a lot like marking gauge. The difference is the point. A slitting gauge has a small knife mounted in the end of the bar. The tool's purpose is to slit (cut or score) thin stock. So, it is both a layout tool and a cutting tool. A slitting gauge is set up and used in the same manner as a marking gauge. If the stock is thin enough, the gauge will cut it cleanly. If the stock is a bit thicker than the tool can cut, you can do one of two things. You can break the stock free the same way you would break a perforated seam in a piece of cardboard. Flex the stock until it cracks along the slit.

The other trick is to flip the stock over and slit it on both sides. If it is still too thick to cut free, flex it until it snaps.

A panel gauge is a large marking gauge. Its purpose is to scribe a line parallel to a jointed edge. The stock is then cut along this line to create a panel, a piece of stock with two parallel edges. The table saw with its adjustable fence for ripping stock has made the panel gauge pretty much obsolete. However, if you prefer to work with handsaws, this is an important tool to own because it can scribe lines on very large workpieces for sawing.



Panel gauge. A panel gauge is simply a large marking gauge that is used to scribe a line parallel to a jointed edge.

Shapes

Three different tools are effective for laying out a circle. Which you use depends on the work. A compass is the tool we usually think of, as we all learned to use a compass in grade school. A compass has a pencil on the end of one leg and a point on the other. The circle's radius is established by turning an adjustment screw.

However, you can also use a pair of dividers to make a circle. A pair of dividers is a required chairmaking tool on our tool list. So many people called me and asked what a divider is and why we needed a pair of them, that I added the note in parentheses that a pair of dividers is like a pair of scissors. It is one tool. A pair of dividers is a tool very much like a compass, except that both legs are pointed. There is no pencil. So, when you make a circle with dividers, you have to scratch it into the wood's surface.



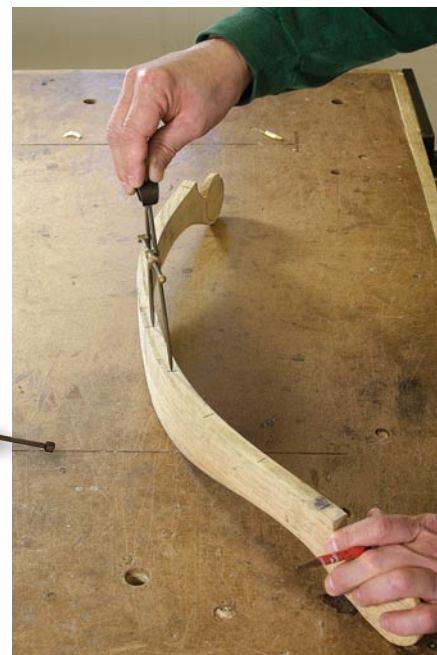
Dividers. These tools resemble a compass, except that both legs are pointed and there is no pencil. Dividers scribe rather than mark.

Dividers are also used for dividing a line or a shape into segments. An example would be to walk off a row of equally spaced holes or other locations. We use dividers for locating spindle holes in chair arms, bows and crests. In carving, dividers are used for such jobs as walking off the divisions in a shell, or for creating a polygon inside a circle.

Dividers are also effective for transferring measurements. For practical reasons this technique usually involves smaller measurements. It is particularly helpful in places that may be difficult or awkward to reach with a ruler. I set the dividers using my tape measure, then transfer the measurement to the work.

Unless your work is all of one size, you will want several pairs of dividers of different lengths. I own pairs all the way from several inches to a foot. There are two features I look for. I want needle-sharp points on the legs. The finer the point, the less of a mark it makes in the wood. Also, because needle points penetrate the wood easily, they are less likely to slip while I am doing layout.

When selecting a pair of dividers I insist on easy-to-use micro adjustment. Dividing a line or a shape often involves walking off many segments. Thus, adjustments have to be very fine; any increase or decrease will be multiplied each time the tool is walked. A clumsy adjustment can end up making the job frustrating; a fine adjustment makes it short work.



Location. Dividers are also used to divide a line or shape into segments to locate positions for spindle holes and more.



Trammel points. A pair of trammel points mounted on a wooden bar are used to lay out large circles. One point is pushed into the work-piece surface and remains stationary while the other swings on the bar and scribes a circle.

Large circles are easily laid out with a pair of trammel points. They differ from a pair of dividers in that you mount trammel points on a wooden bar. One point is pushed into the wood surface and remains stationary. The other swings on the bar, and it is used to score a circle. How big a circle you can make is a function of the bar's length. If you use trammel points a lot I would recommend keeping several bars of varying lengths. It is awkward to use a bar a lot longer than the circle's radius.

Dividers and trammel points will lay out circles. However, the ellipse is another common shape used in woodworking, especially for small tabletops. Laying out an ellipse requires another device. My ellipse maker is plastic and was purchased from a tool catalog. It is only one of numerous ellipse makers available to woodworkers.

An ellipse has two axes. So, when creating an ellipse it is necessary to establish both these lengths. By altering either axis you change the shape of the ellipse. On one extreme, you can make an oval that is almost a circle. On the other extreme, you can make long, narrow ellipses.

If you only need to make an ellipse once and don't want to invest in an ellipse maker, you can do it with nothing more complicated than two push pins, a string, and a pencil. Tie the string into a loop. You have to work out



Ellipse maker. This handy tool is available from a number of woodworking tool catalogs.



Shop-made ellipse maker. If you don't mark a lot of ellipses, consider making your own ellipse maker when needed with two push pins, a piece of string and a pencil.

the length of the loop and the pin locations through trial and error based on the major and minor axes. Loop the string around the two pins and pull it taut with the pencil. As you draw with the pencil, the loop of string will hold it in a path that forms an ellipse.

There are, of course, many other layout tools. Some are available in catalogs and some are shop-made. There are far too many for me to list. So, here is an example of several others that I use.



Dovetail marking gauge. This gauge has a 1:8 ratio on one edge, and a 1:6 ratio on the other. Others angles are available.

While a bevel square will lay out dovetails, a lot of woodworkers like to use a dovetail gauge. These usually look like a small square, only the edge of the blade is not set at a right angle. One edge is at an 1:8 ratio for softwood and the other at a 1:6 ratio for hardwoods. Once the baseline is made with a marking gauge or with a try square, the tails and pins are marked off with the dovetail gauge.

My other dovetail gauge is a bit different. It is two brass blades hinged in the middle. The edge on one blade is at the 1:6 ratio and on the other the 1:8. To use the gauge, I bend it to a right angle and lay the desired ratio on either the face or the end of the board, with the other blade over the other face or end.

I make my own layout tools for some special projects. I have a device I use for dividing a turned surface into horizontal segments: for example, reeds and flutes. It is nothing more complicated than a pencil held in a dowel, while the dowel is held in a flat base. The distance between the bottom of the base and the pencil is the same as the height of my lathe centers above the lathe bed.

I use the index head on my lathe to divide the turning into segments. Then, I slide the base along the ways with the pencil in contact with the turning. The pencil draws lines that lay out the segments. No matter the turning's shape, the pencil traces a line at the height of the lathe centers. **PW**

A chairmaker since 1971, Michael is the founder of The Windsor Institute in Hampton, N.H., where he teaches hundreds of students each year to build Windsor chairs. Visit thewindsorinstitute.com for more information and to read his blog.



Dividing a turned surface. I use this shop-made jig for laying out reeds and flutes on a turning. It's simply a pencil held in a dowel, with the dowel in a flat base.

RANDOM-ORBIT

These mid-size sanders take on the brunt of our sanding chores. Find out what sets them apart.

As we prepared to test random-orbit sanders, we considered the vast number of tools available. In order to make the test manageable, we decided to limit the test to variable-speed tools with 5" pads.

The reason for selecting tools with 5" pads is that most stores carry a wide variety of grits in that size. But why should you purchase a variable-speed sander versus a single-speed sander that costs a few dollars less? Where it helps, in our opinion, is when you have to deal with boards that aren't exactly flat, such as where you've worked a glue seam with a scraper and ended up with a slight valley on

the surface. A sander can move wildly as you traverse that valley. At high speeds the sander has the potential to "walk" and create sanding scratches that require additional attention. Slower speeds allow more control.

Next, we envisioned an article full of charts demonstrating how different these sanders are. But as testing began, we discovered that each sander does the job it is supposed to do. Each one sands a surface smooth and flat without leaving huge swirls.

What we found to be the most important aspects of these sanders were attributes that do differentiate the tools: How the tool fits your



SANDERS

BY GLEN D. HUEY

hand, whether the switch is easily accessible to most hands, and how easy the tool is to control. The other important issues are dust collection and whether or not the tool is aggressive.

A Five-minute Stock-removal Test

In order to test the tools' aggressiveness and dust collection, we ran the sanders through a simple five-minute test. Pieces of surfaced poplar were cut to the same size and weighed to three decimal places.

Then we sanded each board for five minutes using an identical, unused #120-grit sanding disc. (The Festool sander uses a Festool

disc due to the hole patterns.) When the five-minute cycle was complete, we weighed each board to find the amount of stock removed. At the same time we evaluated the dust collection of the sanders, noting any dust that was deposited on the tool, that was left on the board or was visible in the air.

A look at the amount of stock removed should also involve a study of the orbit diameter of each sander. That diameter influences the aggressiveness of the machine. For example, the Festool sander was the least aggressive at removing stock, and it has the smallest orbit diameter of the group. The Porter-Cable 390 is the most aggressive sander tested. It removed more than a half ounce of waste, but it didn't have the largest orbit diameter. That honor goes to Craftsman. The Craftsman

11218 sander ranked second in stock removal. A quick look at the chart on page 62 will give you an idea as to where each tool placed.

Dust Collection Design and Ability

We've all seen or experienced the canister or bag falling off a sander and a cloud of dust bellowing out. That's not good. So a study of dust collection has to begin with how the receptacle attaches to the sander.

Here we give kudos to the Ridgid R2600 because the bag is attached to a frame that's screwed to the body of the sander. There's no chance this receptacle would fall off.

The Porter-Cables, DeWalt and Milwaukee have either a canister or bag that twists and locks onto transition pieces that are attached to the sanders' bodies.

CONTINUED ON PAGE 62



HOW THE RANDOM-ORBIT SANDERS COMPARE

Bosch ROS20VSK

The sander gyrates when in use and feels wobbly to the hand. This action could become irritating after prolonged work. The dust receptacle is of a twist-off design utilizing a see-through canister. Dust collection is adequate with residual dust accumulating around the pad and at the bottom of the canister. This tool is set up to use a 1" hose for an external vacuum. Included with the kit is an adapter to use a 1½" hose. The speed-adjustment knob is located at the back of the handle making adjustment a two-handed effort and not accomplished on the fly. The sanding pad is dense for improved flat sanding, but contour sanding would be less effective.



877-267-2499
boschtools.com

Craftsman 11218

With the largest orbit diameter in the test, the Craftsman sander has a tendency to walk – as you move your hand pressure from side to side, the tool moves in that direction and that increases the likelihood of additional scratch marks as well as escalating sanding time. The dust collection cloth bag fits over a lightweight plastic frame and is attached to the sander with a press-fit. There is no O-ring or gasket to tighten that fit. As a result, there is a noticeable collection of sanding dust along the tool's base just above the pad, but the workpiece was mostly free from residual dust. This sander is aggressive and ranked second in stock removal. It is the least expensive tool in the test.



800-349-4358
sears.com

DeWalt D26453

Control of this sander was a bit jumpy as you extend past the edge of your workpiece, but was markedly smooth when sanding flat areas. The grip of the tool is comfortable and rated above average for the test, but additional rubber instead of a textured body would be beneficial. Dust collection is good with a small accumulation at the front of the tool. The cloth dust bag displays little residual dust on the outside, and the workpiece is clean too. A nice feature of this tool is the soft start that reduces the chances of your gouging the surface as you begin sanding. DeWalt has built-in a vacuum adapter for external vacuum use. Two hose coupling sizes are available by simply removing the bag.



800-433-9258
dewalt.com

Festool ETS 125

This sander is a fine finish sander that we would happily turn to if we needed a surface polished. Due to its small orbit diameter and its less aggressive stock removal, we wouldn't choose this tool for our everyday sanding requirements. This is a smooth running tool. The comfort while sanding, as well as the control, are top notch – rated the best of the sanders in our test – but one complaint is the lack of softer rubber on the tool's handle. Dust collection, without the use of an external vacuum, is better than average, but using paper bags as a dust collection-receptacle is something we would take a pass on. This sander is the most expensive in our test.



888-337-8600
festoolusa.com

Hitachi SV13YA

As you work, control of this sander is relatively smooth, although there is a bit of wobble. Our biggest concerns with the SV13YA are the on/off switch and the dust collection. We found the switch difficult to operate with a single finger. Hitachi could improve this tool by simply changing to a rocker-style switch. Dust collection rates at the bottom in our test primarily due to the cloth dust bag and the press-on fit of the bag's frame. Residual dust collects on the bag and on the tool and is evident on the workpiece as well. Also, the inability to connect an external vacuum to this tool in any way (due to the shape of the port) is cause for concern.



800-706-7337
hitachipowertools.com

Makita BO5012K

Control is good, but there is a slight vibration and gyration as you work with this sander. The oblong handle fits nicely into your palm, is easy to grip and is comfortable. Dust collection is a cloth bag affixed to a soft plastic transition piece. That transition piece slips onto the tool's dust port with a press-fit. Also, you have to position the bag correctly to keep the receptacle above the surface of the workpiece. Without the use of an adapter, which Makita sells but doesn't include in the kit, hookup to an external vacuum is not possible. The BO5012K has a soft sanding pad making it ideal for sanding contours and profiled mouldings. We wish the cord were longer.



800-462-5482
makita.com

Milwaukee 6021-21

We were pleasantly surprised with this sander. Control is fairly smooth on the flats and a bit grabby around the edges so it gets an average rating. The on/off switch is clearly marked and easily located while operating the tool. The dust collection is far better than many sanders in the test, but we did notice a fair amount of residual dust near the seams on the cloth bag. The dust receptacle twist-locks onto the transition piece and is easy to use. The bag itself slips over a spring that's attached to the transition piece. This entire assembly is securely affixed to the dust port. One oddity for me as I tested the tools was how the dust-collection assembly angles from the sander; it bumped into me at times.



800-729-3878
milwaukeetool.com

Porter-Cable 343SVK

We found this sander to be a little jumpy. Even on slower speed settings (that are easily adjusted with your thumb as you operate the tool) the sander runs with a jerky motion causing the tool to walk when you change hand pressure. Dust collection is an issue. The canister is tilted toward the sander, and spills dust back toward the dust port after a fair amount of sanding. Also, the canister is attached to a transition piece that is press-fit to the tool. There is an O-ring, but the improvement makes it only slightly better than the previous model. You can bypass these problems with an external vacuum – the 343SVK has built in adapters for two hose sizes.



888-848-5175
deltaportercable.com

Porter-Cable 390

This is a new design for Porter-Cable and it looks more like an air-powered sanding tool. It has a low profile that gives you the feel of increased control, but the Endura Tech motor must require a wider tool cap because this is the widest sander tested. Braking is excellent – once turned off, the tool stops quickly. The 390 sander is great at stock removal and is a good choice for flat surfaces. But, if you have to pick up the tool or hold it while you sand, be prepared. This tool has the same issues with the dust canister as does the 343SVK. In addition, we noticed more airborne sanding dust while using this tool.



888-848-5175
deltaportercable.com

Ridgid R2600

This sander rates second for overall control. The operation is smooth without any wobble or jerking motion. The soft-start feature is good, as is the braking, so gouging the surface is not a worry. The best feature of this sander is the method used to attach the dust-collection assembly to the body. A cloth bag is slipped over a sturdy plastic frame that is threaded onto the tool's dust port. The speed-adjustment knob is easily reached and dialed-in with your thumb. Make adjustments on the fly if you want. The amount of residual dust gathered on the bag was a bit more than we would have liked, but the overall amenities of this sander make it our winner – even if it does have a slide switch.



800-474-3443
ridgid.com



Not coming loose. By attaching the dust collection to the tool via screw threads, it's highly unlikely the dust bag will fall from the tool.



Dusty seams. Residual dust is all around the body and bag on this sander. If you see dust here, it's in the shop air too.

While Porter-Cable has shown improvements over its earlier models, the transition pieces simply press-fit over an O-ring gasket. The O-ring tightens the connection. The Porter-Cable 390 sander showed quite a bit of dust around the sides of the body just above the pad. We also noticed airborne dust while using this tool when we worked near edges.

DeWalt and Milwaukee each have transition pieces firmly affixed to the sander. The DeWalt sander showed a small amount of residual dust at the front of the tool just above

the pad, and the Milwaukee sander exhibited a large amount on the dust bag at the seams.

The Makita, Craftsman and Hitachi tools have other dust-collection issues.

The Makita sander has a bag twist-locked onto a transition piece, but the transition piece slides over a tube-like dust port and can easily be removed. There are no O-rings to tighten the fit.

The Craftsman sander has a frame that's holding a cloth bag, but the frame simply slides onto a 1 $\frac{3}{8}$ " tube-like port; again no O-ring.

The Hitachi sander has a loose-fitting bag affixed to a transition piece that slides onto the tool. Not only is there no gasket or O-ring, but due to the shape of the fitting, there's no method for hooking the sander directly to a vacuum (something other sanders have addressed. The Makita requires a separately purchased accessory). The dust collection was poor – dust gathered over the entire base of the tool and was concentrated where the bag meets the transition piece.

The Festool sander has a paper bag for dust collection. If you're a Festool user, you probably have an external vacuum. Without a vacuum, this sander ranks in the middle of the pack. And I don't think having to buy replacement paper bags is ideal.

A Sander in the Hand

Regardless of stock removal or dust collection, if a tool doesn't fit your hand you won't like it. And when it comes to sanding, who needs additional aggravation?

Each sander has a unique grip. The fit and feel depends on your hand size and how you grip the tool as you sand.

The sander with the smallest grip is the Festool ETS 125 (2 $\frac{11}{16}$ " across the top of the tool). One of our editors dinged the sander due to the lack of a softer rubber covering;

RANDOM-ORBIT SANDERS

	BOSCH	CRAFTSMAN	DEWALT	FESTOOL	HITACHI	MAKITA	MILWAUKEE	PORTER-CABLE
MODEL#	ROS20VSK	11218	D26453	ETS 125	SV13YA	BO5012K	6021-21	343SVK
Weight (lbs.)*	3.160	3.660	3.760	3.316	3.430	3.062	3.820	3.958
Decibel Level	94	96	99	95	99	97.5	98	100.5
Price	\$78	\$49.99	\$86.88	\$165	\$86.05	\$92.97	\$74	\$81.88
Dust Collection	Canister	Cloth bag	Cloth bag	Paper bag	Cloth bag	Cloth bag	Cloth bag	Canister
External DC Hookup	1 $\frac{1}{2}$ "	1 $\frac{3}{8}$ "	1", 1 $\frac{1}{2}$ "	1 $\frac{1}{8}$ "	NA	2 $\frac{1}{8}$ "	1 $\frac{1}{4}$ ", 2 $\frac{1}{4}$ "	1", 1 $\frac{1}{2}$ "
On/Off Switch	Sealed	Slide	Sealed	Open	Sealed**	Open	Sealed	Sealed**
Amps	2.2	2.8	3.0	1.67	2.0	2.0	3.0	3.0
Orbit Diameter	3/32"	5/32"	3/32"	5/64"	1/8"	1/8"	3/32"	3/32"
Stock Removed (ozs.)	0.352	0.496	0.384	0.192	0.352	0.352	0.416	0.416
Speed (OPM)	7,500-12,000	7,000-12,000	7,000-12,000	6,000-14,000	7,000-12,000	4,000-12,000	7,000-12,000	7,500-12,000
Cord Length	8'6"	8'5"	8'2"	13'3" †	8'	6'7"	12'	8'

* No dust collection attached; ** Internally sealed switch; † Detachable cord.

prolonged use would become uncomfortable. The Bosch ROS20SVK that measures 2⁷/₈" came in a close second to the Festool sander for smallest width, while the new low-profile Porter-Cable 390 sander has the widest grip. The top of this tool measures 3¹/₄" wide. The next widest grip is on the Craftsman sander.

Interestingly, we discovered that width across the top is not the sole determiner of comfort. In examining the sanders, it was the Milwaukee that stood out. The dust collection assembly turns slightly as it extends from the body of the sander. That bit of a twist caused the sander to poke some of us in the midsection while sanding (of course it depends on how you hold the sander).

Make the Switch

Most manufacturers have designed the sanders to turn on or off with a single finger via a rocker-style switch. All the tested sanders that utilize that switch have the control located at the front, top edge of the sander. There it's easily reached with your index finger.

Of all the sanders, only the Ridgid R2600 and the Craftsman 11218 use a switch that slides through the body. Until you get used to working with a switch like these, it's possible to accidentally turn the sander on or off while repositioning your grip. After a while,



A slight turn. The Milwaukee sander's dust collection bag has a bit of a turn as it meets the tool's body. It was just enough to cause me to adjust my stance and feel uncomfortable.

it becomes a non-issue. Also, smaller hands may have difficulty in reaching the switch without engaging a second hand.

One sander stepped beyond either of the two conventional switch designs. Hitachi uses a slide switch located like those with rocker-style switches. However, this switch is hard to use because it's small, stiff and slightly recessed into the tool's body.

Another concern when evaluating switches is whether the switch is sealed from dust exposure. Mounds of dust are created when sanding, and the more dust that gets into the switch, the less likely the switch will endure.

The DeWalt, Bosch and Milwaukee sanders have switches with a protective membrane. Engineers at Porter-Cable thought the membrane resulted in making the switch difficult to use, so they opted for an internally sealed switch. Hitachi also uses an internally sealed switch. However, to the untrained eye these switches appear to be of an open design.

Sand With Control

Control is determined by how the sander operates. The last thing you want is to have a tool be wobbly, grabby or jumpy. What can cause sanders to perform these unwanted moves? Some of the answer is in the orbit diameter and how aggressive the sander is, as discussed above. Other factors are inside the tool itself and can relate to the motor and gearing.

The smoothest in this category by far is the Festool. But if you study the chart you'll see the Festool sander has the smallest orbit diameter and it is the least aggressive in the group. According to Festool Product Manager Rick Bush, Festool designed the ETS 125 sander to



Difficult switch. The Hitachi switch is positioned front and center of the tool's top, but that good location couldn't offset the negatives of the small size and the harder-than-normal operation.

be a finish sander—a sander for smoothing a surface beyond #180- or #220-grit sanding. The company considers this sander to be a final step in sanding and polishing.

Behind Festool we selected the Ridgid R2600 when evaluating comfort. This sander has a larger orbit diameter and aggressively removes stock. There is no wobbling, so the sanding is very smooth.

Other sanders rated in the top five for smooth operation are the DeWalt, Milwaukee and Hitachi.

The Craftsman and Bosch sanders are the most difficult to control. We could expect that from the Craftsman due to the large orbit diameter, but we were a bit surprised at the Bosch. The ROS20SVK was more than wobbly—almost to the point of feeling unbalanced.

Small Attributes Add Up

Your purchase might be swayed by the little things. Does a longer cord length, lower decibel rating or overall tool weight enter into your equation? Use the information in the chart to reach a verdict.

The editor's choice is the Ridgid R2600. We like the smoothness of control when sanding and stock removal ranked in the top three. Dust collection is more than adequate and the dust receptacle is threaded onto the tool. And the price, although not the least expensive at \$69.97, is just more than the lowest price of all the sanders tested. **PW**

Glen is a senior editor of this magazine, a published author and the host of the Woodworker's Edge DVD series. Contact him at 513-531-2690 x 11293 or glen.huey@fwpubs.com.

PORTER-CABLE	RIDGID
390	R2600
3.094	3.896
96	96
\$129	\$69.97
Canister	Cloth bag
1", 1 ¹ / ₂ "	1 ³ / ₈ "
Sealed**	Slide
3.5	3.0
3/32"	3/32"
0.512	0.480
7,000-12,000	7,000-12,000
8'-0"	12'-3"

Taming Handplane **TEAR-OUT**

BY CHRISTOPHER SCHWARZ



One of the biggest frustrations is when the grain tears out instead of slicing clean.

Nothing in handplaning is more frustrating than tear-out – which is when the wood rips up in small chunks instead of being sliced clean away. Over the years, I’ve collected solutions to eliminate it and found the following ones to be the most useful.

No 1: The Answer is in the Branches

Whenever I’m working a booth at a wood-working show, there’s a fair chance that some power-tool-only woodworkers will give me some grief. Usually it starts with a few taunts during a handplaning demonstration (“Hey buddy where do you plug that thing in?”).

But I always relish the moments when they start to ask real questions. Here’s my favorite question (slightly edited to make it saucier):

“So Mr. Handplane guy,” they’d say. “Let’s say you have a hickory board that’s 8' long from a tree that grew on a hill. The board’s in wind, and it’s got a good crook in it as well. How would you flatten that board?”

“Oh that’s easy,” I’d reply. “I’d start with my broad axe.”

“Axe?” they’d say, confusion spreading across their brow.

“Yup, I’d chop the board into 12" lengths and feed them to the wood-burning stove.”

I know this sounds like Southern hyperbole (to which I am prone), but I’m serious when I say that the best way to reduce your tear-out problems (with both hand and machine tools) is through careful stock selection.

About seven years ago I worked with Sam Sherrill and Michael Romano on a project to encourage woodworkers to use lumber in their projects that woodworkers harvested from downed or doomed urban trees.

One of these projects was a large dining table that Sherrill had built using a gargantuan pin oak. The table was nice, but the story behind it was not.

The lumber for the table had come from the enormous, Jurassic-scale branches of the pin

oak. The boards were wide (like those from a bole) but they were still reaction wood. Branch wood. Junk wood.

When Sherrill and Romano went to dry the wood and surface it, the wood self-destructed. It warped, split, you name it. They told wild tales of how it exploded (yes, exploded) in the planer. They lost the majority of what they had cut, according to Sherrill.

That story sticks with me to this day. When I pick my boards for any project. I stay tuned to the grain of the boards at hand. If the grain reverses on itself through the plank a good deal, then I skip the board or saw it into short lengths, which might not give me trouble.

That sounds wasteful. But the most precious commodity in woodworking is not the wood, but the time we spend working (or butchering) it. You can make your work faster and easier just by being a lot more choosy.

No. 2: Look Sharp

For me, sharpening is like changing the oil in my car. It’s messy and time-consuming, but you do it regularly or disaster will befall you eventually.

So I’m not a sharpening fascist. I’m a good sharpener, but I don’t take more than five to 10 minutes to renew a micro-bevel. But I firmly believe that a sharp iron is the second best way to reduce tear-out when handplaning.

This belief guides me when I sharpen my tools and regulates the attention I pay to each tool’s edge. Here is what my typical sharpening chores look like in my shop:

For me, sharpening begins at the end of a project. With the piece of furniture complete and the deadline pressure off, I take a few



Everybody must get stoned. When I have some tear-out that I cannot tame, the first place I turn is my sharpening stones. A sharp iron greatly reduces tearing.

hours to sharpen my tools. I always sharpen the iron of my jointer, smoothing and block planes. If I used any chisels for more than a quick pare, I hone them. Then I move through the rest of the tool box. Any joinery planes (such as router, shoulder, fillister and plow planes) and moulding planes that I used get sharpened. I’ll also examine my marking knives, jack plane, auger bits and marking gauges. If they’re dull, I touch them up.

I do this at the conclusion of the project so when I start a new piece of furniture, everything is ready to go. Anal-retentive? Perhaps. But as I build the next project I don’t stop to sharpen unless I damage a tool by dropping it or hitting a nail, or my smoothing plane leaves tear-out.

If my other planes give me tear-out, I can usually wait it out. But tear-out at the smoothing stage of a project is a frustrating battle to fight. You can try a bunch of different strategies to eliminate the tear-out, but the first one should be to hone up your smoothing plane’s iron and try again.

Conventional wisdom has some solutions, but some of them might not help.

No. 3: Think Small

Most handplane geeks know that across the Pacific Ocean there is a culture that is even more obsessed than we are with the mechanics of cutting wood with a plane.

I'm speaking, of course, about the Japanese, who hold handplaning contests where competitors see who can make the longest and thinnest full-width shaving.

They measure the thickness of these champion shavings in microns. And the results are often affected by the weather. A wet day will swell the shavings by a few microns.

Sadly, Western woodworkers have become obsessed by creating ultra-thin shavings, which requires planes to be tuned to a very high note. What's wrong with this philosophy is that it focuses on the garbage instead of the good stuff. The shavings get thrown away, remember? It's the resulting work surface that we keep.

You want to be able to take the thickest shaving you can without tear-out, chatter or requiring you to bulk up like Conan the Barbarian. A thick shaving will get you done with fewer passes of the smoothing plane over your workpiece.

So how thick should your shaving be? Good question. Most people talk about getting shavings that are less than .002" thick. Or they talk about "sub-thou" shavings. Yes, it's all very empirical, except for the fact that few woodworkers really know how to measure

shaving thickness. Squeeze a dial caliper hard enough and you can make almost any shaving into a "sub-thou" shaving. Wood compresses. Metal bends.

So I go for visual cues instead.

If the wood is well-behaved, I go for an opaque shaving—that is, as long as the curvature of the cutting edge of my iron is significant enough to keep the corners of my iron from digging into my work. See the photo at bottom left to see what this shaving looks like. This shaving gets the work done fast. If the surface has been flattened by a jointer plane, a shaving like this will dress a surface for final finishing in one or two passes.

If I get tear-out with a beefy shaving, I retract the iron into the mouth of the handplane and extend it until the shaving looks like the photo at bottom center.

This shaving will clean up my surfaces in three of four passes. It usually eliminates tear-out more than the shaving above. But sometimes I need to get nuttier.

And that's when I push my tool to get a shaving like the one at bottom right. This thing is about to fall apart. In fact, it sometimes will fall apart when you remove it from the mouth. Usually, this sort of shaving requires a persnickety setup to achieve. I can't get this shaving with an Anant, new Stanley or Groz plane. They are just too coarse to tune to this high level. This is what you are paying your money for when you buy a premium tool. Pre-

mium tools will do this with little fettling. My vintage planes that I've fussed over will do this as well.

The downside to this shaving is that you will be making a lot of them to remove the tear-out on the board. About 10 cycles or more is typical for some small tear-out.

Can you get nuttier? Sure. If all else fails, I can set my plane to remove something between a shaving and dust. These "shavings" don't really look like much. How do you get them? That's easy. When I get my thinnest smoothing-plane shaving possible, I'll rub some paraffin on the sole of the tool. This actually reduces the depth of cut just enough to get the furry, dusty stuff. Beware: Taking a shaving that small will force you into a lot of work. Lots of passes.

But when you need it, you need it.

No. 4: Perfect Pitch

After taking a recent course in handwork, Rick Gayle, a reader and professional painter, visited our shop at the magazine and looked over some of the planes in my wall-hung toolbox. He reached up and pulled out the Veritas Bevel-Up Smoother Plane.

"This plane has made all other planes obsolete," Rick said. "Well, that's what my instructor said."

It's a strong statement to say that hundreds of years of handplane manufacturing have been eclipsed by one tool, but I know what



Thicker is faster. A substantial shaving such as this one reduces the number of passes you take, but it can increase your chances of getting tear-out.



A bit thinner. This shaving is about half the thickness of the thick one. Use this size shaving if you start to see tearing on the surface of your project.



Tissue stops tearing. Before I break out the sander I try cutting a shaving such as this one. It takes more passes than I like, but it is less likely to tear the grain.



Bevel-up can help. All three of these tools have their bevels facing up. This fact makes them easy to configure to a high angle of attack. It just takes a little sharpening.

Rick's instructor was getting at. When it comes to reducing tear-out, one of the most important weapons is the angle of the tool's cutter—a.k.a. the “angle of attack.” And no other tool gets you to a high planing angle as easily.

The higher the angle of attack, the less likely the wood fibers will lift up and tear out. Sounds good, right? What's the catch?

The only practical downside to a high angle of attack is that the tool is harder to push. And that's not too much of a factor when your shavings are tissue-thin. Plus, the high angle of attack works great with well-behaved hardwoods, too.

So what does the Veritas plane have to do with the angle of attack? After all, its cutter seems slung a lot lower than the cutter on a traditional plane. Well, the difference is that the Veritas (and some other block-plane-like tools such as the Lie-Nielsen No. 164) work with the cutter's bevel facing up, while traditional planes cut with the bevel facing down.

This makes a huge difference.

In a traditional plane with the bevel facing down, the angle of attack is almost always set by the frog (the casting that holds the cutter). In almost all vintage metal planes, this angle is 45° (new planes by Lie-Nielsen let you pick a 50° or 55° frog, however).

When you flip the cutter over, the angle the bevel is sharpened at comes into the equation when figuring out the angle of attack. Here's

how: The cutter in a bevel-up plane is usually bedded at 12° or 20° to the sole of the plane. Let's use 12° for our example. If you sharpen the cutter so it has a 30° microbevel on it, then you add the angle of the bed (12°) to the angle sharpened on your cutter (30°) to get the angle of attack (42°).

So this configuration would make a bevel-up plane behave much like a traditional bevel-down plane—or perhaps even a bit worse.

But if you sharpen the cutter at 45° instead of 30°, then the world changes. You add the 45° to the 12° and suddenly you have an angle of attack that is 57°—that's fairly steep. And you can achieve that angle (and remove it) with just one quick sharpening.

So what's the best angle of attack for gnarly woods? I've found that with almost all woods, tear-out tends to disappear with a 62° angle of attack—that means sharpening a 50° bevel on your cutter and putting it on a 12° bed in our example.

If you have a bevel-down plane, you get to this high angle by sharpening your iron with a knife edge, which is more work.

No. 5: Button Your Lip

I have held (and used) three of Karl Holtey's revolutionary No. 98 planes. The first thing you notice about these tools is that they are flawless. Holtey lavishes attention on his planes like Gollum on the Precious. Every

surface, inside and out, is perfect. Once you take that in, the next thing you notice is the non-adjustable mouth of the tool. It is, by most tool snob standards, big enough to drive a scrub plane shaving through. What gives?

To find out, I sharpened up two planes: My trusty Lie-Nielsen No. 4 with a 50° frog and a mouth aperture between .002" and .0025" wide. Then I sharpened up the Holtey so its angle of attack was also 50°. Then I took a board of nasty, surly Jatoba (it's almost as mean as coconut) and planed it with both tools. Then I turned that board around and planed it against the grain with both tools.

I know this board, and it's about as bad a board as I ever want to work. Most standard-pitch planes tear it out. But both the Holtey and the Lie-Nielsen cleaned it up with no problems—both with the grain and against the grain.

This little experiment calls into question the plane snob's obsession with tiny mouth apertures. (By the way, I'm the chapter president of the local plane snob club.) After planing that Jatoba, I had to ask myself: Do you need a fine mouth for high-tolerance work?

I think the answer is: It depends. I think tightening up the mouth aperture of your plane is just one of the weapons you have in your battle against tear-out. But I don't think it's the doomsday weapon.

The long-held theory about the plane's mouth is that a small aperture is preferred



A mini-mouth. Tightening up the mouth aperture of your plane can help in some cases, but you are likely to increase the chance of clogging up the works.

because it will press down the grain of the wood as the cutter slices it. If the mouth is tight, then the cutter will be unable to get under the grain and lever it up ahead of your cut, tearing out the grain. This sounds reasonable, but there's more to it.

The sometimes-forgotten problem with a fine aperture is that it makes your tool more likely to clog, especially if you have the chipbreaker set close. So a tight mouth is usually a time-consuming set-up, unless you have a smoothing plane dedicated to fine cuts.

I start closing up the mouth of a tool only when my other efforts fail: I've sharpened the iron, I've set it to take a fine cut, and I'm using the tool that has a high (62°) angle of attack. If all those efforts fail, then I'll weigh my choices: Tighten up the mouth and face some clogging issues, or get out the card scraper or sandpaper and call it a day.

No 6: Chipbreakers

If you follow the conventional wisdom for setting your chipbreaker, you might hate your handplane.

What's the conventional wisdom? According to Charles Holtzapffel's seminal 19th-century work on the cutting action of tools, you should set your smoothing plane's chipbreaker .02" from the cutting edge of your iron (other respected sources say to set it even closer) and to have an extremely tight mouth.

This, Holtzapffel says, prevents tear-out.

This, says your neighborhood editor, makes your plane choke.

So here's the problem:
If high planing angles
reduce tear-out,
and skewing a plane
reduces your angle
of attack, then how
can skewing the plane
reduce tear-out?

Chipbreakers can do more harm than good in a handplane. Whenever I'm having trouble with a plane (especially if the plane is choking or refuses to cut), the first place I look is the chipbreaker. Whenever I fettle a new or vintage handplane and the thing won't behave, the first thing I'll do is swap out its chipbreaker with another plane that has a working chipbreaker. In almost all cases, this solves my problem.

So what is the purpose of the chipbreaker? My cynical view is that it became widely used so toolmakers could use a cheap, thin steel cutter and reinforce it with an inexpensive iron or soft-steel plate. This is supported by the odd names given to chipbreakers. Some early sources call them cap irons, double irons, break irons or top irons. In other words, not

everyone agrees that they were designed to break chips.

Early planes had thick irons and didn't have chipbreakers, even during the age of mahogany, which is hard to plane well.

In my view, the chipbreaker's primary purpose in a modern plane is to mate with the tool's blade-adjustment mechanism and to aid in chip ejection. Oh, and it exists to frustrate you.

So in what position should you place your chipbreaker? I set mine back about $\frac{3}{32}$ " in a smoothing plane – sometimes even a little further back if the mouth is tight. All I'm really trying to do is to prevent clogging.

Which begs the question: Why did I list a chipbreaker as one of the ways to reduce tear-out? Well, I did mention one use for the chipbreaker in a modern Bailey-style plane – it mates with the tool's depth-adjustment mechanism. This mechanism allows you to easily set your tool to take the finest cut possible, which really will reduce tear-out.

No. 7: Skewing

I keep a list in my head of what I call "The Woodworking Mysteries" – things I pretend to understand but are outside my grasp.

One mystery is how a tree can pump water to the furthest reaches of its branches. There are many clues as to how it works, but a complete picture eludes me. Another mystery is about how yellow glue actually works. Again, I've never read a satisfying explanation.

A third mystery relates to handplanes and basic geometry. One common strategy for reducing tear-out in a board is to skew the plane as you make the cut. This strategy was beaten into my head by all my teachers both dead and living. It's repeated on the Internet by people I deeply respect and trust. And I do it myself in my work.

But if you do the math, you see how this strategy doesn't make much sense.

Let's start with a fact: The higher the angle of attack when you plane a board, the less likely you are to experience tear-out. Another fact: Skewing a plane in use reduces your angle of attack. Mike Dunbar, the founder of The Windsor Institute, explains this in the clearest way possible. When a shaving encounters a plane iron, the angle of attack is like a hill that the shaving has to walk up. If you walk straight up that 45° hill, that's a lot of work. When you skew the tool, it's like the shaving is walking up the hill at a lower angle. Or put another way, it's a bit like building a road up



Break-down at the chipbreaker. The chipbreaker is supposed to reduce tear-out, but if it is set too closely, it will clog your plane. When you have a problem with your tool, investigate the chipbreaker first.

a steep mountain. You don't make the road go straight up the mountain, you build switchbacks so the vehicles can actually make it up the incline. Skewing reduces the amount of work required – both to plane a board and to climb a hill.

How much does skewing reduce your angle of attack? Skewing a 45°-pitch handplane by 30° will reduce your effective angle of attack to 40.9° – that's significant.

So here's the problem: If high planing angles reduce tear-out, and skewing a plane reduces your angle of attack, then how can skewing the plane reduce tear-out?

Hint: The answer is in the branches.

To explore this seeming contradiction, I did a little experiment. I took a short piece of ash with pronounced grain direction – that is, there was no question about which way the grain was traveling in the board.

I cleaned up one face with a smoothing plane and then turned the board around so that I planed against the grain, which is when you are more likely to encounter tear-out. Then I planed the board with a bevel-up block plane. This plane is bedded at 12° and the iron is sharpened with a 35° micro-bevel, so its angle of attack is 47°. The mouth on the plane is wide open, so it's not much of a factor. The tool is set to take a shaving that is about .002" thick.

First I planed the board against the grain without skewing the tool. This cleaned up the board just fine with no tear-out. Then I skewed the tool by 30° (which lowered my effective planing angle to about 43°) and did the same operation. I tried skewing both to the left and to the right. Two areas of the board tore out grotesquely.

Then I cleaned up the board again and tried skewing the plane at 20°. Tear-out occurred at the same two places but not as badly. So I tried skewing the plane at a variety of angles. And without fail, the more I skewed the plane, the more tear-out occurred.

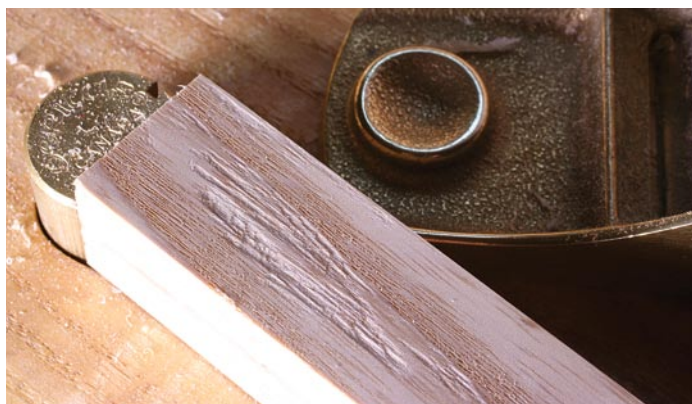
So how can skewing reduce tear-out?

You have to remember that trees are not manufactured items. They are giant cones made of fibers that grow in different directions as the tree responds to its environment: a hill, a disease, a wind storm. Then we slice them up into shapes suitable for building things, regardless of how the fibers are traveling through the tree.

In some boards, grain can change directions on you a couple times. And the grain can be at odd angles – you cannot assume that all



No skew. No tear-out. Planing with no skew resulted in no tear-out on this ash board.



Skewing and tear-ing. Planing with a 30° skew (both skewing left and skewing right) created this ugly patch of torn grain.



And at 20°. Planing at a 20° skew (both skewing left and skewing right) created a little tear-out.

your boards will have grain running from one end to the other – the grain may be traveling at a 20° direction along the face of the board and 10° along the edge. And the grain might be in the shape of a shallow wave.

So there are times when skewing the plane puts the edge in the right position at the right time to deal with that patch of grain.

In my example board above, the two places where the tear-out occurred were at places where the grain rose quickly. So how did I deal with this board? As I encountered the areas that tore out, I straightened out the tool – no skew. When I worked the areas that didn't tear out, I skewed the tool to reduce the effort required for planing.


So the trick with skewing takes us back to the No. 1 way to reduce tear-out: The best strategy is to select the best wood possible and learn to read the grain so you can begin to predict how your tools will behave. Sometimes, the best strategy is to not skew the tool.

Or put another way: Because grain is irregular, sometimes skewing the plane allows the blade to encounter the grain at a non-skewed angle – and to therefore you can plane it without tear-out. **PW**

Christopher is the editor of this magazine and the author of "Workbenches: From Design & Theory to Construction & Use." You can read more about traditional tools at his blog at LostArtPress.com.



Maximum detail. The finger joints in the Gamble dining room sideboard are exquisite. Subtle details transform a simple design into a superb work of art.



Looking beyond the surface
of Arts & Crafts furniture masterpieces.

Greene & Greene

Details and Joinery

BY DAVID MATHIAS AND ROBERT W. LANG

Everyone is familiar with some variation of the following wisdom: “The more you learn, the more there is to learn.” It’s probably very close to a universal truth. Certainly, it’s true of Greene & Greene furniture – the influences, details and construction hold many secrets.

The title of this article is “borrowed” from the Gamble house where, since March 2007, there are monthly “Details and Joinery Tours.” The lucky few on these tours get a chance to see inside (and under and behind) some of the furniture in that wonderful house. The experience is a revelation. And it raises more questions than it answers.

This article is the second in a three-part series on Greene & Greene design. In the first article we gave a broad overview of the style with emphasis on its evolution. In this second installment, we emphasize details and design elements of the furniture. The final article will demonstrate the Greene & Greene touch applied to cabinetry and doors, making utilitarian objects beautiful.

Influences

Charles Greene was a genius. Consider the sheer number of pieces he designed between 1907 and 1910. The volume of work is astounding, all the more so because many of these pieces could define a career. But genius doesn't exist in a vacuum. Charles and Henry were influenced by their training, by their contemporaries and by their predecessors.

Gustav Stickley's influence has been well chronicled. However, this was a jumping-off point for the Greens. They didn't publicly promote the political ideals of the Arts & Crafts movement. Nor were they strict adherents to the design philosophy. They did not, for example, completely eschew applied ornament (neither did Stickley, for that matter – consider Harvey Ellis' designs during his brief career with Stickley).

Clearly the Greens were attracted to the ideas of restrained use of decorative flourishes, honest joinery and utility. Whereas Stickley looked primarily to Europe, Charles Greene often looked to Asia for influence.

The Greens were likely exposed to Asian forms during their education, but in 1893 they had a rare opportunity to see them first-hand at the Columbian Exposition in Chicago. In 1904, Charles once again viewed Japanese designs when he visited the St. Louis World's Fair while working for Adelaide Tichenor. Clearly, he was affected by what he saw.

In some cases the influence is obvious. The exposed-timber construction in Greene & Greene homes is also common in Japanese temples. Also similar to Japanese architectural details are broad eaves (mirrored in wide overhangs on furniture). Less obvious is the scroll detail used to excellent effect in the Gamble and Blacker houses – a Chinese form.

Wood-trim details in the Thorsen house living room frieze resemble a well-known Japanese detail (kaerumata). One must wonder if this form, sometimes described as resembling a pitchfork, was intended as Neptune's trident given the nautical theme in the Thorsen living room. This may seem far-fetched but in a Greene design there are no accidents.

Details

The Greene & Greene design vocabulary is much richer and more varied than often thought. That many woodworking articles emphasize only the most common elements is at least partially to blame. Lifts and ebony pegs are beautiful and essential; they are, however, only a small part of the story.

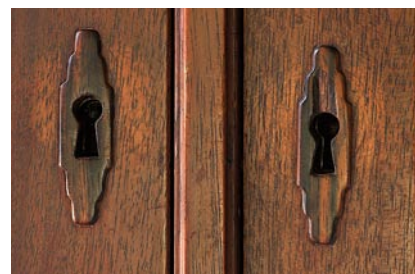
Influences



Beautiful built-in. This built-in bookcase in the Thorsen living room exhibits many beautiful details as does the architectural trim and the frieze.



The art of the drawer pull. Pulls on Thorsen living room drawers are elegant and functional.



Handmade hardware. Certainly, commercially available hardware would have been cheaper and simpler, but the Greens often designed theirs instead, as in these escutcheons.



Influence from the East. The Robinson arm chair, an exercise in understated grace, borrows heavily from Chinese design.



Fantastic floral inlays. Most Greene & Greene motifs borrow from nature. These inlays from the Gamble house guest bedroom are no exception.



Oriental influence and incredible detail. This bookcase from the Blacker house combines oriental motifs with astounding craftsmanship. The cloud scroll details in the upper corners are an excellent example, as are the tsuba shapes in the glass leading.



Additionally, many details appear in varied forms. In the Gamble house, the lifts on the entry table are quite different from those on the living room furniture. The Robinson house dining room wall cabinet has lifts that approximate half dovetails.

Even something as simple as an ebony peg appears in varied forms. Consider the tsuba-shaped pegs on the end of the drawer fronts of the Gamble library table pictured on the next page. The Ford house dining chairs include pegs that are somewhat irregular with concave sides. Those same chairs have long ebony vertical inlays on the back splats. There is always some new surprise.

Finger joints, another obvious element, are among the most striking details. They appear in furniture, built-ins and architectural trim with many variations. Often more beautiful than any dovetail joint, the finger joints are an example of how the Greenes were able to put their signature on existing forms, leaving no doubt about a piece's origin.

No less intriguing are a number of elements that have received far less attention. One favorite is the scroll detail from the Blacker house, highlighted in the first article in this series. Sometimes called "cloud scrolls" in Chinese furniture, the Greenes also used them more subtly. One instance is at the base of the stairs in the Gamble house. Another is in the carvings on the Thorsen library table pictured on the next page. In each case the result would have been beautiful without the extra ornament, but is more so with it.

Many other wonderful details appear in the Greenes' work that are not considered part of the core vocabulary. Shelves are stepped to provide both strength and a lighter feel; ebony pegs or pins are used to secure drawer dividers or align table leaves; subtle carving details mirror lifts; escutcheons are made of exotic woods. And the list goes on.

Construction

Greene & Greene furniture is relatively scarce; the opportunity to examine construction details is truly rare. Due to the kindness of numerous individuals, we've had unusual access to several pieces. Sincere thanks to those who have assisted us in our efforts.

The first thing one notices when examining the construction of this furniture is that it is quite well done. Despite their age, and in some cases neglect, the pieces are in very good condition. They are solid, with few signs of damage due to design or implementation.

Details



Everywhere you look. The problem with visiting these masterpieces is that beauty lies in every direction. Here is the Gamble living room, including the fireplace and inglenook.



Elements in one place. Variations in the vocabulary are endless. The elements in this Gamble library table appear in other forms elsewhere. Notice the tsuba-shaped pegs at the ends of the drawer fronts.



From furniture to architecture. Greene & Greene stairs typically share details found in nearby furniture. The ultimate bungalows, such as the Gamble house staircase pictured above, allowed for perfection of the form.



Cabinet in context. The Robinson dining room is recreated in the Huntington Library. Perhaps that house should be considered the first of the ultimate bungalows.

Details from joinery. Another example of variation, the lift forms on this reproduction of a Robinson dining room cabinet resemble a half dovetail.



Complex combination. The base of the Thorsen dining table is a mixture of exposed joinery and unexpected angles. Somehow it works.



Joints remain tight. There are few splits due to wood movement (though some do exist).

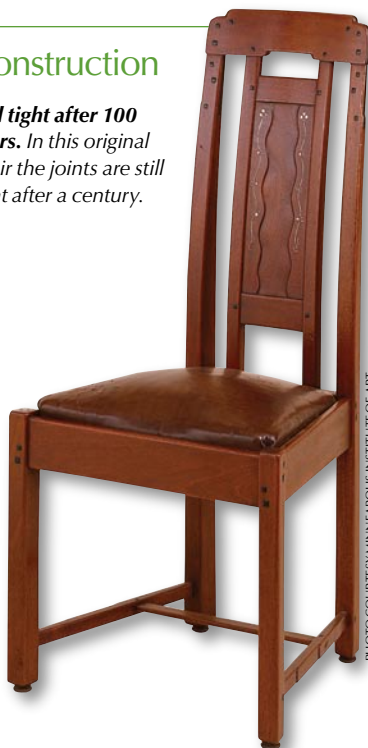
One notable construction feature is the housed mortise. Designed to conceal minor separation of the mortised-and-tenoned members, the housed mortise is a fussy joint to construct. In this joint, a shallow mortise is cut around the primary mortise. The shallow mortise accepts the entire shoulder of the

tenoned member. In other words, the joint is visible – the fit must be perfect. Amazingly, these joints were used not only in furniture but in architectural trim as well.

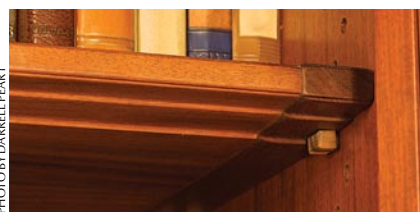
Drawers are well constructed with fantastic attention to detail, as in the example below from the Culbertson house. It's well-known that drawers were not dovetailed except for those in the Thorsen house. The locking joints

Construction

Still tight after 100 years. In this original chair the joints are still tight after a century.



Not your ordinary mortise. Here we see an example of a housed mortise, on a Blacker dining chair reproduction by Jim Ipekjian. The housed mortise was commonly employed in the Halls' shop.



Details without end. Even a bookshelf is given the full treatment. Continuing the edge detail into the breadboard end is a particularly nice touch.



Carved lift. Some details are unique. This carving detail on a Thorsen living room table is unlike any other in the Greenes' work. The table is believed to have been designed by Henry.



Perfect form. The Blacker living room armchair is a perfect design. The crest rail is a sculpture. The brackets and ebony splines are iconic.

Tradition and detail. Furniture from the Culbertson sisters' house (right) is a departure from the Greene & Greene norm. The forms may be more traditional but intricate detail dominates as always.

Beyond the surface. This drawer front (below), wrapped in ebony, displays trimmed brass screws. Along the bottom edge of the drawer, the screws are counter-sunk instead.



CONTINUED ON PAGE 76

used are strong and tight, not least due to being pinned. Drawer sides are shaped to provide support for the drawer as it is extended but decrease the likelihood of binding. Runners are stout and smooth, even a century later.

Dining tables extend in clever and often beautiful ways. While the Gamble and Robinson tables are likely the most spectacular examples, the Blacker table is also quite

impressive. Arms extend from each end of the table to support two leaves each. Each arm has a retractable ebony and brass indexing pin to hold the leaves in place. Only Charles or Henry could tell us why such effort was expended on a detail that only the servants would ever see.

Which brings us back to obsession – that devotion to even the most trivial design ele-

ments. It's part of what distinguishes great designs. It's part of the genius. It's part of the reason Greene & Greene still have a devoted audience after more than a century. **PW**

David is a woodworker in Columbus, Ohio, who spends his spare time teaching computer science at the Ohio State University. Bob is senior editor of this magazine and the author of "Shop Drawings for Greene & Greene Furniture" (Cambium Press).

Construction, CONT'D



Function with distinctive form. The extension mechanism for the Gamble dining table is a prime example of one of the Greenes' philosophies: Make useful objects beautiful.



Peg evolution. The Robinson dining table is a precursor to the Gamble dining table. Notice the use of round pegs – the change to square ebony pegs was not yet complete.



Attention to detail. Though a much more straightforward design than some other Greene & Greene dining tables, the Blacker table is quite pleasing. Small details make the piece.



View from the floor. A rare look at construction details helps demystify a design. Here the extension arms of the Blacker dining room table are revealed.

My Favorite Power Tool Accessories

Hand tools complement and complete work begun with power equipment.

Most folks I talk with in the woodworking hobby seem to follow a similar path. They start out by emulating what they see on television, which is of course, power tools. Eventually, whether through magazines, web sites, forums or local clubs, they hear other woodworkers raving about the virtues of hand tools. Not wanting to miss out on something great, they usually head out to the nearest hardware store and purchase their first plane, typically a bench plane or a small block plane.

Their first attempt at using the tool actually becomes a pivotal point in their development: a three-pronged fork in the beginning craftsman's path. Depending on their first impressions, the woodworkers are then subdivided into one of three camps.

First we have the power-tool users (affectionately termed "Normites" after one of the most popular power-tool users in existence, Norm Abram). These amperage addicts love their horsepower and scoff at the thought of cutting any type of joinery by hand.

Second, we have the hand-tool users (frequently referred to as "Neanderthals" due to their love of older, simpler tooling – not because they have large foreheads and bad posture). This calmer, gentler variety of woodworker enjoys the quiet and controlled interaction between human and wood.

The third category of woodworker is what I like to refer to as the "Hybrids." A hybrid woodworker approaches each project with the question, "Which tool will get the job done quickly and accurately?" Whether rated in rpm



I'm a "hybrid" woodworker. I refuse to choose hand tools over power tools, or vice versa. My ultimate goals are accuracy and efficiency. So in my shop, hand tools finish what power tools begin.

or the Rockwell scale, a tool is a tool. Power, tech specs and nostalgia take a back seat to the bigger picture: getting the job done. Generally speaking, my hybrid approach involves using a power tool as the primary workhorse and the hand tools for fine tuning. Here are some of my favorites.

No. 80 Cabinet Scraper for Panels

Gluing up flat panels is fundamental to doing quality woodworking. A jointer, planer and table saw take care of the milling process in short order. But, despite our best efforts, the joints between the boards are seldom completely flush, and they require some attention.

Once the glue is dry, I like to even things out with a No. 80 cabinet scraper. In most cases, three to five smooth strokes diagonally across the joint result in a smooth continuous

surface. If you need to remove more stock, simply turn the thumbscrew on the back of the scraper and more of the blade will be exposed, resulting in a more aggressive action. The wide base of the No. 80 scraper is perfect for



***Smoothing a panel.** A No. 80 cabinet scraper makes quick work of leveling the joints and smoothing the surface of this walnut panel.*

Online EXTRAS

To watch a video of The Wood Whisperer as he demonstrates these power tool accessories in his shop, go to:

popularwoodworking.com/oct08

this job as it stabilizes the tool and resists following small hills and valleys. And best of all, because you are scraping the surface, there is virtually no chance of tear-out.

Router Plane and Shoulder Plane

If you have a bunch of rabbets and dados to make, nothing can batch them out faster than a table saw outfitted with a dado stack. But one thing is for sure – the grooves you cut will rarely be the exact same depth across the entire board or panel. And the longer or wider the workpiece, the worse the problem gets.

Common causes of this phenomenon include bowed panels, uneven table saw surfaces and panels lifting as they are pushed over the dado stack. Regardless of the cause, there are two planes that come to your rescue every time: a router plane and a shoulder plane.

A router plane is perfect for cleaning up those dados. Simply set the L-shaped blade to the appropriate depth and push it through the dado. The first time I did this, I was amazed at how uneven the dado really was.

A shoulder plane is my preferred tool for cleaning up rabbets. The unique design of the shoulder plane allows the blade to glide right along the shoulder of the rabbet, yielding a smooth, crisp edge. And the long body of the plane provides a great reference surface that results in a smooth and true 90° rabbet.

Your extra effort will be rewarded with beautiful flat-bottomed dados, grooves and rabbets that provide a much better bond surface for an adjoining workpiece.

Flush-cut Saw for Dowels

Exposed dowels and screw plugs are trimmed quickly and easily using a flush-cut saw. The flexible, fine-tooth, zero-set blade allows you to reference off of the work itself without damaging the surface. I usually use one hand to press the blade against the work surface, while my other hand moves the saw back and forth. A light sanding afterward and you've got yourself a perfectly flush dowel or plug.

The flush-cut saw comes in handy for more than just trimming dowels and plugs. In fact, it's probably one of the most frequently used handsaws in my collection!

Tools to Fit Tenons

Using a power tool to cut tenons that perfectly fit a mortise can sometimes be tricky business. One slight over-adjustment and your tenon goes from a weensy-bit snug to



A router with no cord? A router plane is a great tool for finishing off uneven or rough dados and grooves.



A shoulder to lean on. The shoulder plane allows you to fine-tune the fit of your tenons, one wispy shaving at a time.

way too sloppy. Fortunately, this frustration is easily avoided. The trick is to intentionally mill your tenons slightly oversized, then use hand tools to finesse the fit. In most cases, I find that by the time I remove the milling marks left by power tools, the tenon's fit is just about perfect.

As an added bonus, there are a number of tools that can do this job effectively including rabbet, shoulder and block planes, and even a chisel. I find removing a paper-thin slice of wood at a time is the most satisfying and least frustrating way to sneak up on a perfect fit.

Chisels for Hinge Mortises

Whenever I mortise for hinges, the trim router is my “go-to” tool. Its light and nimble form gives me the control I need to create flat-bottomed mortises at a consistent depth. But a router bit only gets you so far. Because the bit is round, all of the corners are round. And unless you have the hands of a surgeon and the eyes of an eagle, you're going to want to stay a good distance away from your layout lines.

I find that the best way to take care of removing extra material is with a nice sharp chisel. I start by firmly chopping into my layout lines (which have been scribed with an X-Acto knife). Then, I remove the remainder of material by carefully paring it away, using the flat portion of the mortise as a reference surface. A few chops, a few swipes and your hinge should fit perfectly every time.



Feeling flush? A flush-cut saw is the perfect tool for trimming proud plugs and dowels without marring the surrounding surface.



A sharp chisel. A few taps with a chisel and a hammer produces nice crisp lines when making hinge mortises.

These are just a few examples of the many ways you can incorporate hand tools into a power-tool shop. In fact, we've only scratched the surface. The more I learn about hand tools, the more opportunity I see to incorporate them into my everyday power-tool routines. Of course, not everyone likes the hybrid concept. After all, there will always be Neanderthals and Normites duking it out for woodworking supremacy. As long as they're happy, who am I to criticize? But if your ultimate goal is to be as efficient and accurate as possible, you just can't beat the hybrid approach. By combining the old and the new, you will truly experience the best of both worlds. **PW**

Marc is a professional woodworker as well as the creator and host of *The Wood Whisperer* (thewoodwhisperer.com). *The Wood Whisperer* (an instructional Internet woodworking show) represents Marc's three passions: woodworking, technology and education.

About This Column

Our “Wood Whisperer” column features woodworking thoughts and ideas, along with shop techniques from Marc Spagnuolo. Each column has a corresponding video related to the techniques or views expressed in the column available at popularwoodworking.com/video.



Shellac and Sealing Wood

Clearing up the confusion.

Shellac was once the most widely used wood finish in the world. Now it's commonly promoted in woodworking magazines as a sealer, often as the “best” or “universal” sealer, even though virtually no cabinet shop or furniture factory, and very few professional woodworkers, use it in this way.

How did this happen? How was shellac transformed, actually diminished, from being the most popular finish in the world to becoming just a “sealer,” the first coat? And why is it that shellac is represented so positively as a sealer in amateur woodworking circles when virtually no large users of finishes think of it this way?

A Little History

From the 1820s until the 1920s, almost all furniture made in the United States (and in Europe) was finished with shellac. It was then replaced by nitrocellulose lacquer in factories because lacquer was cheaper and its drying can be controlled better with lacquer thinner, a very versatile solvent.

But shellac continued to be used extensively by painters finishing woodwork and floors, and by amateur woodworkers until the 1960s and '70s. If you are old enough, you surely used shellac as a finish in shop class in high school.

Four things happened in the 1960s and '70s that transformed shellac from a finish to a sealer:

- Polyurethane was introduced as a very durable “no wax” floor finish, and many people decided they wanted that durability on their woodwork, cabinets and furniture also.

- Homer Formby achieved success selling his thinned varnish, which he labeled and represented as tung oil, to amateur woodworkers.



Various shellacs. Shellac is available in orange (amber) and blonde (clear) colors. Orange shellac, whether already dissolved in a can or in flakes for you to dissolve, still contains its natural wax. Blonde is usually available either with wax (Bulls Eye Shellac) or without wax (Bulls Eye SealCoat) in its already dissolved form, and is always dewaxed in flake form.

- Fine Woodworking began promoting Watco Danish Oil, an oil/varnish blend, as an easy-to-apply wood finish for woodworkers.

- Zinsser “Bulls Eye,” the largest (now almost a monopoly) supplier of shellac, didn’t defend the finish for its quite adequate water-resistant qualities. Instead, the company, which specializes in sealers and primers, reduced the finish to a sealer in its marketing—even enlisting several prominent woodworking writers to help promote it in this way.

So shellac was replaced as a finish in the amateur woodworking community by polyurethane, various brands of thinned varnish (“wiping varnish”) and various brands of oil/varnish blend, all quite legitimate finishes in their own rights. Shellac became a sealer in the minds of most woodworkers.

What is a Sealer?

The first coat of any finish you apply to wood stops up the pores so the next coat doesn’t penetrate. It just bonds to the first coat. So this first coat is logically called the “sealer”

coat. Every finish can serve as a sealer if it is applied as the first coat.

There is no rule that says you can’t use one finish for the sealer and another for the topcoats (all the coats of finish applied over the sealer coat). But why would you do it? Why would you buy a second can of finish when the first can (the finish you intend to use for the topcoats) seals just fine?

There are two good reasons you might do this: to make sanding easier and faster, and to block off a problem in the wood. (There’s also a third reason for professionals using a catalyzed finish. They might use a special “vinyl” sealer for various reasons. But amateurs rarely use these finishes, so I’m not discussing vinyl sealers here.)

Easier Sanding

When you apply a coat of any finish to wood, fibers get raised and locked in place, which makes the surface feel rough. This roughness should be sanded smooth so additional coats go on smoothly.



Blocks problems. Shellac is extremely useful as a barrier against problems in wood that are commonly encountered when refinishing. This oak has a very bad case of silicone contamination, which causes fish eye (left). A sealer coat of shellac (right) “seals off” the silicone so a lacquer finish can be sprayed on top without problems.

But common alkyd varnish and nitrocellulose lacquer (not polyurethane varnish or water-based finish) are difficult to sand because they gum up the sandpaper. So manufacturers produce a special product called “sanding sealer,” which is the varnish or lacquer itself with soap-like lubricants included to make the finish powder when sanded.

The problem with sanding sealers is that they interfere with the bond of the finish to the wood, actually weakening it. You’re better off not using a sanding sealer unless you’re finishing a very large project (for example, a set of kitchen cabinets) and don’t want to fight the sandpaper constantly gumming up.

There’s a good way around using sanding sealer, anyway. You can thin the first coat of finish half with the proper thinner (mineral spirits for varnish or lacquer thinner for lacquer). This thinned finish coat will dry harder more quickly because it is thinner on the wood. It will be easier to sand smooth than a full coat of finish.



Sanding sealer. Sanding sealers, which powder when sanded as shown above, are available for varnish and lacquer because these finishes gum up sandpaper when sanded.

Problems in the Wood

Shellac becomes useful when there’s something in the wood you want to block off because it interferes with the drying or leveling of the finish, or produces an unpleasant odor. In fact, no finish is as effective at blocking off problems as shellac.

But if you build furniture or cabinets, you rarely have problems you need to block off. Almost all the problems for which shellac is useful occur when refinishing previously finished wood.

Refinishing problems include fish eye (the finish bunching up in ridges) caused by silicone oil from furniture polishes having penetrated into the wood, poor bonding due to residual wax from paint strippers, and odors from smoke or animal urine. Professional refinishers often use shellac routinely as a barrier coat to overcome these problems.

The only common problem you might experience finishing new wood is getting varnish or lacquer to dry over the resin in pine knots. Shellac will seal off this resin so that you can apply these finishes without problems. Resin problems don’t exist in common hardwoods.

Not only is shellac rarely helpful as a sealer on freshly milled hardwoods, it’s also more difficult to sand than sanding sealer because it has a tendency to gum up sandpaper—especially if the shellac hasn’t fully hardened.

Furthermore, unless you use the special dewaxed shellac, called SealCoat (which isn’t available everywhere), or dissolve your own dewaxed shellac from flakes, you run the risk of the finish wrinkling or not bonding well because clear and amber Bulls Eye shellacs contain wax and have a short shelf life.

Why would you use shellac as a sealer if you don’t have a good reason to?



Gums up sandpaper. All types of shellac tend to gum up sandpaper, especially if the shellac hasn’t fully hardened. So there’s no reason to use shellac as a sealer if your goal is easy sanding.



Shellac as finish. Shellac is an excellent wood finish. As an example, consider this 125-year-old Eastlake Victorian chest of drawers. Its original shellac finish has dulled some but is otherwise in excellent condition.

Other Reasons?

Other arguments sometimes given for using shellac as a sealer, and the reasons they don’t apply, include the following:

- Reduce grain raising under water-based finishes. (Shellac will do this, but so will varnish and lacquer and all three will introduce yellowing, which you may not want. Water-based finish isn’t difficult to sand anyway.)

- Prevent dye bleeding. (Non-grain-raising dyes such as Solarlux and Transtint don’t bleed significantly into any finish. Alcohol-soluble dyes bleed into shellac. Water-soluble dyes bleed into water-based finish, so shellac could be used to block the bleeding. But so could varnish or lacquer.)

- Improve moisture resistance. (All other film-building finishes are at least equivalent to shellac at providing a moisture barrier.)

- Improve adhesion. (Finishes generally bond best to themselves. There’s always risk in applying one type of finish over another.)

I’m not against using shellac as a sealer coat under another finish. I just don’t see why you would use it when finishing freshly milled hardwoods. I can only see downsides. **PW**

Bob is the author of “Understanding Wood Finishing” and a contributing editor to Popular Woodworking.

Et tu, Brute?

But a small cut may lead to thoughts of treason.

I already have more lumber than I can use. However, I cannot seem to resist acquiring new trophy pieces. My dilemma comes from the fact I do not feel qualified to use any of my prize pieces in my work. Each time I pick up one of my “special” boards I am washed with a wave of self-doubt that echoes in my ears the message of unworthiness.

I have wide Gaboon ebony. I won’t tell you how I got it; don’t even ask. Let’s just agree that I have three pieces of Gaboon ebony. Each is 10" to 13" wide and 48" long. They have the beautiful half inch of contrasting sapwood and natural edges.

It is some of the legendary Missionary Wood. You know the story. A missionary went to Africa in the 1950s. He built a church in a village, and the people wanted to pay him back. So they gave him a bunch of Gaboon ebony that they waxed and cut down to 48" per piece (just the right size to fit in a 55-gallon drum). It sat in the missionary’s woodshop for 50 years. I was told the story by a man full of sincerity, but I couldn’t bring myself to believe the legend. I wanted to believe it, but I resisted. It didn’t matter if the story was true. The boards were beautiful, I wanted them, and I jumped at the chance to buy them. They have sat on the top level of my lumber rack for two years. I never felt worthy of them.

I made arguments for using them: Life is too short. Wood is a renewable resource. Use them, and you will find something else to replace them.

I made arguments against touching them: I am not experienced enough. My project is

not deserving of wood this nice. As soon as I cut them, I’ll find a project significantly better to use them on.

I waffled for two years. Occasionally, I would show them off and get stupid offers like, “Can you let me cut a 1/2" off of one of them that I can use for inlay?” (Some people don’t get it.) I resisted touching them.

Finally, I felt the time had come to break the seal. If I just cut off a small piece of one board it

would allow me to find clarity. I knew one cut would allow me to see them as just wood.

It would be a pen. It would be a teacher’s pen. After waiting for years, I would finally cut one of the boards to get a small piece of Gaboon ebony to use on a pen for a math teacher friend.

I set the board on my bench with one end overhanging. I clamped it down. I hooked up my Festool vacuum to my jigsaw. I looked toward the bench. With the first step, my apron turned into a toga. With my second step, the jigsaw became a dagger. As I hit the switch, the vacuum roared and became the sound of the Senatorial mob. The Gaboon ebony plank cried out, “Et tu, Brute?!” and I started the cut.

It was over quickly, and as I held the two cubic inches of ebony in my hand, I looked around. There was no mob. I again wore my shop apron, and my hand held a jigsaw. There was no bloody dagger, but there was a wounded friend in front of me. What had I done? It was just a tiny little biopsy. I had made the cut between end checks. Deep down, I knew it was a very prudent use of the wood.

I put the planks back on the top shelf, and I made my friend a pen. It was just a tiny piece of ebony and it was outside the board’s usable area for any future furniture project. But I was wrong when I thought the cut would make me think of those boards as being “just wood.” **PW**

Jeff designs car parts for a living, but spends a lot of time writing his new blog at jeffskiver.blogspot.com. In his spare time, he heads for the woodshop.

