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APRIL 2005
ISSUE #147

POPULAR Woodworking

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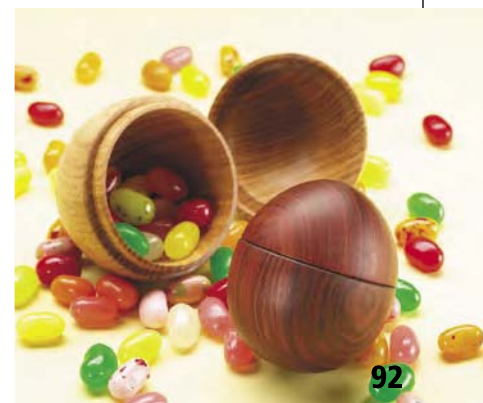
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ON THE COVER

Our ingenious router table clamps into your bench vise and stores easily. Inexpensive and quick to build, this is superior to many commercial versions.

Cover photo by Al Parrish

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Forget the pricey commercial ones that hog precious shop space. This inexpensive, quick-to-build router table clamps into your bench vise and stores easily.

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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.

On Making Chairs & Exploring Mysteries

It was a crazy idea, so crazy it just might work. Instead of attending a woodworking class out of town we'd bring the instructor here.

Call it a busman's holiday – as if we don't see enough of one another, have enough to do or get in enough woodworking – but a couple phone calls later and all the arrangements were made. Don Weber, a traditional woodworker, chairmaker and great guy agreed to come to our shop to spend four days showing us how to build Welsh stick chairs.

Never mind that it's supposed to be a five-day class, we'd get it done in four. We're used to working fast!

We thought the class, which required the use of hand tools primarily, would be a good way to explore making stick chairs, a craft that is experiencing an amazing renaissance in the United States. It was a great exercise and enjoyable for reasons we didn't foresee. (We did, however, accurately predict how much we'd enjoy plying Mr. Weber, a Welshman, with pints of stout in the evenings.)

Here's a short list of other reasons the four days were so enjoyable:

We steam bent the chair arms, a process I'd never undertaken. Many of us used tools and materials unfamiliar to us. I'd never used a trapping plane or rounding plane to taper chair spindles. The chairmaker's devil, travisher and concave spokeshave were other new tools. We got to work with elm to make the seat, and I discovered the amazing strength that comes from its cross-linked grain.

I also learned how stress-free a class project can be. All I had to do was follow Weber's instructions. Unlike most projects I've built, the planning and problem-solving weren't my responsibility.

It was very interesting to observe how each student tackled certain aspects of the building

process in his or her own way. Even though we were all building the same chair, each builder called on his or her own experience to approach the various challenges. In some respects, you could almost do a psychological profile based on the differences.

Taking the class was a terrific idea and I'd encourage all of you to enroll in a class in the near future. To aid your search, see the school directory on page 91. It lists some of the best schools in North America.

New Column: Arts & Mysteries

This issue inaugurates a new column that I think you'll find intriguing. It's called "Arts & Mysteries," and it explores the lost or almost-lost techniques of 18th century woodworkers, who produced breathtaking work at breakneck speed.

The column is written by Adam Cherubini, an aircraft designer from New Jersey, who has spent years researching early woodworking techniques and putting them into practice in his own shop and as a volunteer in the joiner's shop at Pennsbury Manor, a recreation of the country home of William Penn, the founder of the state of Pennsylvania and a Quaker.

Cherubini argues that there is much that we can learn from our 18th century counterparts – if we can only figure out how they worked. After reading his first column on page 32, I think you'll agree with him. **PW**

Steve Shanessy

Steve Shanessy
Editor & Publisher



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SCOTT GIBSON

One Christmas about 25 years ago Scott Gibson's father gave him the parts of a cherry Hepplewhite table – the legs, aprons and top. None of the joinery was cut. Scott



wasn't sure what to do with the gift. His father, a Windsor chairmaker and carver said, "You'll figure it out." Scott, then a newspaper reporter and editor, did. The project became one of

many. For 25 years Scott has effectively wedded furniture-making and his journalism career. He began working for magazines and was editor of *Fine Woodworking* for three years. Now a freelance writer, editor and photographer, he often can be found in his woodshop in Steep Falls, Maine. His story, "Total Shop in a Box," begins on page 57.

ERIC HEDBERG

Eric Hedberg couldn't help but quit his mechanical engineering gig to build furniture and restore old houses. Woodworking is in his blood. A descendant of a long



line of woodcarvers and shipbuilders, Eric began inheriting old family tools when he realized his right brain was thirsty for stimulation. Today he satisfies both sides of his brain

through technologically challenging projects that require an artistic touch, such as building an orchestrion (think player piano with drums, cymbals, etc.) for a children's museum, traditional wooden sleds for his sons, and chairs. Eric, who lives in St. Paul, Minn., contributed to "Cheating at Chairmaking," which begins on page 62.

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Show the Original Design You Altered

Showing a Photograph of the Source Of Your Design Would Assist Readers

Thank you for the December 2004 issue – I enjoyed it all, and the “Shaker-inspired Bench” is just beautiful. I’m sorry to write you one letter on two issues but here goes:

When an article’s writer modifies a classic design such as the Shaker bench, could you also publish the photograph of the original item? I would like to make a bench the original 94” long. I also would like to see the unmodified corbel detail for myself.

Also, I read with interest of your enthusiasm for spiral cutterheads with carbide inserts. I have read elsewhere that carbide cutters will harden the surface of wood as they cut, while high-speed steel cutters tend to leave the surface of the wood more amenable to sanding. Is there any truth in this?

Dick Marlow
Huntsville, Texas

The original bench is shown in Christian Becksvoort’s “The Shaker Legacy” (The Taunton Press) on pages 130 and 131. He refers to it as courtesy of the Metropolitan Museum of Art (metmuseum.org). We couldn’t publish the photo because of space and copyright issues.

As to carbide cutterheads, I don’t see how they could harden the surface of the wood. High-speed steel can theoretically be ground to a sharper edge, leaving a smoother cut, but once you have run a few boards over the knives the edges would be about the same. I haven’t noticed any difference in “sandability” of pieces surfaced by our jointer, and can’t think of any good reason to go back to a standard three-knife head. The spiral head gives a much better surface, especially on figured wood, and it is much quieter and easier to use.

— Robert W. Lang, senior editor

Avoiding the Phantoms of Shop Class

In 1944, I was a very excited boy of 11 when I reached grade six and learned that I was to

take a woodworking class for a whole afternoon once a week. Each boy was assigned a junior-sized workbench beautifully made of maple and fully equipped with hand tools.

During the war, there were no men available, so women taught woodworking courses. Our teacher was very strict. I guess she had to be strict in order to keep control of 15 boys who were 11 years old. We were told right off that there would be no horseplay in her class.

Woodworking was my favorite course. It was not boring like geography or history lessons. We were given the wood we needed for the simple projects we would build in the class. I loved the aroma of the room where the beautiful wood was kept.

One day as I finished planing a piece of wood, I placed the plane on my bench. As I let go of the plane, a 3’-long pointer came down swiftly across my hand. I recoiled in pain and horror. As I backed away, the teacher poked the pointer into my body repeatedly to emphasize each of the following words: “Never lay your plane down on its blade!”

I really do owe that teacher a great deal for introducing me to the joys of woodworking. I think of her every time I place my plane on its side on my bench.

continued on page 12

WRITE TO US

Popular Woodworking welcomes letters from readers with comments about the magazine or woodworking in general. We try to respond to all correspondence. Published letters may be edited for length or style. All letters become the property of *Popular Woodworking*. How to send your letter:

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LETTERS

continued from page 10

So go right ahead Mr. Schwarz, lay your plane down on its sole ("Hand Plane Cabinet" October 2004). But don't think you are going to change my habits. No sir, not me! Although I don't believe in ghosts, I'm not going to take a chance on some phantom with a 3' pointer whacking me across these now-arthritis hands. No way. I'm going to continue treating my planes as I have for the past 60 years and lay them on their sides.

Roy Oram
Pender Island, British Columbia

How Thick Should I Have The Sawmill Cut Green Wood Before Drying?

I have been a hobbyist woodworker for about 20 years. I have always bought kiln-dried lumber from a local dealer.

But I am going to try my hand at solar-kiln drying. I have built a small kiln that holds about 500 board feet and I am having a portable sawmill cut some green lumber.

I don't know what thickness to tell him to cut. I plan to air-dry it and then kiln-dry it to about 8 percent. I want to end up with $3/4$ " lumber after planing.

Should I tell the sawmill operator to cut the green lumber to $5/4$ thickness? And can I mix these different woods in the same stack when air-drying the lumber?

Ken Kindle
via the internet

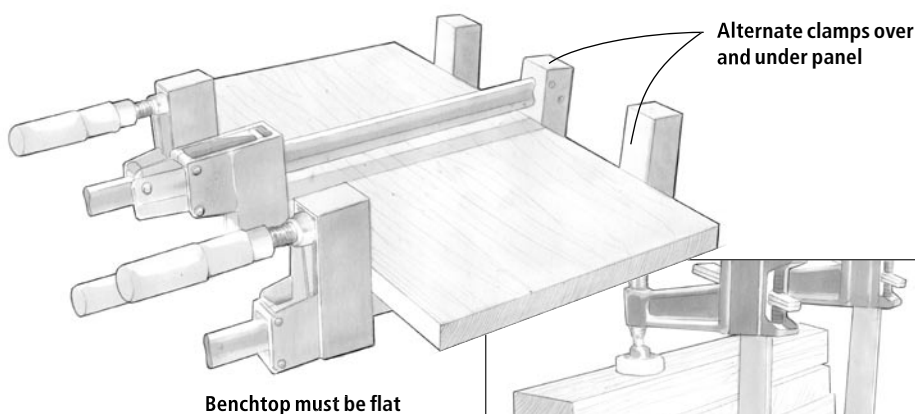
Personally I'd shoot for $5/4$. More often than not when I purchase $4/4$ lumber (even from a mill) the defects in the wood have me losing about 15 percent of the board.

Plus, this is your first time out with your kiln. Once you get your first few batches dry, you'll know what sort of shrinkage and warping you can expect with the species, your kiln and your drying technique. And yes, you can mix species in an air-drying stack.

For more information on harvesting your own lumber, I recommend you check out the book "Harvesting Urban Timber: A Complete Guide" by Samuel B. Sherrill (Linden Publishing). The book walks you through the entire process of harvesting lumber at home, from finding the trees, to moving the wood, having it properly cut and how to season it. PW

— David Thiel, senior editor

Clamping Strategies For Flat Panels



Are There Tricks to Gluing up Panels So They End Up Flat?

What is the best way to edge-glue wood to make medium to large panels? Are there special clamps that you use? I can't make the parts all come to the same height or I end up with a bow in the panel.

Any help or advice you can give on tools, clamps or anything would be a big help.

*Paul Cantrell
via the Internet*

Probably the most important thing is to be sure that the surface you are working on is flat. I find it effective to rip some strips of scrap wood about 1 1/2" wide, and a few inches longer than the finished panel's width. I place these every 12" to 16", and lay the parts for the panel on them. This way you can easily place clamps both over and under the panel. If all of your clamps are on one side of the panel only, the pressure from the clamps can cause the panel to bend. You also might want to try clamping two straight boards across each end, sandwiching the panel between, to keep the panels flat. Once you have your clamps across the board fairly tight, you can take a rubber mallet and smack the boards into alignment. Just about any variety of bar clamp can produce good work; the more expensive parallel-jaw clamps make it easier to keep things flat as you apply pressure.

— Robert W. Lang, senior editor

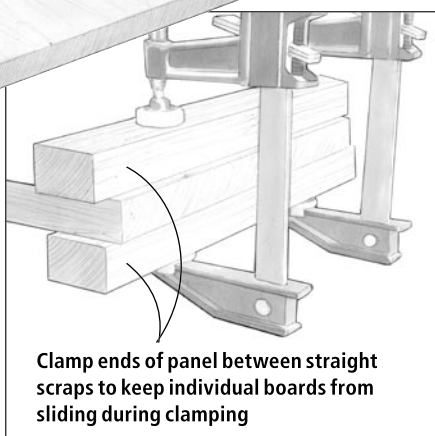


Illustration by Hayes Shanessy

Finding a Workbench Plan And Southern Yellow Pine

The cabinet on the cover of issue 145 ("Arts & Crafts Tool Cabinet" December 2004) has been added to my "will do" list.

However, the workbench below it also

continued on page 16

WRITE TO US

Every day we get questions from readers on all subjects about their woodworking. Some are letters; many are e-mail messages. 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. In addition to the hundreds we answer privately every month, we want to share the best questions here with readers.

Send your questions via e-mail to popwood@fwpubs.com, or by mail to:

Q&A • Popular Woodworking
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caught my eye. I can't remember if that workbench was the subject of an article or not. Can you help me out? And where would I find some decent yellow pine to build it?

Terry Falknor
West Milton, Ohio

The workbench is our "\$175 Workbench," which was published in the February 2001 issue (#120). Because that back issue is no longer available, we have made the plan available for free on our web site. Visit popwood.com and click on the "Free Project Plans" link.

The only major alterations I have made to the bench include replacing the wooden-jawed vise with a traditional metal-jawed face vise and cutting the legs so the bench is 34" high.

To find Southern yellow pine, your best bet is to visit the Southern Pine Council's web site at southernpine.com. The site has a "product locator" that allows you to search for dealers by state. Southern pine isn't for sale everywhere, but it's more widely available than most suspect.

Also, when choosing your boards for the project, you'll find the wider and longer boards are the clearest and straightest. There's more ripping involved, but the extra effort is worth it because the stock is vastly superior.

—Christopher Schwarz, executive editor

Should Plywood and Solid Wood Be Stored Flat or On Edge?

I have some plywood that is standing up against an 8'-high wall. I also have some that is lying flat. Both of them seem to develop a curl to them after awhile. Is there a right and wrong way to store plywood? If so what is the best way to store it?

How about storing dry hardwood lumber? Does it matter how it is stored? I was going to build a compartment that could organize and store my hardwoods standing on end. Some of the lumber is 8' long.

Guy LaRochelle
Zenon Park, Saskatchewan

I've found that plywood—especially the thinner varieties—tends to curl no matter what you do. Perhaps it's because of uneven moisture exchange or perhaps the wood used in the core is drying unevenly. Many times the curl will correct itself if air can circulate all around the panel. Our local lumberyard stores plywood flat in the warehouse, and the weight of the material keeps the pieces flat.

Then they put it in the showroom on edge so you can flip through it and select what you need.

Because of this tendency of the material to curl (and because plywood takes up so much space) I purchase plywood right as I begin a project and then work quickly with it so it doesn't curl up during construction. So my way around the storage problem is to not store it.

For dry hardwoods, either storage method is commonly employed. If you have a basement shop, you might want to avoid storing the lumber on end. Basement floors can get a little damp.

—Christopher Schwarz, executive editor

How Do You Flatten a Panel With Hand Planes?

On a couple of recent projects my glued-up panels have been slightly bowed (probably from poor clamping technique). I've used a well tuned No. 4 smoothing plane to level them out, but I'm wondering if a jack plane or a jointer plane would do a better (and quicker) job. I've also considered getting a belt sander for this task. What is the best approach?

Robert Barron
Madison, Alabama

I find belt sanders too aggressive and they require great skill to wield accurately. I tend to use hand tools because I find it more enjoyable and less prone to error (though it may actually be a bit slower). Here's my technique: I use a jack plane and jointer plane plus winding sticks—perfectly straight pieces of wood that allow me to sight down the panel and see any warp, bow or twist.

Once I identify the problem areas, I mark off the high spots with chalk and then knock them down with my jack plane. On a jack plane the iron should be cambered with a fingernail shape and the cut should be pretty rank. You want to remove material quickly.

Once the panel looks flat, I turn to my jointer plane. It has a slightly cambered iron and takes a finer cut. Take passes at 45° all the way across the face one way and then 45° the other way. Don't worry about tear-out. This process just gets the panel flat. Check your work with your winding sticks. Once the panel is flat, come back with your jointer plane and take a few passes with the grain to clean up the diagonal marks.

Now you're ready for either sanding, scraping or smoothing with a No. 4 plane, whatever you do to get your panel ready for finishing. **PW**

—Christopher Schwarz, executive editor

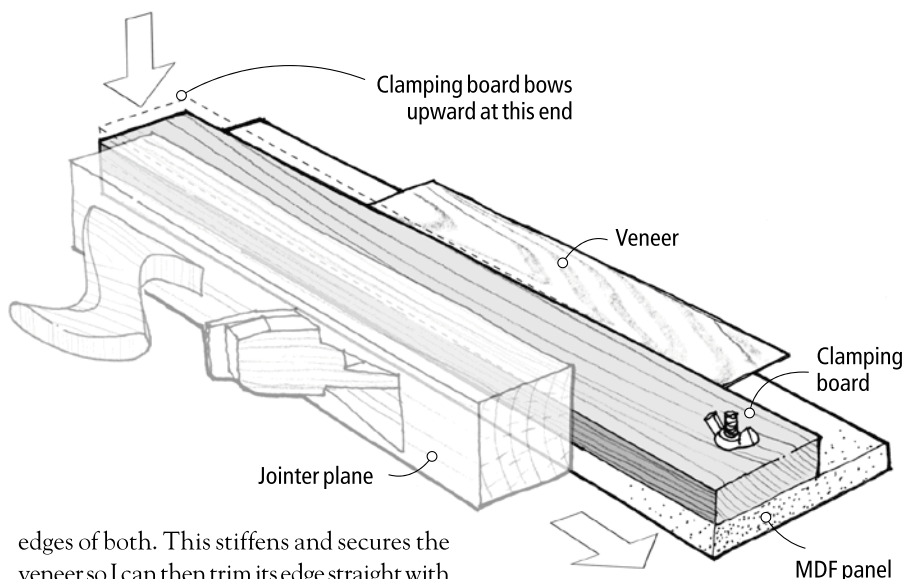
A Shooting Board For Perfect Veneer

THE WINNER:

When laying out veneers for my marquetry patterns, I often have to joint the edges of adjacent pieces for a good seam. To do this, I use a shooting board and a jointer plane. The shooting board consists of an MDF panel to which I've attached a straight-edged clamp board, aligning the edges of the panel and clamp board, and securing them together with a flat-head machine screw and wing nut.

The real trick here is to use a bowed piece of wood for the clamp board, orienting the convex face downward. That way, when you push down on the unbolted end, the rest of the board applies pressure to the veneer to hold it securely for planing.

To use, sandwich the veneer between the panel and the clamp board, with the edge of the veneer projecting slightly beyond the



edges of both. This stiffens and secures the veneer so I can then trim its edge straight with the plane riding sideways on the bench.

*Adolf Schneider
Alpha, New Jersey*

CASH AND PRIZES FOR YOUR TRICKS AND TIPS!

Each issue we publish useful woodworking tips from our readers. Next issue's winner receives a great set of three perfectly matched Veritas hand planes from Lee Valley. These three high-quality planes (7" Medium Shoulder Plane, 15" Low-angle Jack Plane and a 5 1/2" Apron Plane) make a great three-piece set to tackle almost all of your woodworking needs with ease. This terrific prize package is valued at almost \$400.



veritas® Tools Inc.

Runners-up each receive a check for \$75. 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.

O-rings Help a Bit

When installing a bit in a router, it's important that the shank doesn't bottom out in the collet, which can distort the collet and cause the bit to work loose. And sometimes the amount of the shank that gets inserted in the collet varies, depending on the desired projection of the bit for a particular cut.

When trying to position the bit properly during installation, I often wish I had a third hand to hold it while I tighten the collet nut with the wrenches. I've found that the next best thing is to slip an O-ring on the shank before inserting it in the collet. I can then position the O-ring as necessary to hold the bit in the desired position as I tighten the wrenches. You should be able to find suitable 1/4" and 1/2"-diameter O-rings in the plumbing section of your local home-supply store.

*Lewis Kougher
Meadville, Pennsylvania*

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Shop-made Magnetic Featherboard

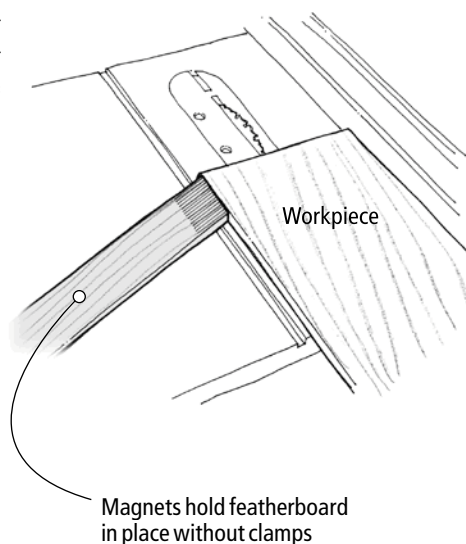
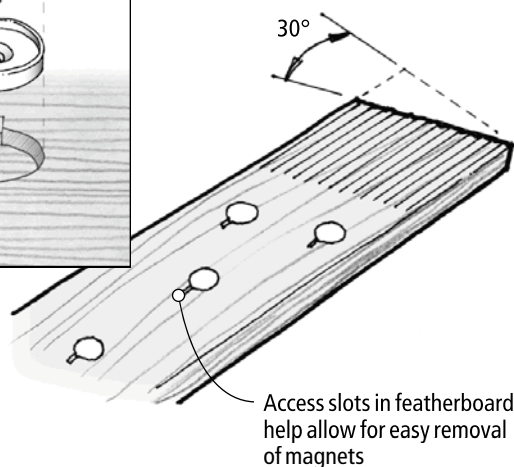
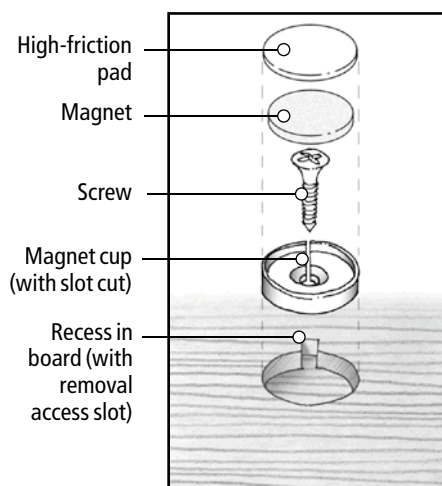
Being safety conscious at the table saw, I have always used a featherboard to keep stock firmly against the fence to help prevent kickback. For narrower work, I often use a small featherboard that rides in the miter-gauge slot. When ripping wide boards that cover the miter-gauge slot, I've used to clamp a large featherboard to the saw's extension wing. But the clamping was often such a hassle that I just didn't bother to use the device, although that made

me nervous. What I needed was something that was quick and easy enough to position that I would never hesitate to use it.

To solve the problem, I got out my stash of 3/4"-diameter rare earth magnets, cups and high-friction pads I got from Lee Valley (800-871-8158 or leevalley.com) a while back. I drilled four shallow holes for the magnet cups: two near the fingers and two centered along the length of the board. I sawed a slot partially through each cup and chiseled small slots in the board adjacent to each hole so the magnets could be pried out with an awl for other uses if necessary. I screwed the cups into their holes, inserted the magnets, then applied the high-friction pads, which prevent the featherboard from sliding or twisting.

It holds firmly and, because it's long enough to extend over the edge of the wing, it can be released by pulling up on the end. To position it, place the fingers against the workpiece, then tap the opposite end just enough to make the fingers flex a bit. For a more secure grip yet, you could use 1"-diameter magnets but beware – they are powerful!

*Carole B. Valentine
Onley, Virginia*



Cleaning Glue Brushes

In addition to the disposable solder flux brushes that I use to apply glue, I also have a collection of artists' brushes of various sizes and shapes to better suit particular applications. Although I make sure to clean these after each use, they still tend to get stiff over time. When this happens, I've found that the best method for cleaning and softening hardened white and yellow glue from the bristles is to boil them in some shallow water on the stove, swishing the bristles against the bottom of the pan. If the bristles are particularly stiff, adding a bit of vinegar will help soften the residual glue.

*Peter Black
Los Angeles, California*

Soft Metal for Jigs

A while ago, I was working on the table saw using a specialized sled that I cobbled together with steel drywall screws. Unfortunately, when attaching the exit guard block for the sled, I used too long of a screw, and part of it ended up in the blade's path when I made the first cut. I was glad to be wearing safety glasses as I felt a bit of hot metal hit me in the face. Happily, no real harm was done and the blade wasn't damaged too badly. All the same, I've learned since then to use brass or aluminum screws on any part of a jig that may encounter a blade or other cutter in use.

*Albert Teller
Las Cruces, New Mexico*

Closing Down the Throat

I often need to cut small parts or trim away slivers of wood using the table saw, scroll-saw or band saw. Unfortunately, it's all too easy to lose a tiny part that falls into the saw's throat-plate opening. And thin off-cuts can jam between the opening and the blade, creating an unsafe situation. I have found that the best and easiest way to prevent this is to seal off the throat opening with wide cellophane tape. Just cut an opening in it to accommodate the blade. Small parts will lie on the tape until you decide to clear them off.

*David Bartle
Scottsburg, Indiana
continued on page 22*

TRICKS OF THE TRADE

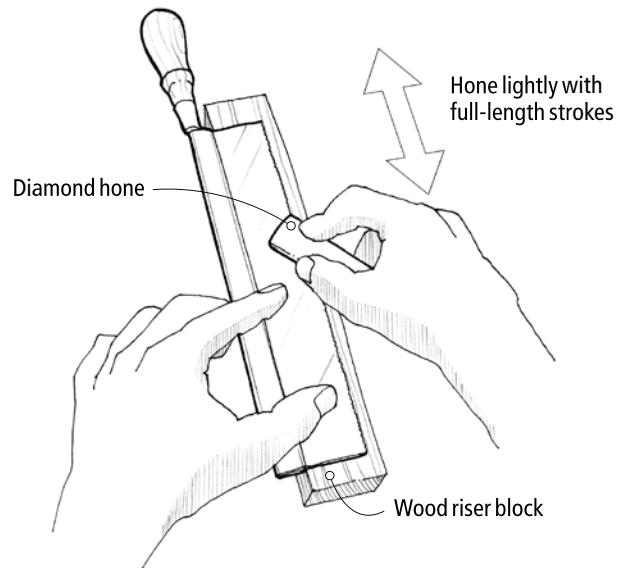
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Tuning a New Dovetail Saw

Like many new hand tools, a dovetail saw may not be prepared to cut its best right out of the box. It's not unusual for the teeth to be excessively or erratically set to each side. Excessively set teeth create a wide kerf that allows the saw blade to wobble in the cut, making tracking difficult. Erratically set teeth contribute to a rough cut. You can get much better performance from even a cheap saw by lightly honing the sides of the teeth.

Before tuning your saw, make a couple of sample cuts, ripping along the grain of a piece of scrap wood for comparison later. Then lay the saw blade on a riser block of scrap wood and hone the sides of the teeth, taking full strokes back and forth a few times with light pressure. I use a fine diamond hone, but an oilstone works well, too. (The saw teeth will gall soft waterstones.) Then inspect the sides of the teeth with 8x or 10x magnification under strong light. When a small flat is apparent on the side of every tooth on one side of the blade, flip it over and give the other side the same number of strokes with the same pressure. Inspect again. When every tooth has been touched, make a cut and compare it to a pre-tuned sample cut, inspecting both surfaces under a strong glancing sidelight in a darkened area of your shop. The cut from the honed teeth should be smoother.

To test the tracking, gauge a straight line along the grain, then cut to the line as best you can. If the kerf is still too wide for good tracking, you can dress the teeth more. The kerf really doesn't need



to be more than a few thousandths of an inch wider than the blade thickness to prevent binding. After this tuning, you should get better, straighter cuts.

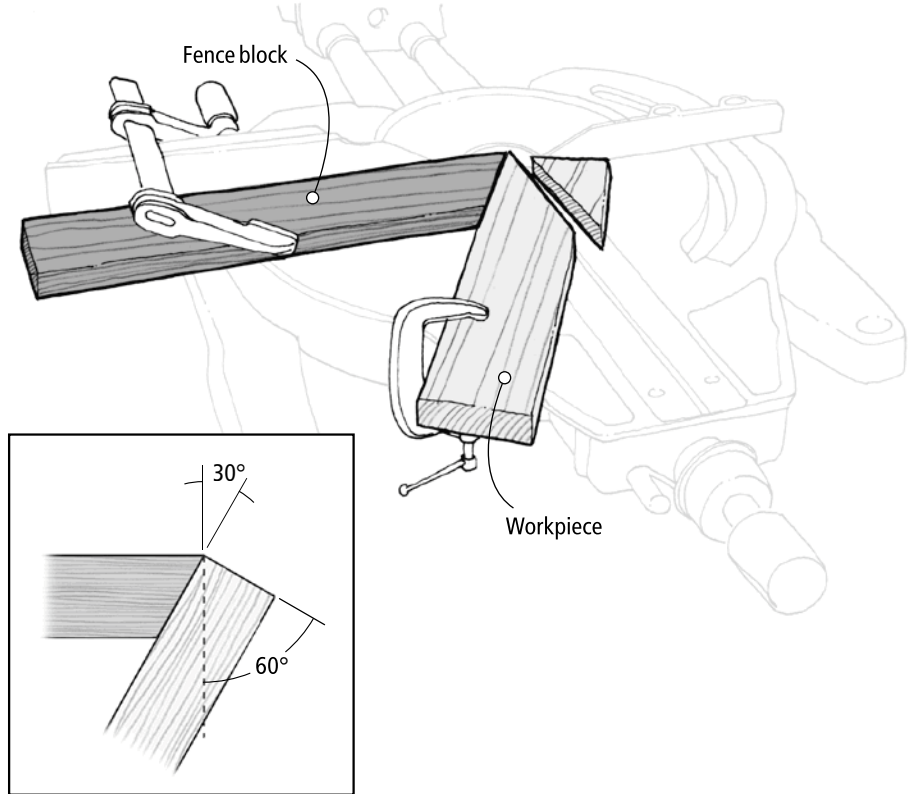
*Paul Anthony
Riegelsville, Pennsylvania*

Acute Miter Saw Trick

As a trim carpenter, I sometimes need to cut angles that are more acute than my miter saw will allow. Most miter saws won't cut beyond 50° , but sharper angles are often required, especially when trimming out stairs. More acute angles can be achieved by using a fence block that has been cut to the complementary angle, which is arrived at by subtracting the desired angle from 90° .

For example, say you need to cut a 60° angle. Begin by subtracting 60 from 90, which yields 30° . Cut a short length of 2x4 material at 30° and clamp it to the miter saw fence with the long edge against the fence. With the saw's miter gauge set at 0° , place one end of your workpiece against the 30° end of the fence block, and clamp the opposite end to the saw table. The resulting angle cut will be the difference between the angle of your fence block and 90° .

*Marshall Switzer
Nashville, Tennessee
continued on page 24*



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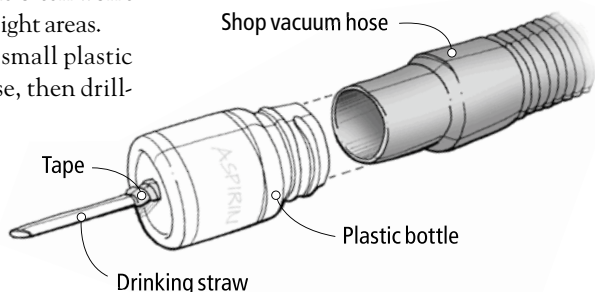
Vacuum Mini-reducer

Cleaning debris from crevices in a project can be a problem. Using compressed air works, but it fills the air with dust and – with some projects – can blow metal filings and other particles all over the shop. I prefer to use a shop vacuum for this type of cleanup, but a shop vacuum's relatively large nozzle often won't reach into crevices and other tight areas.

I solved this by slipping a small plastic bottle over the end of the hose, then drilling a hole in the bottom of the bottle to accept a straw, which I inserted into the hole and then taped in place. Cutting the end of the straw at an angle helps it reach into

tight areas. Many bottles from vitamins, aspirin and other pills are just the right size to fit over the end of the hose.

*Ellis Biderson
Huntington Beach, California*



Trucker's Hitch Will Save Your Load

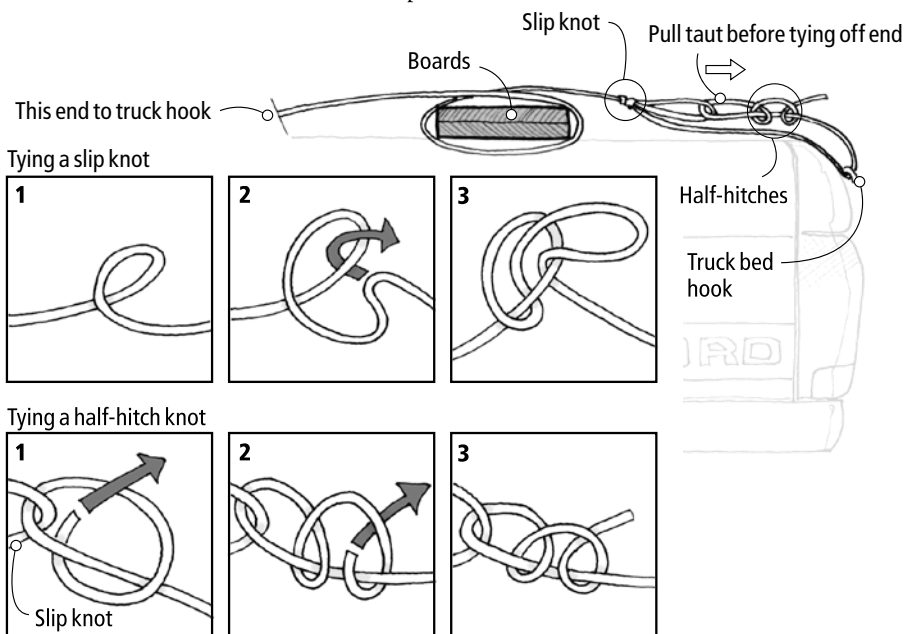
There's one old trick of the trade that everyone who hauls building supplies needs to know: How to make and use a trucker's hitch. This excellent method of tying down loads allows you to cinch a rope extremely tight to hold down loads or keep lumber from shifting as you drive. And it's fairly simple to make.

The principle involves feeding the end of a rope back through a slip knot loop made in a foregoing section. This allows the loop to act like a pulley while you yank it taut and tie the end off to itself. One of the slick aspects of a trucker's hitch is that because the loop is

a slip knot, it can easily be pulled apart after unloading at your destination.

I very commonly use the hitch to secure a small load of lumber that's leaning on the tailgate of my truck. After tying the beginning of the rope to a hook on one side of the truck bed, I then tightly wrap it once around the stacks of lumber before fixing it to the opposite side of the bed, using a trucker's hitch to pull the rope taut. **PW**

*Pat Hood
Athens, Georgia*



Bench Dog ProLift AL

The manufacturer has improved some things we wanted changed on what is still a shop favorite.

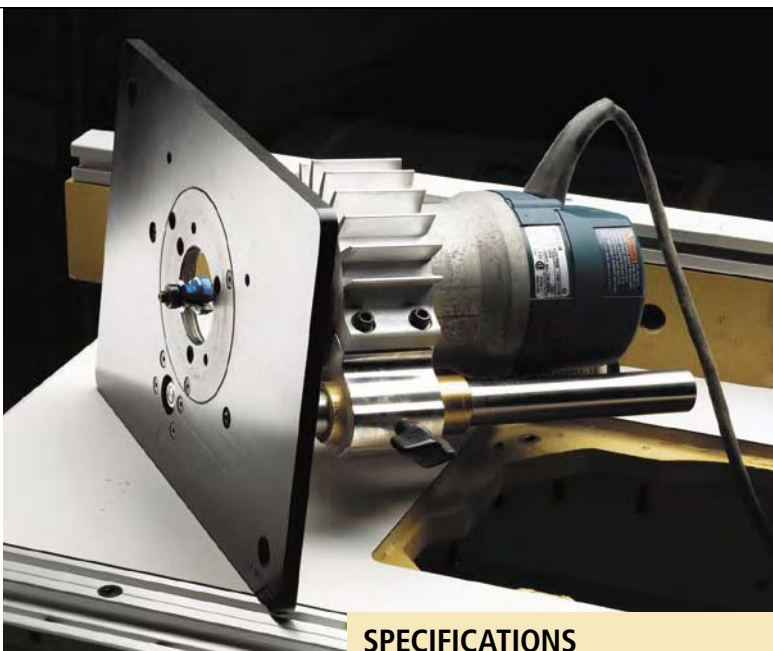


Photo by Al Parrish

More than two years ago we reviewed the Bench Dog ProLift AL and compared it to a Department of Defense project: built like a tank and priced in the same range. The router-lift category has matured since then and many newer lifts have also taken on NASA-like pricing proportions – astronomical.

We decided it was time to take a look at our ProLift and see how it was holding up. The answer is very well, thank you.

In 2002 we were pleased with the stability and support offered by the solid, machined-aluminum motor bracket and steel columns. The lift still offers rock-solid support to the motor base with no perceptible loosening of the motor bracket. The bracket incorporates cooling fins to help pull damaging heat away from the router motor – also a nice feature. The bronze nuts controlling the up-and-down action are tension pre-loaded to avoid backlash, improving accuracy during height setup. The movement of the mechanism has remained smooth and accurate.

We're also still very pleased with the lift's ability to raise the router's collet above the plane of the table to make bit changes simple without having to remove the router. The lifting mechanism operates via a $\frac{9}{16}$ " nut (operated by a provided socket wrench) set below the table surface. A graduated collar integrated in the provided nut driver allows

precise height adjustment, referencing the eight threads-per-inch screw, with one-quarter turn equalling $\frac{1}{32}$ " adjustment. This feature also is still working smoothly.

Our one initial and continued irritant is the top plate. The reduction rings are held in the plate (all milled aluminum) with three hex-head screws. While this holds the ring tightly in place during operation, it's a pain to have to remove the screws every time we want to change bit sizes.

And while we're on the subject of reduction rings, the smallest (2" diameter) isn't small enough for safe operation with smaller diameter (straight or small profile) bits.

As we began this article we learned from Bench Dog that it was about to introduce an updated version of the ProLift AL called the MiniLift. The differences are listed below, and we're happy to say our two annoyances have

SPECIFICATIONS

Bench Dog ProLift

Original street price: \$260

Plate: Aluminum with 2", 2 $\frac{5}{8}$ " & 3 $\frac{3}{4}$ " rings

Housing: Cast aluminum, 3 $\frac{1}{2}$ "-dia. capacity

Vertical travel: 5 $\frac{1}{2}$ "

What we like: Stable router support; smooth, precise height adjustment; easy bit change without removing router.

What we'd change: Need to screw down reduction rings before operation; smaller diameter (opening) reduction ring.

For more information: Contact Bench Dog at 800-786-8902 or benchdog.com

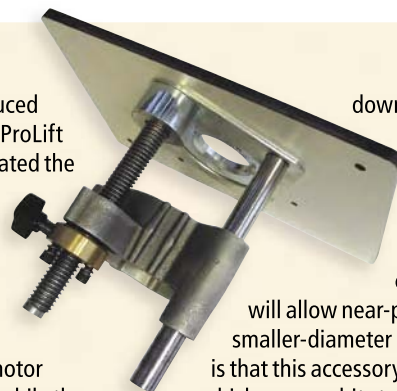
been addressed successfully – and they've lowered the price. The ProLift (now MiniLift) is still a winner in our shop, and thanks, Bench Dog, for the improvements! **PW**

— David Thiel

THE MINILIFT

Bench Dog recently introduced the updated version of the ProLift AL, which has been designated the MiniLift. Priced at \$225, the MiniLift not only is more affordable, but also offers upgrades we like.

The lift will still accommodate most 3 $\frac{1}{2}$ "-diameter motors and the motor housing is cast aluminum, while the insert plate is a phenolic resin rather than aluminum and the reduction rings are now steel. It is no longer necessary to screw



down the reduction ring (yeah!), except in operations using the starting pin.

And Bench Dog now offers a zero-clearance insert that

will allow near-perfect fits for any smaller-diameter bits. The only problem is that this accessory is priced at \$18.99, which seems a bit steep. Otherwise, Bench Dog has improved a good product and made it more affordable. And it's still made in the United States.

ABOUT OUR ENDURANCE TESTS Every tool featured in our Endurance Test column has survived at least two years of heavy use in our shop here at *Popular Woodworking*.

All-new Fein Cordless Drill

When we reviewed all the 12-volt drills on the market more than a year ago, we knew Fein had a new one headed our way. Well, it's here and the results are positive.

The new drills are available in 9.6, 12, 14.4 and 18 volts, but we always test the 12-volt model because that's what we consider to be the right balance of power and weight for a woodshop. The ABS 12-volt drill is available in a 2.0-amp/hour (Ah) NiCd or 3.0Ah NiMH battery configuration. We opted to test the 3.0Ah drill – for more power, of course.

To test this drill, we went back to our previous 12-volt review and decided this drill was in a class to compete for top honors. So we compared it to the 12-volt, 3.5Ah Panasonic. I'll cut through the suspense: The Panasonic still holds top honors, but the Fein is a close second compared to the other competitors in the review.

We re-ran our 1/2" spade bit boring test in 1 1/2"-thick poplar. The Fein finished out at 103 holes on a charge, while the Panasonic made 131. Must be the extra .5Ah.

We didn't have any wrist-jerking torque problems with the Fein, and the charge ran steady right up to the last hole drilled. The motor did heat up in the workout, but not excessively so and not surprisingly.

It has a good steel 1/2" single-sleeve chuck with a nine-position clutch, two speeds and a 20-minute smart charger that has a trickle charge to keep the battery ready to use. Fein also included a good bit set to put the drill to use.

Beyond the performance difference, the drill is taller, longer and slightly heavier than the Panasonic, making it more cumbersome in your hand (well, my smaller hands). It's also still slightly more expensive than the Panasonic (\$20 more for the 3.0Ah version). All-in-all, Fein's new drill is impressive and outshined almost all the other drills we've tested. It's a good drill.

—David Thiel

For more information, circle #169 on Free Information Card.



Photos by Al Parrish

SPECIFICATIONS

Fein ABS 12 Drill/Driver

Street price: 3.0Ah: \$200, 2.0Ah: \$180

Batteries: 2 - 12 volt

Torque: 274 in./lbs. for both

RPM: 0-400, 0-1,400

Weight: 4.5 lbs. (3.0Ah)

Performance: ●●●●○

Price range: \$\$\$\$

Fein: 800-441-9878 or

feinus.com

Drill Doctor Drill Bit Sharpener

I've always considered drill bits to be disposable items. You buy an inexpensive 29-piece set and use them until there are too many missing, or they're too dull to use. The thought of spending \$100 for a machine to keep those disposable items around didn't impress me.

But after seeing how simple it is to put a fresh edge on a drill bit with the Drill Doctor I've changed my mind. I'm going to spend a little more effort keeping my bits in good shape. It seems other woodworkers also are being won over. The company is quickly approaching its two-millionth Drill Doctor sold.

Drill Doctor bit sharpeners are available in a variety of prices, ranging from \$75 to \$130. We chose the DD400 model, priced at \$100, to test as middle of the range and with a feature we wanted to try – the ability to create and sharpen split-point bits.

But first the essentials: The Drill Doctor simply is a 1.75-amp universal motor with a diamond sharpening wheel that spins at 20,000 rpm. The magic comes from the alignment process. A drill bit (sized from 3/32" to 1/2") is locked in the chuck, aligning the

bit's cutting flutes in the process. The chuck is then inserted into the sharpening hole, and the bit and chuck are rotated against the sharpening wheel. Half a dozen turns and you're done.

The DD400 will sharpen high-speed steel, carbide, cobalt, titanium nitrate-coated and even carbide-tipped masonry bits.

Well that's nice, but do you really have enough bits to justify the expense? How about if you can improve inexpensive bits? The DD400 allows you to take a standard twist bit and reshape the tip to form a split-point bit. This allows the bit to bite faster and not wander at the beginning of the cut. I've paid extra for new bits that will offer that feature, but now I'll buy less expensive bits and make my own.

The Drill Doctor is simple to use and will give you new respect for your drill bits – whether they're affordable or not.

—DT

For more information, circle #170 on Free Information Card.



SPECIFICATIONS

Drill Doctor DD400

Street price: \$100

Bit sizes: 3/32" - 1/2"

Bit angle: 118°

Wheel: #180-grit, replaceable diamond

Performance: ●●●●○

Price range: \$\$\$\$

Drill Doctor: 800-597-6170 or

drilldoctor.com

Veritas Straightedges

No matter what sort of woodworking you do, you need a quality straightedge. Power-tool woodworkers need them for setting up machines. Hand-tool woodworkers need them for knifing in joint lines. All woodworkers need them to determine if joints are true.

Now Veritas makes straightedges that are as accurate as the expensive machinist versions (.001" in steel and .003" in aluminum) but are 13 percent to 50 percent cheaper.

Buy the aluminum version (available in 24", 38" and 50" lengths) if you're only going to check machine setups and furniture assemblies. Get the steel version if you also need the tool for layout work with a knife. Both versions are hefty, well-made and accurate (we checked both against two other reference surfaces). I also liked the convenient hole for hanging the tool—straightedges will go out of true when stored improperly. This is the deal of the year in my book.

— Christopher Schwarz

For more information, circle #171 on Free Information Card.



SPECIFICATIONS

Veritas Straightedges

Street price: \$19.50 in aluminum (24");

\$36.50 in steel

Dim. (aluminum): 7/16" x 1 3/4" x 24"

Dim. (steel): 1/4" x 1 1/2" x 24"

Performance: ●●●●●

Price range: \$

Lee Valley Tools: 800-871-8158 or
leevalley.com

Grizzly Disc/Spindle Sander

The combination of an oscillating spindle sander with a 12" disc sander makes a lot more sense than the usually seen belt and disc combination. Here are two tools that you will really use. Both functions share a single 1-hp motor and stand. The spindle moves up and down at 60 strokes per minute and is ideal for smoothing concave curves. Four different sizes of spindles are included, along with appropriate table inserts, and all of these have built-in storage slots on the base.

Our test model ran smoothly, was free of vibration, and had an effective dust collection port for each sander. Our only complaint was with the table mounting trunnions on our test model. Neither of the adjustable tables would stay locked in position under moderate downward force. The manufacturer has addressed this issue, and says the trunnion mounts on current models are more substantial.

— Robert W. Lang

For more information, circle #172 on Free Information Card.



SPECIFICATIONS

Grizzly G0529 Spindle Sander

Street price: \$450

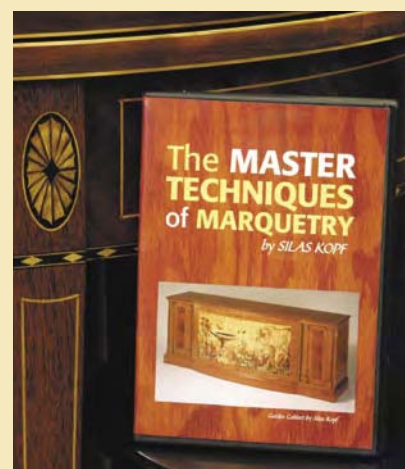
Motor: 1 HP, 110V, TEFC Motor

Tables: Both tables tilt to 45°

Performance: ●●●○○

Price range: \$\$\$

Grizzly Industrial: 800-523-4777 or
grizzly.com



KOPF MARQUETRY DVD

"The Master Techniques of Marquetry" by Silas Kopf is an opportunity to look over the shoulder of a recognized master of his craft as he explains what he is doing and why he is doing it a certain way.

Kopf begins with the historic background of various forms of inlay and marquetry work, and the tools and techniques used to produce them. He also covers traditional methods, points out when it makes sense to follow them and when to use a more modern technique.

Kopf starts with basic materials and techniques, and visually explains the differences between inlay, marquetry, parquetry and bouble work. Along the way he discusses cutting and assembling geometric patterns, working with wood and metal together, and several methods of cutting and assembling different styles of work.

This nicely produced DVD always has the viewer in the right place to see the fine points. Like any good reference, it will be viewed many times. If you have any interest at all in this type of work, then a copy of "The Master Techniques of Marquetry" belongs on your shelf. The DVD is available for \$25 + \$3 shipping from Silas Kopf, 20 Stearns Court, Northampton, MA 01060. Visit silaskopf.com for more information.

—RL

ABOUT OUR TOOL RATINGS

Performance is rated on a one-to-five scale. You won't see a low rating ("one or two") because we don't publicize inferior tools. "Five" indicates the leader in the category. Five dollar signs indicates highest price in the category. Three indicates an average price. If you have tool questions, call me at 513-531-2690 ext. 1255, or e-mail me at david.thiel@fwpubs.com. Or visit our web site at popwood.com to sign up for our free e-mail newsletter.

— David Thiel, senior editor

No Math Required with this Flute Spacing Jig

Woodworking appealed to me in my youth because I thought it had nothing to do with math. Of course, I learned that I was wrong, but not until after I was hooked on wood.

Nothing seems quite so confusing as accurately spacing anything across the face of a board, especially when fluting. Trying to divide the board evenly (or unevenly) to give proper spacing is a complete nightmare for the math-challenged woodworker (me).

I know I'm not alone in my frustration, and the existence of this jig proves it. This flute spacing jig allows you to accurately and evenly space one to seven flutes with no math required. And using it is a piece of pi!

First choose your preferred bit (bushings for 1/4", 3/8" or 1/2"-diameter fluting bits are included) and set up your router table. Next, determine the number of flutes to be cut. Check the chart on the jig and you will find that five flutes, for example, requires using holes one, four and seven.

Place the correct bushing in hole one and

(with the power off and the bit set to the desired depth) slip the jig over the bit.

Next place the board to be fluted between the indexing pin and your router table fence, and adjust the fence until it's just short of snug against the board. Run your board, then relocate the board using holes four and seven, and you're done. The jig is limited to cutting flutes on boards up to 12" wide.

If you don't use fluting bits often, this jig might be too specific for your woodshop. But with some simple jigging you can make staggered or stopped fluting. And by using different types of bits the options increase. You'll never worry about math again. We're anxious to try all the possibilities this simple jig offers. —DT

For more information, circle #173 on Free Information Card.



SPECIFICATIONS

Automatic Flute Spacing Jig

Street price: \$45

Flute diameters: 1/4", 3/8" and 1/2"

Performance: ●●●●○

Price range: \$\$\$\$

Woodcraft: 800-225-1153 or
woodcraft.com

Ashley Iles Turning Tools

Although highly regarded and widely distributed in England, turning tools from famous toolmaker Ashley Iles have been scarce as hen's teeth on this side of the Atlantic. Now, speciality tool online retailer Tools for Working Wood is changing all that and turners here should take note.

This line of well-made tools include the standard offerings of most turning tool manufacturers such as spindle and bowl gouges, parting tools, scrapers and skewers. But Ashley Iles also offers some specialty tools and hefty versions of the more common tools, like standard traditional pattern spindle gouges, and a long and strong 1" bowl gouge.

Ashley Iles is a second generation Sheffield, England, toolmaking company with a good reputation for making quality tools from excellent steel in the best Sheffield tradition. These high-speed steel tools are no exception. They will take and hold a keen edge. And they are sharp out of the box, each having been factory sharpened by Tony Iles, son of founder Ashley Iles. Of special note is the excellent degree of finish the steel exhibits. Even the deep flutes in these gouges show

virtually no abrasion marks from grinding. And the extra thick steel used for scrapers and skewers is noteworthy. The only complaint is the handle sizing on some larger tools. The handles are just too short for the task. In England, most turning tools are sold unhandled on the correct theory a turner will want to make his or her own.

We tested a sampling of turning tools from the line including a 3/4" bowl gouge (which we rehandled), a 1" round-nose scraper, a 1/4" spindle gouge, a 1 1/4" skew, a massive 1 1/2" roughing gouge and an 1/8" parting tool. All the tools performed well.

SPECIFICATIONS

Ashley Iles Turning Tools

Street price: Ranges from \$99.95 for 1 1/2" roughing gouge, to \$24.95 for 1/4" spindle gouge; a 3/4" bowl gouge costs \$73.95

Steel: High-speed steel

Performance: ●●●●○

Price range: \$\$\$\$

Tools for Working Wood:

800-426-4613 or toolsforworkingwood.com

Turning tools from Ashley Iles are premium priced in line with other quality English manufacturers. Sets are available. **PW**

—Steve Shanessy

For more information, circle #174 on Free Information Card.



The Striking Knife

Discover a nearly extinct tool that can help you work faster and more accurately.

As preposterous as the notion seems, the historical record suggests cabinetmakers working in dim shops with hand tools were able to produce fine furniture with great speed. Despite the superiority of our modern tools and shops, few can match their productivity. So modern woodworkers are left with this question: How were they able to work efficiently with hand tools?

This article is the first in a series I will write for *Popular Woodworking* on the subject of working wood quickly and efficiently with hand tools. I shall humbly attempt to do what my 18th century counterpart swore not to do: Reveal the once secret “arts and mysteries” of working quickly and efficiently with hand tools.

My Favorite Tool: The Humble Striking Knife

Do you have a favorite tool? It may be a tool that fits your hand well or does a fine job. Or it might be a tool that simply appeals to you. Well I certainly do. It's a tool not much used anymore called a striking knife. A striking knife is a double-ended marking tool with



Photo by Al Parrish

The striking knife was a tool frequently found in the tool kits of early woodworkers. Though it's extremely useful, it is a surprisingly uncommon tool to encounter today.

ARE THERE REALLY ARTS & MYSTERIES IN WOODWORKING?

The phrase “Arts and Mysteries” was typically used in contracts between masters and apprentices. Some modern scholars consider it merely a term of “art,” and open to interpretation. I interpret the phrase literally to mean that there are tricks and trade secrets that were passed on from master to apprentice. Each apprentice swore to keep these secrets. The fact that not a single English language text was written on the subject during the whole of the 18th century attests to the seriousness with which the oath was taken.

a skewed chisel-like blade on one end and a scratch awl on the other. My striking knife came to me in a parcel of old Sheffield brace bits purchased from an English auction house. It appears to have been made from a thin, fine-toothed file. Some striking knives have wooden scales (handles), but not mine. Two carefully placed and well-smoothed indentations are all its maker offered to comfort those who have used it.

I understand those who would question the striking knife's relevance. The 0.5mm mechanical pencil is indeed the fine woodworker's friend. And while I accept the accusa-

tion that I am a traditionalist—even a Luddite in my preference for wooden bodied planes—I defend my use of the striking knife as an important and helpful tool. As a marking tool, it leaves exactly the line you want. It's like a pencil that can lay a different thickness line depending on the situation. But unlike the pencil, the striking knife leaves a physical feature that is not only useful, but responsible for fine craftsmanship. Allow me to explain.

Awl Marks With the Grain & End Grain

Many marking knives currently available don't have awl ends, which is unfortunate. The awl side seems crude but it's quite helpful. Marking with the grain, even on rough-sawn surfaces, is simple with the awl side of the tool (the blade end can catch the wood's grain, pulling the edge and line astray).

Begin the long grain mark by laying the awl's point in the corner made between the

by Adam Cherubini

Adam Cherubini makes reproduction furniture using the tools and techniques of the 18th century. He demonstrates his craft at Pennsbury Manor in Bucks County, Pennsylvania, on Historic Trades Days. You can contact him at adam.cherubini@verizon.net.

work to be marked and your straightedge. The point of the awl should hang off the workpiece as you begin the line. Keep the upper end angled back toward you and pitched slightly away from the straightedge. Drag the point onto the work and along the straightedge. Use a light touch and several passes to make an acceptable line. In fine-grained woods, you needn't make a deep line. Your line will be difficult to find in nearly every species of oak.

When planing to a scratched line (or even a gauged line) you can see where the plane has met the line from the top. The edge of the board becomes slightly narrower as you reach the scored line. Even the shavings emerging from the plane will reveal this.

I also use the awl end of the tool to mark end grain. Unlike awl lines, I can't see knife lines in freshly sawn end grain, and I prefer not to plane end grain just to see my marks.

The long thin awl end is especially helpful when marking dovetail pins. There is an advantage to making the pins very small and the tails very wide, but the trouble with this approach is the marking. The long awl end of a striking knife fits into tiny spaces well.

Knife Marks Across the Grain

Making cross-grain marks is where the striking knife excels. Hold the knife using a pencil grip with the tool nearly vertical. Lay the flat side of the knife against a try square's blade or a straightedge. Place the center of the blade on the corner of your work and make a deep nick.



Marking cross grain begins with a nick in the far corner. Notice the angle at which the knife is held. Because most of the wear happens at the tip of the blade, the middle of its edge stays sharp. Draw the knife toward you in one smooth motion. A light touch is all that's needed here. Notice the knife is still nearly vertical. The grip is relaxed. The wrist is straight.



Marking parallel to long grain requires a sharp tool and a light touch. Begin the mark with the tool hanging over the end of the work. The striking knife must be angled down (toward you) and slightly away from the straightedge as shown.

Draw the knife slowly towards you, cutting lightly with its tip. To keep the knife firmly against the square or straightedge, rotate the knife to steer the blade toward the square. Just before you reach the near end, roll the blade down to mark the near corner with a deep nick. If you want a deeper line, make another pass. Never force your knife. That will only cause inaccuracies. Remember: The slow knife cuts best.

Those nicks at the beginning and the end of the line offer four important advantages:

1) Positioning your try square: When you wish to make an accurate crosscut, it's helpful to mark the face and both edges. After mark-



Here, the wrist is relaxed and still quite straight. For softer woods such as this poplar, a single pass is usually sufficient to leave an acceptable mark. The mark is finished with a near side nick. This is easily made thanks to the low skew angle of the blade.



It's difficult to accurately mark end grain. Pencil lines across sawn end grain of dark woods such as black walnut, are nearly invisible in anything but direct light. A scratched line is much better, especially in the raking light typical of all workshops. Here, the striking knife offers an extra benefit: Its slender awl end reaches into tight places like these tiny "London pattern" dovetails.

ing the face, place your knife back into the nick in the corner from your first mark. Reposition your square to the knife to then mark the edge of the board. Repeat this process each time you reposition your try square.

This is an accurate way to mark multiple faces. If you are working rough stock and the corners aren't crisp, this technique is especially helpful. But I also appreciate it because my nearsight vision is failing. Pencil lines, you see, force you to align your square by eye. At least some of my woodworking is done in the evening when my eyes are weary. This technique allows me to continue doing good work hours after I should have hung up my shop apron. It may also help explain how such good work was possible in poorly lit period workshops.

2) Guiding saw cuts: Not only is the mark accurate, but it guides my saw or chisel. The teeth of my crosscut-filed backsaw jump into the knife mark. By keeping a relaxed grip on the saw, I've found the saw will find the mark, again sparing me from straining my eyes.

3) Fixing wayward saw cuts: Many beginning sawyers quickly learn to track the line on the face of the stock, but they lose square in the thickness. I do as well. In that case, and provided you are off on the heavy side, you can easily pare away the excess with a chisel. The marked line is most helpful for this operation. I much prefer this approach to planing end grain, which is difficult.

4) Preventing breakout: Having a knife mark all around your stock also helps prevent tear-out when using a crosscut saw. This is especially helpful if your stock has already been surface planed.

Having both ends on a single tool is handy when both types of marks are required for a job. Marking a tenon comes to mind. I use a marking gauge to lay out the cheeks, but the

awl end marks across the end grain. Obviously the knife end defines the shoulders.

Beyond marking (I told you this was my favorite tool) I find my striking knife helpful for pencil sharpening, dovetail paring, slicing drips of gelled hide glue and clearing shavings from my planes' throats.

Characteristics of a Good Knife

Old striking knives aren't common. It would be easy to overlook one. There's little wonder you don't see them in tool shops, or even in period inventories of tools. They are among those once-ubiquitous items such as pencils or chalked string lines that would have been accounted for under the catch-all heading: "smalle things forgotten." The famous Benjamin Seaton tool chest includes a striking knife under the heading "marking awl."

The old knives look far less like X-acto knives than modern marking knives do. The blade end has dramatically less skew, maybe 15° or 20° off square. While this forces you to hold the knife nearly vertical, I find this a distinct advantage. When marking the near corner, you must roll the knife down toward your body. If you held the knife as you would a pencil (laying back against your hand), that

last roll can be a wrist breaker.

For right-hand use, the left-hand side should be flat. For southpaws, the right side should be flat. I've used but don't love the V-shaped knives, which are supposed to work either handed. The problem I have with them is that the angle at the point is either too steep or exactly double what I would prefer it to be. I've never sharpened one, but it seems like it would be a touch more work to hone. Still, a bad knife is better than no knife.

A striking knife would make a great addition to any shop. I love mine, but maybe not solely for the reasons I've stated thus far. You see, the striking knife, like this article, offers the attentive craftsman the chance to learn important lessons about woodworking quickly and efficiently with hand tools. For if you think this article is about how to use a striking knife, you're only half-right. Read it again, but this time forget about learning how to use a striking knife and concentrate instead on learning the lessons it wants to teach you. Consider the ramifications of its use. Only then will you understand my first lesson to working quickly and efficiently with hand tools ... and it has nothing whatsoever to do with the striking knife. **PW**



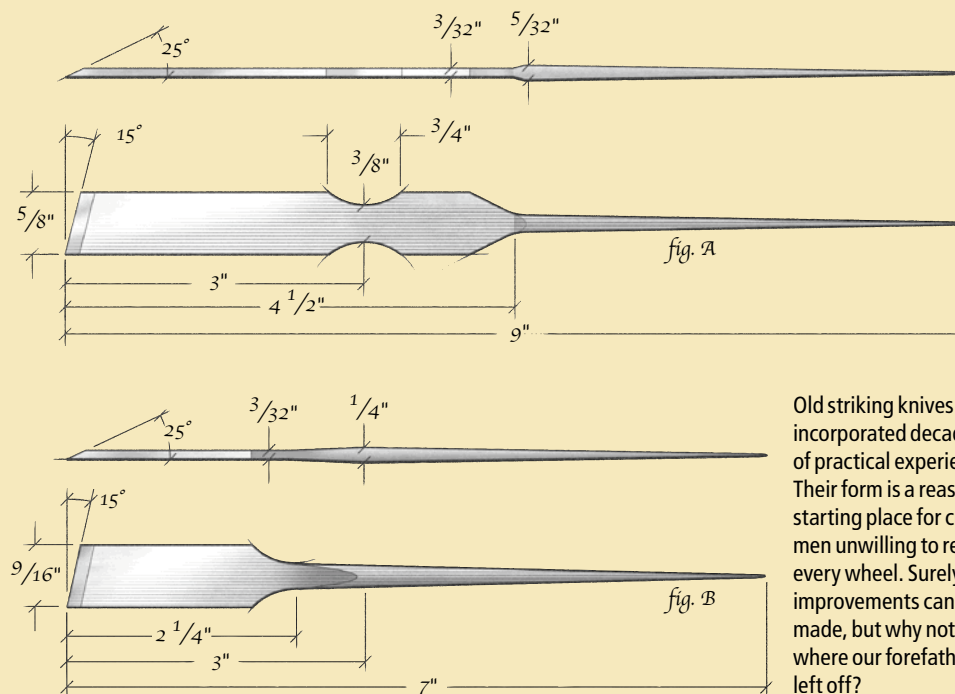
The striking knife is easy to overlook. This has no doubt led to its near extinction.

FINDING A STRIKING KNIFE – OR SOMEONE WHO WILL MAKE ONE FOR YOU

It's possible but rare to find striking knives "in the wild." Most folks don't know what they are. Knowledgeable tool dealers or tool-collecting organizations may be helpful. British tool dealers seem to be more familiar with the tool and may actually have one or two to sell from time to time.

Failing that, I recommend seeking a blacksmith accustomed to making tools or knives. The striking knife can be forged from high-carbon steel; its hardness should be that of a chisel. An old file would be a good place to start. The dimensions in fig. A are for my knife. The dimensions in fig. B are for a knife owned by Executive Editor Christopher Schwarz.

—AC



Illustrations by Matt Bantly


Old striking knives have incorporated decades of practical experience. Their form is a reasonable starting place for craftsmen unwilling to reinvent every wheel. Surely improvements can be made, but why not start where our forefathers left off?

Greene & Greene Sideboard

Authentic details are easier
than you might imagine.



Photo by Al Parrish

A photograph of a wooden desk with a lamp. The desk is made of dark wood and has a simple, functional design. On top of the desk is a lamp with a dark, curved metal base and a white, conical shade. The lamp is turned on, casting a warm glow. The desk has a flat top and a lower section with drawers or storage compartments. The background is a plain, light-colored wall.

In 1907, the architectural practice of brothers Charles and Henry Greene was at its peak of popularity in southern California, with several houses under construction. Equally busy was the workshop of Peter and John Hall, another pair of brothers who were responsible for the actual construction of the ultimate bungalows designed by Greene and Greene.

In addition to acting as general contractors, the Halls were also responsible for all of the interior woodwork and the furniture for these magnificent homes. In researching this piece, I tried to discover what the original details were, and also tried to place myself in the setting in which the original work was done. Given the volume of work performed in the Halls' millwork shop, this furniture must have been made as efficiently as possible.

by Robert W. Lang

Comments or questions? Contact Bob at 513-531-2690
ext. 1327 or robert.lang@fwpubs.com

The original version of this serving table was made from mahogany with ebony accents for the Freeman Ford home in Pasadena, Calif. My version is about 12" shorter than the original and about 6" narrower. In planning this project, I wanted to come as close as I could to the details of the original piece. I found an amazing online resource for original Greene and Greene drawings and

photographs. See "The Greene & Greene Virtual Archives" below for more information.

Digging for the Details

In many Greene and Greene reproductions, the finished project doesn't look quite right, or the methods used are terribly inefficient. In highly detailed projects like this, half the battle is making nice details quickly. The other half is the sequence in which the work is performed.

Many times people follow someone else's reproduction, rather than referring to an original example. The problem with this is that details get changed or exaggerated, and then are taken as good examples. The style gets watered down and the methods become too complicated. I wanted to make this piece as it would have been made by the Hall brothers; excellent workmanship done efficiently, faithful to the design.

I also wanted the color and character of the mahogany to look the way original pieces do. It took some detective work and head scratching to work out the methods and materials. In the end, this table looks more like the original than most reproductions.

My plans called for 32 mortise-and-tenon joints and 72 square plugs. The plugs on the legs appear to be going through the mortise-and-tenon joints that connect the rails to the legs. If you look closely at the inner set of legs on the previous page, you will notice that the plugs are centered in the width of the legs.

The only way these plugs could be functional would be if the tenons were long enough to cross the midpoint of the leg. If that were true, then the tenons would need to be reduced in thickness, so that they could cross each other. This would complicate these joints as well as weaken them. This set of plugs is just for show.

I also questioned the need for pinning all three of the plugs at each of the corner joints. One would be sufficient to reinforce the joint. Pinning all of them could weaken the tenons, and introduce problems when the rails expand and contract seasonally. I decided to pin only the middle of each tenon and make most of the plugs only decorative.

The original drawings detailed the breadboard ends, the splines and the way they are attached with screws behind the plugs.

Our local wood supplier had 3"-square by 30"-long leg blanks in stock, so I decided to purchase eight of them instead of milling my own out of 12/4 material. You might need to glue up the leg blanks from two or more pieces to get the thickness of 2³/₄".

The rest of the material all has a finished thickness of 7/8" except for the breadboard ends, which are a full 1" thick. I had wood that was long enough to make all of the top rails out of one piece and all of the bottom rails out of the other. I kept them in order to match grain and color around the entire table, which adds a nice touch.

Which Leg is Which?

After laying out all of the legs and rails for grain direction and orientation, I numbered each leg on the plan view of my drawing, and wrote the number on the top of each leg to keep them in order as the work progressed. I also marked each end of the rails with the number of the leg it joined to.

My first task was to find an efficient way to cut all the mortises. Instead of using a hollow chisel mortiser, I decided to use a plunge router along with a template to quickly locate all of the cuts.

THE GREENE & GREENE VIRTUAL ARCHIVES

The University of Southern California hosts an amazing online collection of original drawings, photographs, correspondence and other documents from the work of Charles Sumner Greene and Henry Mather Greene. You can find it online at: usc.edu/dept/architecture/greeneand-greene/index.html

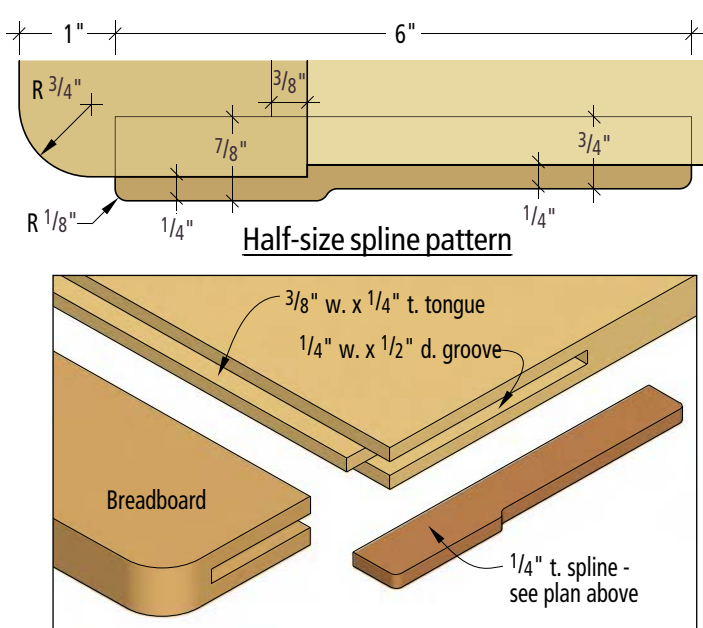
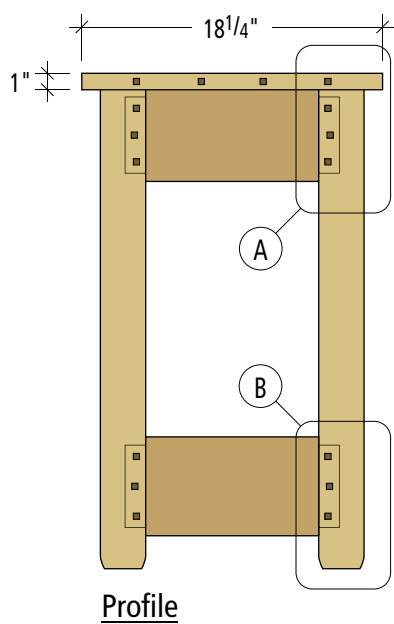
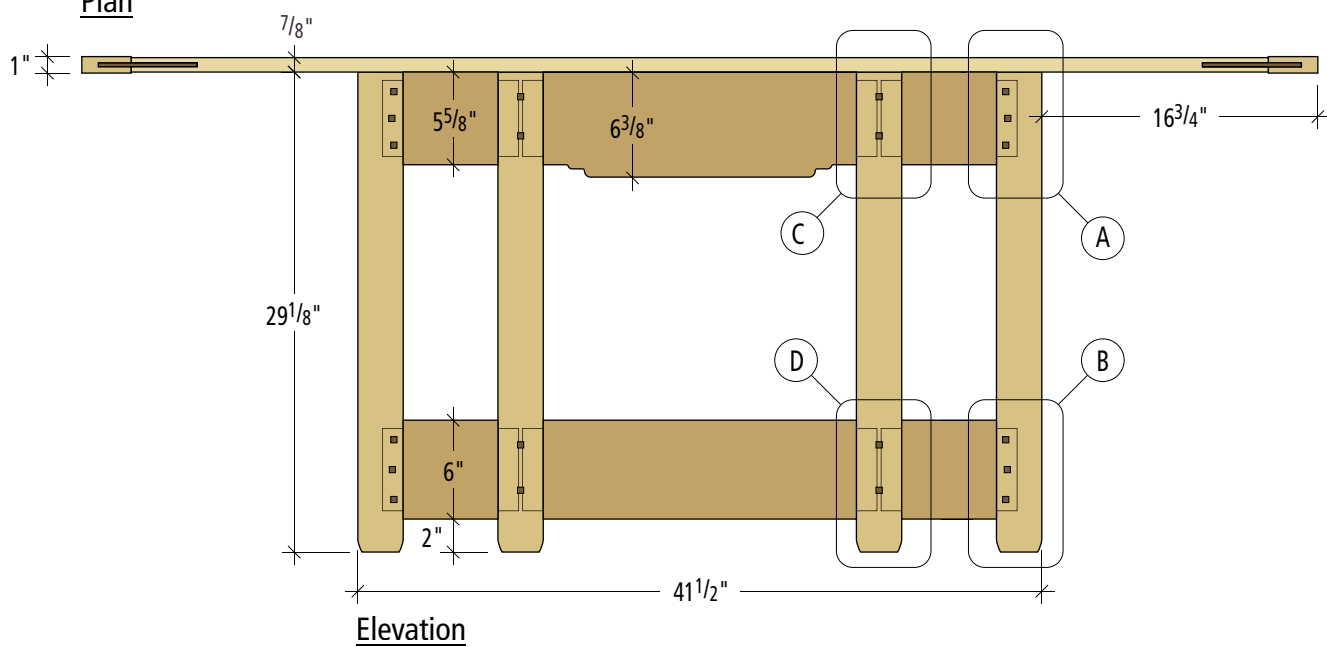
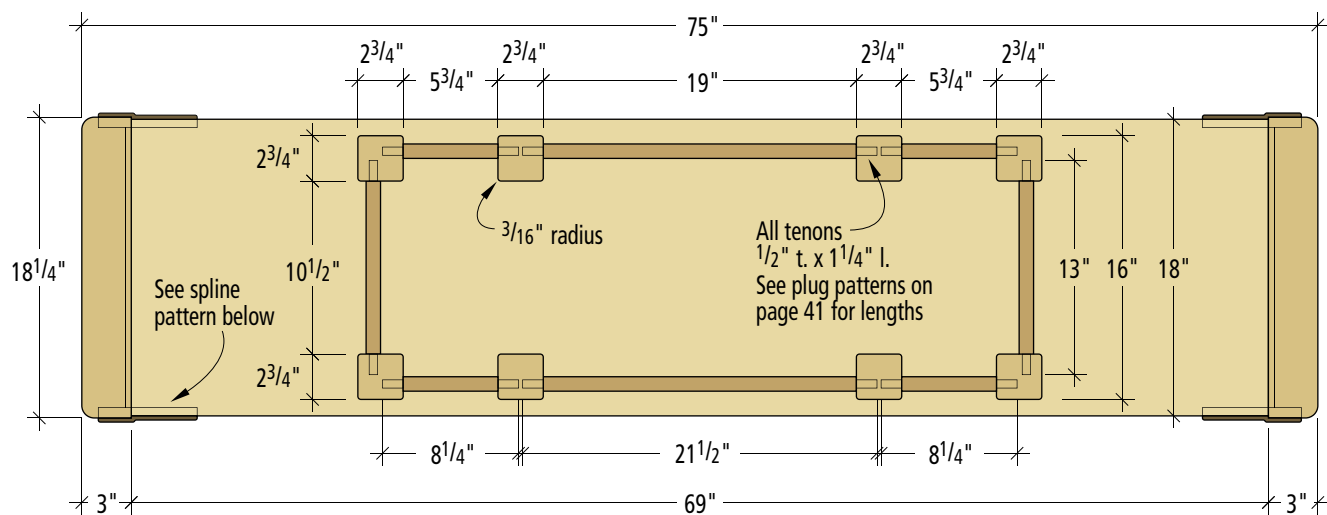
The database of digital images can be searched by project name or by type of object. Once a document has been found, you can zoom in and pan around on individual drawings and photographs. Background information and other reference material is also available.

I was able to find an original black and white photograph of the table featured in this article, and while drawings for this table don't exist, I looked at working drawings for other furniture from the same house, as well as a finish formula from the William Thorsen house.

This material served as the basis for how I made the details of this table. The shape and projection of the square plugs and splines on the breadboard ends, the treatment of the edges of the legs and top, and the finish color were all completed by following the details shown in these original documents. —RL

GREENE AND GREENE SIDEBOARD

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL	COMMENTS
		T	W	L		
1	Top	7/8	18	69 3/4	Mahogany	1/4" x 3/8" tongue each end
2	Breadboard ends	1	3	18 1/4	Mahogany	1/4" x 3/8" groove one edge, 1/4" x 5/8" x 2" groove both ends
8	Legs	2 3/4	2 3/4	29 1/8	Mahogany	
2	Top end rails	7/8	5 5/8	13	Mahogany	1/2" x 1 1/4" x 4 5/8" tenon each end
2	Lower end rails	7/8	6	13	Mahogany	1/2" x 1 1/4" x 5" tenon each end
4	F & B top rails	7/8	5 5/8	8 1/4	Mahogany	1/2" x 1 1/4" x 4 5/8" tenon each end
2	F & B cloud lift rails	7/8	6 3/8	21 1/2	Mahogany	1/2" x 1 1/4" x 4 5/8" tenon each end
4	F & B bottom rails	7/8	6	8 1/4	Mahogany	1/2" x 1 1/4" x 5" tenon each end
2	F & B bottom mid rails	7/8	6	21 1/2	Mahogany	1/2" x 1 1/4" x 5" tenon each end
72	Plugs	3/8	3/8	5/16	Walnut	Ebonized
4	Splines	1/4	7/8	6	Walnut	Ebonized
2	Cleats	7/8	7/8	10 3/8	Mahogany	
2	Cleats	7/8	7/8	18 7/8	Mahogany	

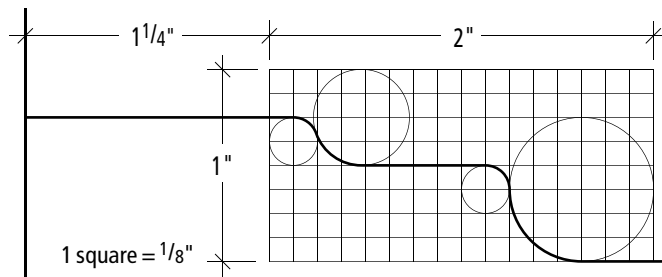


More Mortises per Hour

The fence for the plunge router was used to locate the distance in from the edge of the leg to the mortises. In order to set the beginning and end of each mortise, I added a sub-base to the router as shown below, and attached a 1/2"-square block of wood to the sub-base. This size block matched the diameter of the bit I was using. I placed it in line with the router bit and square to the fence. The template was made to the exact length of the leg, with the notches

cut at the end points of each mortise. After the notches were cut, I added a stop to locate the template at the top of each leg.

I took the four outer legs, and with a lumber crayon, marked the general location of the mortises on adjacent corners. I marked the four inner legs on opposite sides. These marks were to keep straight which surfaces were to be mortised. The exact locations of the mortises would come from the template without my needing to locate and mark each one.



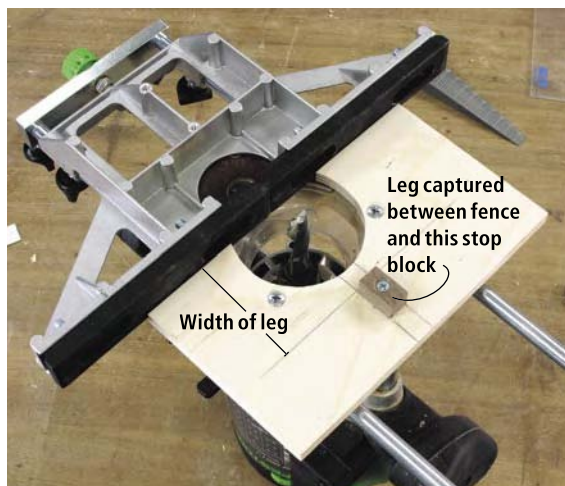
Full-size cloud lift pattern

I put each leg, along with the template in my bench vise, with the surface to be mortised facing up. I then routed the mortises, plunging back and forth until I reached the final depth of 1 1/4\".

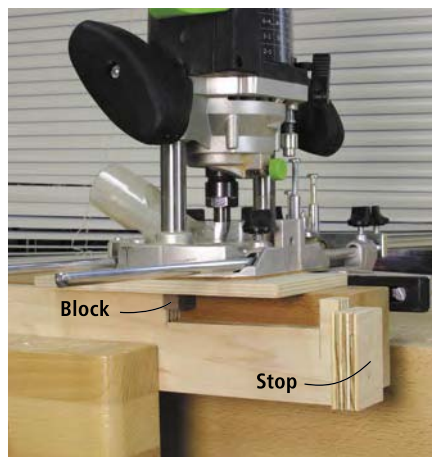
I cut all of the tenons on the rails with a jig on the table saw, coming in 3/16\" from each face and 1/2\" from each edge to form the tenons. I used a rasp to round off each of the tenon shoulders to match the rounded ends of the mortises I routed earlier.

To make the cloud lift patterns on the center rails, I made a template out of 1/2\"-thick plywood, carefully filing the inside and outside curves at the corners. I then rough cut each of the cloud lifts with the band saw, and used the template and a 1/4\"-diameter flush trimming bit in the router to cut each rail to the pattern.

I fit each of the tenons, trimming with my shoulder plane, and then made a dry run assembly of the entire base of the table.



The small block on the sub-base is the same size as the bit, placed farther away than the width of the leg from the fence.



The block is lined up with the bit so that the template can be made to the exact size and location of the mortises.

With the template and the leg held in the vise, the fence on the router places the cut laterally, and the block hits the template to locate the ends of the mortises.

Using this method allowed me to mill all 32 mortises quickly and precisely, without doing any layout work on the legs.



Productive Method for Plugs

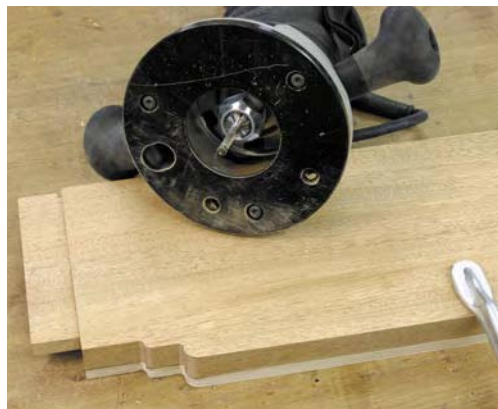
With 64 square plugs to make for the table base, I didn't want to lay out the location of every hole. So I made a template the width and height of the legs and marked out the center points of each of the plugs, drilling a 1/8\"-diameter hole at each of these points. I marked all of the legs by sticking my awl through each hole and into the face of the leg.

With a 3/8\"-diameter Forstner bit in my drill press, set to bore 1/4\" deep, I drilled a hole for each of the square plugs. I could have made these holes with the mortiser, but with some of the squares offset 1/8\" from the others, I didn't want to set up the mortiser fence three times. With the center points marked from the template, I saved time.

To make the holes square, I took a worn out $\frac{3}{8}$ " chisel from the mortiser, ground the points off the end, and with a conical bit in a Dremel tool, sharpened the back of each corner of the chisel. I clamped a scrap of plywood to the face of each leg with its edge tangent to each row of holes as shown below right. This kept the chisel square to the edge of the legs, and with a few smacks of the hammer the round holes were now square. I could have used a standard chisel and made four cuts on each hole, but this would have taken four times as long.

The bottoms of the legs were radiused with a 2"-radius round-over bit. I set up the bit in the router table, so that the radius ended $\frac{3}{4}$ " up from the bottom of each leg and $\frac{1}{4}$ " in. Using a thick block of wood to back up the legs, I moved each edge of the leg bottoms across the bit as seen on page 42.

Before finish sanding all the parts to #220 grit, I used a round-over bit in my router to ease all of the edges to a $\frac{3}{16}$ " radius on the legs, and a $\frac{1}{8}$ " radius on the rails and edges of the tabletop.



A small-diameter flush-cutting bit follows the template and shapes all of the cloud lifts accurately and identically leaving only minimal sanding to be done.



The tenons are adjusted to fit with my shoulder plane. A piece of scrap plywood attached to the bench acts as a bench stop to hold the work.

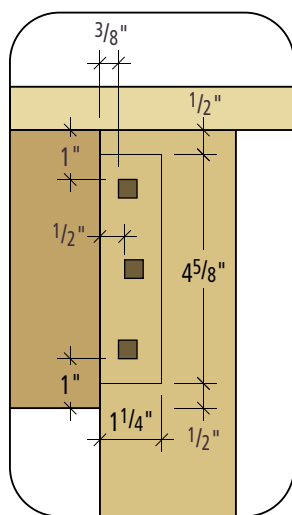
Not Ebony, but Ebonized

In original Greene and Greene furniture the square plugs were made of ebony, but I decided to use walnut, ebonizing them with a solution made from vinegar and steel wool. I took a pint of white vinegar and dropped in a shredded pad of steel wool. After letting this soak for several days, I strained the liquid through a coffee filter to remove any metal.

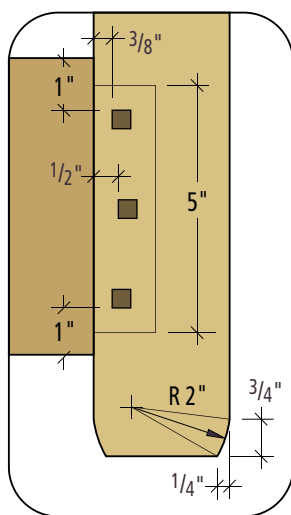
Because I would be coloring the legs and the plugs separately, I wanted to shape the plugs and cut them to finished length before putting them in place.



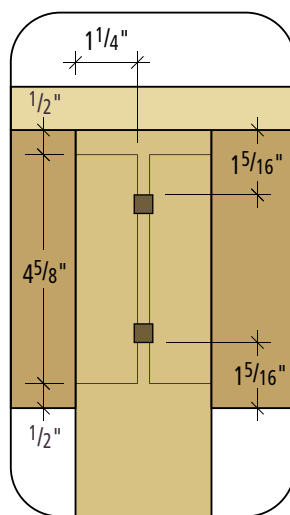
A modified chisel from a hollow chisel mortiser turns round holes square with just a few hammer taps. Plywood clamped to the leg keeps the chisel straight.



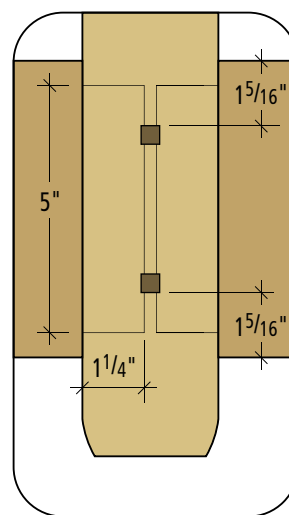
Plug pattern A



Plug pattern B and
bottom of leg detail



Plug pattern C



Plug pattern D



Just a portion of a 2"-radius roundover bit shapes the bottoms of the legs.



A piece of plywood clamped across the top guides the router to cut the tongue for the breadboard ends.

To make the plugs, I ripped strips about $\frac{1}{64}$ " over the size of the $\frac{3}{8}$ " square holes. Using the miter gauge on the band saw I cut 1" long blocks. These were long enough to round over and bevel the ends before cutting them to final length. I put a slight dome and bevel on each end of the 1"-long blocks with a quarter-sheet pad sander, and set up a stop block on the miter gauge for the bandsaw $\frac{5}{16}$ " away from the blade. Carefully holding the blocks against the miter gauge with the point of an awl, I cut them to length.

The last step was to put a small chamfer on each of the back edges with a chisel. The chamfer let me get the plugs started in the holes before driving them in with a dead-blow mallet.

The top was glued up from three 1"-thick boards, and after surfacing it to $\frac{7}{8}$ ", I trimmed it to length. Each end of the top has a $\frac{1}{4}$ "-wide by $\frac{3}{8}$ "-long tongue to hold the breadboard ends. I clamped a piece of plywood across the top to serve as a straightedge for the router to mill the tongues, as shown above right.

I used a $\frac{1}{4}$ " straight bit in the router table to cut the groove in the center of one edge of the 1"-thick end pieces. I then raised the bit to 2" above the table to cut the $\frac{5}{8}$ "-deep slot in the end of the breadboard to receive the splines. The last slot to cut was in the top for the other end of the splines. This was made with a slot-cutting bit in my hand-held router.

I made the first spline, and I used it as a pattern for the remaining three. I cut the splines a little oversized on the band saw and then fixed them to the pattern with double-sided tape. I used the flush-trim bit in the router to make exact copies of the splines. With a little sanding on the edges, and a few strokes of my block plane to adjust the thickness, the splines were ready to be ebonized.

The breadboard ends are held to the ends of the tabletop with #8 x $3\frac{1}{2}$ " screws. I drilled oversized holes through the ends, and moved the bit side to side in the two outer holes to elongate them. With glue applied only to the middle 6" of the tongue, I put the ends in place, temporarily inserted the

splines to align the breadboard ends and tightened the screws.

Authentic Color Uncovered

One of the most interesting discoveries I made on the Greene and Greene Virtual Archives was a recipe for the finish for the furniture from another house. I have always admired the rich, vibrant color of the mahogany in origi-

SUPPLIES

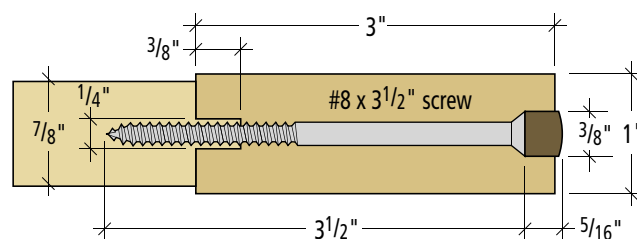
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nal Greene and Greene furniture, something rarely seen in most reproductions of their work.

The formula called for a treatment of potassium dichromate applied "as work proceeds" followed by a "filler" composed of four colors mixed in linseed oil. Potassium dichromate is a powerful oxidizer and must be handled carefully. I wore a respirator while mixing it and gloves while applying it. After experimenting, I used a solution of $\frac{3}{8}$ ounce of powder to a quart of distilled water.

For the colors, I used artist's oil colors. Chrome Yellow ($3\frac{1}{2}$ parts of the formula) and Raw Umber (3 parts) were easy selections. White Lead ($2\frac{5}{8}$ parts) is no longer made, so I used Titanium White. The last color listed was Sylvan Green ($\frac{1}{8}$ part), and I couldn't find an oil color with this name. Because it was a small part of the original mixture, I took a guess and used Hooker's Green.



Breadboard-to-top connection



The breadboard end is attached to the tabletop with screws and the ebonized walnut spline is glued in the slot in the table only.



The solution of potassium dichromate oxidizes the mahogany, turns it a rusty orange color and gives it an aged patina. After this treatment, a green stain made of artist's oils and Danish oil is applied.

I squeezed out the colors in the proportions given on a scrap of plywood and mixed them together with a pint of Danish oil. Following a recipe, I hadn't thought about what color would be the result. I was expecting a rich, reddish brown and was surprised to see a shade of green I haven't seen since my son has been out of diapers.

I was ready to abandon the experiment because of the horrendous color I had mixed, but curiosity won and I tried it on my sample board. After wiping off the excess, I was pleased to find a truly wonderful color and sheen on the

mahogany, as shown above. What first appeared as a mistake makes sense technically. On a color wheel, the red from the chemical treatment and the green from the stain are opposite each other, producing a perfect color.

Finish Now, Assemble Later

Before I did any assembly work, I brushed on the potassium dichromate solution and wiped each part dry. Letting the parts dry overnight, I applied the stain I had mixed, waited about five minutes and wiped off the excess. Doing all of the color work before assembling



After wiping off the excess, the mahogany is left a rich, reddish brown color. This is the same technique used in original Greene and Greene furniture. After the stain dries, three additional coats of oil are applied.

bly let me get an even coat on all the surfaces of all the parts. This saved me from reaching in and around the legs and rails on the assembled table base.

After letting the color coat of oil dry overnight, I assembled the table base in stages. I first glued and clamped the four pairs of outer and inner legs. After these had been in the clamps for an hour, I glued the longer center rails in between each subassembly, as shown at left. Finally I glued the four end rails between the front and back assemblies to complete the base of the table.

With the table base together, I drilled 1/4"-diameter holes through the mortise-and-tenon joints in the central plugs of the outside legs. I inserted 1 1/4"-long dowels in each of these holes, driving the ends flush with the bottom of the square holes.

I dipped the plugs in my ebonizing solution and applied it to the visible parts of the splines with a brush. After these small parts were dry, I put a small amount of glue on the end of each plug and drove them into place, as shown at right. The splines were driven into their slots after I applied glue to the slots in the top only.

I screwed 7/8"-square cleats to the inside of the two end rails, and to the two long front and back rails so that I could attach the top to the base with screws. With 107

parts now in their proper places, I gave the entire table three additional coats of Danish oil.

Greene and Greene hold an important place in the history of American design, melding the influences of the Arts & Crafts movement with Japanese design elements in a unique way. Making this piece provided an opportunity to practice authentic detailed work. Had I been working for the Hall brothers in 1907, with a houseful of trim and many more furniture pieces to go, I would have been just warming up. **PW**



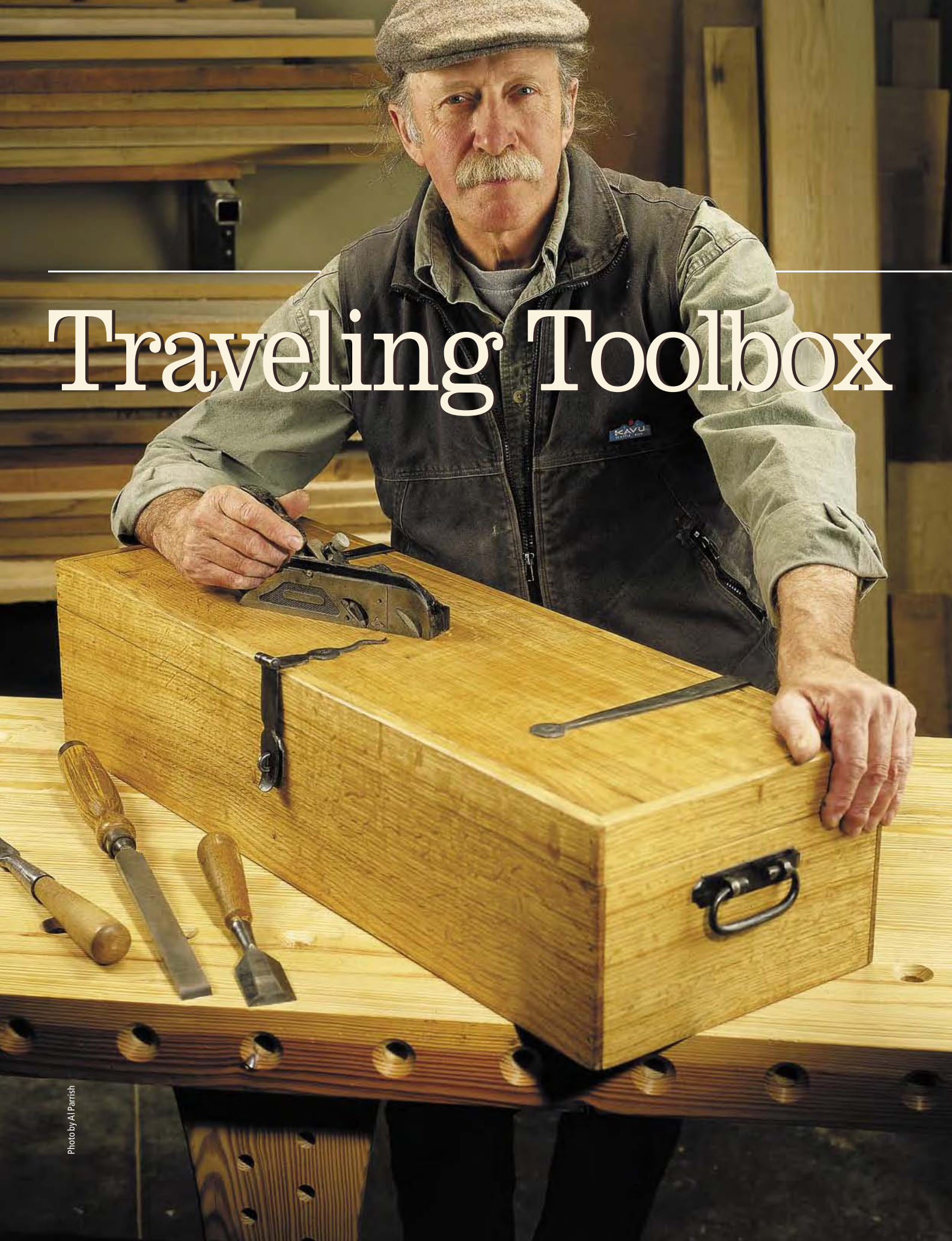
Once the coloring of the wood is complete, the table base is assembled in stages. Here I'm gluing the center rails between each subassembly.



A small, flat riffer is used to clean up the edges of the square holes. A slight chamfer on the back of the oversized square plugs gets them started in the holes before they are driven home with a dead-blow mallet.



Traveling Toolbox



Bodger and blacksmith Don Weber shows how to effectively combine power and hand-tool techniques to build a simple and sturdy toolbox.

I'm a bodger and a blacksmith, making tables and chairs in iron and wood. When I'm not in the shop, I'm journeying to woodworking shows to demonstrate the spring pole lathe or teach workshops in traditional woodworking and metal smithing. I travel quite a bit, and if you've ever watched the way the baggage handlers deal with your luggage, you'll understand why I built an oak box banded in iron to carry my woodworking tools.

The tool box described here was made of quartersawn oak from a winery in northern California. I've built instrument cases for rare and antique musical instruments, and I've found the lid moved considerably with humidity changes. So with this toolbox I've allowed the top and bottom to float in a groove in the sides and ends, much like a frame-and-panel door.

I had the oak boards resawn to 1/2" thick. All the joinery was done on a table saw with the help of a rebate plane (here in Amer-

ica we call a "rebate" a "rabbet," but I prefer the traditional English term, rebate), a Stanley No. 5 (jack plane) and a low-angle block plane. I reinforced the corners of the box with 1/8"-diameter locust pins because I forged corner brackets (not shown here) as well as the hinges, latch and handles. (I've been influenced by the Tansu hardware of Japanese chests.)

Edge Jointing by Hand

The top and bottom panels were made by gluing up two boards edge-to-edge. I prepare the edge for gluing with my jack plane (Mr. Jack, I call him). Cabinetmakers of old would use a longer jointer plane, but a board of this length can be accurately planed with the shorter jack. Use your fingers as a fence along the face of the board as you plane each edge. Check your results with a try square.

If you've done a good job with the plane, you should be able to create what we call a "rubbed" joint. This is where you glue each



I use my jack plane to joint the edges of the side boards. The plane's iron is slightly cambered across its width to allow me to correct an out-of-square edge.



When gluing up a panel, I rub the glue joint up and down to ensure a gap-free joint.

by Don Weber

Don Weber specializes in Windsor and Welsh-style stick chairs. Also a teacher and blacksmith, he currently resides in Paint Lick, Kentucky. You can visit his web site at handcraftwoodworks.com.

HAND-FORGED HARDWARE

I hand-forged the hardware you see here in my blacksmith shop. To learn more about my blacksmithing workshops, visit my web site at handcraftwood-works.com for class information.



To purchase hardware for your toolbox, check out these sources:

Ball and Ball

800-257-3711 or
ballandball-us.com

Horton Brasses

800-754-9127 or
horton-brasses.com

Whitechapel Ltd.

307-739-9478 or
whitechapel-ltd.com

edge and rub the mating edges together until the glue begins to set up. A clamp or two is a good idea while the glue cures.

Rebates by Hand and Power

I cut the rebates on the side pieces by first defining the joint's shoulder with my table saw and then reducing the thickness of the tongue with my rebate plane, a vintage Record No. 778. Set the height of the table saw's blade to half the thickness of the stock of the sides and ends, which is $\frac{3}{8}$ " in this case. Set the rip fence so your rebate will be $\frac{3}{4}$ " wide. Cut the shoulder on the ends of the sides. Now reduce the thickness of the joint with your rebate plane as shown in the photo below.

For those purists out there, you can cut the rebate entirely with a rebate plane (or a Stanley No. 10, a carriage maker's bench plane). Just be sure to use the plane's side nicks to score across the grain to prevent your grain from tearing out as you cut the joint.

The edges of the top and bottom panel were rebated all around in the same manner to fit in the groove cut in the sides and ends

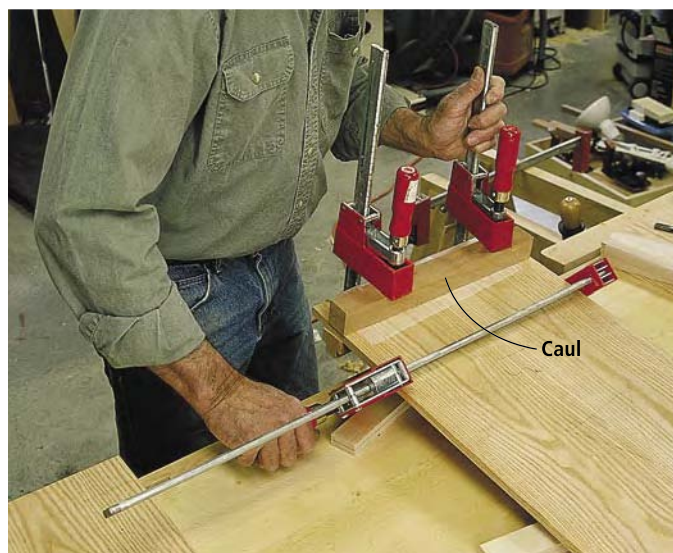
of the box. I set the raised portion of the panels so they are flush with the top and bottom edges of the sides. Note that the rebates on the ends of the panel are $\frac{3}{8}$ " wide. The rebate on the long edges is a different width, $\frac{1}{4}$ ". This arrangement allows the panel to expand across its width but not along its length. And that is proper cabinetmaking.

A small chamfer is planed

around the inner sides of the box frame, and the raised portion of the top and bottom to create a visual break when the panel moves with humidity variation.

Plowing the Grooves

The top and bottom panels are fit into the grooves in the sides and ends. You could cut this groove using your table saw. But if you have a plow plane (see "The Plow



A couple clamps across the joint are good insurance – even if you have a good edge joint. The cauls keep the panel flat.



Start the plane at an angle as shown. After each pass bring the tool a bit more level. This makes a square joint.



Chamfering the edges of the top and the raised panel with a block plane softens the look.

Plane” on page 48), this is the place to put it to use.

The plow plane is designed to cut grooves of different widths, which are varied by changing the cutter in the tool. The location of the groove is determined by the tool’s fence, which bears against the edge of the work during the cut. The depth of the groove is determined by the tool’s depth stop. Once the joint reaches its final depth, the tool will then cease to cut.

Glue, Drill and Peg

Glue and clamp the ends to the sides with the top and bottom panels in place. Be careful not to get glue in the groove or the panel can’t expand and contract as it needs. When the glue has cured, drill 1/8"-diameter holes in

the corner joints to accept the 1/8" locust pins.

The top is cut away from the glued-up box 1 1/2" from the top edge, using a table saw. After the first two cuts are made, wedges are inserted in the slots to keep the saw blade from binding. A few pieces of masking tape keep the wedges in place.

With the saw cut complete, clean up the tooling marks on the top and bottom using a plane, scraper or (my favorite) a small scraping plane.

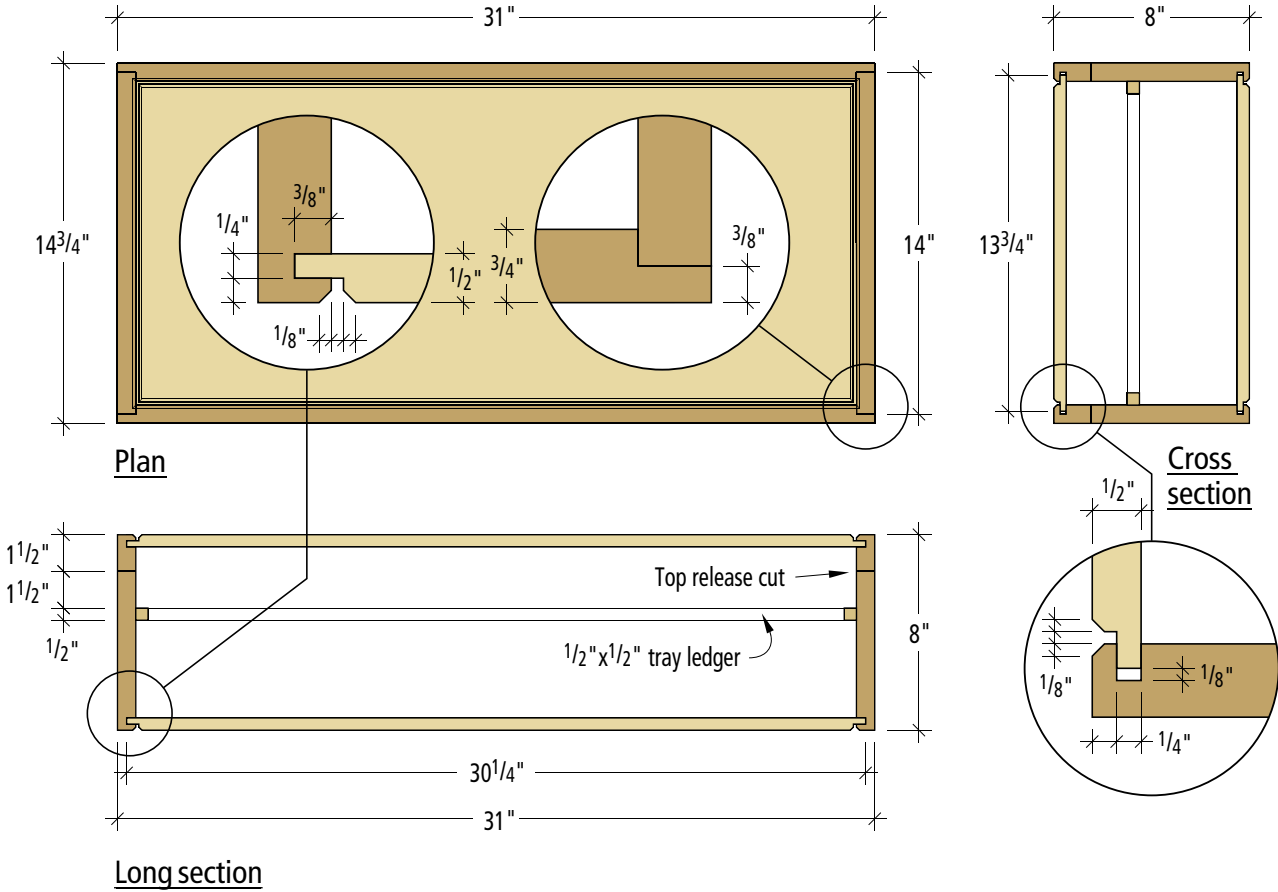
The hardware for my box was hand forged in my blacksmith’s shop, though there is some decent hand-wrought hardware out there (see “Hand-forged Hardware” at left for details). To fasten the handles to the box, I added a 1/2" x 1/2" ledger to the inside of the box



Here I’m using a hand drill (sometimes called an eggbeater drill) to bore the pilot holes for my locust pins.

TRAVELING TOOLBOX

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL
		T	W	L	
❑ 1	Top	1/2	13 3/4	30 1/4	Oak
❑ 1	Bottom	1/2	13 3/4	30 1/4	Oak
❑ 2	Ends	3/4	8	14	Oak
❑ 2	Sides	3/4	8	31	Oak



to strengthen the attachment of the handles as well as providing a ledge for a tray for small tools.

All surfaces were dressed with a cabinet scraper and finished with an oil varnish (one pint Marine spar varnish, one pint boiled linseed oil and enough gum turpentine to thin to the consistency of half-and-half).

Once rubbed up with a Scotch Brite pad and some Briwax, the job is done. I have done a lot of traveling with this toolbox, inevitably filling it with more tools than it should carry and it is still doing its job admirably. **PW**



Carefully part the lid on the table saw with wedges to hold the kerf open (left). Once the lid has been parted from the bottom, plane or scrape the sawn edges of the toolbox to remove the tooling marks (below).



THE PLOW PLANE

In this article I mention the use of the plow plane to create the grooves necessary to house the top and bottom panel of the tool chest. Here are several passages from the book "Planecraft: Hand Planing by Modern Methods" by C.W. Hampton & E. Clifford (C. & J. Hampton), originally published in 1934. My edition was published by Woodcraft Supply in 1972.

"The modern joiner and cabinet-maker accept the plough as an essential tool in the kit, for without a tool that will make a groove of some sort all work would be very limited; yet there was a time when woodworkers had no such tool. Constructions prior to the 15th century are without grooves. How is it then that the plough has become so necessary a tool since that time?

"Probably in no better way is this question answered than in the evolution of the chest – that simple box-like structure from which practically all our modern furniture can trace its ancestry. Chests may be traced back to the 13th century, many of the earlier ones being laboriously "dug out" from a solid baulk of timber, and strongly bound (for conditions were rugged, rough, and precarious in those days) with iron bands. A natural progression from this was a chest nailed up from boards;

and a few such chests are still preserved in some of our churches and museums. If an examination of these is made, it will be found that, as a rule, the front and back and the bottom are single boards with the grain running vertically; and it will be found in most cases that the front and back boards are split. This of course is natural, and to be expected, for wood naturally shrinks across the grain, but very little along the grain, and as the boards of the front are nailed across the grain, but very little along the grain, and as the boards of the front are nailed across the vertical long grain ends, when shrinkage occurs, something has to give way. Hence the carpenter sought out a way of preventing this damage.

"The practical outcome was the invention of a panelled construction, a construction which is standard practise to this day. If

the wood could be free to shrink (and for that matter to expand also – as in a moist atmosphere) the problem was solved; and a frame, grooved for a panel, offered the solution. So in the 16th century we find chests the back and front of which are panelled, whilst the ends remained solid ... Perhaps the first grooves were made with a scratch tool, for the ancestry of this tool goes far back – it was used for mouldings long before moulding planes were common. Yet a scratch tool has its limitations, and it is never a happy tool to use in any case, and so a plough plane made its appearance."

The plow plane is a chisel-like plane with an adjustable fence and depth stop. The wooden variety had wooden threaded rods extending from its sides to secure the fence so that the groove could be set a fixed dimension from the edge. The Stanley No. 45 and No. 55

were metal versions of the old wooden plow planes, kind of like a pair of skates with a tooth sticking out the bottom, and lots of adjustment screws, etc. Most of the cutting was done with the grain. But with the use of spurs (also called nicks) attached to the side of the plane it would score the wood across the grain as well. You could cut a groove with a marking gauge (to define the shoulders) and a chisel (to remove the waste between the lines). —DW



Photo by Al Parrish

WOODWORKING ESSENTIALS

BY NICK ENGLER

CHAPTER

5

Advanced Joinery

In Chapter 3 of this series we discussed basic joinery on the table saw, including miters, bevels, rabbets, dados and grooves. In this chapter we're going to take those concepts a step further. Essentially we'll be using the same techniques. These joints simply require a little more thought before you begin. We'll be looking at compound miters, tenons, dovetails, lock joints and splines.

Each of these joints can be created using tools other than the table saw. Some might even argue that they can be made more easily on other tools. For example, compound miters can be easily created using a miter saw. Tenons, dovetails (with the help of a jig), lock joints

and splines can be handily created using a router or a router table.

But why buy extra machinery, tools and jigs if you don't have to? All of these joints can be easily achieved with your best friend, the table saw.

Compound Miters

To start we'll take a look at compound miters on the table saw. While regular miter joints are a mainstay in picture framing, if you want to make a more complicated, three-dimensional frame

you need to cut a compound miter. Useful for much more than picture framing, the compound miter joint is probably most commonly used in forming corners for crown moulding. This joint can be accurately created on the table saw with just a little help from mathematics.

To cut a compound miter on a table saw you need to both tilt the blade and angle the miter gauge for each cut. When two boards are joined by compound miters, the boards slope, rather than rest on an edge or a face. This

PRO TIP:

1-2-3 Crown

When adding crown moulding to a cabinet, start by cutting the compound miter on one end of the front piece, then allow plenty of length and rough cut the other end a bit long. Then cut the appropriate compound angle on both short return pieces for the sides, again leaving plenty of length to the back of the cabinet. Use one return moulding to align the front moulding (forming the complete compound miter), then mark the exact location of the second miter cut on the front piece. Attach the front moulding, then simply mark the square cut on the back of each return, make the cuts and attach.



Photo by Al Parrish

TIPS & TRICKS

PRO TIP:

Choose Your Blade



Fitting tenons into mortises can be a little tricky, but by using the right blade you can make it easier. If you know you can cut a tenon to fit perfectly, then using a ripping blade (or flat-bottomed dado) to form the cheeks makes good sense. But if you want to make your tenon oversized and sneak up on the final fit with a shoulder plane, you don't want to have to plane too much material for fitting. Rather, use a crosscut blade to form your oversized tenon. The tooth configuration on the blade will leave a corduroy-type finish on the tenon cheeks with hills and valleys. Planing away only the hills to get a perfect fit is much easier.

SMART TIP:

Easy, Cheap Clamping

You'll notice I used simple tape to hold together my compound miter test at right. Tape can come in handy after the test as well. When you're assembling odd-shaped pieces such as a six-sided compound miter shape it's nearly impossible to put clamps on the piece. Go ahead and use tape instead. Lay the pieces to assemble with the miters facing down. Butt the joints together and put tape across the joint. Repeat this for all but the last joint. Then carefully flip the taped pieces, add glue and fold the shape, taping the last joint. The pressure exerted by the tape as the joints close will be plenty adequate to hold everything together.



To make a compound miter, angle the miter gauge and tilt the blade. Compound miters are used to join boards whose faces slope, such as crown moldings.

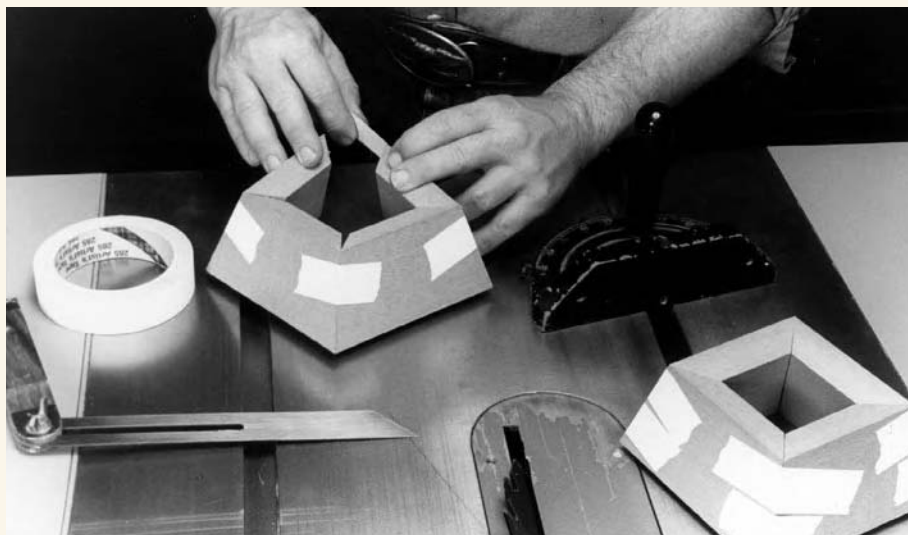
slope and the number of sides of the frame determine the necessary blade tilt and the miter gauge angle. (See the chart at right to find the settings needed for different frames.)

A standard crown moulding (fitting in a 90° inside or outside corner) commonly has a 45° slope. Reading our chart, for four-sided miters, we come up with a blade bevel angle of 30° and a miter gauge angle of 54.74°.

Before committing to the compound-miter setup called out on the chart, make a sample to check your angle. Cut some small scrap pieces using the recommended angles. Cut enough to complete your test shape. To make matching left

and right compound miters, flip each board face for face so that a different edge rests against the miter gauge and a different face rests against the table when cutting each end.

After cutting all the compound miters, tape the pieces together to complete the frame and inspect the joints. If the joints gap on the inside, decrease the blade tilt. If they gap on the outside, increase the blade tilt. If the slope is greater than you expect it to be, decrease the miter gauge angle. If it's less than expected as measured from horizontal, increase the angle. Just make sure you don't change any one setting more than 1/2° between tests.



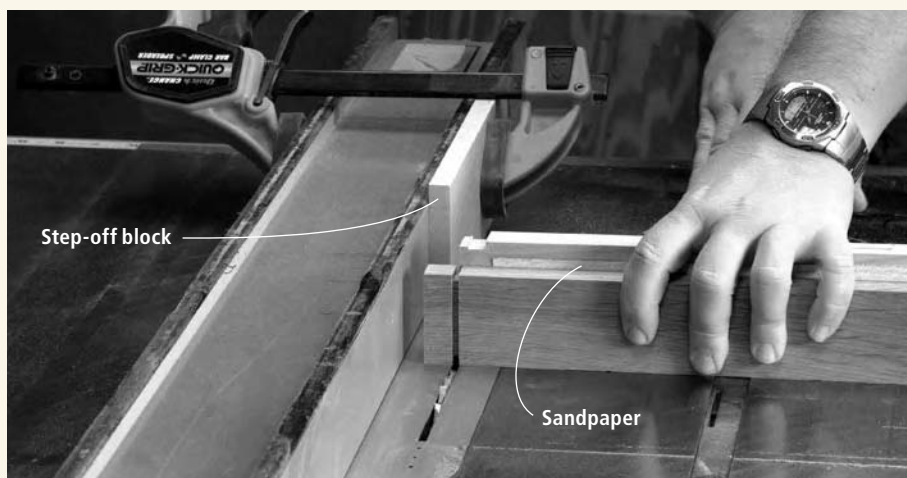
To test a compound miter setup, cut enough sample pieces to form your ultimate shape. Cut all the pieces to the same length so you can complete a small frame. Tape the parts together, then inspect the joints and measure the slope.

Another way to calculate compound miters is with a scientific calculator (about \$9 at most office supply stores) with SIN, COS, TAN and INV buttons. On some calculators, the INV button is labeled FUNC or the key is blank. If you have a computer and use Microsoft Excel software, you can download a simple Compound Miter Calculator that I wrote. Visit popwood.com and click on the "Magazine Extras" link.

Tenons

When it comes to reliable joinery the mortise and tenon is excellent for frames, including table bases, doors and cabinetry. The male part of the joint, the tenon, is easily made on the table saw.

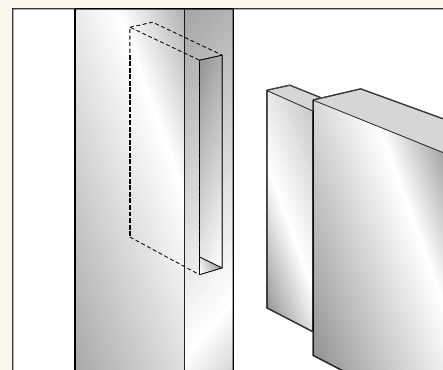
First, the shoulders of the tenon are cut using a miter gauge to guide the workpiece. Depending on the required dimensions of your tenon, you may be able to make all four shoulder cuts without changing the saw setup. Traditionally a tenon is half the thickness of the workpiece. With a $\frac{3}{4}$ "-thick piece of wood that would require a $\frac{3}{8}$ "-thick tenon. This leaves a $\frac{3}{16}$ " shoulder on the



Defining $\frac{3}{16}$ " shoulders on all four sides of a tenon is simple. The piece is run over the blade using a miter gauge. I've added sandpaper to the face of the miter gauge to keep the piece from slipping. I'm also using a step-off block that allows me to set my fence to align the cut, but as the miter gauge moves forward, the block stays behind to avoid kickback if the piece binds.

two wide sides of the tenon and that's usually a perfectly good size for the two narrow shoulders as well.

With the shoulders defined it's time to cut the cheeks. There are a few ways this can be tackled on a table saw, primarily either with the piece held vertically or horizontally. To cut the cheeks horizontally, a dado cutter works well and will accurately center the tenon. Another advantage to using this accessory is that you can cut both a shoulder and a cheek in one pass. If you don't own a dado cut-



Mortise-and-tenon joint

Compound Miter Chart for the Table Saw

SLOPE°	4 SIDES BUTTED		4 SIDES MITERED		5 SIDES MITERED		6 SIDES MITERED		8 SIDES MITERED	
	MITER ANGLE	BEVEL ANGLE	MITER ANGLE	BEVEL ANGLE	MITER ANGLE	BEVEL ANGLE	MITER ANGLE	BEVEL ANGLE	MITER ANGLE	BEVEL ANGLE
0			45	90	54	90	60	90	67.5	90
5			45.11	3.53	54.1	2.94	60.09	2.5	67.58	1.91
10			45.44	7.05	54.42	5.86	60.38	4.98	67.81	3.81
15			45.99	10.55	54.94	8.75	60.85	7.44	68.19	5.69
20			46.78	14	55.68	11.6	61.52	9.85	68.73	7.52
25			47.81	17.39	56.64	14.38	62.38	12.2	69.42	9.31
30	49.11	48.59	49.11	20.7	57.82	17.09	63.43	14.48	70.27	11.03
35	50.68	42.14	50.68	23.93	59.24	19.7	64.69	16.67	71.26	12.68
40	52.55	35.93	52.55	27.03	60.9	22.2	66.14	18.75	72.4	14.24
45	54.74	30	54.74	30	62.81	24.56	67.79	20.71	73.68	15.7
50	57.27	24.4	57.27	32.8	64.97	26.76	69.64	22.52	75.09	17.05
55	60.16	19.21	60.16	35.4	67.38	28.78	71.68	24.18	76.64	18.26
60	63.43	14.48	63.43	37.77	70.04	30.59	73.9	25.66	78.3	19.35
65	67.09	10.29	67.09	39.86	72.93	32.19	76.29	26.94	80.07	20.29
70	71.12	6.72	71.12	41.64	76.05	33.52	78.83	28.02	81.94	21.07
75	75.49	3.84	75.49	43.08	79.35	34.59	81.5	28.88	83.88	21.7
80	80.15	1.73	80.15	44.13	82.81	35.37	84.27	29.52	85.89	22.12
85	85.02	0.44	85.02	44.78	86.38	35.82	87.12	29.87	87.93	22.43
90	90	0	90	45	90	36	90	30	90	22.5

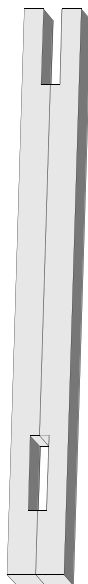
Note: The slope is measured from horizontal, with the assembly resting on a bench or work surface.

TIPS & TRICKS

PRO TIP:

No-mortiser Mortise

Large through-mortises in furniture can be time consuming and require equipment (a mortiser and appropriate chisel) that you might not own. These types of mortises often occur in table legs and there you're in luck. You can build the mortise into the leg and use your table saw to make it. Most trestle-style legs are too large to be cut from one piece of wood, so a glue-up is required. By running matching, wide dados in the leg halves prior to glue-up, you can make almost any size through mortise with a minimum of effort.



PRO TIP:

Dedicated Dovetail Blade

If you do a lot of dovetailing on the table saw, you may find it convenient to have a blade modified specifically for the task. Have your sharpener grind the teeth of a rip or combination blade so all the teeth are angled at 10° (be sure to indicate which way your saw tilts). This will allow you to cut right to the shoulder line on the tail board, saving a lot of handwork. You'll still be able to use the blade for most regular work. — *Excerpted from Cutting Edge Table Saw Tips & Tricks, by Kenneth S. Burton (Popular Woodworking Books).*

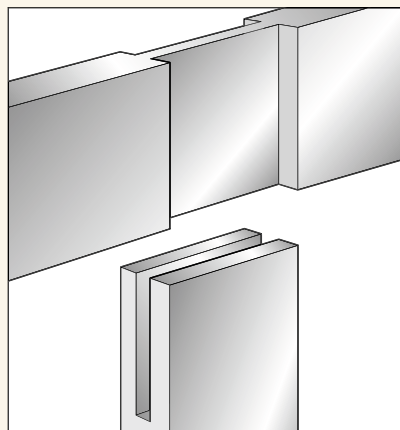


Cutting a tenon vertically on the table saw is really only safe if the piece is held tightly in place during the cut. A simple shop-made tenoning jig like the one shown here locks the piece in place quickly with the snap of the toggle clamp's lever. My tenoning jig is designed to straddle my rip fence, adding even greater stability and control during the cut.

ter, a single blade can also be used by making repeated cuts to nibble away the waste. It's slower, but it still works.

To cut the tenon in a vertical manner I recommend using a tenoning jig that holds the piece tightly in place, as shown above. Another advantage to a tenoning jig is it also guarantees a centered tenon. The piece is flipped to cut both cheeks, but the jig remains in place, centering the tenon. You should always make a sample piece to test-fit the tenon to its mortise and adjust the setup as needed.

While you can't make a mortise on a table saw, you can make a variation on the traditional mortise-and-tenon joint known as the bridle joint. This joint leaves the mortise and the tenon visible from the ends of the adjoining boards.



Bridle joint

Illustration by Len Churchill

While not as strong as a true mortise and tenon, it greatly simplifies the mortising operation and both parts can be cut with a single setup on the table saw using a tenoning jig.

The bridle joint shown below is designed for joining a rail to the center of another piece. If the top piece were trimmed away at the left end of the joint, you could easily form the corner of a door frame. All of this can be done on the table saw and without having to fuss with cutting a mortise.

Dovetails

Dovetails on the table saw? Not possible! At least you might think so, but if you're making through dovetails (dovetails that allow the joinery to be visible from both sides of the joint), it can be done.

Jim Stack, an accomplished woodworker and author, shared his method for through dovetails on the table saw. The trick is all in a special sled specifically designed to keep everything aligned during the cuts.

You still need to lay out your dovetails as you would with any dovetail jig, but with this method you're not limited by templates and you can make the pins as thin as you'd like without the worry of fitting a router bit into the opening. The page at right shows you how to make the jig and how to put it to work. I'm afraid we're still working on a method to cut half-blind dovetails on the table saw.

TABLE SAW DOVETAILS

The table saw is great for cutting dovetails because it can cut straight and square. You can create the look of a hand-cut joint by using this two-sided sled and a rip blade.

1. Use three #6 x 3/4" wood screws to attach the hardwood miter guide to the bottom of the base at dead center.
2. Use #8 x 1 1/2" wood screws to attach the angled fences to their mounting cleats and cut a 10° angle on the each end.
3. Draw a line down the center of the base and screw the assemblies to the base.
4. Attach the blade-guard blocks behind the angled fences. Then put the jig in one of the miter slots on your table saw and mark where the blade meets the base. Attach a blade-guard

block behind the fence at this location. Put the jig in the other miter slot and repeat the process.

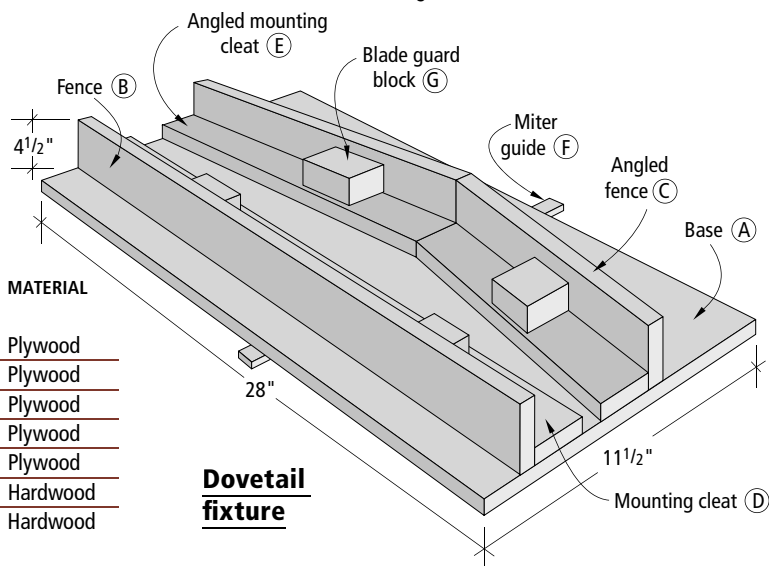
5. Screw the straight fence to its mounting cleat, then screw one end of the mounting cleat to the base, allowing the fence to pivot until you square this fence to the blade. With the jig in one of the miter slots, hold a framing square against the long fence and line up the other arm of the square with the saw blade. Screw the assembly in position.

6. Attach the blade-guard blocks to the straight fence in the same manner that you did with the angled fence. Use glue and screws.

7. Set your saw blade so it's square to the table and about 1" above the base of the jig. Cut a kerf into each angled fence. Don't cut all the way through the blade-guard blocks.

8. Turn the jig around and bevel your saw blade to 10°. Cut this angled kerf into both sides of the straight fence.

— Jim Stack

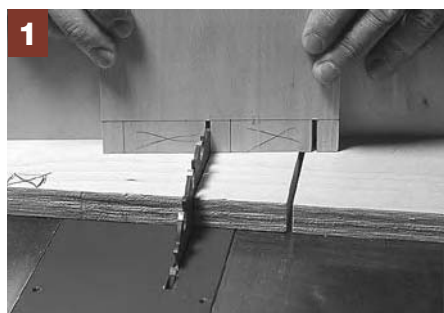


DOVETAIL FIXTURE

NO.	LET.	ITEM	DIMENSIONS (INCHES)			MATERIAL
			T	W	L	
1	A	Base	3/4	11 1/2	28	Plywood
1	B	Straight fence	3/4	4 1/2	28	Plywood
2	C	Angled fences	3/4	4 1/2	14	Plywood
1	D	Straight mounting cleat	3/4	2	28	Plywood
2	E	Angled mounting cleats	3/4	2	14	Plywood
1	F	Miter guide	3/8	3/4	13 1/2	Hardwood
4	G	Blade-guard blocks	1 1/2	2	3	Hardwood

To Cut Your Dovetails:

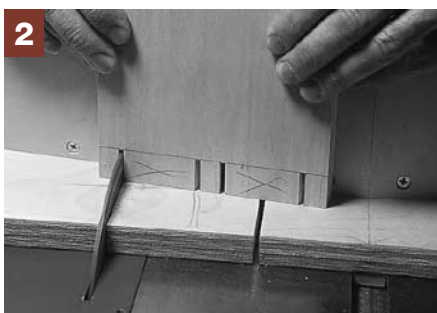
Illustration and photos by the author



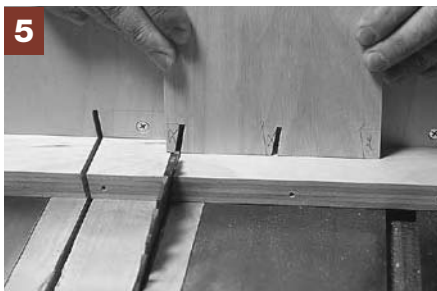
Lay out the pins on the end and both faces of the workpiece. Be sure to mark the waste material. Set the saw blade height to the thickness of the stock. Using the angled fence on the fixture, make your defining cuts for one side of the pins.



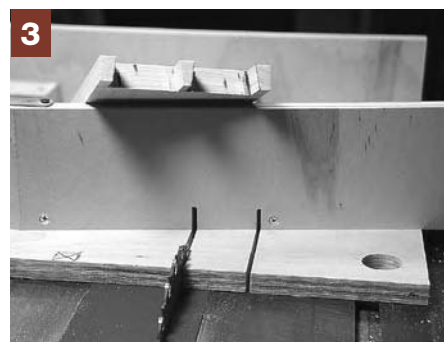
Use the pins as a template to lay out the tails.



Move the fixture to the other miter gauge slot, switch to the other angled fence and make the cuts on the other sides of the pins.



Tilt the blade to 10° and turn the fixture around so the straight fence faces the blade. Raise the blade to the material's thickness. Make the defining cuts on one side of each tail.



Nibble away the waste between the pins with repeated passes over the blade.



Flip the part face for face and make the defining cuts on the other side of the tails. Then clean out the waste. Clean out the corners of the tails with a chisel.

TIPS & TRICKS

PRO JIG:

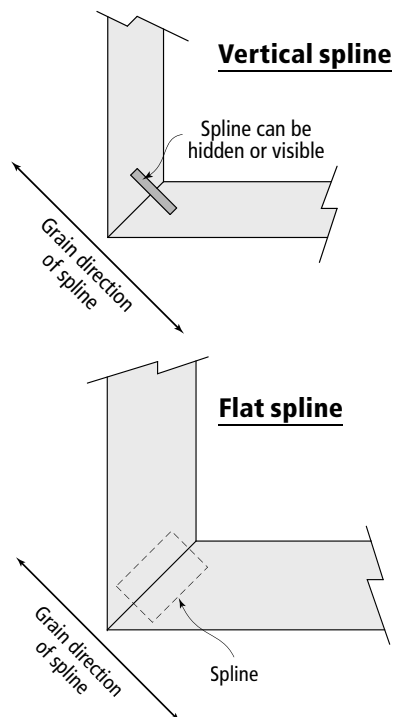
Joinery Dividers

Once you've mastered the lock joint, put it to work for the inside of the drawers as well. The same joinery technique can be used to add fixed dividers to any drawer or box. Simply space off the locations for the dado cuts, running both sides at the same time (to make sure they're even). Then run the tenon cuts on as many dividers as you need. This same concept can be used for curio shelving.

PRO TIP:

Spline Grain Direction

The grain in a corner spline should run across the joint for maximum strength. For a hidden spline, this means the length of the piece will be only about $\frac{3}{4}$ ", while the width will be considerably more. Rather than try to cut such a short, wide piece, make the splines from fairly narrow pieces and use as many as necessary to fill the groove. — *Excerpted from Cutting Edge Table Saw Tips & Tricks, by Kenneth Burton (Popular Woodworking Books).*

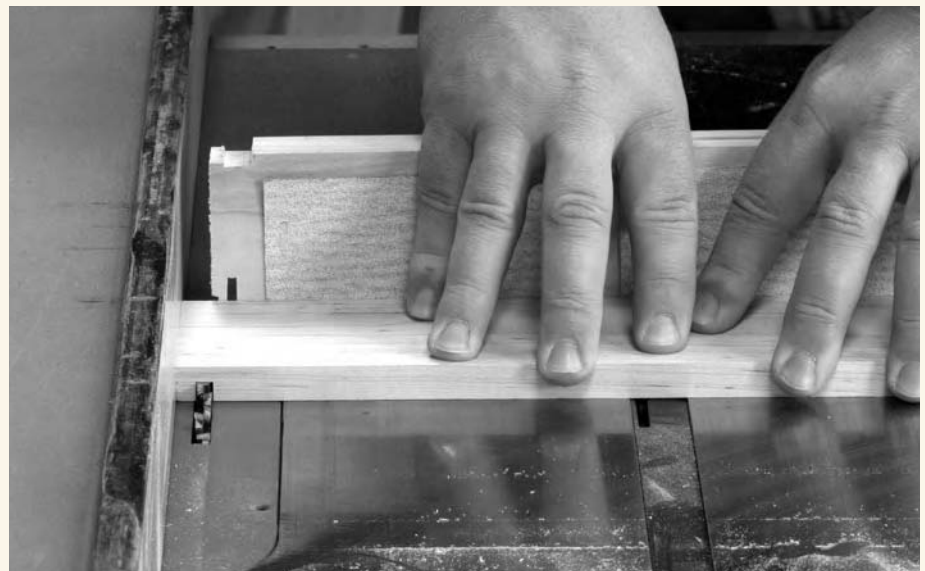


Lock Joints

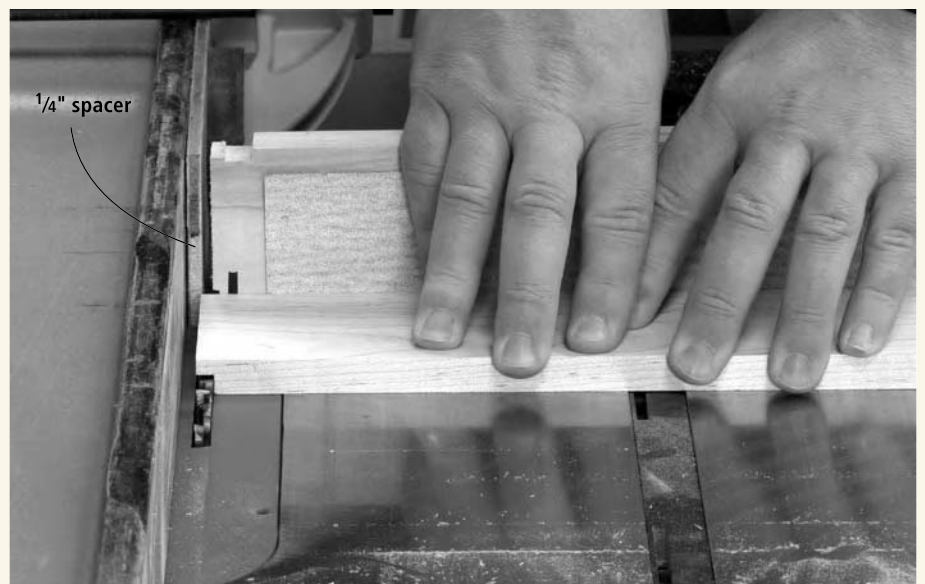
Similar to half-blind dovetail joints, lock joints (or locking tongue-and-dado joints) cannot be seen from one direction and are often used to assemble drawers. They're much easier to make than dovetails – you can cut them with a single setup on a table saw. The trade-off

is that they don't withstand shear stress as well as dovetails (the wood in front of the dado will shear off if you pull too hard on the drawer front). However, they are still a good choice for small drawers or drawers that won't see much use.

To make a lock joint, mount a dado cutter on your saw and adjust the depth



The first cut for the lock joint is made with the inside face of the drawer part flat against the table saw. The piece is slid snug against the fence to locate the dado $\frac{1}{4}$ " in from the end. The miter gauge must be set accurately at 0° and the fence exactly parallel to the blade to avoid binding.



A $\frac{1}{4}$ "-thick step-off piece is used to cut the tenon on the end of the drawer fronts and backs. Not only does this simple block add a bit of safety against binding, but it also allows you to make this second lock joint cut without having to reset the blade or fence.

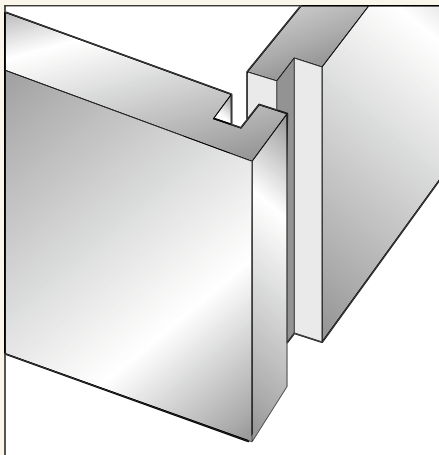


Illustration by Len Churchill

Lock joint

of cut to equal half the thickness of the board. As most drawer boxes are made of $\frac{1}{2}$ "-thick material, make the tongue and the thickness of the dado $\frac{1}{4}$ " thick. This works out fairly well for the dado stack as well, requiring only the two outer blades to make a $\frac{1}{4}$ "-wide dado. And as an added benefit you can actually set the saw and fence once for both cuts.

Using the fence and your miter gauge to guide the stock, cut the $\frac{1}{4}$ " x $\frac{1}{4}$ " dado in the workpiece. The stock is held flat against the saw table and snug against the fence face.

To cut the mating tongue section, you essentially want to shift your dado cut to the end of the board, rather than $\frac{1}{4}$ " in from the end. To do this, use a $\frac{1}{4}$ "-thick spacer against the fence.

Set the tongue board flat on the saw table as before, using the miter gauge again as your guide. Slide the board against the $\frac{1}{4}$ " spacer and then push the board forward toward the blade. The spacer remains behind, leaving a $\frac{1}{4}$ " space between your board and the fence face. Hold the piece tightly against the miter gauge and make your cut. That's all it takes – you have your $\frac{1}{4}$ " x $\frac{1}{4}$ " tongue that should fit your dado perfectly.

Splines

A spline is a small board, usually just $\frac{1}{4}$ " to $\frac{1}{8}$ " thick, that spans the joint between two boards. The spline rests in two matching grooves – one in each board.

You also can install a spline in matching rabbets or dados if needed. Splines can be made of solid wood, plywood or hardboard. Solid wood is best if the spline is decorative and the grain runs perpendicular to the joining pieces. Plywood is excellent when the top plys run with the grain of the joint making a good glue surface while the cross-grain plys add strength. Hardboard, which has no grain direction, is good for any grain direction.

Making a spline groove is no different than making an ordinary groove. Use a saw blade or dado cutter to cut a groove as wide as the spline is thick. Cut the depth about $\frac{1}{32}$ " more than half the spline's width to allow excess glue space.

If centering the spline is necessary, simply run the board twice with opposing faces against the fence. Start with the blade near center on the edge, then sneak the fence over till the groove is exactly the right width.

Dry-fit your spline. Half the spline should fit in one groove and half in the other, with just a little side-to-side slop. If everything checks out, spread glue on the adjoining surfaces, the splines and in the grooves, and assemble the joint.

The advanced spline joint is one used to reinforce miter joints. Depending on how a miter joint is oriented, you can run the splines either horizontally or vertically. Also, you can choose whether to cut the spline before or after you assemble the miter joint. Splined miters in which the grooves are cut after the parts have been assembled are sometimes referred to as open spline joints, because both ends of each spline are clearly visible. **PW**

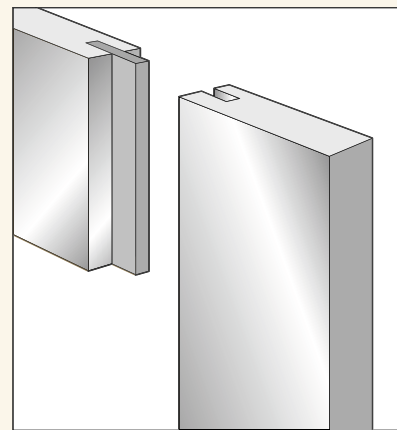
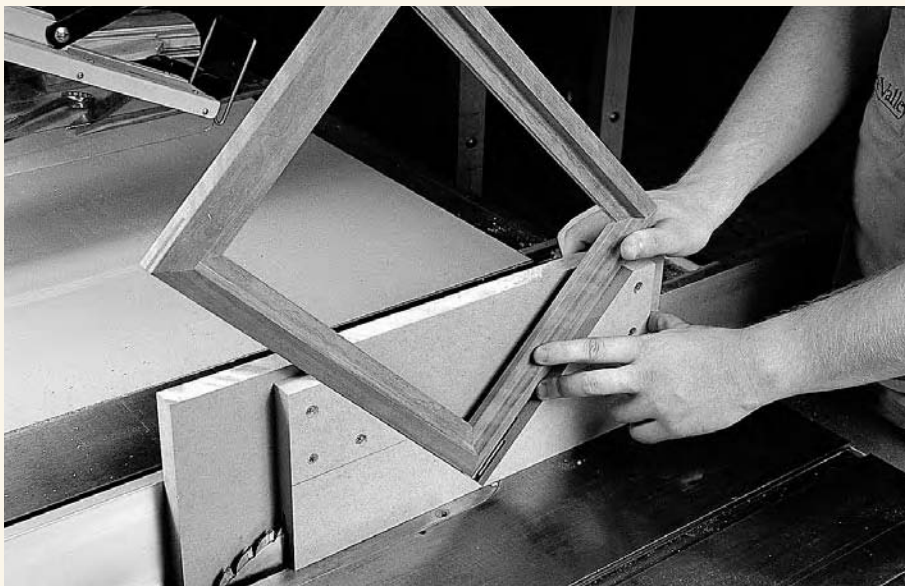


Illustration by Len Churchill

Spline joint for frames



For splines, make a quick carriage to help support the assembly as you move it past the blade. The blade height should be just shy of the joint's inside corner. For flat frames, you can saw right through the carriage's supporting pieces. Just be sure no screws are in the path of the blade.
– Excerpted from *Cutting Edge Table Saw Tips & Tricks*, by Kenneth Burton (*Popular Woodworking Books*).

Microadjustable Finger-joint Jig

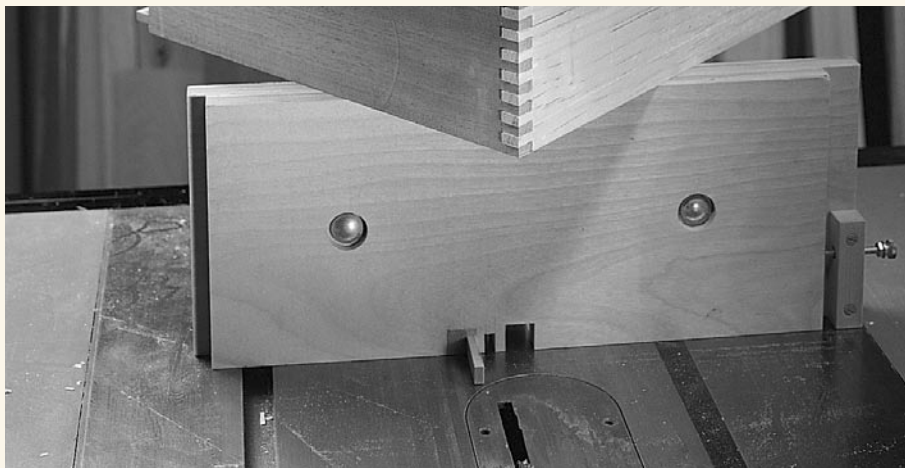


Photo by Al Parrish

This finger-joint jig is designed to make evenly spaced, square notches in the ends of adjoining boards, leaving multiple tenons that interlock to form a finger joint. A standard finger-joint jig has just three parts: a back that you attach to your miter gauge, a movable face that feeds the wood into a dado blade to cut the notches and a tenon that aligns the wood for each cut. To space the fingers properly you move the face right or left to adjust the space between the tenon and the dado blade. If the fingers are too close together, they will be too tight to assemble easily. If too far apart, the joint will be loose.

Positioning the face properly is often a frustrating loop of trials and errors. Cut a finger joint, test the fit, move the face, cut another joint and so on. By add-

ing one more part to this jig – a small wooden block that mounts a #10-32 machine screw and serves as an adjustable stop – you can make this adjustment simple and accurate.

Because the machine screw has 32 tpi, one turn will move it precisely $\frac{1}{32}$ "; one half-turn moves it $\frac{1}{64}$ "; one quarter-turn is $\frac{1}{128}$ ". When the flat head is resting against the face, the face will move a precise amount. No guesswork!

Make the tenon and stop from hardwood such as oak or maple. Drill a $\frac{5}{32}$ "-diameter hole for the machine screw and then cut threads in the hole with a tap. (You can purchase a #10-32 tap at most hardware stores.) To make it easier to turn the machine screw, simply install a knurled nut on the end and tighten a stop nut against it.

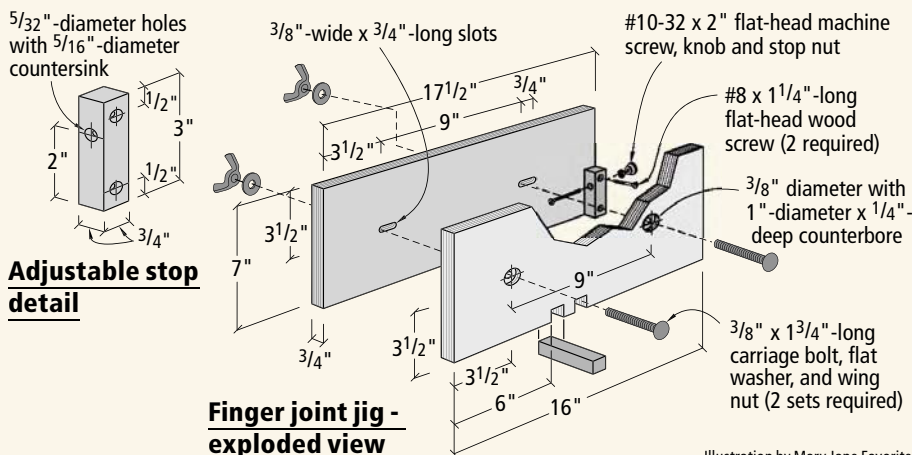


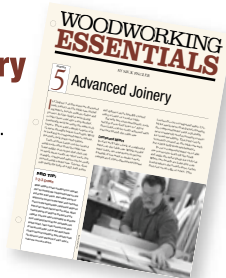
Illustration by Mary Jane Favorite

Everything you need to know about the table saw in our special series!

For woodworkers, the table saw is the most important machine in their shop. This series aims to give you all the information you need to get the most from this versatile tool.

Chapter 5 (#147) Advanced Joinery

A closer look at some of the more intricate joints to make.



IN PAST ISSUES

Chapter 1 (ISSUE #143) Intro to the Table Saw

An in-depth look at the basics of table saw setup.

Chapter 2 (#144) Using the Saw Blade

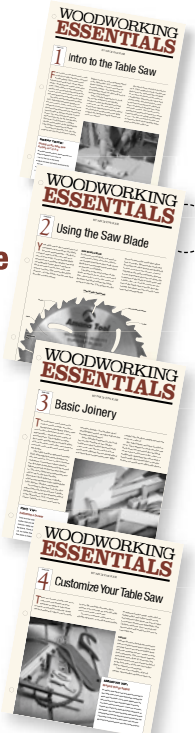
The most important part of the saw is the blade.

Chapter 3 (#145) Basic Joinery

The saw is great for making some simple joints.

Chapter 4 (#146) Customize Your Table Saw

Simple saw additions can greatly enhance your time in the wood shop.



IN FUTURE ISSUES

Chapter 6 (#148) Special Techniques

Learn how to turn your saw into a multi-faceted tool.

Chapter 7 (#149) Advanced Techniques

Do things you never even imagined with your saw.



Total Shop in a Box

Can a system of portable European power tools find a home in U.S. woodshops?

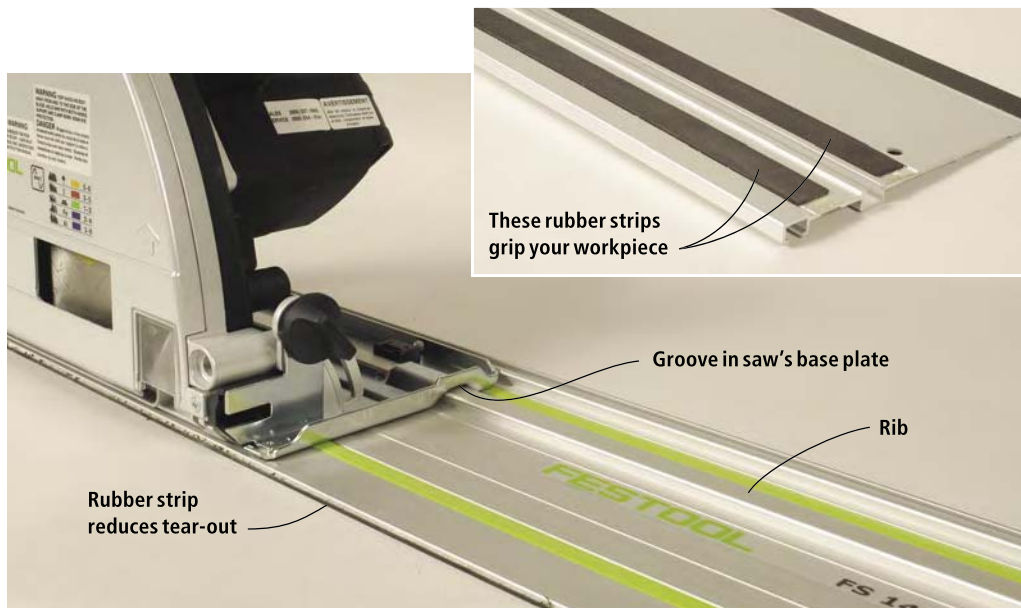
If you work alone in a small shop, it's easy to dread the backbreaking start of a cabinetmaking project. It usually means spending hours reducing 4' x 8' sheets of plywood to finished cabinet parts that are ready for assembly. Getting straight, square, chip-free cuts is a job for a table saw equipped with a good blade. Yet wrestling 75-pound sheets of $\frac{3}{4}$ " birch or maple plywood around the shop and over the saw can be awkward, even dangerous, work.

With a stack of plywood parts at hand, there are still a variety of operations that may follow: routing dados and rabbets, drilling holes for shelf pins, and boring 35mm holes for European-style cup hinges. These operations may require several table saw or router set-ups and building one-purpose jigs. Working with large pieces of solid lumber—a glued-up tabletop, a heavy slab of hardwood or a door, for example—presents exactly the same problems as woodworking with plywood does.

by Scott Gibson

Scott Gibson, author of *"The Workshop,"* (Taunton Press) is a writer and woodworker in Steep Falls, Maine.

Photos by the author



A groove in the base of Festool's plunge-cut circular saw fits over a corresponding rib in the guide for straight, wobble-free cuts. Guide rails also work with other tools. A thin strip of rubber along the edge of the guide rail acts just like a zero-clearance table saw insert, holding down wood fibers to eliminate chipping. Soft rubber strips on the base of the guide rail help to hold the rail in place without clamps. The strips are replaceable.

That, at least, had been my experience until I was introduced to Festool, a German manufacturer that has turned that concept on its head. Festool sells the same kinds of portable power tools as other manufacturers – sanders, routers, circular and jigsaws and drills. The difference is in how they're designed—not as unrelated, one-purpose tools but as a system

built around common accessories. The premise is simple: Why man-handle large pieces of stock when you can move the tools instead?

The Heart of the System: Accurate Guide Rails

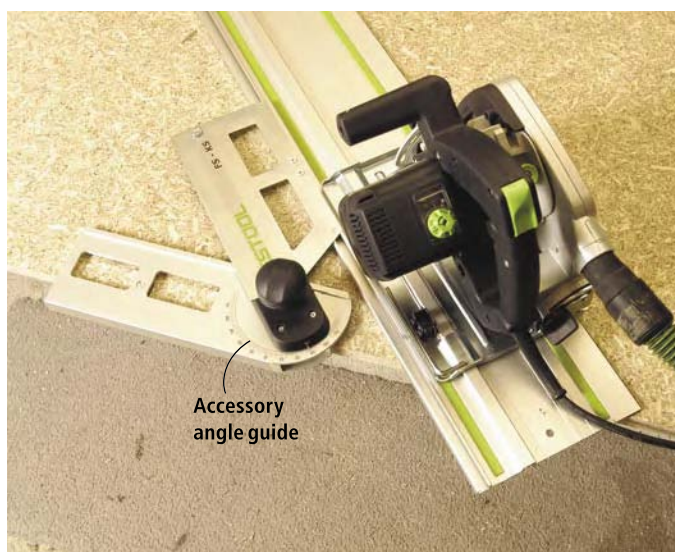
The keys to the system are alloy guide rails and related accessories that can be used with Festool's circular saws and routers. Available

in lengths from about 32" to 197", the lightweight guides are made with a lengthwise raised rib that fits into a groove on the bottom of the saw and router guide. Play between the guide and tool can be adjusted to provide free travel without any lateral play, so making straight cuts exactly where you want them is a breeze.

The guide rails have two other

important features. The first is a narrow strip of hard rubber along the edge of the rail where the blade of the circular saw travels. It serves the same purpose as a zero-clearance table saw insert, eliminating splinters on thin veneer faces by holding down wood fibers as the blade passes by. The narrow rubber strip comes slightly oversized and is trimmed to its working width by the saw blade. That guarantees the saw will make a cut exactly where this strip is aligned on the workpiece.

Rails also have strips of a softer rubber-like material on the bottom surface that grip the work surface, even without clamps. That means cutting or routing a piece of plywood is as simple as marking the work, lining up the rail and pushing the tool through the cut. Unless it's inadvertently shoved out of position, and that takes some doing, the guide rail will stay put. (Festool does sell clamps whose low-profile heads slide into the ends of the rail in case you think you'll need them.) An accessory kit, the FS-SYS/2, works with the guide rails for making precise angled cuts.



An accessory kit attached to a guide rail makes it possible to set accurate angled cuts for your circular saw or router.



Festool's multi-function tables are sturdy, collapsible work stations for cutting and sanding. An adjustable guide rail works with a circular saw or a router, and accessory clamps bolt in pre-drilled holes in the MDF top.

As a result of the design and engineering, cuts made with the circular saw are chip-free. There's no need to make a trip to the table saw to clean them up.

Routers and saws also can be used on Multifunction Tables (available in two sizes), which combine a guide rail with a fence that can be set for square or angled cuts. Tables have sturdy steel and alloy frames, tops made of medium-density fiberboard and folding legs. When the table isn't needed, it can be folded up and tucked in a corner. You can also build an inexpensive cutting table, as I did, that makes cutting full-size sheets of plywood relatively simple (see "Getting Started with a Cutting Bench" below).

Other guide accessories include a drilling system designed for 32mm case work. The hole-drilling system (FS-LR 32) can make shelf-pin holes on precise

layouts as well as the cup holes for European-style case hinges.

Saws and Routers To Fit the Guides

If half the system is comprised of rails and related accessories that guide cuts accurately, the other half is the innovative tools that go with them. Among them are the only circular saws I've ever seen with a plunge mechanism, including the ATF 55 E-Plus that I used. Depressing a thumb latch on the handle allows the blade to pivot into the work. Depth of cut is set by a sliding stop that can be set precisely with one hand. The plunge cut allows a cut to start and stop in the middle of a panel.

Truth be told, I wasn't sure initially how helpful this plunge feature would really prove to be. Then I had to cut out a piece of particleboard for a one-piece countertop that wrapped around



Festool's small router can be used with a special guide rail to bore shelf-pin holes accurately. A spring-loaded pin snaps into holes in the guide as the router moves along the rail.



Depth of cut for Festool's circular saw consists of a push-button slider on the saw housing. It's easy to operate, but get used to metric markings.

GETTING STARTED WITH A CUTTING BENCH

Cutting large plywood pieces with the saw/rail combination requires finding a place in the shop spacious enough to lay panels out flat. My shop is too small for a dedicated assembly bench that will accommodate a full sheet of plywood, so I made my first cuts on the floor, elevating the panel off the concrete with pieces of 1"-thick rigid foam insulation.

The advantage was that off-cuts didn't have anywhere to fall, but the arrangement was clumsy to say the least. Rather than build a permanent table or bench for this work, I made a cutting table with folding steel legs and a foam-insulation top that can be set up quickly when I need it and tucked away when I don't. The 3' by 7' top is a simple grid made from kiln-dried 2x4s held together with yellow glue and two #20 biscuits at each joint. Cross pieces are set on centers of about 14". The whole thing can be built in an hour.

The layer of foam isn't absolutely necessary, but it supports the panel completely without adding much weight to the table and it won't dull the blade as much as a layer of wood, particleboard or MDF would. I set the depth of cut so the blade cuts about 1/8" into

the foam. When the foam sheet wears out, it will be easy and inexpensive to replace.

With 16" legs and a working height of about 18", the grid is high enough off the shop floor to keep me from bending too far over the work and it can be tipped easily to one side to load a full sheet of plywood. I

thought a table at standard height – 29" or 30" – would be too high to use comfortably. I bought a set of legs from Woodworker's Supply (800-645-9292 or woodworker.com) for about \$28, so the whole tab for building the grid was only about \$38.

–SG



A cutting table with a top of rigid foam insulation and folding metal legs is a convenient work surface for cutting full sheets of plywood. The frame of this one is made with 2x4s and stands about 18" high.



an inside corner. It required several angled stop-cuts, and with the plunge-cut saw and guide the whole error-free operation took about five minutes.

Because the blade retracts completely into its housing, the saw sits flat when you're not using it. It also comes with a removable splitter that prevents material from pinching the blade, a major cause of kickback. (For plunge cuts, you'll have to use the on-board wrench to remove the splitter temporarily.) High-quality blades help to make smooth, splinter-free cuts on veneered plywood, which are prone to tear-out.

The saw blade is smaller than one on a conventional saw, just 6¼". I won't be using this saw to cut a stack of rafters, but the blade is big enough for a 1½" depth of cut at 90° when used on the guide rail and 1⅞" at 45°. An electronic speed control has six settings – altering blade speed from 2,000 to 4,800 rpm – so the saw will cut aluminum and plastic as well as wood. A slightly larger model, the 65 E-Plus, increases cutting capacity by ½" with a 7½" blade.

Festool's plunge routers can be set precisely for position over the cut as well as for depth. They can be used with accessory guides

and working tables, with standard edge guides or freehand, just like a conventional router. Both models can be equipped with a chip hood that helps direct debris into one of several tool-activated dust extractors, another Festool system component. Dust extractors are very effective with the circular saws and sanders, slightly less so with the routers.

Festool's cordless drills also are designed as systems with more than one component (see "Cordless Drills with Quick-change Chucks" at right).

Boxes to Carry it All in

Many tools are sold with plastic or metal carrying cases that protect the tools and store extra blades and accessories. But Festool has taken it a step further. Its cases, called "Systainers," are all 15½" wide. Latches allow boxes to be stacked atop each other and locked together so it's relatively

SOURCE

Festool
888-337-8600 or
festool-usa.com

easy to move a number of tools at one time – either by picking up a couple of small containers with the top-most handle, or stacking a number of containers on a hand truck or the mobile vacuum. Cases are narrow enough to be maneuvered up narrow staircases and through doorways.

Systainers make it easy to pull the right tool for the job and keep all the odds and ends that go with a tool organized.

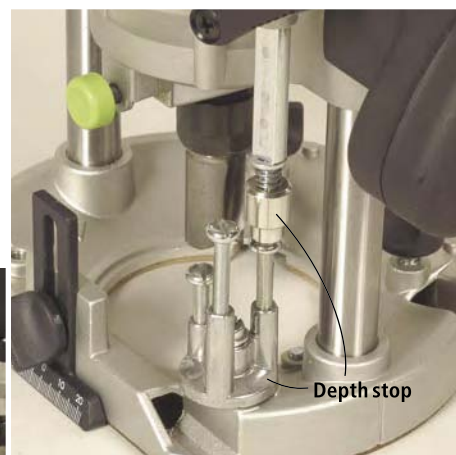
The High Cost of Good Tools

There's a lot to like about the system, but its components are pricey. The ATF 55 E-Plus circular saw sells for \$385, which includes a

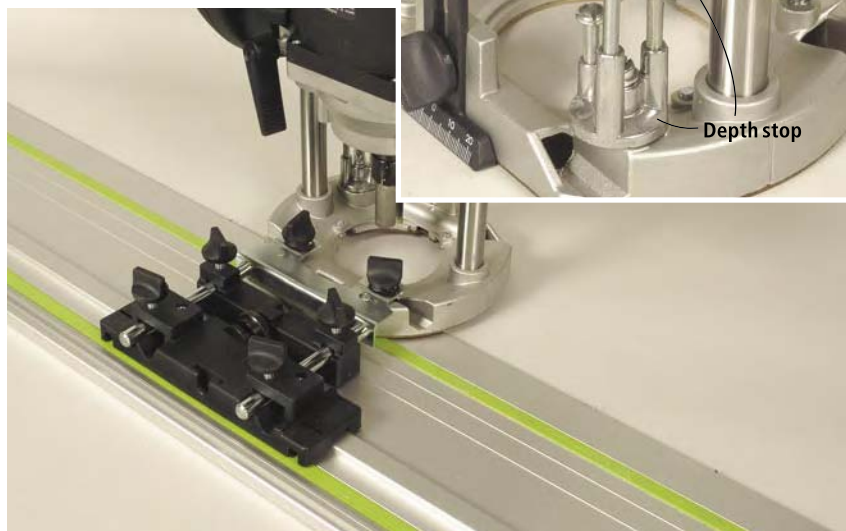
A splitter mounted behind the blade of the circular saw prevents stock from pinching the blade, which can cause kickback. Remove the splitter before making plunge cuts.



Festool's plunge router incorporates an accurate and easy-to-use depth setting (right). With an accessory jig, the router uses the same guide rails as the circular saw (below).



A variable-speed function allows the circular saw to be used on plastic and aluminum as well as wood.



55"-long rail, a carbide-tipped blade and a case. That makes it about twice as expensive as any professional quality 7 $\frac{1}{4}$ " circular saw now on the market. The larger capacity Festool saw is an additional \$110. A 2,700mm guide rail, which you'll need to rip full-sized sheets of plywood, costs \$167. Price tags on the rest of the Festool line are equally eye-popping.

Nor are these tools a realistic substitute for all of your stationary power tools. You'll still need a jointer and thickness planer for milling solid material, for example. And although some users have found a way to make Festool's tool line take the place of a table saw, I'm not ready to give up mine just yet. One final gripe: the instruction manuals that come with some of the more complicated accesso-



A chip collection hood that snaps into the base of the router connects the tool with Festool's dust collectors. Turning on the router activates the vacuum. The dust collector is quiet and moderately effective when used with the routers.



Uniformly sized storage containers reduce clutter and keep easy-to-lose parts in one place. Containers snap together, making it easy to move several tools at once.

ries. Reading them several times may not really explain what you're looking at. More illustrations and reader-friendly text would help.

Quibbles aside, and assuming you're willing to invest in improved

shop efficiency, these tools are a real departure from what you're used to. Someone at Festool has been thinking about the particular needs of cabinetmakers, especially those who work in smaller

shops. The tools also will shine for the person who works on a job site, away from the convenience of a shop. There, these tools will perform as nicely as all that cast iron you left at home. **PW**

CORDLESS DRILLS WITH QUICK-CHANGE CHUCKS

Festool makes two cordless drills, the conventional-looking TDK (in 12- and 15.6-volt models) and the more unusual CDD 12. Both use an innovative chuck system that is head and shoulders above anything else I've seen.

The standard keyless chuck can be loosened and tightened with one hand, and removed from the tool in seconds by sliding back a spring-loaded collar. It can be replaced with either a right-angle chuck, which can be locked in one of a number of positions, or

an eccentric (off-center) chuck for drilling or driving screws straight into a corner without marring the work. Yet another quick-change chuck, the Centrotec, is for hex-drive drill bits.

Although the chuck system is versatile, a standard hex-drive bit also can be inserted directly into the drill without using a chuck at all. This reduces the overall length of the CDD 12 to less than 7". I didn't appreciate that feature until I had to install drawer slides in an opening that was only 7 $\frac{3}{4}$ " wide and 22" deep. I was able to drive screws all the way at the back of the drawer opening with the drill, saving what would have been the cumbersome task of using a gimlet or awl to start the holes and a hand-held screwdriver to drive the screws.

The CDD comes with two 12-volt nickel-cadmium (NiCd) batteries, a Centrotec chuck and a straight chuck (\$325). The 12-volt TDK model costs \$325, the 15.6-volt model \$375. Accessory chucks are \$73 each.

Although versatile and compact, the CDD felt out of balance to me, probably because of its unusually shaped handle and weight distribution. I found the familiar T-handle drill, the TDK, better balanced. But with either one, the chuck system makes the tool.

—SG



Interchangeable chucks made the drills more versatile than standard cordless drills. Choices include eccentric and right-angle chucks, as well as a quick-change chuck for hex-shaped drivers.



Cordless drills come in two styles. The ergonomics are different but both use an innovative chuck system.



A hex driver can be inserted directly into the drill's drive mechanism, allowing the drill to squeeze into very small spaces.

Tricks and secret weapons
to assist the beginning
(or city-dwelling) bodger.

Cheating at Chairmaking

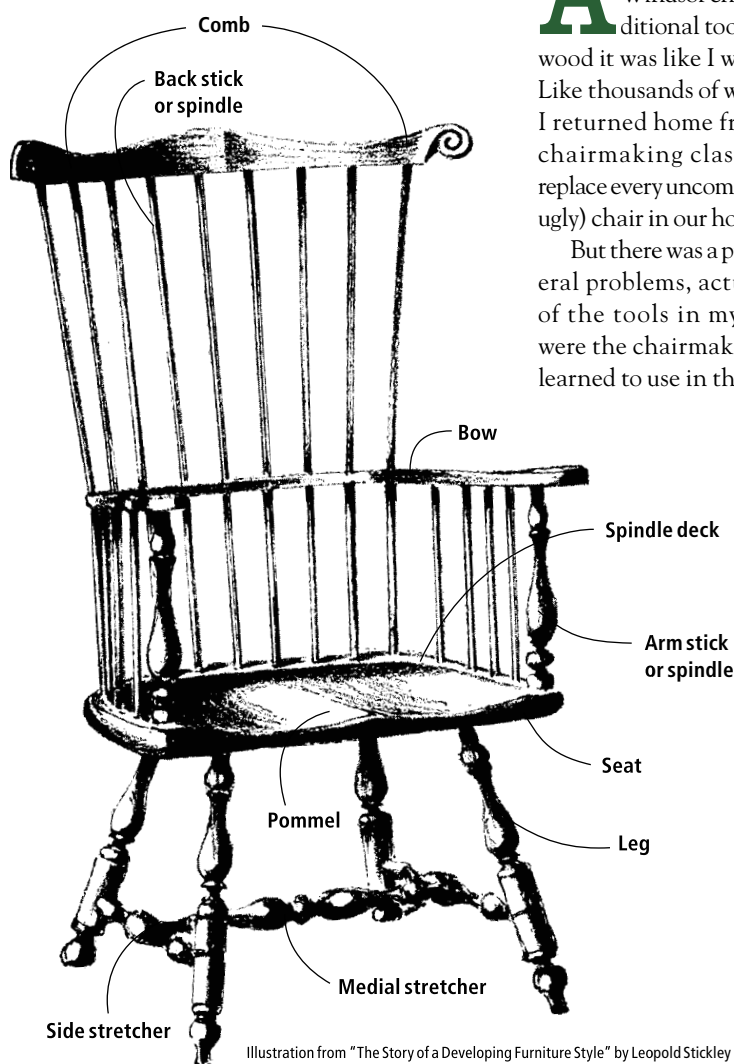


Illustration from "The Story of a Developing Furniture Style" by Leopold Stickley

After building my first stick Windsor chair using traditional tools and green wood it was like I was on crack. Like thousands of woodworkers I returned home from my first chairmaking class aching to replace every uncomfortable (and ugly) chair in our house.

But there was a problem. Several problems, actually. None of the tools in my workshop were the chairmaking tools I'd learned to use in the class. And

a couple hours with a calculator and the Highland Hardware catalog convinced me that my credit card didn't need that kind of one-time workout.

Plus there were other barriers besides tools. Getting green wood is a challenge in some cities. And making room in a crowded shop for chairmaking activities can be a head-scratcher.

I knew it was time to cheat.

So I talked to professional chairmakers and would-be bodgers about how they work around their limitations. And I focused the jigg-making part of my brain on the chairmaker's universe.

And most importantly, I launched into making another set of chairs, despite the murky water ahead of me. The following pages contain the best tricks, cheats and workarounds I encountered in my search. Not all of them will work for you, your temperament or your pocketbook (though most of them are dirt-cheap solutions).

But these cheats do work for me and other chairmakers. It is our hope that some of them might help you launch your next chairmaking project.

—Christopher Schwarz,
executive editor



Photo by Al Parrish

Cheating Nature

Kiln-dried Lumber Can Work

Building a chair with green wood that is split from a stump is a joy. The wood is easy to work and the grain is arrow-straight.

But for some of us, green wood is hard to come by. So I tried using dowel stock and spokeshaving it to size, but that was frustrating. Dowels don't have the straight grain of riven materials, which are split out along the grain using a froe.

Dowels also aren't as strong and they are difficult to spokeshave without tear-out. In the end, I used a card scraper to finish up the

sticks. In other words, it was more work and didn't look as good.

John Brown, a Welsh stick chairmaker and personal hero, has used sawn stock for his sticks in the past, according to his columns published in the British magazine *Good Woodworking*. He would band saw the lumber along the grain lines and then shape it with "rounding planes," which are small metal and wooden gizmos that make dowels (more on those tools later in the article).

That was good enough for me. I purchased quartersawn ash, and I sawed out my sticks by following

the grain lines. My results were good. The sticks are strong and you can spokeshave them readily. It's not as easy to work as green wood, but it's good in a pinch.

I had even more luck when using kiln-dried wood for the other parts of the chair besides the sticks. I used kiln-dried white oak with great success to make legs and stretchers. Poplar from the lumberyard made an excellent and easily worked seat. —CS



The sticks are kiln-dried ash; the leg blanks are kiln-dried oak. By sawing them out by following the grain lines of the wood I was able to get reasonably sturdy and workable stuff.



Traditionally, the inshave is used after the seat is roughed out with an adze. But my experiments found that the seat can be roughed out by an inshave alone. It takes a little more time, but is a good option until you find (or can afford) a proper adze.

Cheating the Seat

Alternative Hand Tools

Many woodworkers are put off by "saddling" the seat, which is where you scoop out the wood to make things more comfortable. Traditional bodgers hew the seat with an adze, then finish it with some combination of inshave, travisher, compass plane, scrapers and sandpaper.

I wanted to see if it could be done well with fewer tools.

So I skipped the adze and began the work with the inshave, a tool that resembles a drawknife with a curved blade. Working across the grain, the tool was quick. After hogging out most of the seat, I then worked with the grain to tune things up a bit more.

Cleaning up the tool marks left by the inshave is usually a job for a travisher. One option is to use a chairmaker's curved rasp. These tools resemble overgrown rifflers and can smooth out just about any part of the seat. The French rasps shown in the photo at left are from Auriou and are the sweetest rasps I've ever used.

If you're comfortable with hand planes, a curved-sole plane can saddle a seat. The vintage Stanley No. 100½ model makers plane has a sole that curves both front to back and side to side. Woodcraft makes a copy of this plane, and another manufacturer is planning its own version. —CS



Curved rasps are great for many parts of the chair, from removing tear-out in a seat to shaping the outside of the seat, the bow and the comb. Their strength is they can detail curves and work (in general) without regard to grain direction.



The Stanley 100½ might not look like much, but its scarcity (and utility) make it a hard plane to find. New adaptations of this tool are available for less money (I paid \$80 for my vintage one. Ouch).



When in a hurry, the Arbortech Pro Industrial Woodcarver is like an electric adze.



After the Arbortech, I clean up my work with these abrasive wheels, which come in different grits.



The final step to smoothing the seat is to fair out the saddle with sandpaper stuck to a foam pad, which will follow the seat's complex contours.

Saddling With a Grinder

As a maker of traditional Welsh chairs, I like to use traditional tools. But there are times when I have a huge order with a short deadline, or a chairmaking workshop where I have to supply 12 students with roughed-out seats so they can finish their chairs within six days. So I cheat!

Traditionally I use an adze to rough out the shape, a travisher to smooth the adze marks and a devil (a cabinet scraper in a wooden body) to smooth the travisher cuts. The chamfer on the underside is cut with the adze and cleaned up with a spokeshave. By the end of the day my forearms are bulging like Popeye and I have to shake them out to get the feeling back in them.

When in a press, though, I use an Arbortech Pro Industrial Woodcarver – a metal disk with three carbide teeth. After the Arbortech, I use tungsten carbide disks made by Kutzall, which comes in three grits and two profiles, to fair out the marks left by the Arbortech. The final surfacing is done with 2" Velcro sanding disks on a foam-backed wheel. I begin with #80 grit and progress to #280 grit.

When all is said and done, the noise, dust and vibration send me

back to the adze, travisher and devil. The surface is crisper and the pleasure of hearing myself think make up for the labor.

— Don Weber,
a bodger and blacksmith
in Paint Lick, Ky.

An Easy-to-make Travisher

In the world of hand tools, many classic designs came from a world with material, manufacturing and knowledge (or Guild) limitations. Today, we are free to experiment thanks to new tools and technology. Thus when faced with the need to make a travisher, I decided to try a new way.

I love the sweeping shape of the classic travisher, but I've also seen many with split handles and cracked throats. Plus I'm not keen on making heirloom tools. Don't get me wrong, I lust for those curly maple and bubinga beauties, but my goal with this travisher was to get a curved blade to quickly and reliably scoop out seats. The pretty version would have to wait.

I call my design a "moose-eared" travisher in honor of that famous Minnesotan from Frostbite Falls. It is built using the travisher blade from Country Workshops, but is adaptable to any blade. My tool makes two departures from traditional designs.

First, the toe in front of the blade is a separate piece of wood. This allows me to choose the toe length I want, to contour it to the blade, to add shims behind it to open or close the throat and to easily replace it when it wears.

The second departure is the moose-ear shape. I like to push my travishers, and the ears let me extend my fingers and comfortably apply force through my thumbs. I find it to be ergonomically a better design, and with a traditional sweep under the ears, I can still cup it in my hands like a traditional travisher and pull.

Fabrication is straightforward. Begin with rectangular stock and mark out where the mortises should go to accommodate the blade's tangs. Aligning the cutting edge of the travisher blade with the front of the stock locates where the back edge of the tang will go. Mark

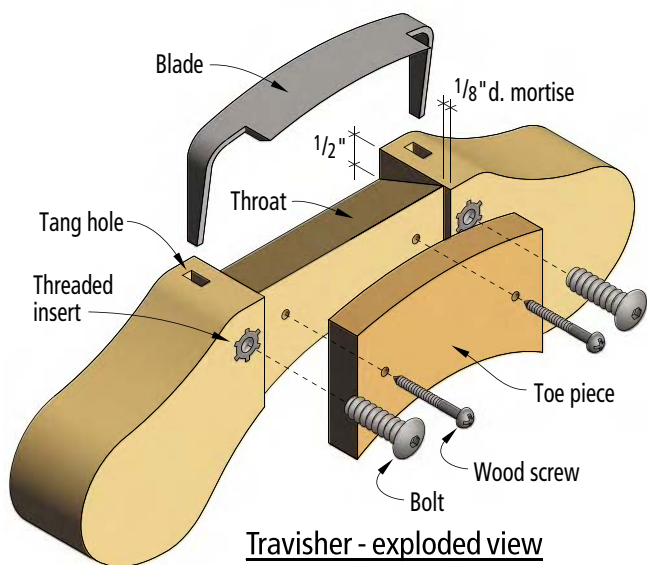
the location and add about 1/8" to allow for throat clearance and a recess for the toe. Using a mortising attachment in my drill press, I cut "square holes" that are centered on the tangs with their backs aligned to my layout marks.

Next lay out and cut the shallow recess for the toe piece. Drop the blade in its mortises and bottom it onto the stock. Mark the ends of the blade and remove it. I add another 1/16" of width to each mark and carry these marks around to the front of the stock perpendicular to the bottom edge. Cut an 1/8"-deep dado between the lines. This dado will hold the toe piece. I cut 1/2" stock for the toe piece that fits in the groove and is the width of the stock plus approximately 3/4".

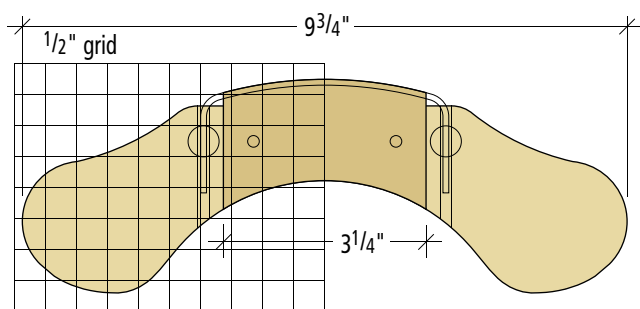
Cutting the throat of the tool – a ramp from the front to the back of the stock – is easy on this



This travisher design is easier to make than the traditional version and allows you to shape the toe piece of the tool to suit your work.



Travisher - exploded view



Travisher - elevation

design. The ramp begins at the front and ends at the back, where it is $\frac{1}{2}$ " deep. Using a chisel and saw clean out the throat from the front edge to the pencil cut line on the back. Now install the bolts to secure the blade. I use bolts with threaded inserts, which is a reliable and durable system.

Drop the toe piece into its dado with its extra width extending over the blade. Secure it with two screws. Use the blade's edge to scribe a line on the toe piece. Remove the toe piece and cut up to the line. Round the front of the toe piece and reinstall it on the travisher's body.

Mark the moose ear profile on the assembled travisher, remove the blade and head to the bandsaw. Cut out the shape and then rasp, sand and trim to the desired final shape. Remove the toe piece and slide a shim under it and reinstall. Put in the blade and back it out for the depth of cut you want.

With a little tuning, I think you will find that this is a fun travisher to use and modify to your personal preference.

— Eric Hedberg,
a chairmaker and woodworker
in St. Paul, Minn.

Cheating the Drilling Perfect Holes for the Legs

The geometry of the leg angles is tough to wrap your brain around. It's a compound angle, and chairmakers have come up with many ways to jig it up. For a complete discussion (and to figure out the best angles for you) I recommend Drew Langsner's book "The Chairmaker's Workshop" (Lark). This book is essential reading for chairbuilders. It is packed with everything you need, from how to use a froe to the geometry and math behind the methods. Langsner spent years working on the book to get it "just right," and we are the beneficiaries.



This simple but effective jig holds my auger bit at just the right angle. With its assistance, it's hard to miss your mark or stray.

Once you decide what angles you would like your legs to be, this jig makes it simple.

In essence, it's an oversized doweling jig. Your auger bit is guided by 1" pipe (that's the interior dimension). The pipe is positioned on 2 x 4s that have a V-groove plowed down the middle and have been trimmed to the correct angle. The pipe is secured to the 2 x 4s with pipe-hanging straps and screws. The 2 x 4s are screwed to the plywood top. And cleats around the bottom of the plywood hold the seat blank.

It works like a charm. The only downside to the jig is that it cannot be adjusted to make holes at other angles. Once you build it, you're set. If you want a different set of leg angles, you'll have to build another jig. —CS

Straight Shooter: The Best Way to Drill Spindle Holes

As a boy my father told me stories of my Swedish great-grandfather. An expert marksman, he would line up flat-lain bottle caps along the edge of my grandmother's favorite bench and shoot them off to the delight of my dad and the chagrin of my grandmother. Unfortunately, I learned early that the marksman's eye is not a dominant gene, and that I would be relegated to a life of glasses, odd squinting and creative jiggling.

As ancient legend and popular mythology goes, the bodger eyes his target, grabs his brace and augers deftly and accurately from point to point. I believe this is often true, but I also believe that paint covers a multitude of sins. So, when faced with drill-



You cannot miss with this hole-boring jig and you never have to figure out any angles. Clamp the bow in place and place the jig in a small countersunk hole on the spindle deck. Put your drill bit in the bushing and fire away.



Here's a close look at the section of the jig that guides the drill bit into the bow of the chair. The location of the bushing is locked in place by the T-nut and knob. The bushing is sized to your drill bit, $\frac{5}{8}$ " in this case.



The hemisphere is placed in a countersink in the seat while you drill the hole in the chair's bow.



The Veritas Dowel Maker will turn any species of wood into a dowel. Setting up the jig takes some time and can be frustrating, but the results are good.

ing through the arm of my first Welsh stick chair into the seat, I stood back and pondered the consequences. I could argue the virtue of the quaint variations that would occur or I could realize my marksman-eyed spouse would be forever querying me as to whether that was intentional or not.

After some thought, I came up with a fixture that I call a straight-shooter joystick. Like all fixtures in my shop it is borne of necessity and assembled out of the scraps piled under my miter saw.

The heart of the joystick is two blocks of wood. The bottom block holds a partial wood sphere, and the top block is drilled straight through to hold a drilling sleeve both located exactly the same distance from their mounting edge. Attached to the stick, their common offset center line lets me shoot a straight line from the seat to the arm.

Using the device is straightforward: The spindle locations are located on the seat and a small countersink is used to create a small cone-shaped depression at each location. I clamp the arm into place above the seat and mark in pencil the corresponding through-points for the spindles in the arms. I place the hemisphere of the joystick in the selected location on the seat and then, with a brad point bit in the sleeve, locate the bit on the corresponding pencil mark. A touch of the trigger quickly makes a hole through the arm. Next I take a drill bit extender with a $\frac{5}{8}$ "-hardwood sleeve bearing and slide the extender through the $\frac{5}{8}$ " hole. The hardwood sleeve is then fit snugly in the spindle hole of the arm. I attach my bit to the extender's end, align it with the location in the seat and drill away.

The system is quick. If you

make an MDF template for the seat with pre-drilled-to-size spindle locations you can make quick "production" runs. When I use a template, I bore my seat spindle holes with a Forstner bit. It rides on the edges of the template hole and creates nice clean holes.

One shortcoming with this system is the spindles themselves. Variations in the spindles can make dry assembly a little frustrating, but because of the accuracy of the holes it is straightforward to find the rogue spindle and make the appropriate adjustments.

—EH

Cheating the Spindles Avoid Turning and Shaving

Getting your spindles to a round shape can be a challenge without a lathe. You can spokeshave them, but that can be time-consuming and requires a bit of skill.

Luckily, there are a couple good

jigs. They cost a bit, but they're cheaper than a new lathe.

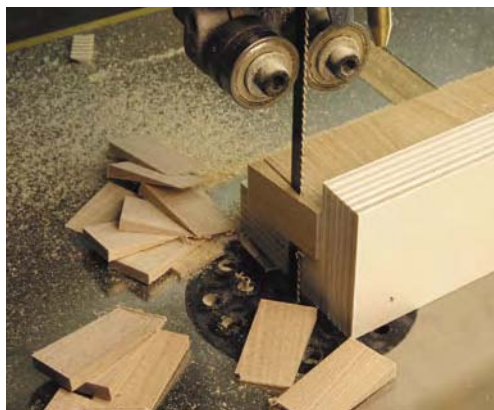
The Veritas Dowel Maker is an ingenious jig that turns square stock into a dowel. A socket in your drill turns the stock as it passes two knives—one to rough out the shape and the second to shave it to perfect thickness. You can adjust the jig in tiny increments to get just the right size.

While the jig works well, it has a couple drawbacks. It requires a lot of little adjustments to get the device working just so. It's not particularly complicated, but it is time-consuming to learn. The second drawback is the price. The basic unit costs \$145 and cuts only 1" and $\frac{15}{16}$ "-diameter dowels. To cut other common chairmaking sizes ($\frac{1}{2}$ ", $\frac{5}{8}$ " and $\frac{3}{4}$ ") you will need to purchase almost \$100 of additional tooling.

The other option is to buy rounding planes. These tools



This rounding plane by Ray Iles excels at turning down your sticks to the right dimension.



This simple three-piece band saw jig will cut perfect wedges all day long.

make one diameter of dowel, so you have to buy a few of them to make a chair. However, once you set them up, you leave them (until they need to be sharpened). I tried several brands (including a homemade one) and recommend – without reservation – the ones made by Ray Iles. These are heavy-duty, have excellent blade geometry and are well made.

You can spin the tools on your stock by hand (that's what the handles are for) or you can drive your sticks through them using a drill and socket. Ray Iles has made these for a while now, but they are only recently available in the United States.

— CS

An Easier Way To Make Wedges

Making perfect wedges – which secure the spindles in the bow – stymies many first-time chairmakers. My first wedges looked like crooked gnome caps. Granted they would be buried in a piece, but the thought of them waving back and forth as they descended seemed rather humorous and slightly unprofessional.

Serendipity visited one night as I was poking around the dark corners of Lee Valley's web site. I found an archive of tips and to my delight a description of how to make wedges using a miter gauge. It was a “duh” moment to realize how easy this would be to adapt this technique to my band saw.

I use a sled that is made of two pieces of scrap and a wooden guide that fits in the miter track of my band saw. It is super simple to make. First glue the two pieces of scrap together to make an “L” about 8" long. Next pencil a line on the guide that will hold it 4° clockwise to the blade. Carefully glue the “L” onto the guide aligning the back edge with the pencil line. Allow the “L” to extend past the band saw's blade. A couple of short brads ensure the “L” won't come off the guide.

When all is dry pass the sled through the blade and cut off the end. To use, take your “squared” wedge stock, put it in the sled and cut. Reverse the stock aligning the wedge “point” near the edge of the sled. Cut again and you have a perfect 8° wedge. — EH

For Shaving Spindles, Meet the Shaving Pony

Several years ago a few upstate New York members of an Internet mailing list for hand-tool enthusiasts got together to enjoy a picnic, share toys and admire each other's work. One brought a Windsor chair she'd built at Michael Dunbar's school, The Windsor Institute. It was the first time we'd seen a hand-built Windsor. The comfort and beauty of the design was impressive, and it was much nicer than a machine-made replica.

We decided as a group to build Windsor chairs using the techniques described in Dunbar's

book. This group approach gave us the opportunity to share our skills, learn from each other's mistakes and pool our tools.

Handmade Windsor chairs are noteworthy for their spindle construction, each split down

the grain and then shaped with a drawknife and spokeshave. This gives them strength and flexibility that turned spindles lack, along with the facets that give character to a handmade chair. Traditionally, a large shaving horse would be employed to do this. The horse permits the blank to be clamped firmly yet turned repeatedly as it is shaved round. None of us had a shaving horse. No one had the space to store one or access to the timbers required to build a traditional horse. We tried to use vises and clamps to shave spindles at the bench, but it didn't work.

We needed something small enough for the group sessions and



The shaving pony allows you to work chair spindles without a space-sucking shaving horse. This simple jig clamps in your bench vise and stores away in a corner or on the wall when not in use.

easy to build from common and inexpensive materials.

A shaving horse uses a moving head that comes down on a fixed plate attached to a bench to clamp the workpiece. A foot pedal attached to the head allows the worker to apply and release pressure quickly. The fixed plate could be held in the bench vise, with a foot pedal to apply clamping pressure. Offsetting the pivot points of the clamp would improve the clamping action.

So one night Dave Matthews devised a prototype that did all this out of a 2x4, some drywall screws, and a couple of bolts. It was simple and it worked. Robb Young fleshed it out with uprights supporting each side of the jig, removable dowels and adjustable jaws to better grip different blank thick-

nesses. Now we could sit or stand right at the workbench and shave away. Our group christened it the “shaving pony.”

The “shaving pony” is easy to make from construction lumber, a couple of hardwood dowels and screws. The dimensions shown in the illustration seem comfortable for work at a 34"-high bench, but can be modified. Softwood is best, so the jaws won't mar your work and the uprights will grab the dowels. Screw the parts together.

Use the drawing as a guide for construction. Each shaving pony is a bit different depending on the height of the bench, the materials available and what you want to clamp. The pony shown in the drawing will accommodate bigger stock, including a chair's crest rail. If you are merely shaving spindles the uprights can be considerably shorter, more like 34".

First, cut all your pieces to size. Sandwich the uprights together,

temporarily clamp them and drill $\frac{5}{8}$ " holes through the pieces in the locations shown. Cut the bottom ends of the uprights at about a 10° or 12° angle down toward the front.

Make the pedal by gluing the two foot pieces together face to face. Now make the jaws. Cut a few lengthwise grooves about $\frac{1}{8}$ " deep in the middle inch of the inside faces of both jaws. These grooves help hold your blank tight.

Drill $\frac{5}{8}$ "-diameter holes through the jaws in the locations shown. These will secure the jaws to the rest of the pony.

Add a support block to the lower jaw that will allow you to clamp the shaving pony in your vise. The size and location of this block will depend on your vise and where it is on your workbench. The object is to clamp it firmly while allowing as much of the lower jaw as possible to rest on the vise and benchtop for stability.

Now assemble the shaving pony. Screw and glue the pedal between the uprights at the proper angle. Then do the same to the top piece. Put the lower jaw in place and secure it with one dowel through the jaws. This will allow the pony to pivot but keep the jaw between the uprights. The upper jaw is secured by the other dowel, which will allow you to move the jaw to a higher or lower position. Add a knob to the end of each dowel to make them easy to remove.

To use the shaving pony, clamp it into your bench vise with the pedal facing you. Locate the upper jaw with its dowel through one of the upper pairs of holes, leaving just enough space between the jaws to accept your blank. Stepping on the pedal clamps your work firmly, but it can easily be shifted just by lifting your foot.

This shaving pony can be as stylish as you wish, but we'd save

SUPPLIES & RESOURCES

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

- Auriou chairmaker's curving riffler rasp
#AU-CH.XX, \$64.95 (10")
- Ray Iles rounding planes, available in a variety of sizes
#MS-IROUND.XX, \$65.95 to \$68.95

Lee Valley Tools
800-871-8158 or
leevalley.com

- Veritas Dowel Maker
#05J45.01, \$144.50

Additional inserts available, priced between \$28.50 and \$31.50

- Veritas Power Tenon Cutters, available in sizes from $\frac{5}{8}$ " to 2" diameter. Priced between \$72.50 to \$89.50 each.

Woodcraft
800-225-1153 or woodcraft.com

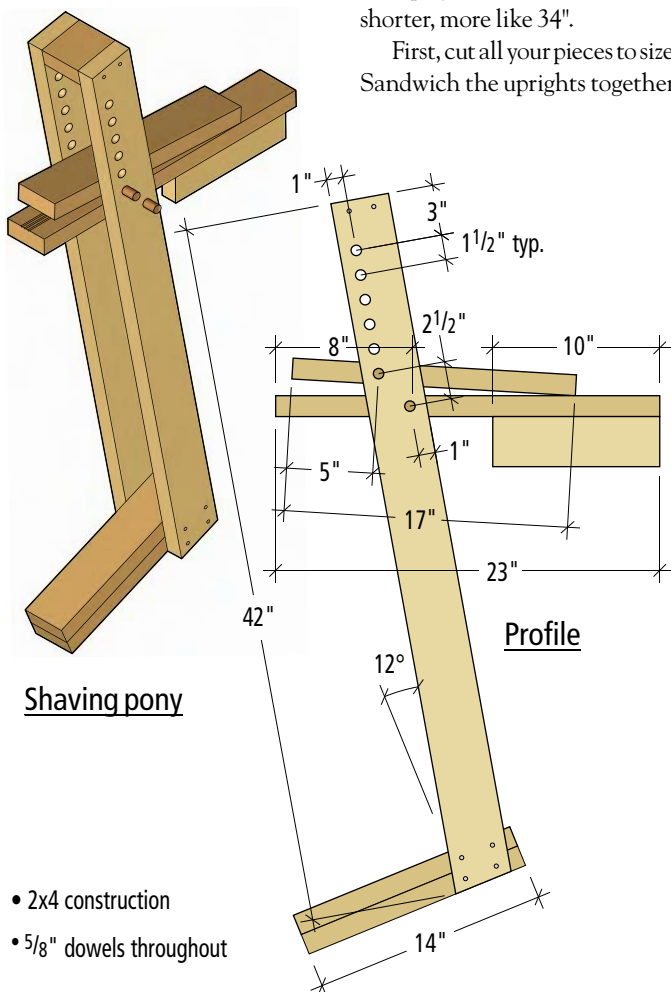
- Arbortech Woodcarver
#128258, \$129.99
- 100½ plane, #129216, \$83.99
- Kutzall wheels, \$49.99

The Country Workshops
828-656-2280
or countryworkshops.org

- “The Chairmaker's Workshop,” \$25
- Travis blades, available in four curvatures, \$28.25 each

Windsor Chair Resources
windsorchairresources.com

- An online treasure trove of sources for tools, hints from chairmakers and lists of chairmakers across the country. An essential bookmark for every bodger's browser.



our energy for shaving all those chair spindles!

—Dave Matthews and Robb Young are amateur woodworkers in Retsof and Pittsford, NY. (Thanks to Esther Heller and Tim Fuss.) **PW**

ONE-WEEKEND Router Table

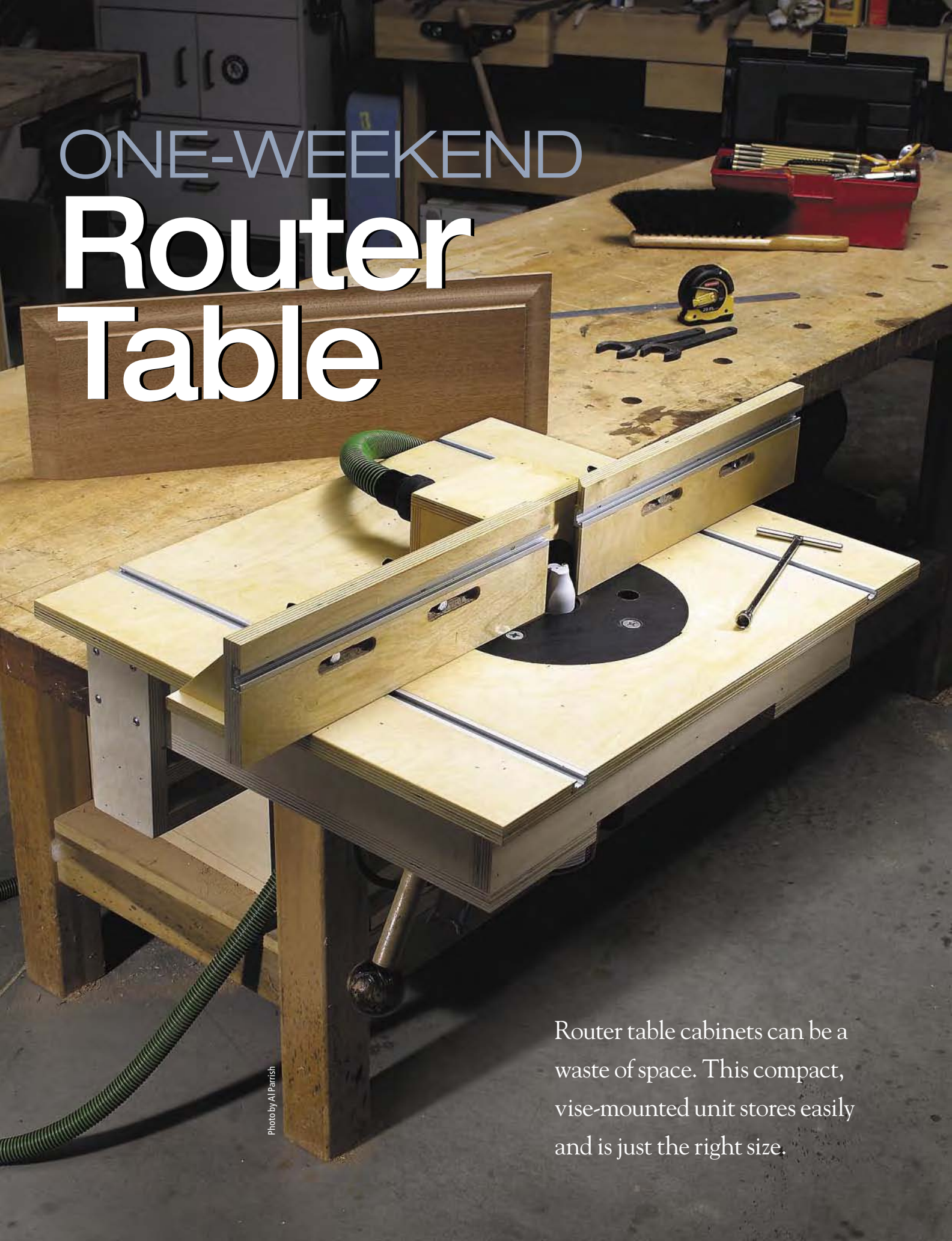


Photo by Al Parrish

Router table cabinets can be a waste of space. This compact, vise-mounted unit stores easily and is just the right size.

I think it might have been seeing a \$1,000 router table setup at a recent woodworking show (it's very cool, but \$1,000?). Or maybe it was realizing that our shop's router table's cabinet mostly takes up space and fills with dust. Either of these observations was enough to get us rethinking our router table needs.

Essentially you need a stable, flat working surface that can support most work. You need a fence that guides, supports and moves easily for adjustments (both the fence location on the table and the faces themselves toward the bit). You also need easy access to the router for bit changing and height adjustment. Other than that, it just needs to be up off the floor, hence the cabinet.

So we decided that a lightweight, easily stored router tabletop that would still offer all these benefits would be preferable. Oh, and we wanted to be able to make it in a weekend for less than \$120. No problem! The hardware came to \$65 and change. You can purchase the plywood locally or we've included a source on page 73 that will provide the necessary wood for less than \$50.

An Ingenious Design

For a stable, lightweight top the solution that made sense was a torsion box made of high-density plywood. The size that seemed most functional was a 20"-deep x 24"-wide platform that only needed to be about 4" tall. The box itself has an open center section on the bottom to accommodate the router body. There are two lengths of T-

track installed front to back on the tabletop to easily reposition the fence.

The fence itself is a variation of one we've built half-a-dozen times. The fence base is almost a torsion box – more of a torsion corner – that provides stable support for the laterally adjustable fence faces and allows for dust hook-up.

For the router itself, we went shopping. After looking at a number of router lifts and router table plates we chose the Milwaukee 5625-29, a 3½ horsepower router that offers through-the-base height adjustment. And, no, the price of the router is not included in the \$120 figure. You don't have to use this router, but in our opinion it has the horsepower you want to swing large panel-raising bits on your router table, and the through-the-base adjustment means you don't need to buy a router lift. The variable speed is also a big plus.

We chose a circular router plate from Veritas because it replaces the sole plate on your router and allows you to still use the router freehand or in the table without changing the base. The base also fits into the table without the use of any tools, and slips in and out from above in seconds.

Now the fun part: To bring the router table up to height, but still make it compact, we designed a brace that is mounted to the table and then the entire thing is simply clamped in your bench vise. Instant router table!



Allowing the proper clearance for your router is critical. You can see that I've removed the handles from the tool to allow as much space as possible. Mark out the space and then assemble the frame to fit.

Torsion Top Construction

The top itself is very simple to make. A frame made of ¾" x 3" plywood pieces is sandwiched between two pieces of ¾" plywood. The bottom piece is notched to accommodate your router (you'll need to test fit your router to locate the center frame pieces and the notch). The top piece extends 1½" beyond the frame on all sides to allow for clamping featherboards or other guides to the top surface.

Start by cutting out the top, bottom and seven frame pieces. If you opt to use the Veritas plate, the instructions are very clear on

how to cut the hole in the tabletop to fit the plate. Otherwise, follow the instructions for your individual router plate.

We chose to locate the router plate closer to the front of the table rather than in the center of the table. Most router table work happens within 6" of the fence and this location keeps you from having to lean across the table for operations. If you have a larger piece to run, the fence can be reversed on the table to give you a larger support surface.

With the router plate located in the top, suspend the router from the top and locate the two center frame members the necessary distance to clear the router. Make a note of that dimension, then lay out your frame accordingly.

by David Thiel

Comments or questions? Contact David at 513-531-2690 ext. 1255
or david.thiel@fwpubs.com

I used glue and an 18-gauge brad nailer to assemble all the pieces for this project. While perhaps not the height of joinery, it's fast and reliable.

With the frame assembled, place the frame on the bottom, and mark and notch the center section to allow clearance space for the router body. You could leave the center section open, but the extra strength along the back of the tabletop is worth the effort.

Attach the bottom the same way you assembled the frame.

Before fastening the top to the table, you need to install the aluminum T-track inserts for fence adjustment. I used a dado set on my table saw to run the grooves before attaching the top.

Next, attach the top, centering it on the frame assembly. Pay extra attention when attaching the top to keep the fasteners below the surface of the tabletop.

This will keep you from scratching your work, or worse, allowing your wood to hang up on a brad head during an operation.

Down and Dirty Fence

The fence is also absurdly simple to make. Accuracy is important to make sure it sits square to the tabletop, but other than that, it's brads and glue.

Start construction on the fence by cutting out the base, sub-

face, faces and braces. All but the braces are very straightforward. The braces are actually triangles. The best method is to rip a piece of plywood to 3" wide, then head to the miter saw. First miter both ends of the strip at a 45° angle, then reset the miter saw for a 90° cut and cut the 3" triangles from the strip. Repeat this process and you've got four braces.

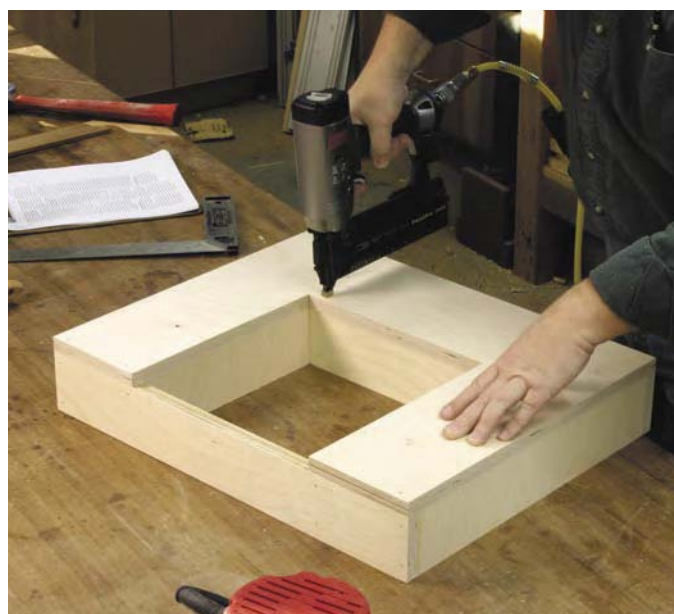
The sub-face and base need to have a 3"-wide half-circle cut at



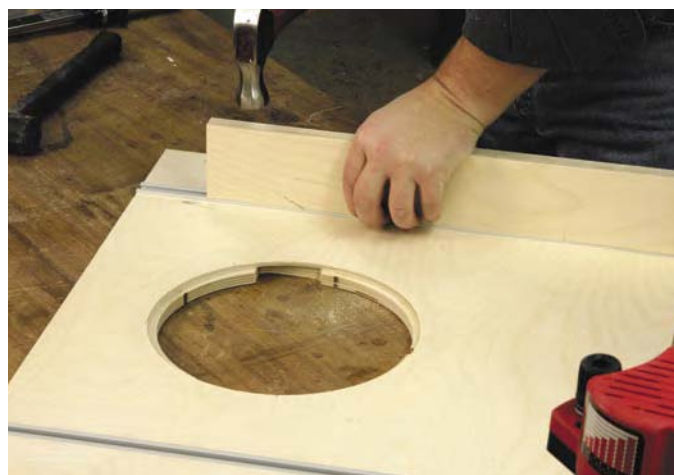
More marking: With the frame assembled and resting on the bottom piece, mark out the notch that will allow the router to extend through the top.

ONE-WEEKEND ROUTER TABLE

NO.	LET.	ITEM	DIMENSIONS (INCHES)			MATERIAL
			T	W	L	
❑	1	T1 Top	3/4	20	24	Plywood
❑	1	B1 Bottom	3/4	17	21	Plywood
❑	2	B2 Frame F&B	3/4	3	21	Plywood
❑	4	B3 Frame dividers	3/4	3	15 1/2	Plywood
❑	1	B4 Frame divider	3/4	3	10 1/2	Plywood
❑	2	B5 Support stems	3/4	3	7	Plywood
❑	2	B6 Support braces	3/4	3	21	Plywood
❑	2	F1 Fence faces	3/4	4	14	Plywood
❑	1	F2 Fence sub-face	1/2	3 1/2	28	Plywood
❑	1	F3 Fence base	1/2	3	28	Plywood
❑	4	F4 Fence braces	3/4	3	3	Plywood
❑	1	F5 Hood top	1/2	5	3 1/2	Plywood
❑	2	F6 Hood sides	1/2	2 1/2	3	Plywood
❑	1	F7 Hood back	1/2	5	3	Plywood
❑	2	H1 Fence T-tracks	3/8	3/4	14	Aluminum
❑	4	H2 Hex-head bolts	1/4"-20	1 1/2"		
❑	4	H3 Star knobs				
❑	2	H4 Cam clamps				
❑	2	H5 Table T-tracks	3/8	3/4	20	Aluminum



With the bottom notched, simply glue and nail it in place on the frame.



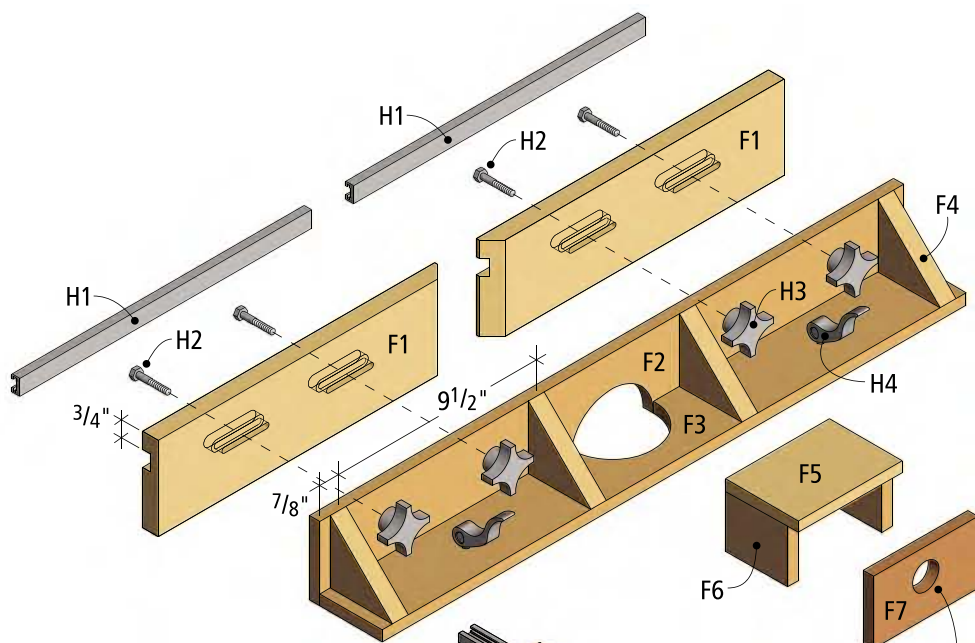
After cutting the grooves for the T-track, tap it in place using a backing block. If you have to tap too hard with the hammer, your groove is too small. Attach the track with 1/2" x #4 flathead screws. Pre-drill and countersink each hole.

the center of each piece along one edge as shown on page 74. This space will be the opening for the router bits.

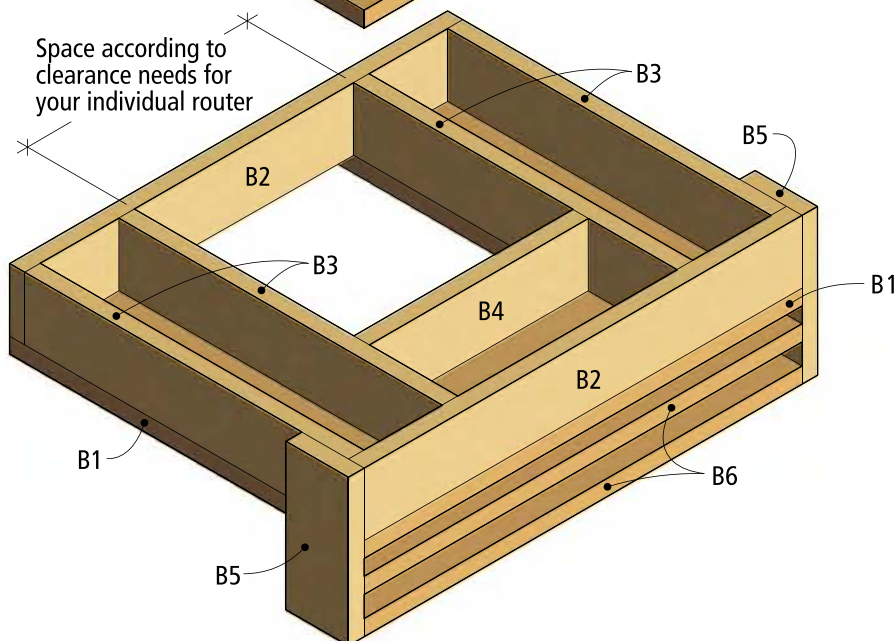
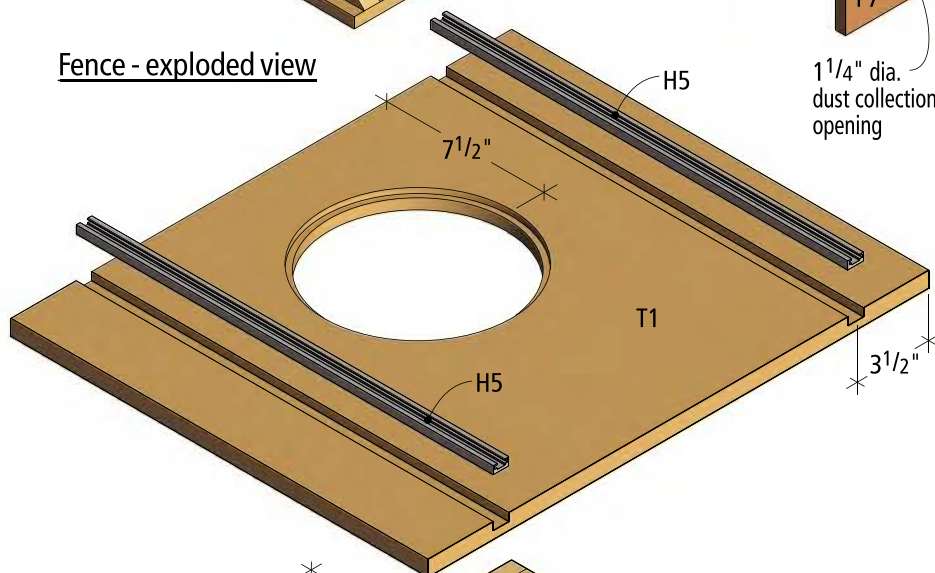
The sub-face is then glued and nailed to the base. Then glue the braces into the corner formed by the sub-face and base. Make sure to locate the braces as shown to avoid interference with any of the fence handles. I again used brad nails to hold the braces in place.

For the router table to be as useful as possible it needs dust collection. This is achieved by building a simple hood to surround the bit opening in the fence. Drill a hole in the hood back piece. Adjust the hole size to fit your dust collection hose, usually 1 1/4" in diameter.

Then attach the hood sides to the hood back, holding the sides flush to the top edge of the back. Then add the top to the box.



Fence - exploded view



Router table - top removed

SUPPLIES

Lee Valley Tools
800-871-8158 or
leevalley.com

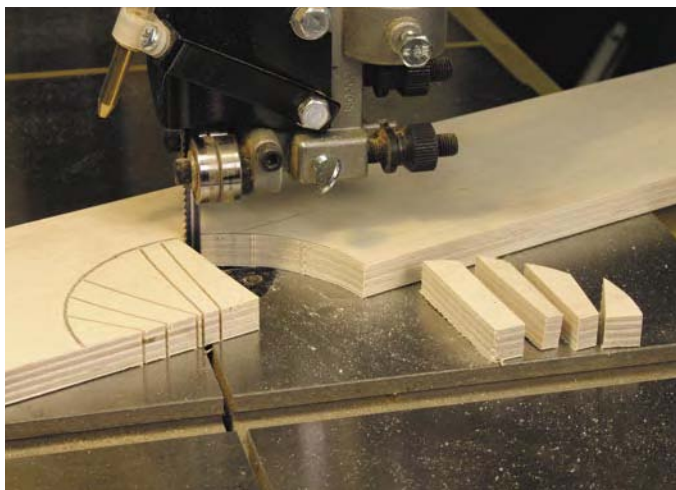
- 4 • Four-arm knobs
#00M55.30, \$1.50 each
- 1 • Veritas Router Base Plate
#05J25.01, \$29.50
- 2 • 2' T-slot extrusions
#12K79.01, \$6.50 each
- 1 • 3' T-slot extrusion
#12K79.03, \$9.50 each
- 2 • Cam clamp mechanisms
#05J51.01, \$3.50 each

The Wood & Shop Inc.
314-731-2761 or
woodshop.com

- 2 • 3/4" x 30" x 30" Birch ply
#BBP3/4C30X30, \$18 each
- 1 • 1/2" x 20" x 30" Birch ply
#BBP1/2 20X30, \$6.90 each

**Available from any
hardware store:**

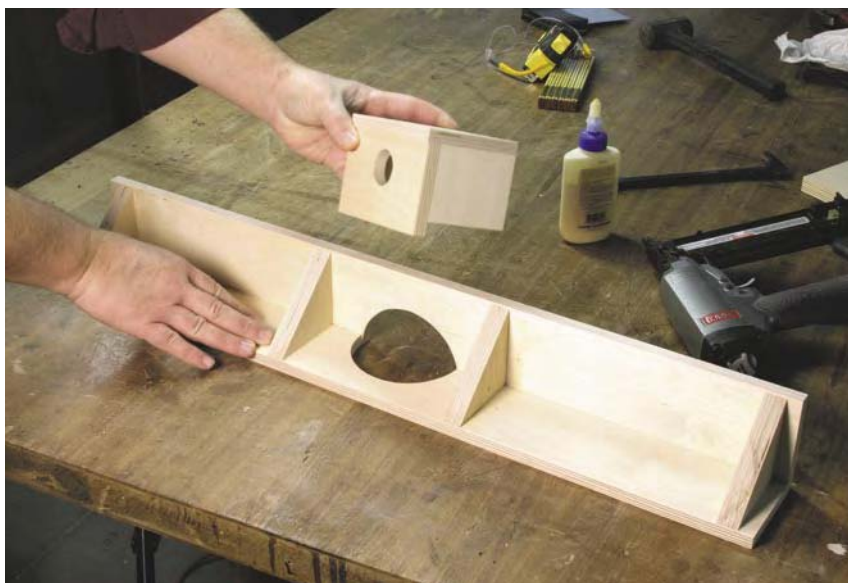
- 4 • 1 1/2" 1/4"-20 hex-head bolts
- 2 • 1 1/4" 1/4"-20 hex-head bolts



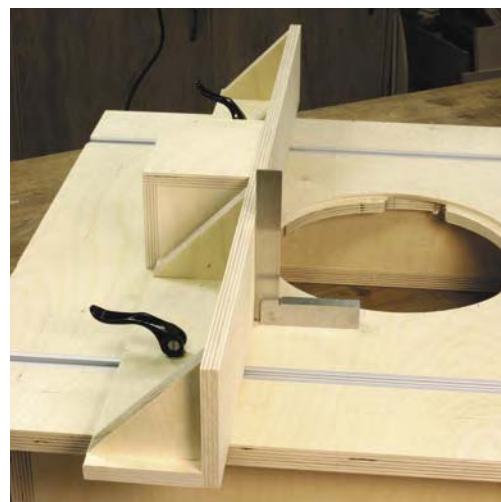
Cutting out the bit clearance hole on the band saw is made simple by first cutting "spokes" toward your line. These relief cuts allow the pieces to fall out in small chunks, rather than fighting with one bigger piece.



With the sub-face and base assembled, add the four triangular braces with glue and brads. Space them adequately to support the fence, but make sure you leave room for the knobs.



The dust collection hood completes the router table fence. It should seal tightly around the fence to provide the best dust collection, so don't skimp on the glue here.



After installing the cam clamps, lock the fence in place on the top and check for square. If adjustment is necessary, you can do it by sanding the base or adding thin shims. You don't want to add shims behind the fence faces because they're moving parts. Adjust the base.

The next step is to locate and drill the holes for the cam clamps that hold the fence to the table and for the knobs that hold the faces. Place the fence assembly over the table and orient the cam clamp holes so they fall in the center of the T-tracks in the top. There can be a little bit of play, but not too much.

Secure the fence to the table with the cam clamps so it seats tightly. Use an engineer's square

to check the fence against the top. If it's not square you need to adjust the base slightly, either by shimming or removing material from the underside of the fence base to make it square.

Next, drill the holes for the fence knobs, again avoiding the braces so the knobs can be easily turned. The holes should be 2" up from the tabletop.

The fence faces are next. To allow the best fence clearance

near the bit, I beveled the inside lip of each of the faces at 45°. Next you need to rout two, 2½"-wide stepped slots in the front of each fence face. These will allow the faces to be moved left-to-right to accommodate different bit sizes.

The easiest way to do this is on a router table, but if you're building your first, you can use a drill press with two different bits. Use a ½"-diameter Forstner bit to first cut a ¼"-deep slot. Then change to a

5/16"-diameter bit to drill through to the back of the fence face. This will create a slot that will let a ½"-hex-head bolt drop into the slot, recessing the head, but capturing the sides of the bolt head to keep it from spinning.

I also added a T-slot fixture to the front of each face. This allows you to attach featherboards, a guard to protect your fingers and other guides. Again, you can use a router or your dado set in the table



Seen from the front, the fence faces have been grooved for the T-tracks, and the clearance holes to attach and adjust the faces are drilled. Note that the face slot shows the rough edges from the overlapping holes made on the drill press. A few minutes with a file and some sandpaper will clean up the slots so the bolt will move smoothly.



After drilling clearance holes, you can locate the holes in the fence faces and add the knobs.



Here you can see the fences in place and the fence attached and ready to run. The T-tracks in the fence faces can be used for featherboards and you can use them to attach a simple guard to keep your hands a safe distance from the bit.



The support brace (customized for my bench vise) holds the router top firmly in place with plenty of clearance (and no wasted space).

saw to make the slot (about 1" down from the top of the fence).

Attach the fence faces using the bolts, washers and knobs.

The Mounting Support

To make the whole thing work, you need to be able to secure the table in your bench vise, but still have access to the router motor. We used a U-shaped support screwed to the sides of the table. The actual size of the support will

depend on your bench vise, but you want the tabletop to rest on the vise as much as possible. In fact, if you can also get the top to rest on the vise at the rear of the table, that's even better support. Our larger router forced us to move the support all the way to the rear of the table. This is something else that can be individualized on your table.

You'll see in the photo that we used two support braces to catch

the vise at both the top and bottom of the jaws for more support. Your vise may require a different arrangement, so give it a test run to make sure it's held tight.

Finishing Touches

With the support mounted you can put your table to work. But you may want to add a step—finishing. While a bare plywood surface will perform reasonably well, a slicker surface will make things move eas-

ier. You can add a topcoat of spray-on lacquer (as we did), or simply add a coat of oil or shellac.

Some other simple additions for your table can include some shop-made featherboards (that will fit nicely in the T-tracks on the fence face) and if you're really industrious, you could actually add a couple of storage drawers to either side of the opening in the top. Customize the project to meet your needs. **PW**

FUNDAMENTALS OF LAYOUT

Owning the right tools and knowing a few tricks
will ensure accurate work.

Layout is one of the most important processes in woodworking; it provides an essential “road map” to point you in the right direction when cutting and fitting your joints. Layout is also an area of woodworking where it’s easy to make costly mistakes; and it’s disheartening to cut and fit joints only to find out that they won’t go together properly or that they’re in the wrong location.

Yet I’ve found that by using the right tools for the job and following some simple procedures that accurate layout is virtually assured. Let’s first take a look at some layout tools that should be part of every woodworker’s tool kit; then we’ll go over the techniques that I use to measure and mark accurately.

Tools for Marking

Although I sometimes use a pencil for layout (more on pencils in a minute), my first choice of a marking instrument is a knife. I remember early in my career when I first used a knife for marking.

Immediately my woodworking improved. A knife is the best choice for accurate layout, especially when you’re using hand tools. Pens and pencils make a mark on the surface of the wood, but a sharp layout knife incises the

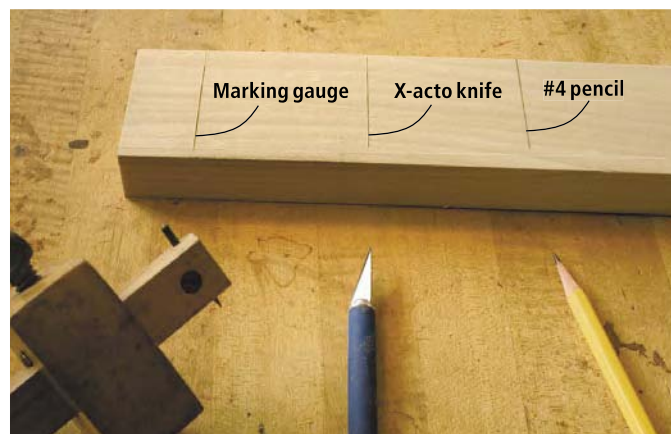
wood. You’ll find it much easier to saw or chisel accurately to an incised line than to a pencil mark; the saw or chisel will naturally follow a scored line.

Although there are a number of fancy layout knives available in woodworking tool catalogs, my favorite is still an X-acto knife. It’s razor sharp so it doesn’t require honing, the long, slender tip reaches into tight spaces and when it becomes dull it takes just a minute to replace the old blade with a sharp one.

If you’ve been trying to cut dovetails to a pencil line you will see a noticeable improvement when you switch to using a knife for marking out the joints. The chisel will easily slip into the knife line and give you a clean, crisp cut every single time.

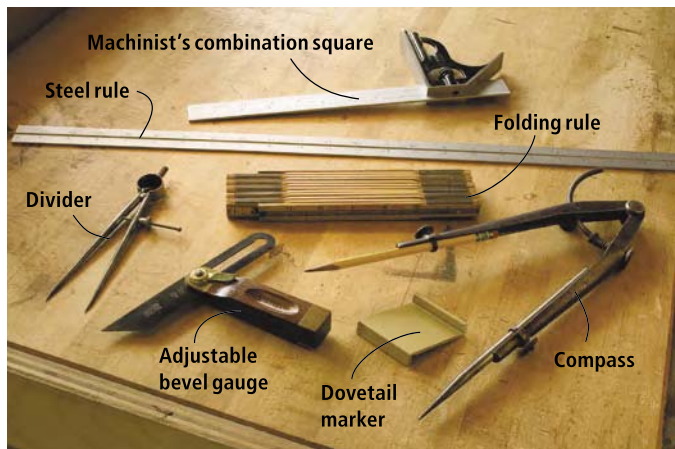
by Lonnie Bird

Lonnie is the author of “The Complete Illustrated Guide to Using Woodworking Tools” (The Taunton Press) and teaches woodworking. You can learn more about his classes online at lonniebird.com.



Here you can see three lines scored on a piece of wood. The left line was made using a marking gauge, the middle line was made using an X-acto knife and the right line was made using a #4 pencil beveled to a chisel profile.





These layout tools should be in every woodworker's toolbox.

For incising knife lines parallel to the edge of stock I choose a marking gauge. The tiny knife or wheel of a marking gauge actually scores the wood like a knife. The head of the gauge follows the edge of the stock to ensure that the layout line is parallel to the stock's edge. The marking gauge is the best tool for marking baselines on dovetail joints. But once you own a gauge, you'll find a number of uses for it. When shopping for a gauge, look for one with a graduated beam and a cutter that removes for sharpening.

Although pencils are not my first choice for precision joinery, they still find a use in my shop. When I need a fine, accurate layout line but I don't want to see a scored line in the finished product, I use a #4 pencil. Unlike the common soft #2 pencil, the #4 has a very hard lead, which can be finely sharpened and will hold its edge. You can find #4 pencils at most office-supply stores. When sharpening a #4 pencil I use an old draftsman's trick and bevel the edge to a chisel profile with fine sandpaper.

Tools for Measuring

Open almost any woodworking tool catalog and you're sure to see a wide variety of measuring tools

—from steel tapes to steel squares with engraved markings and a satin finish. A good rule should be easy to read and convenient to carry around the shop. My personal favorite is still the venerable Lufkin X46 folding wood rule.

It measures 6', which is longer than the majority of woodworking projects, yet it folds easily and quickly to slip into a pocket. And unlike a steel tape it holds itself open and stays put while I'm marking. It's even got a brass slide at one end that serves double duty for taking inside measurements and measuring depth, such as the inside of a mortise. Put a drop of oil on each joint occasionally and this tool will last for many years.

Steel tapes self-wind onto a spool for convenience but when unwound, the tape doesn't lie flat. This creates a potential parallax problem as the curled edges of the tape lift the graduations off the workpiece. Even so, the steel tape is still a favorite among many woodworkers. The shorter versions, 10' to 12', are lighter and more compact than the large, awkward 25' tapes that really are intended for the construction trades and not for woodworking.

When making precise measurements, such as a drawer opening, I always use a steel rule. The best ones are machined, rather than stamped, and the numerals are engraved. Nowadays, a satin finish is available, which eliminates glare and prohibits rust. The engravings allow you to slide the point of a layout knife precisely into position for the highest degree of accuracy.

When measuring equal distances, don't overlook dividers. This simple tool has legs, which adjust to step off equal spaces with accuracy. The best dividers have a thumbscrew for locking in precise adjustments.

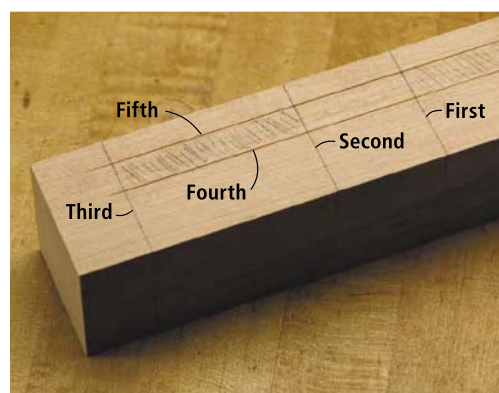
Every woodworker should have a good-quality square; it's one of the most useful and important tools you'll own. I'd suggest that

you avoid the fancy rosewood and brass versions, and purchase a machinist's quality combination square. This versatile tool works as both an inside and outside square, a 45° square, and a depth gauge. The best ones have a hardened head and an engraved rule. Cheap squares feature a die-cast head, a stamped rule, and are often, in fact, not square.

To mark angles other than 90° you'll want an adjustable bevel gauge. This tool has a blade that pivots to any angle and locks in place. The best examples of this layout tool use a lever to lock the blade rather than a wing nut. The lever is low in profile and pivots out of the way. In contrast, many newer bevels use a wing nut, which can often be obtrusive.

Laying out dovetails involves marking the same angle on the stock repeatedly. You can use a bevel gauge and set it to the required angle with a protractor or you can use a dovetail marker. A dovetail marker has the angle built in so there's no need to set it before each use.

For drawing arcs and circles you'll need a compass. Similar to dividers, a compass has two steel legs but one can be replaced with a pencil. Trammels are useful for large arcs and circles beyond the



Here you can see mortise locations and sizes marked out on a table's leg. Notice which dimensions you should mark out first.



To deter parallax, position your rule on edge and view the numbers you're marking head on, as shown here.



For an exact fit, mark measurements on pieces using mating parts, not rulers. Here you can see I'm marking a stile for a cabinet.

reach of a compass. Their capacity is limited only by the length of the stick that they're clamped to. And trammels will give you much greater accuracy than the old string and nail trick.

Layout Technique

Remember, layout is a road map to guide you as you cut joints, curves and profiles. To ensure that joints and assemblies fit together as planned, here are the guidelines that I follow:

■ **Start with straight stock.** Your finest work always begins with stock that is flat, straight and square. It's difficult, at best, to perform accurate layout and joinery on even slightly warped stock. Consider skipping the S2S that's surfaced at the lumberyard and milling your own stock from rough lumber. And always mill mating parts, such as the stiles and rails of a face frame, together to ensure uniformity.

■ **Label the parts.** Labeling the parts in a project helps avoid confusion and mix-ups. Before layout I carefully examine each

piece of stock to determine the "show" faces. After selecting the figure and orienting the grain, I label the parts "top," "bottom," "left," "right," etc. The labels tell me at a glance how each piece is to fit within the assembly.

■ **Mark overall dimensions first.** With each piece of furniture I build, the overall dimension is usually the most critical. For example, chair seats are usually 17" from the floor; tabletops and the writing surfaces on a desk are 29" from the floor. I measure and mark this critical dimension first, then I measure and mark the location of joints, drawers, doors, feet, etc. In contrast, if you measure and mark the smaller dimensions first and expect them to add up, small errors can accumulate to throw the overall dimension off.

■ **Avoid parallax.** This phenomenon can cause small errors in your layout. It occurs when the marks on the rule are viewed at an angle. To avoid this, position the rule on edge so that the graduations touch the stock and view the number you're marking head on.

■ **Avoid measuring.** Although this may sound odd, there are many times I don't measure at all. Instead, I mark the workpiece from the mating part. For example, all joints involve at least two members; rather than measure and mark the second piece, I lay it out from its mate. Doors and drawers are another example. Because they're made to fit a cabinet, I position them adjacent to the opening for marking. Using this method I can avoid calculation errors and ensure a precise fit.

■ **Mark "Lefts" and "Rights."** Most furniture pieces are symmetrical and so they involve making mirror image parts. During layout it's easy to mistakenly mark two "lefts" or two "rights." Often the mistake isn't noticed until the joints are cut and it's time to assemble the project.

An easy method for avoiding this common layout error is to clamp the mating pieces together for marking. Start by measuring and marking the first piece, measure a second time to check the layout for errors, then clamp the mating pieces together and transfer the layout.

This method not only ensures that you have both a left and right,

but it also avoids the errors that inevitably come if you measure and mark each piece separately.

■ **Keep the tools sharp.** Whether you're using a pencil, knife, or marking gauge, remember to keep the tools sharp. A sharp layout knife will score the wood cleanly while a dull knife will tear the fibers and make it difficult to craft a clean, precise-fitting joint.

Remember, too, that while a hard, #4 pencil may be appropriate for some types of layout, it becomes imprecise as it wears. A quick rub over fine sandpaper will restore the fine chisel edge.

■ **Make sure you can see.** Recently my eyesight has dropped off slightly and I've found it difficult to see details. One of the guys in a class offered use of his reading glasses and it made a world of difference. I've also found that extra lighting helps.

■ **Measure twice, cut once.** This adage still rings true. I'll often measure the completed layout and find an error. In fact, layout errors are my most common mistake. So I've found that measuring twice ensures that after careful cutting and fitting the joints, all the parts fit together during assembly. **PW**



Clamping mating parts and transferring layout lines ensures accuracy versus individually measuring each part.

Best-selling Plant Stand

A spline-and-miter joint ensures
this elegant table will remain stable.

When I started building custom furniture many years ago, I discovered the best way to advertise my work is to let people see it. To do this my wife and I attend art and craft shows, and our local farmers' market. We take along a selection of jewelry boxes and other small items that we feel show the quality of our work.

At the start of each year we try to come up with something that our regular customers haven't seen before. And we hope it will be something that they will want to have for themselves.

A couple years ago, I designed this small table. Because all my work is one-of-a-kind and made using solid hardwoods, I needed something I could build in about four hours to make it affordable for my customers. This table is the result.

Since its first outing, I have made a considerable number of these tables. I have made them from native hardwoods and imported exotics, including teak, mahogany and purpleheart. The tops have been round, square, octagonal and other custom shapes. The legs have been tapered, straight and some have been Queen Anne style. All of these variations have an elegance all their own.

by Barry Black

Barry Black builds custom furniture in Red Deer, Alberta, Canada, using hand tools as much as he can. His passion for antique hand tools has become a sideline and he sells them on his web site, blackboardcreations.com.



The Right Wood

Although I used 5/4 material for the top in the table shown here, the entire project can be built from 3/4"-thick stock. The wood should be planed reasonably accu-

ately to thickness, but there is some room for small variations. Try to bear in mind that we are building a table, not a part for a space shuttle. No matter how carefully you prepare your wood, when the weather changes, it most likely will change, too.

The wood for the legs should be relatively straight-grained for obvious reasons. When I make a table with Queen Anne legs, however, I look for wood with some curve in the grain that mimics the curve in the leg's shape. It looks great and adds strength.

For the top and the shelf, I select something showy, maybe some bird's-eye maple or other figured wood. The aprons and stretchers are less conspicuous, and so more ordinary grain patterns can be used.

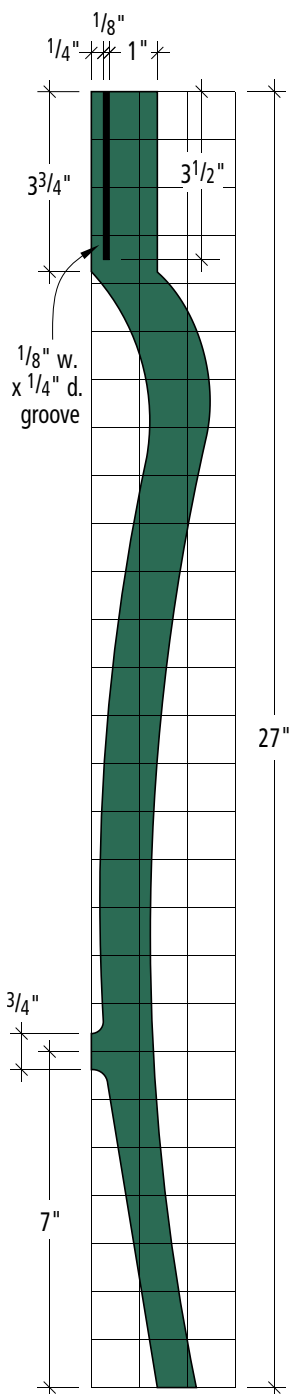
The dimensions shown are for a table that is ideal as a plant stand. But you can easily adjust them to build a table of up to about 20" square without increasing the thickness of the legs. Tables larger than this tend to look a bit spindly in the leg department. So to improve the look it is better to use thicker material for the legs, maybe 1 1/4" or even 1 1/2" thick. All the other dimensions would be basically the same.

Queen Anne Legs

It's best to cut the joinery in the legs before shaping them. To join the legs to the aprons I use a mitered spline joint. Using my table saw, I cut an 1/8"-wide slot in the leg and a matching slot in the mitered end of the apron. A spline in the slots holds them correctly in place and adds strength.

I attach the stretchers to the legs using dowel joints. Once all the joinery is cut I stack the legs together using double-sided tape and shape them.

To make the legs shown here, begin with four blanks 3/4" x 3"



Quarter-scale leg pattern

PLANT STAND

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL
		T	W	L	
4	Legs	3/4	3	27*	Walnut
4	Aprons	3/4	3 1/2	8	Walnut
2	Stretchers	3/4	3/4	10	Walnut
1	Top	1	12	12	Curly maple
1	Shelf	3/4	7	7	Curly maple

*Finished dimension; cut oversized for shaping

x 29". Near the top of each leg mark where the slot will end at 3 1/2" from the top. On the table saw (with the saw off of course), lower the blade and clamp a block of wood to the fence to stop the cut in the right place.

You will need two fence setups, one for the left side of each leg and one for the right sides. Cut each groove 3/8" from the board's edge. This operation will most likely require that the blade guard be temporarily removed. Set the height of the blade to 1/4" and make your cuts.

When the slots in the leg have been made, square up the ramped end of the slot left by the shape of the saw blade with a narrow chisel. Next, stack the leg blanks together using double-sided tape, and mark out and drill the dowel holes for the lower shelf stretch-

ers. The holes should be 5/8" deep. I use 1/4"-diameter by 1 1/4"-long birch dowels. It's hard to drill these holes accurately after the leg profiles have been shaped.

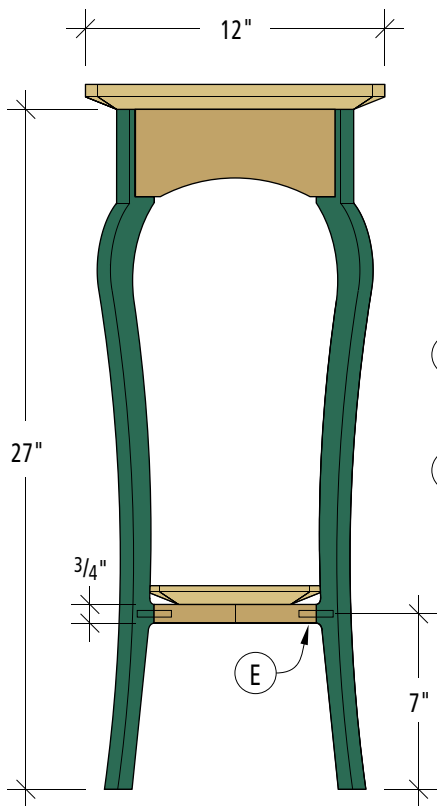
Trace the shape of the leg on to the top piece on the stack, and cut to this line using a band saw or jigsaw. Clean up the saw marks using a spokeshave, plane or rasp, and finally sandpaper.

Now apply the edge treatment to the legs. There are many things you can do here. I like to use my old Stanley No. 66 hand beader.

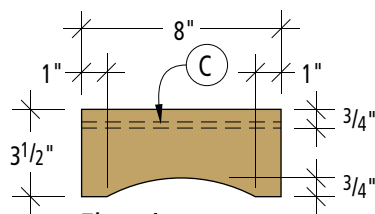
I filed a bead profile into a piece of hacksaw blade and carefully work that shape into the edges of the legs. Be careful to not do too much to the projection left for the lower stretchers to attach to. It's best to shape this section after the stretchers have been glued in place.



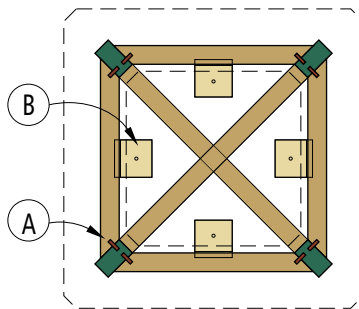
A stopped groove is cut on each side of the legs for the splines that will join them to the aprons. A stop block ensures accuracy.



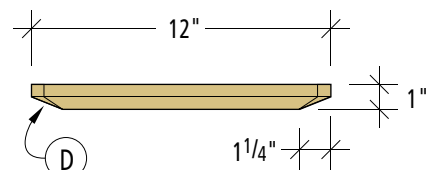
Elevation



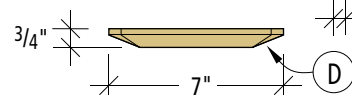
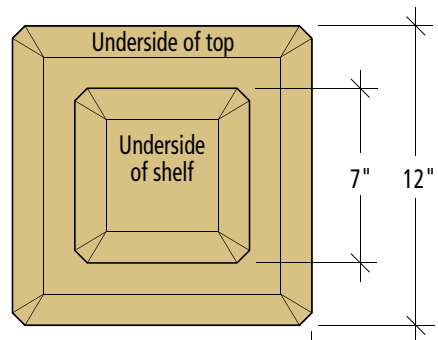
Elevation - apron



Plan



Elevation - top



Elevation - shelf

- (A) 1/8" t. x 1/2" w. x 3 1/2" l. splines
- (B) 1 1/2" x 1 1/2" x 3/4" t. top-mounting buttons reduced on one edge to 1/4" tongue
- (C) 1/4" x 1/4" groove on back of aprons for top-mounting buttons
- (D) 1/2" h. x 1 1/4" w. taper on underside of top and shelf
- (E) 1/4" dia. x 1 1/4" l. dowels



With the legs stacked and held together with double-sided tape, the pattern is used to lay out both the shape of the legs, and the location of the holes for the dowels.



After the stack of legs is cut to shape, the edges are detailed by hand.

Aprons and Stretchers

To make the aprons, I first cut the blanks to length, miter the ends of each piece, and cut a $\frac{1}{4}$ " x $\frac{1}{4}$ " groove for the buttons that attach the top to the base.

Now I need to make a saw kerf $\frac{1}{4}$ " deep in each mitered edge for the spline. I actually prefer to do this step using a sled I made that tilts the wood at 45° rather than tilting the saw blade.

When this operation is complete, I stack the apron pieces with

double-sided tape and then mark out the lower edge profile. I cut and then sand these edges, and complete the edge treatment the same way as was done on the legs.

The stretchers are made with $\frac{3}{4}$ "-square stock. Cut the two pieces to length and then drill dowel holes in the center of each end. The pieces are joined to each other using a simple bridled joint. You can cut this joint on a band saw, or with a handsaw and a some light chisel work.

Top and Shelf

Choose your finest pieces of wood for the top and shelf. Sometimes I will use the same species I used for the base assembly, but occasionally I will become bold and use a contrasting wood. When this is done properly, it can be very eye-catching and the table will usually command a better price.

Because my tops typically are at least 12" square, I generally find it necessary to glue together pieces for them. If you take the time to match the grain, the joint can be hardly noticeable.

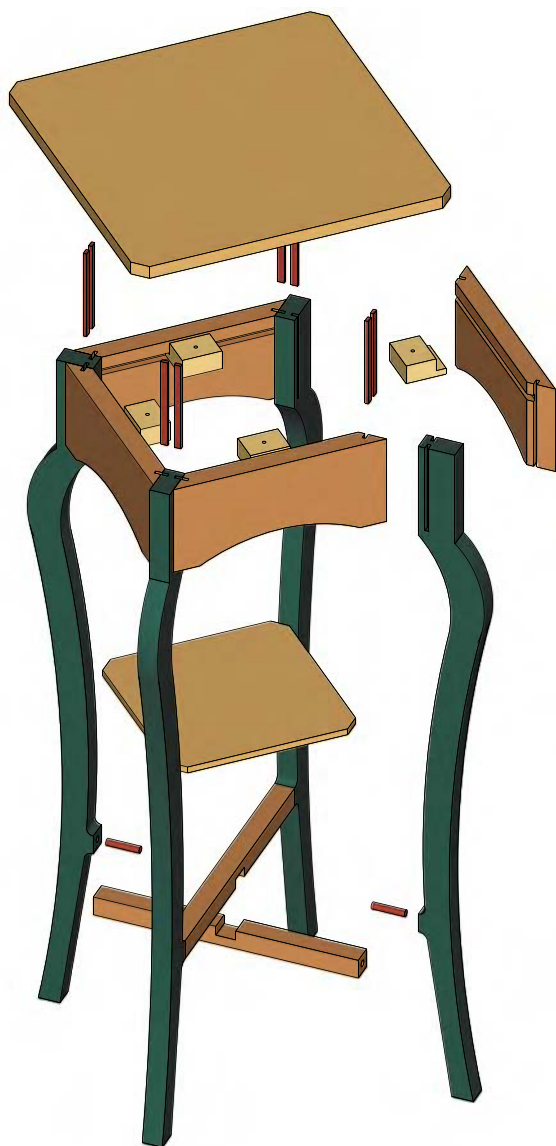
On square or rectangular tops and shelves I usually clip the corners at 45° and bevel the underside of the parts about $1\frac{1}{4}$ " back from the edge to a $\frac{1}{2}$ " taper with a hand plane. I find that this makes the finished piece look less top-heavy. The top edges can be chamfered or rounded over.

Prior to assembly I like to sand or scrape all of the parts, usually finishing at #240 grit for the legs and aprons, but going to #400 grit on the top and shelf. I then apply a first coat of oil finish to the top and shelf (as these parts won't be glued), which I allow to soak in while I glue up the legs. I allow the finish lots of time to penetrate, but not so much that it's difficult to wipe off. This, of course, depends on your local conditions, and where I live this will change from day to day.

Final Assembly

When it comes time to assemble the base unit, do a dry run first to make sure that everything fits. A tip here is to make sure that the dowels and splines aren't too tight a fit or too long.

You can make your splines from any species of close-grained hardwood. I make them "cross-grained," i.e. with the grain at 90° to the length of the spline. If it was done the other way, the splines could easily split down their length as they are only slightly less than $\frac{1}{8}$ " thick. I like the splines to run the full length of the slots, finish-



Exploded view



Each mitered end of the aprons receives a slot for the splines. The completed joint is strong, even though the splines are thin (inset).

ing them off cleanly with a sharp chisel when everything is dry.

If I'm alone, I do the glue-up in two stages. I glue up the legs in two stages. I glue up the legs and aprons in two sets. When these have had time to dry, I assemble them with the other two aprons and hold the whole thing together using surgical tubing. This stretchy tubing allows me to spring the legs open enough to get in the two stretchers along with their dowels.

When this is accomplished, I bind more tubing around the legs near the stretchers. I find this works best when the base portion is assembled upside down and on a flat surface to ensure accurate alignment of the aprons with the top of the legs.

If the miters were cut accurately, when the surgical tubing is stretched tightly the whole thing squares itself. The beauty of the spline-and-miter joint really shows itself off in a project of this type. I usually clean up any squeeze-out glue at this time and while doing so I carefully inspect the joints for tightness.

I allow the glue to cure and then add the edge profile to the stretchers, sand everything again and attach the top and shelf. I use

traditional wood buttons, keying in to the grooves in the inside of the aprons to attach the top, which allows for wood movement.

The buttons need to be $1\frac{1}{2}$ " square x $\frac{3}{4}$ " thick. The buttons' tongues need to be $\frac{1}{4}$ " thick. The length of the tongues isn't critical but they shouldn't bottom out when the top expands or contracts with changes in weather. The grain on a button should run into the slot in the apron—a cross-grained button would be very weak and could easily split.

Also, the holes to attach the buttons should be larger than the screws used, which will allow for movement and adjustment. If necessary, a washer should be used under the screw head to protect the button from splitting. Always use round-head screws. The taper under the head of a flat-head screw will almost certainly crack the surrounding wood.

I make my buttons from hard maple scraps. I usually make a lot of them at a time so I always have some on hand.

The table's shelf only needs two through holes for screws drilled into the stretchers and up into the underside of the shelf to do the job adequately.

Careful Finishing

As with any woodworking project, finishing can make or break the piece. The difference between a great and a mediocre piece can be as little as 15 minutes extra in sanding or scraping. I scrape whenever possible to maintain my crisp edges and to keep down the dust in my shop. Sometimes though, sanding works best and then I use a random-orbit sander.

My finish of choice is an oil and varnish mixture. I always use this on the legs and aprons. The finish for the top and shelf depends on the intended use

of the piece. If it's to be a plant stand, a water-resistant polyurethane makes sense, but if it just has to look pretty or maybe display an ornament, it gets about four coats of the hand-rubbed oil. It's also easy to repair if anything does damage the finish at a later date. One of the few drawbacks with oil is the possibility of the used rags spontaneously combusting if left around so it is imperative that they be disposed of properly.

This table has uses in every room of your house. Be creative with your design, and maybe try your hand at selling a few. **PW**



A bridle joint holds the stretchers together in the middle, dowels join the ends of the stretchers to the legs.



Surgical tubing applies pressure evenly on all the joints, pulling the assembly tight and square while the glue cures.

Tongue and Groove

There are many ways to cut this popular edge-to-edge joint.

A tongue-and-groove joint is an edge joint with a mechanical interlock. The edge of one board has a groove. A matching tongue is formed on the edge of the mating board. The tongue goes into the groove, and the boards are joined.

You probably are most familiar with the joint's many applications in building construction, such as strip flooring and paneling. In furnituremaking, the tongue and groove is excellent for edge-to-edge glue-ups. If cut precisely, the joint ensures that the faces of adjoining boards come flush easily and that they can't creep out of alignment as you position and tighten clamps. When the clamps come off, a little scraping and hand-sanding is all that's needed before moving on.

Cutting the Joint

Consider the design of the joint before you set up to cut it. Good proportions are essential to produce a strong joint, but the intent of the joint also is important. The general rule says you should have a square tongue that's roughly one-third of the stock thickness and centered on the edge. Working with $\frac{3}{4}$ " stock, that plays out to a $\frac{1}{4}$ "-thick by $\frac{1}{4}$ "-long tongue, and a matching groove.

A longer tongue (one that's $\frac{1}{2}$ " long for example) is prone to break at the shoulder. Also, the walls of a deep groove may crack. But a tongue and groove for a panel glue-up



Photos by the author

When setting up the table saw to cut the joint, just eyeball the rip-fence position for the groove. Sight down across the end of the stock and align a centerline drawn on it with the center of the cutter. A two-pass work routine centers the groove and eliminates the need for test cuts. When making the joint (right), a snug press fit is your goal. This is a first try – honest!



– just to register and align the faces – requires only a small tongue. All it takes is $\frac{1}{8}$ ".

The joint should be a firm press fit: If you have to knock the pieces together, then struggle to pull them apart, the joint's too tight. A tongue that's a hair too fat for the groove may actually seat, but it will stress the groove

sidewalls and may, in time, prompt them to split. On the other hand, you don't want the tongue to rattle in the groove, especially where the joint is intended to register and align the faces during assembly.

You can cut tongue-and-groove joints with a table saw, shaper or router, either hand-held or table-mounted. I'm going to focus on the table saw and the router.

There's no hard rule on which half of the joint you cut first. I prefer to make the groove first, because I think it's easier to fit the tongue to it than the other way around.

by Bill Hylton

Bill is the author of several books about furniture construction and router operations. When he isn't writing about woodworking, he's doing it in his home shop in Kempton, Pennsylvania.

On the Table Saw

To produce a tongue and groove on the table saw, use a dado cutter rather than your everyday blade (unless your stock is $\frac{3}{8}$ " or less in thickness). I use the two outside cutters to produce a $\frac{1}{4}$ " cut width when working $\frac{3}{4}$ " stock. Thicker stock calls for a wider groove.

Set the cutter height next – $\frac{1}{4}$ " to $\frac{3}{8}$ " is optimal for a joint that's to be assembled without glue. If you're making a glue joint, a shallow $\frac{1}{8}$ " groove is all that's needed.

Bring the rip fence into position, endeavoring to position it to center the groove on the working stock. Make a test cut and measure the groove shoulders with dial calipers. Adjust the fence setting to center the cut as close as possible, then center it by making two passes on each board. When you're content with the samples, cut a groove on each workpiece.

To switch to the tongue-forming setup there are no changes in the cutter height. Use a sample groove to position the fence, aligning the outside edge of the cutter with the edge of the sample's groove as shown below. You will probably need a sacrificial facing on your fence, as shown in the photos at right.

Cut a sample tongue and fit it to the groove. Slide the work along the fence, cutting one shoulder, then spin the work around and repeat the cut to form the second shoulder, as shown below. Adjust the fence position as necessary to get a good fit.

With a Router

Using a router gives you more options in terms of the approach and the cutters. You can do the work on the router table or you can move a portable router across planted boards.

If you're going to use the former approach, you can cut tongue-and-groove joints with a straight bit, a slot cutter or a dedicated tongue-and-groove cutter assembly or set. If you want to use a portable router, then I'd recommend using the slot cutter.

Using a straight bit: On the plus side, you use a commonplace bit that has a multiplicity of applications. On the negative side, you may, depending on the hardness of your stock, need to make more than one pass per cut to reach the full depth. That can trigger work sequence woes, especially on a job with lots of pieces. Specifically, you have to make a pass on each workpiece, adjust the cut depth, then make a second pass on each piece.

Using a straight bit to cut a tongue-and-groove joint in a portable router requires balancing the tool on narrow edges, a tough assignment. Cutting the joint on the router table with a straight bit mimics using a dado cutter on the table saw.

The cut controls are these: The bit's extension above the tabletop governs the tongue length/groove depth. Fence position controls lateral placement of the cut. You cut both elements with the work on edge, with the face tight against the fence.

The setup sequence and cutting routine also mimic those of the table saw approach:

- Install the bit and set its extension.
- Position the fence for the grooves. With one end of the fence secured, swing the free end to align the centerline on a sample workpiece with the bit's center. Auxiliary coverings on the fence and tabletop downsize or eliminate the bit opening to forestall workpiece hangups.

- Rout the grooves, centering them most easily by making two passes.
- Reposition the fence for the tongues.
- Rout the tongues by making two passes on each workpiece.

Using a slot cutter: An alternative, one



A sacrificial facing on the rip fence preserves the dado cutter and the fence, yet allows cut width adjustment using the fence position. More than just a facing, mine straddles the fence; one out-of-the-way clamp immobilizes it.



Use a grooved piece to set the fence for the tongue cuts. Align the outermost cutter tooth with the inner wall of the groove. A test cut and some fine-tuning may be required at this stage to fit the joint properly.



A rabbet cut into each edge of the board forms the tongue. It's smart to cut a sample and check its fit before cutting all your work.



When you're using a straight bit, repositioning the fence for cutting tongues can be an optical challenge. Sight across the bit to the grooved sample to make an initial setting. Cut a sample tongue, and adjust the fence position if necessary based on a test fitting.

that works equally well in table-mounted and portable routers, is the slot cutter. On the positive side, it will cut a full-depth groove easily. It's a good choice for thin stock, because a variety of slot widths less than $\frac{1}{4}$ " are available. However, there aren't single cutters available in widths greater than $\frac{1}{4}$ ". To produce a wider-than- $\frac{1}{4}$ " groove requires an assembly with two or more cutters on its arbor.

When cutting with the slotter, the tongue length/groove depth is controlled by the pilot bearing or the fence, while the position of the cuts on the edge of the work is controlled by



Two passes form the tongue. Note that the cut is on the fence side of the work. In addition, the table is set up to prevent stalled cuts. While not zero-clearance, the opening in the tabletop is minimized and the fence facing is seamless.

the bit-extension adjustment. All the cuts are made with the work flat on the tabletop or the router on the face of the board.

Start by cutting the groove. Rest the stock flat on the tabletop by the cutter, and raise or lower the cutter until its tip is centered on the stock's edge. Adjust the fence for the desired depth of cut. Feed the stock across the tabletop, its edge tight against the fence, to make the cut.

As with the straight bit, you can use a two-pass approach to center the groove. Make one pass with the face against the tabletop, the

second with the back against the tabletop. The groove will be slightly wider than $\frac{1}{4}$ ", most likely, but it'll be centered. Then fit the tongue to that groove.

When you switch the setup for cutting the tongues, leave the fence setting alone. Lay your grooved sample beside the bit and lower it until the cutting tip aligns with the groove wall that's closest to the tabletop. (You don't want to trap the work.) Cut a test tongue and adjust the setup as necessary to fit the tongue to the grooves.

Dedicated tongue-and-groove cutters: Most bit manufacturers sell individual bits or sets of bits designed specifically for cutting tongue-and-groove joints. Most give you two separate bits, one for cutting the grooves, the other for the tongue. The benefits are:

- You shouldn't have to "fit" the tongue to the groove. Out of the box, the cutters will produce the optimally fitted joint. Provided the bits have sufficient capacity to work stock more than $\frac{3}{4}$ " thick, and provided you mark a reference – and mind the marks as you work – having the groove and tongue off-center shouldn't be a problem.
 - Set up two tables, one for each bit, and you can mill stock in production mode.
- But unless you do a lot of tongue-and-groove joinery these dedicated cutters aren't a worthwhile investment in my opinion. **PW**



The tongue-and-groove joint requires preciseness of fit rather than preciseness of dimension. As with other setups, I eyeball the slot cutter elevation in relation to a centerline marked on a work sample. The groove is centered using the two-pass work sequence, and the exact groove width is only marginally relevant.



With a slot cutter, the work rests flat on the tabletop throughout the cut. Center the cut accurately in the usual way: Make passes referencing both faces. The second pass will probably widen the groove slightly, but it will ensure it is centered.



Always make the tongue-forming cuts with the cutter lowered to the table, rather than trapping the work between it and the table. As with the other tool setups, you use a grooved sample piece for the initial setting. (This router table has a topside adjuster.)

Strategies for a Fitted-lid Box

These egg boxes are perfect practice projects for turning objects with snug-fitting lids.

A fitted-lid box is one of the most interesting things to make on the lathe. While there are many steps involved that all have to be done correctly (especially when fitting the lid), with some patience even a beginning turner can successfully complete one. Boxes can be just about any shape or size; in honor of this season of growth and renewal, this one is made in the shape of an Easter egg.

This type of fitted-lid box is turned end grain. That is, the grain of the wood runs parallel to the axis of rotation of the lathe, and the interior of the box is cut into the end grain of the piece. With this orientation, the wood is more stable and the lid is less likely to fit badly as the wood moves (some movement will occur even with dry wood) after the box is finished.

You can use just about any kind of wood for box-making, but hard, close-grained woods will work best. More open-grained and especially softer woods will be difficult to cut cleanly deep inside the box. For example, hard maple would be better than boxelder. Most exotics and many domestic ornamental and “wild” woods (such as rose-of-sharon, swamp privet, honey locust, redbud, apricot, dogwood, etc.) will work very well. The wood should be very dry (ideally around 6 percent to 8 percent, for those of you with moisture meters you’re anxious to use); if it isn’t, the movement as it dries further will cause the fit of the lid to change, possibly significantly.

Beginners will find it easier to make a box that is not too deep, because hollowing into end grain can be more difficult than cutting side grain, as in a bowl. Always keep in mind that patience will make the job much easier and in turn, more enjoyable.



Photo by Al Parrish

Turning a fitted-lid box, such as these egg boxes, can be challenging. Practice and patience are key.

First Turn the Inside of the Lid

Begin by choosing a suitable piece of wood about $2\frac{1}{2}$ " x $2\frac{1}{2}$ " x about 5" long. Mount it between centers and turn it to a cylinder. Turn a straight tenon on each end (for mounting in the chuck; make sure the diameter of the tenon is not too large or too small for your chuck) about $\frac{3}{4}$ " long. Make a parting cut to separate the body from the lid, about one-third of the way from one end. I use a thin parting tool (the less wood you remove, the closer the grain pattern will match where the lid and the body of the finished box meet), and I cut almost to the center, but not quite all the way. If you leave just a very thin bit of wood holding the pieces together, the lid won't get separated from the body (an issue for me because I usually prepare many blanks at

once); a quick twist will separate them when you're ready to make your box. You should not part all the way into the center of this kind of workpiece or the pieces will be wrenched loose from the lathe and may hit you.

Mount the lid in a chuck, but don't tighten the jaws yet. Just snug them enough to hold the piece. You may need to center the workpiece by tapping gently on the high side and then rotating by hand to check it; when it is centered, tighten the jaws.

Start the lid by using a fingernail gouge to turn the end off smooth and square. Begin hollowing the lid by pushing the gouge into the center of the workpiece, then pulling it to the left and out. These are scraping cuts; you should keep the flute of the tool pointing well to the left, or the edge may dig in. Keep removing wood until you have the shape you want. You may find a domed or rounded scraper useful for smoothing the surface. Hold it at an angle and make light cuts, or it will dig in.

Cut the lip where the lid will go on the box (see the illustration). You can do this with the

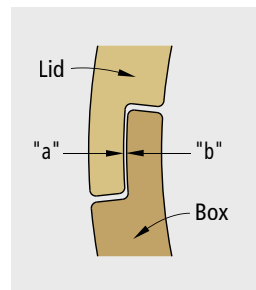
by Judy Ditmer

Judy, author of two turning books and many articles, has been turning since 1985. She teaches and demonstrates her skills throughout the United States and Canada.

fingernail gouge, but you might find it easier to do with a small scraper shaped for the purpose. (The critical surface is at "a" and "b;" this surface must be straight and aligned with the axis of the lathe and of the workpiece for the lid to fit properly.) When you have finished hollowing the lid and cutting the lip, sand and apply finish to the interior. Turn a small radius on the outside edge.

Next Turn the Inside of the Box

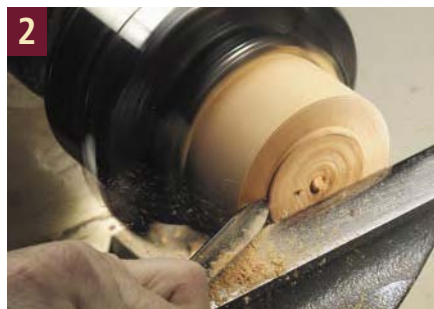
Mount the body of the box in the chuck and face off the surface just as you did with the lid. Measure the inside diameter of the lid with a metal caliper. To transfer the measurement to the workpiece, with the lathe on, lay the caliper on the toolrest and gently touch only the left point to the wood. This will create just enough of a mark for you to look at the right



It's imperative that surfaces "a" and "b" fit together perfectly. A too-tight lid could cause the wood to split; a loose lid will fall off easily.



Turn the stock to a cylinder, turn spigots on ends and cut partway in to separate the lid from the box.



Face off the end of the workpiece so it's smooth and flat (or very slightly hollowed).



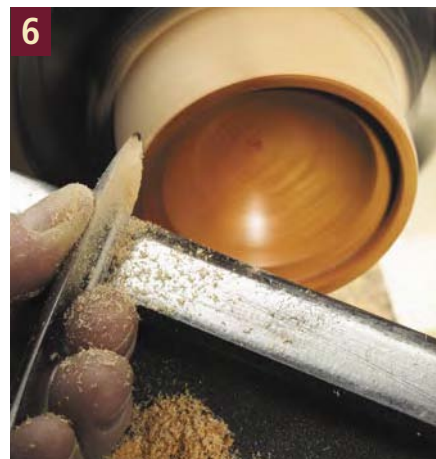
Begin hollowing the lid, using the fingernail-grind spindle gouge.



A rounded scraper is useful for smoothing the interior. Hold it at an angle and make a light cut.



This little scraper, which has a long straight edge nearly parallel to the shaft of the tool, makes cutting the lip easier.



After finishing the interior, turn a small radius on the outside rim of the lid. Sharp corners are hard on fingers and are vulnerable to chipping.



Measure the inside diameter of the lid with a metal caliper.



Transfer the measurement to the box.



Cut the shoulder where the lid will fit.

point (which must never touch the wood) and see whether it aligns. If not, move the caliper to the left or right as needed, and when both points of the caliper are aligned to the same circle, push the left point into the wood a bit to create a clear mark. This approximates the final diameter you're aiming for.

Cut the shoulder for the lid. You will need to go slowly here; if you take off too much, you'll have to reduce the length of the box and start over. What you are after here is to make surface "b" exactly parallel to "a" (on the lid), and only a hair smaller, so the fit will be very snug. You're going to turn the outside of the lid and box together, and the friction of this fit will be the only thing holding the lid on as you shape the box. Test the fit often, and remove less wood each time, not more, or you will suddenly find you have made it too loose. Remember, the amount of material removed is double that where the cut is being made. Don't force the lid on if it's way

too tight; this will split the lid. Practice and experience will make it easier in time.

Finally, Shape the Outside of the Box

When you have the lid properly fitted and in place, proceed to shape the outside of the box. Remember to look at the inside of the lid before you put it on, and remind yourself what it looks like so you'll know what shape to make the outside. You can take it off to check, but it will get looser each time you do as the fibers are compressed and smoothed, so it's better if you don't have to.

Continue to shape the box and lid. Remember this is spindle turning (grain parallel with the axis of rotation of the lathe), so cut from the larger to the smaller diameter. Use great care when working close to the chuck. Your left hand should be firmly anchored on the toolrest, and not moving along the toolrest as you make those last cuts. Complete the outside, sand and apply finish.

Remove the lid (it's now completed), and hollow out the body of the box as you did the lid. Be patient; go slowly. When this is done, sand and finish the inside; then make the final fitting of the lid. Sand the surface "b" very gently and test the fit often. It's very easy to take off too much. The idea is that when you pick the box up by the lid, it won't come off, but won't resist when you take it off.

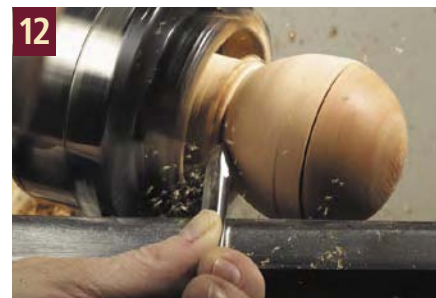
Re-mount the box in the chuck (using leather strips to protect the box), center it and tighten the jaws. Here again experience will teach you how tight; too loose and the workpiece will pull out of the chuck; too tight and you may mar or even break the box. Working gently, left to right and with small cuts, turn away the waste wood of the spigot and finish the shaping. Be careful to blend the curve so you don't have a bump near the bottom. Sand and apply finish, remove from the chuck and put the lid on. Your fitted-lid egg box is complete. **PW**



Test the fit. The lid should fit very snugly so it will stay on as you shape the outside of the box.



Turn the outside of the lid. Make small cuts and try to avoid catches, or you may pull the lid off.



Continue shaping the outside of the box. Note that although I am working close to the chuck, my hands are safe because I am not applying any pressure towards the chuck. My left hand is firmly on the toolrest and is not moving side-to-side at all; all the controlling of the cut is done with my right hand.



Sand very lightly to do the final fitting of the lid. It's very easy to take off too much, so use fine sandpaper and test the fit often.



Re-mount the box in the chuck to turn off the spigot. Use fairly thick, stiff leather to cushion the finished box from the jaws.



Sand and apply finish.

Choosing an Exterior Coating

Five different types of protection exist. Here's a guide to choosing the best one for your project.

The need to protect wood outdoors is much greater than the need to protect it indoors because of exposure to sunlight and rain. These cause wood to gray, split, warp and rot; and moist conditions make the growth of mildew possible.

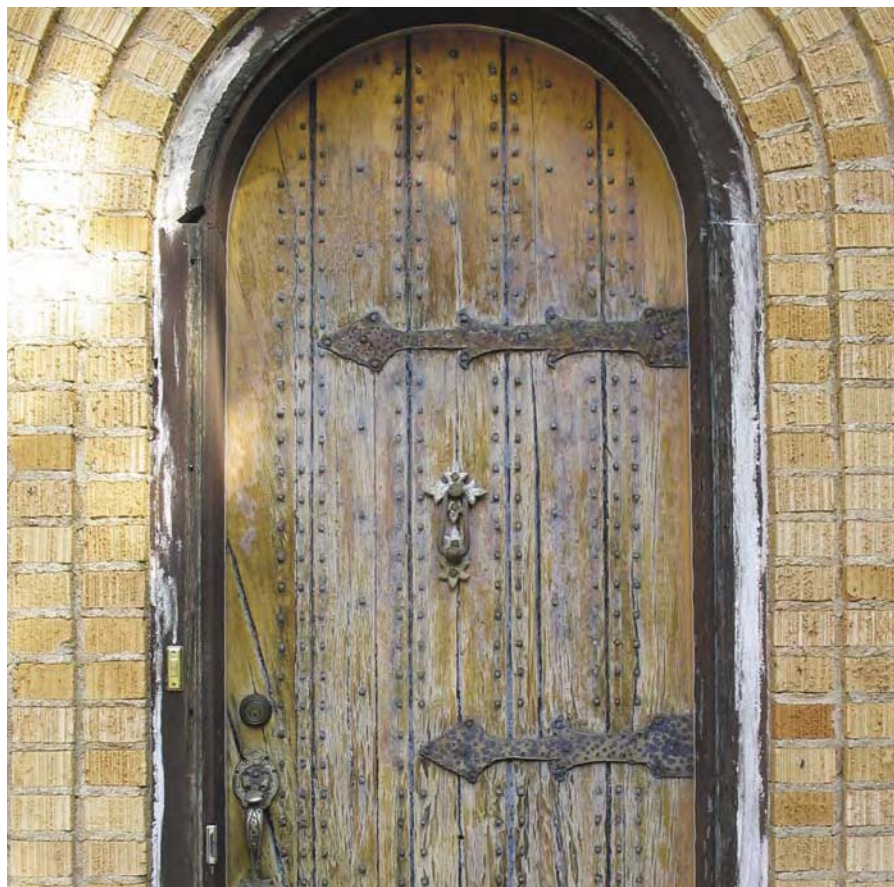
You can use paint, stain, clear finish, water repellent and preservative to prevent or retard damage to exterior wood. But first, it's helpful to understand the causes of the damage.

Exterior Damage

Sunlight contains strong ultraviolet light, which is very destructive to wood over time. UV light destroys the lignin that glues the cellulose wood cells together, and rain then washes the lignin away. Because the lignin contains the extractives that give wood its distinctive coloring, the wood turns silvery gray on the surface when the lignin is gone.

Sunlight also heats the surface of the wood and draws out moisture, causing shrinkage. This leads to splitting and warping, and these are made worse by rain when it comes in contact with only one side of the wood—as on decks, tabletops and exterior doors. The water makes the surface cells swell, but the thickness of the wood prevents the surface from expanding. The cells are then forced to compress to oval shapes, and they hold these shapes even when dry.

This phenomenon is called “compression shrinkage” or “compression set,” and I described it in the context of finishing both sides of wood in the October 2004 issue. (Back issues are available online at popwood.com.) Compression shrinkage causes wood to warp and split as the exposed side continues to



Photos by the author

This front door faces west with no trees or other obstructions to block afternoon sunlight. You can see that the door is in good shape at the top where the deep recess in the framing protects it. But the condition worsens progressively from there down because of contact with both sunlight and rain. An overhang would offer the best protection, but this would change the design and the architect's intent. To preserve the design, the best solution is to coat the door with a marine varnish high in UV-absorber content, and sand back and recoat whenever the varnish begins to dull.

shrink a little more each time it goes through the wetting and drying cycle.

Rain is partially responsible for rotting and the growth of mildew, because both require moisture to occur. Rain is also indirectly responsible for a visually similar damage—insect infestation—because insects require moisture to thrive.

The heartwood of redwood, cedar and

some hardwoods is naturally resistant to rotting. Some softwoods are pressure treated with chemicals to make them resistant to rotting. These woods have the familiar dull green or dull brown coloring. Sapwood and non-pressure-treated pine and fir are not resistant to rotting.

There are five different types of coatings you can use to protect against the problems caused by sunlight and rain: paint, stain, clear finish, water repellent and preservative. You can buy any of the first four types of coatings with a preservative included to retard mildew, or you can sometimes buy a

by Bob Flexner

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

concentrated preservative separately and then add it yourself.

Paint

Paint is the most effective coating for protecting wood. The thick film blocks water penetration and the pigment blocks UV light. You can find wood siding that is in perfect shape after 200 years because it has been protected continuously with well-maintained coats of paint.

There are two large categories of paint: oil-based and water-based (latex). Because oil-based paint wears better than latex paint, it is best for objects that see a lot of abuse such as chairs and picnic tables.

Oil-based primers are also best when you are painting wood that has been exposed to the weather for a month or longer, especially if the wood has grayed. Oil-based primers penetrate deeper than latex primers, so they are better able to penetrate the degraded wood caused by the destruction of the surface lignin and bond to good wood underneath. If the wood is freshly milled or sanded, acrylic-latex primers perform well.

Latex paint is best for wood siding because it is better than oil paint at allowing moisture vapor created inside a building to pass through. If the moisture vapor can't get through the paint layer, it builds up behind

the paint and causes it to peel. (A primer coat of oil-based paint applied under latex paint is not thick enough to stop moisture penetration.)

Paint is great for siding and house trim because they can be caulked to keep water from getting into the wood and causing the paint to peel. Paint is also great for furniture and exterior doors if they don't get a lot of exposure to moisture.

But paint is a poor choice for decks and often for fences because it's rarely possible to seal off all the end grain effectively. The paint peels and requires too much work to effectively keep up.

Pigmented Stain

Pigmented stain is the next most effective coating for exterior wood. Just as with paint, it resists both moisture and UV-light damage because it contains both binder and pigment. But because there is much less of each and little or no film build, pigmented stains are not as resistant as paint.

On the other hand, the lack of film build makes maintenance easier. Usually, all that is required is a fresh application of the stain every year or two, depending on the climate and amount of exposure. There's seldom a reason to scrape, strip or sand.

There are three types of binder and two

concentrations of pigment to choose from. The binders are oil-based, water-based and alkyd-based. The pigment concentrations are semi-transparent and solid color.

Oil-based stains are the most popular and easiest to use. You can brush, spray or roll on a coat and enough of it will either soak into the wood or evaporate so that you end up with very little or no film build. With no film build, there is nothing to peel, so recoating is easy. Simply clean the wood of dirt and mildew, and apply another coat.

Water-based acrylic stains are popular because of their lack of odor, ability to be cleaned up easily and reduced amount of polluting solvents. But water-based stains leave a build that somewhat obscures the wood and may peel if water gets underneath. Water-based stains also show traffic patterns more easily than oil-based stains because of the thin build wearing through.

Alkyd-based stains make use of a soft varnish to attach the pigment to the wood. These stains are meant to build on the wood, but they resist peeling because they attach so well to the wood, and they are so flexible. Often, manufacturers recommend as many as three coats and instruct you to clean the surface and apply an additional coat every year or two.

The disadvantages of these stains are that they will peel anyway if the wood isn't nearly



The combination of sunlight and rain causes wood to turn silvery gray. If you like the gray color, and you aren't having other problems, you can leave the wood unprotected. The grayed surface is very effective at blocking further degradation below. UV light erodes wood at only about 1/4" per century.



Quartersawn wood (right) is much more resistant to splitting than plainsawn wood (left). If you have a choice, always use quartersawn wood in exterior exposures. The two boards shown here are from a cedar tabletop left outside and unfinished for about eight years.



The mildew on the lower part of this board is a dark fungus that develops in moist conditions, especially in sheltered areas away from sunlight. You can prevent mildew by applying a wood preservative or a coating that contains a preservative. You can remove mildew by power washing or applying household bleach diluted with two to four parts water. Mildew causes little harm to the wood, but it looks bad.

perfectly clean during initial application or recoating, and visible wear is common in high traffic areas. It's very difficult to blend these areas back in.

The primary difference between semi-transparent and solid-color stains is the amount of pigment included. Solid-color stains contain more pigment (and also more binder), so they are better at blocking UV light. But the higher pigment concentration causes greater obscuring of the wood.

Stain is usually the best choice for decks and fences, and a good choice for cedar-shingle siding, and cedar shingles and shakes. Stain can also be used on furniture and doors. Alkyd, solid-color and water-based stains tend to build on the wood, which makes them vulnerable to lap marks and peeling. Semi-transparent stain is less resistant to UV light and water, but there is no peeling so recoating is easier.

Clear Finish

Clear film-building finishes, including water base and all types of varnish, resist water penetration well, but not UV light. Destructive UV light penetrates the film and causes the wood to degrade. The lignin that glues the cellulose cells together loses its strength, and the surface fibers separate from the rest of the wood. When this happens, the finish, which is bonded to these surface fibers, peels.

The trick to getting a clear finish to survive in UV light is to add UV absorbers, and many manufacturers supply finishes with these added. There is, however, a great deal of difference in effectiveness of various products. "Marine" finishes sold at home centers and paint stores contain much less UV absorber than marine varnishes sold at marinas.

Clear finishes sold for exterior use can be divided into three categories: marine varnish, spar varnish and oil. Water-based exterior finishes are also available, but they have not found much acceptance thus far. Marine varnish is a soft, flexible varnish with UV absorbers added. Spar varnish is a soft, flexible varnish without UV absorbers added. Oil may or may not have UV absorbers added, but it is too thin on the surface to provide much resistance to sunlight even with them.

Linseed oil, whether raw or boiled, is also susceptible to mildew growth. In fact, mildew feeds on the fatty acids in linseed oil, so

mildew develops faster than if no linseed oil had been applied. Only in very dry climates should linseed oil be considered as a finish for exterior wood.

Marine varnishes from marinas are the best clear finishes to use outdoors. They are always very glossy (for better light reflection), relatively soft (for better flexibility), and require eight or nine coats to reach maximum UV resistance. In addition, because the UV absorbers in these finishes don't prevent the finish itself from deteriorating, you will need to sand off surface deterioration (dullness, chalking and crazing) and apply a couple of additional coats whenever the surface begins to deteriorate. This might be as often as once or twice a year if the finish is exposed to bright sunlight in Southern exposures.

Use marine varnish on objects where you want maximum UV resistance with a clear finish and are willing to deal with peeling if water gets underneath the film. Use spar varnish if UV resistance isn't critical. Use oil only if you are willing to reapply it often and don't expect much UV or water resistance.

Water Repellent

Water repellents are usually mineral spirits with low-surface-tension wax or silicone added to repel water. Sometimes, they are simply thinned water-based finish.

Water repellents are fairly effective at reducing water penetration for a short time. If UV absorbers are included, water repellents block UV light for a short time. Both types of resistance wear away within months, so unless

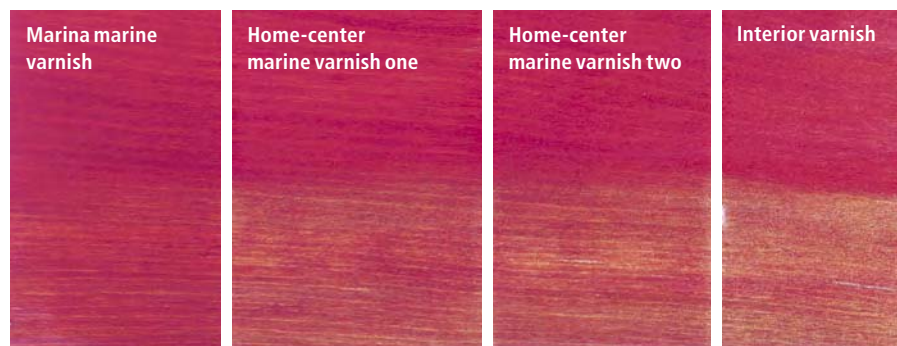


Rot is very destructive to wood, as is obvious in this photo. Pressure-treated wood and the heartwood of redwood, cedar and a number of exotic woods including teak, mahogany and ipe resist rot. A wood preservative that is not pressure-injected is fairly ineffective at preventing rot on non-rot-resistant woods.

you are willing to devote a lot of attention to upkeep, the wood will gray and split almost as fast as if no coating were applied.

Water repellents provide the least protection of any exterior wood coating, but they are easy to apply because they don't leave lap marks, and they don't peel.

Use water repellent on decks if you don't mind the wood graying or splitting. Use water repellent with a preservative included to fight mildew if you live in a humid climate. **PW**



Many exterior finishes claim UV resistance, but there is a big difference in effectiveness. I applied a red dye to this panel, followed by five coats of a marine varnish bought at a marina (left), five coats of two common marine varnishes bought at a home center (center) and five coats of an interior varnish (right). Then I exposed the panel to sunlight for six months with the top half protected by newspaper. The fading of the dye shows that the home-center marine varnishes provided little more resistance to UV light than the interior varnish with no UV absorber.

Almost a Plane Wreck

The perilous flight of the world's most valuable tool.

Half of the airplane's hydraulic system had failed at take-off; the other half failed as the plane was 10 minutes from the Atlanta airport. So the flight crew prepared the passengers for an emergency landing because they were going to hit the ground at about 200 miles an hour.

"Arms crossed; heads down," came the instructions from the crew. Clarence Blanchard was about to do as he was told, but there was something nagging at him so much that he just had to stand up and rummage through the overhead compartment.

Blanchard, you see, just happened to have the world's most expensive tool in a 1971 hard-case Samsonite above his head. He retrieved the ebony and ivory hand plane and cradled it between his legs. And then he waited for the plane to hit the ground.

The story of Blanchard and the now-famous Sandusky centerwheel plow plane began on the last day of June 2004 with a phone call to Blanchard's office at Brown Auction Services in Pownal, Maine.

The woman on the phone had a relative who wanted to sell an antique hand plane, and asked if Blanchard's auction house would sell it for them. Blanchard said he would be willing to take a look; and so they e-mailed him some photos.

When he saw the tool on the computer screen, he knew it was special – despite its crust of 100 years of coal dust. This was a "presentation" tool made by the Sandusky Tool Co. in Sandusky, Ohio, to likely display at the 1876 Centennial Exposition.

After the Sandusky Tool Co. fell on hard times and was sold in the early 20th century, some of its assets went on the block about 1934. A local construction magnate, John Charles Feick, wanted that plane badly. After the sale he walked out of the building and handed the tool to his son, Thomas,

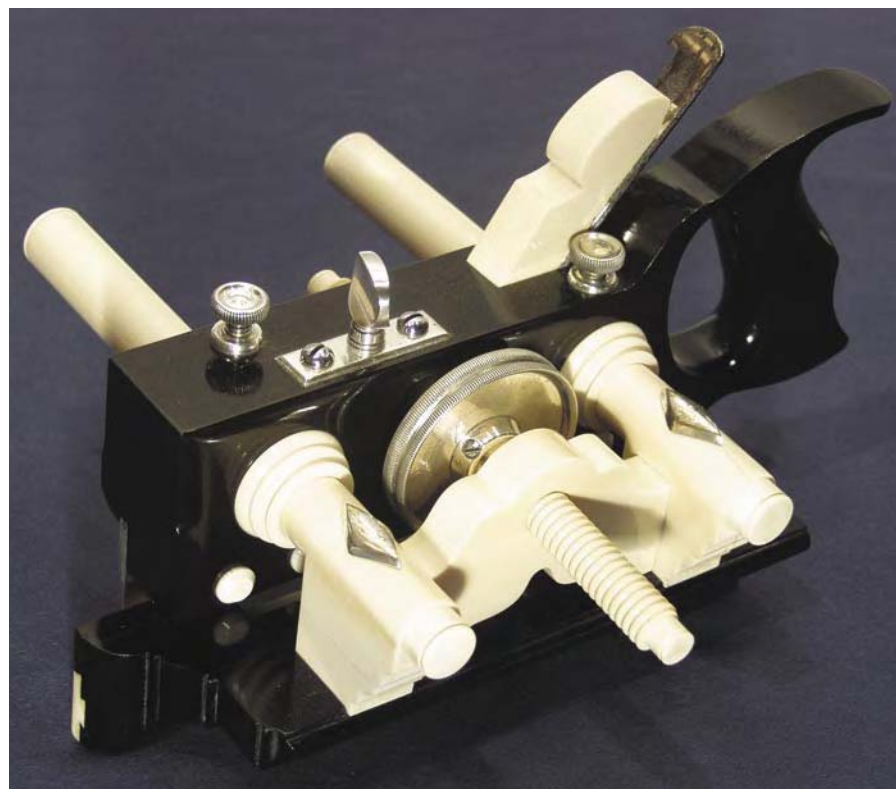


Photo courtesy of Brown Auction Services

who was then 4 or 5 years old. John told his son he bought the contents of the entire building just to own that tool.

The plane remained in the family and then passed to Thomas, who retired to Florida and kept the plane there until a phone call summoned Blanchard to fly south to retrieve it during the 4th of July weekend.

While in Florida, Blanchard disassembled the tool to get it through airport security. The metal parts went in his checked luggage; the ebony and ivory parts into his carry-on. And as the airplane lost altitude on its final descent into Atlanta, Blanchard says he wasn't afraid for his life.

Instead, he feared what would happen to the tool after the plane went down and Blanchard tried to leave the airplane with lots of officials around. "What would I do,"

Blanchard says, "if one of these great big guys tries to take it away from me?"

The airplane landed smoothly. And the Sandusky plane – which Blanchard affectionately calls "Sandy" – was unscratched.

Three months later in Harrisburg, Pa., lot #308 opened up at \$64,000. Until that moment, the record for any single tool sold at auction was about \$32,000. There were three bidders left when the plane hit \$100,000, and the gavel fell at \$104,000. With the buyer's premium, the total price was \$114,400 plus sales tax (the buyer was a Pennsylvania tool collector in the audience).

Avrum Silverman, a Massachusetts tool collector, says the room erupted in cheers when bidding hit \$100,000 and then applause for the buyer when the hammer dropped. "I don't think there's anything out there that can top this plane," he says. "It came out of nowhere. It has never been written about and it was only rumored to have existed. What else can top this plane?" **PW**

by Christopher Schwarz

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