

TAUNTON'S

Fine Woodworking

Secrets to building perfect drawers, p. 42



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Four essential router jigs

Get sharp fast with diamonds

Compound-angle dovetails without the math

Spray finishing for less

Mid-century coffee table





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- Motor: 3 HP, 240V, single-phase
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- Maximum depth of cut @ 45°: 2 1/2"
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- Blade tilt: Left • Table height from floor: 34"
- Table size with extension: 27" x 74 1/4"
- Arbor speed: 4300 RPM • Arbor size: 5/8"
- Maximum dado width: 1 1/4"
- Maximum depth of cut @ 90°: 3 1/4"
- Maximum depth of cut @ 45°: 2 1/2"
- Maximum rip capacity: 50"
- Distance from front of table to center of blade: 17 1/4"
- Overall dimensions: 40" H x 41" W x 82" L
- Approximate shipping weight: 557 lbs.



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- Motor: 3HP, 240V, single-phase, 3450 RPM, 12A
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- Motor: 3 HP, 220V, single-phase, TEFC
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- Max. depth of cut: 1/2" • Max. rabbeting depth: 1/2"
- Cutterhead dia.: 3" • Cutterhead speed: 4800 RPM
- Cuts per minute: 20,000 (G0656P), 21,400 (G0656PX)
- Approx. shipping weight: 500 lbs.

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- Min. stock length: 8"
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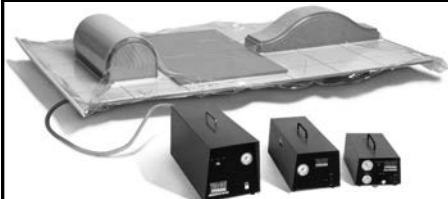


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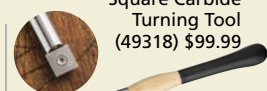
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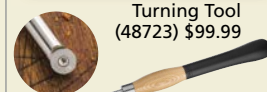
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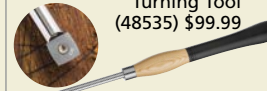
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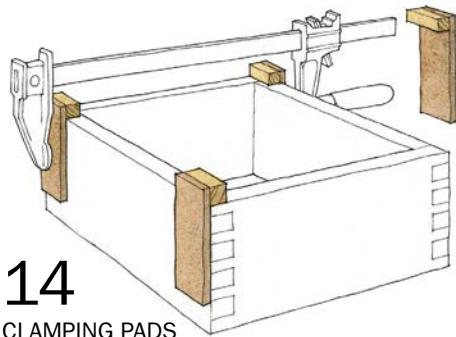
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Visit our website to access free online extras, available July 30. While you're there, don't miss our collection of free content, including tool reviews, an extensive project gallery, and must-read blogs.



Handheld Router Secrets

Learn three simple tricks for easier, safer handheld routing (p. 56).



Quicker Compound Angles

Take an in-depth look at a simple setup block (p. 82) that takes the math out of tricky compound-angle joinery.



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Country Charm, Built by Hand

Unplug your power tools and learn how to build a beautiful hutch (p. 64) that harkens back to the colonial American countryside. Best of all, you can do it without a single power tool. Andrew Hunter guides you through the entire process, with tips on how to:

- Mill rough lumber by hand
- Cut and fit traditional joinery accented with period-appropriate cut nails
- Craft beautiful hand-hewn spindles





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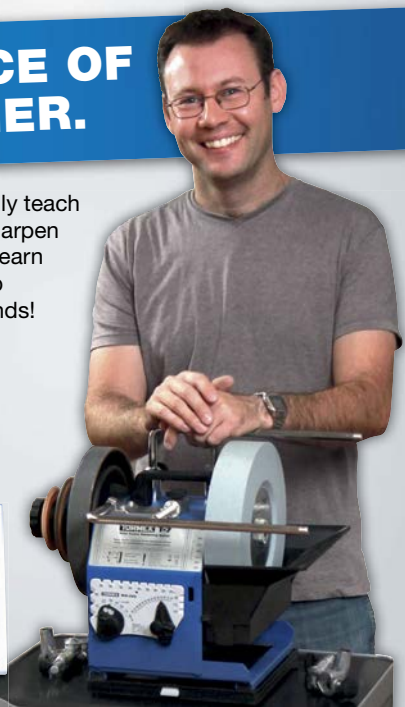


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contributors

Teri Masaschi (“*Spray for Less*”) lives near Albuquerque, N.M., but was raised in “New Hampsha.” She’s been a professional furniture finisher for 45 years, and also teaches finishing at well-respected schools, such as the Center for Furniture Craftsmanship in Rockport, Maine. Her book *Foolproof Woodfinishing For Those Who Love to Build and Hate to Finish* (2006, Fox Chapel Publishing) is in its second printing. When it comes to furniture making, she says she likes it best when wood and iron are used together as design features, and has a special love for antique wrought iron.

What do you do outside the shop? “Spend lots of time with my dog, Woody, and collect antiques.”



When **Brian Boggs** (“*Get Sharp the Diamond Way*”) made his first chair in 1982 in Berea, Ky., he had no training, no tools, and no money. For a guide, he used John Alexander’s book *Make a Chair from a Tree*; for material, he used a log found beside the road; for a chisel, he used a sharpened screwdriver. That chair led to nearly a thousand more in a 20-year quest to perfect the Appalachian post-and-rung ladderback. Boggs now lives in Asheville, N.C., and has branched out, building outdoor chairs that incorporate aluminum, a chair made for acoustic guitarists, even a swinging settee.



Tim Celeski (“*Domino Changes the Game*”) was introduced to woodworking by a magazine he bought to read during quiet evenings while camping. He built a workbench as his first project and fell in love with the work. Using skills developed as a student of architecture and design and honed during 30 years in business as a designer, his focus today is on original furniture. But he still has a special love for workbenches. His website, workbenchdesign.net, was built to help fellow woodworkers with plans, design information, and other resources.

Ottawa furniture maker **Jacques Breau** (“*Stylish Coffee Table with Sleek Lines*”) got an early introduction to woodworking from his father, and to creating art from his mother, a seamstress. After university, he studied at the Silva Bay Shipyard School and the Inside Passage School of Fine Woodworking, both in British Columbia. One of Breau’s favorite projects is a small Japanese-style box from some very special eastern hard maple. The wood came from the family farm when land was cleared to make way for the Trans-Canada Highway, and had been air-drying for decades.



For more information on our contributors, go to FineWoodworking.com/authors.

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Spotlight

ISSUE NO. 241
July/August 2014
p. 92

IVY CARVING GROWS ON HIM

I am just now reading issue #241 (July/August). What really caught my eye was Greg Brown's ivy carving on the legs of the table featured on the back cover, and on p. 90 (How They Did It). Having been an amateur woodworker since I was a kid in the early 1960s, I guess I had gotten pretty jaded, thinking I had seen it all. But I was blown away by the winding ivy carvings on the legs of that table.

Bravo! Maybe I am not so jaded as I thought I was.

—ZACK SIKORSKY, Bowie, Md.



Good points on dividers article

Just a comment about the photo demonstrating how to sharpen dividers ("Dust off your dividers," FWW #241, p. 27). The photo doesn't show enough of the belt sander to have context for which direction the belt would be running.

All work, especially pointed objects, should touch the belt in an orientation that does not allow digging in and catching. A pointed object that catches can pierce the belt and cause it to shred. I've done it. It's exciting, but I don't recommend it.

Divider points can also be sharpened using a whetstone. On quality dividers, the point can be sharpened to have a tiny, slightly rounded knife edge, which is superior to a conical point for scribing a line in wood.

—ALAN LAPP, Oakland, Calif.

While demonstrating how to divide a circle into six equal parts in last issue's Handwork, I erroneously stated that the radius of the circle equaled $\frac{1}{2}$ the

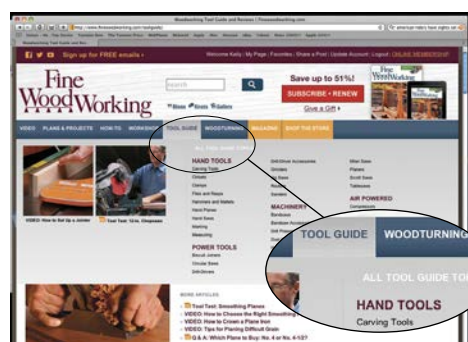
circumference. I should have stated that walking a set of dividers set to the radius breaks the circumference into six equal parts.

—STEVE LATTA, contributing editor

One of the best issues

I am contacting you to let you know that #241 is one of the best issues in recent years, and it doesn't have either of my favorite authors, Garrett Hack and Christian Becksvoort.

FWW has always pushed me to pursue skills beyond my repertoire. It has been inspirational, a great combination of both machine work and handwork. I'm still



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jaded that you are offloading content to "members only" sections on your website. And I think you should give access to full tool reviews online, forcing manufacturers to improve.

Enough of the bitter. Way to go with this issue.

—KURT JURGENS, Chicago

Editor replies: Thanks, Mr. Jurgens. By the way, although our tool review articles are only available to Finewoodworking.com members, you can access individual reviews for free. Just go to Finewoodworking.com and click on the Tool Guide tab.

Case construction article fills a void

Thanks for the great article "Engineering a Chest of Drawers" (FWW #241). This is one of those articles that is most useful in helping craftsmen understand sound case construction. Combined with articles on specific projects and techniques, this engineering article fills in the void for woodworkers.

—CHARLIE BUCHANAN, Winston-Salem, N.C.

I have read any number of books and magazines, but Curry's article was the first I found which so clearly laid out the "why" behind the "what" of building a typical carcass. Once one understands "why," then the various options become much clearer. Thank you very much to the author and staff (great images as always).

—STEPHAN WINTER, Sunnyvale, Calif.

Editor replies: Curry's follow-up article on building drawers appears on p. 42 of this issue.

Wrong number

In our review of benchtop mortisers in FWW #241, we reversed the model numbers of the Woodtek mortisers on p. 48.



Fine Woodworking

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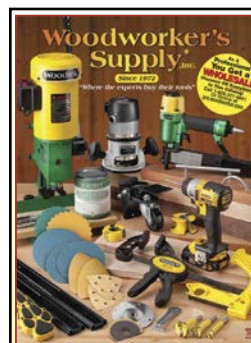
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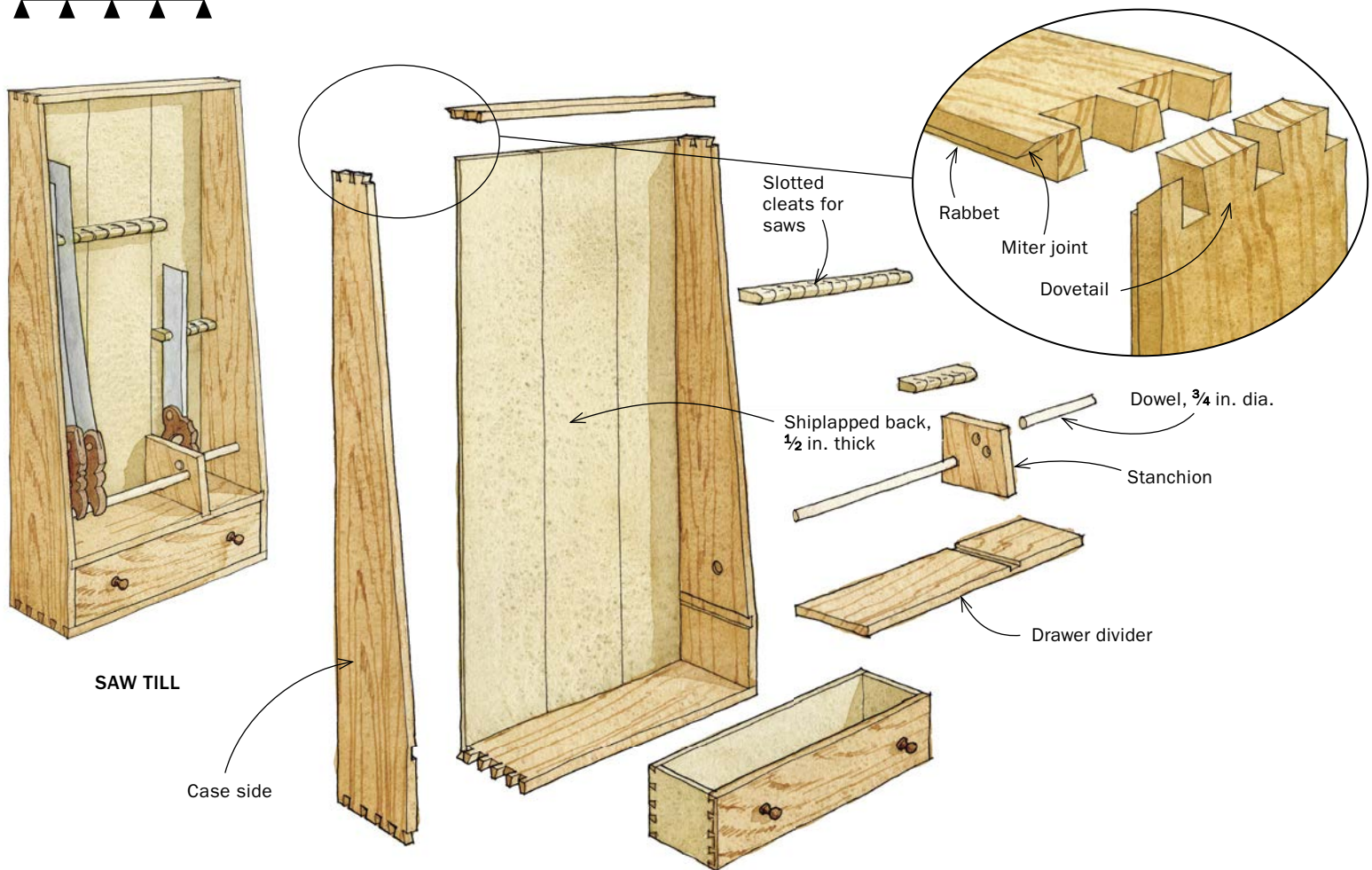
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Best Tip Convenient way to store handsaws



John Holland is a retired minister who loves to build period furniture, including tall case clocks and lowboys, using mostly hand tools. If he's not in his shop, he's usually spending time with his grandchildren or working in his garden.

Like most addictions, my handsaw habit started innocently: a great buy at a flea market, a high bid at an auction, a treasure found at a yard sale—and I was hooked. Finally, I got a grip and decided I was a builder, not a collector, so I chose 12 saws to keep and no more: two rippers, six crosscuts, one dovetail saw, one carcass saw, and two tenon saws.

Once I had my collection pared down, I designed this saw till to display ... er, store ... my saws, making them easily accessible from my bench, and included a drawer to hold a saw set, files, and a diamond stone. I chose southern yellow pine for the primary wood and poplar for the secondary.

Cut the sides, top, and bottom to length and mill these parts, along with the material for the drawer divider and stanchion, to $\frac{3}{4}$ in. thick. Rabbet the four case pieces full length to receive the back. Dado each side for the drawer divider, and taper the sides. Through-dovetails join the case, with a miter at the back to hide the rabbeted edge. Cut the drawer divider to length after the dovetails are fitted

and dado it for the stanchion. To fit the stanchion assembly to your saws, hold the long dowel up inside the carcass and place a couple of saws over it, leaving a few inches of space above the drawer divider. Mark the dowel's location. Do the same for the smaller backsaws, then drill the holes, glue up the case, and install the stanchion. Then make and fit the drawer. Finally, screw on the slotted cleats from the back and hang the till on the wall.

—JOHN HOLLAND, Madison, N.C.

A Reward for the Best Tip

Send your original tips to fwmow@taunton.com or to Methods of Work, *Fine Woodworking*, PO Box 5506, Newtown, CT 06470. We pay \$100 for a published tip with illustration; \$50 for one without. The prize for this issue's best tip was a DeWalt router kit.

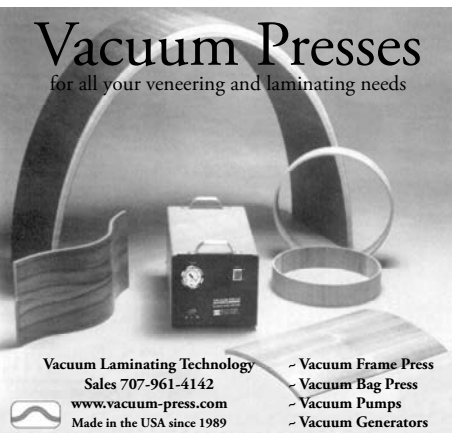


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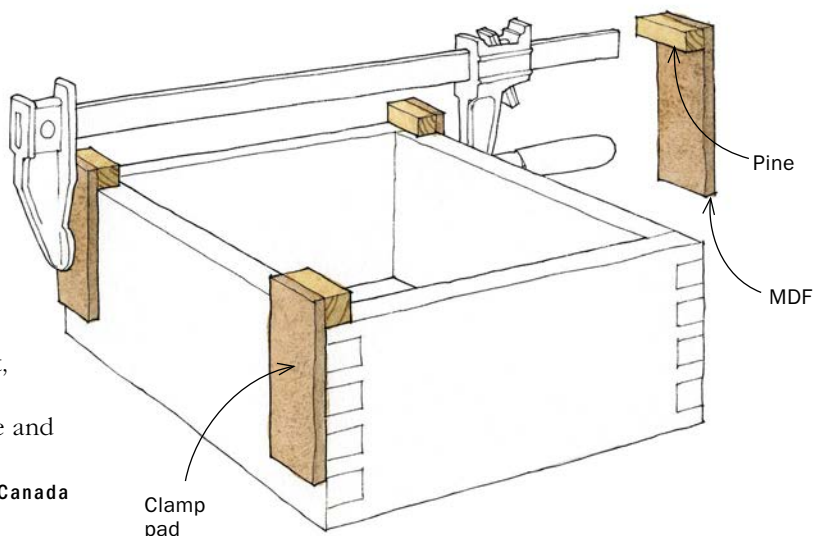
methods of work continued

Clamp pads stay put during glue-ups

When clamping up an assembly, I use these shopmade protector pads made from ½-in.-thick pine and ¼-in.-thick MDF glued together as shown. In use, the pine part serves as a ledge that sits on top of the component to be glued and prevents the pad from falling during the clamping process. The jaws of the clamp hit the MDF part, protecting the workpiece.

To make the pads, glue together a couple of feet of pine and MDF. Then crosscut the long strip into 1-in. segments.

—R. HONEYCOMBE, Kitchener, Ont., Canada



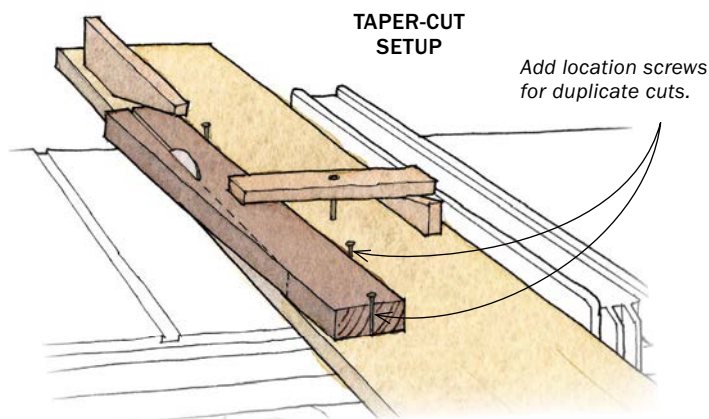
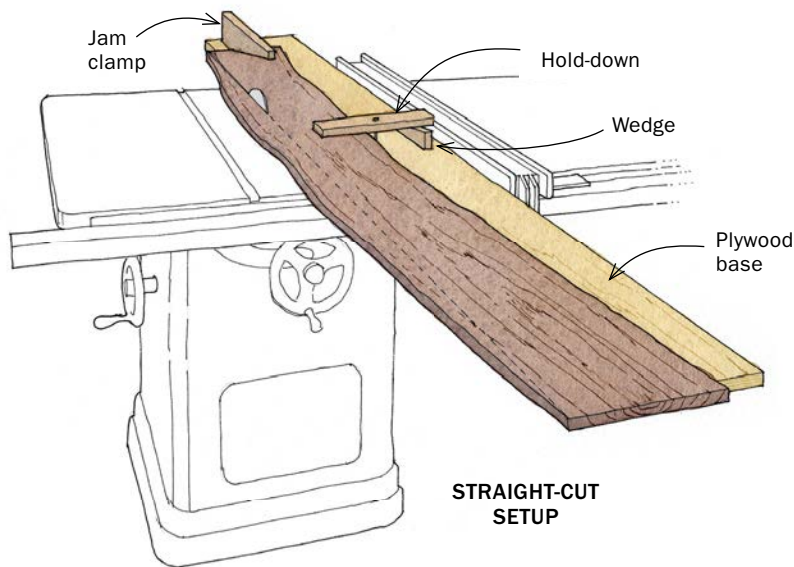
Multipurpose sled for the tablesaw

I created this jig to straighten curved boards and to cut tapers, and I've found it to be one of the handiest jigs in my shop. Cut the base to size and mount a wedge on one end to create a jam clamp. Then screw a hold-down that can be adjusted with a wedge to the middle of the board. The wedge and hold-down can be relocated as needed. To straighten a curved board, push one end of the board under the jam clamp until it is tight, and

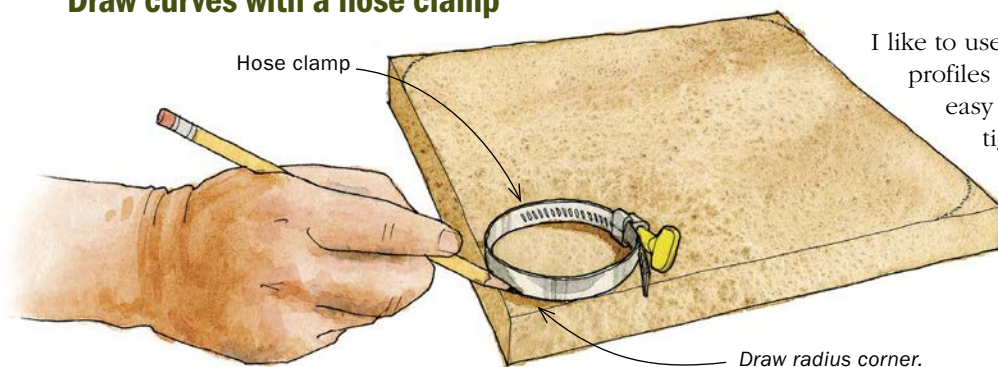
swinging the other end out until 1 in. or so extends over the edge of the jig. Lock the board in place by positioning the wedge under the hold-down at the same height as the workpiece, and tighten the hold-down with a screwdriver. Then set the rip fence, and push through to straighten the edge.

To cut a taper, set one end of the workpiece under the jam clamp. Make sure the taper waste extends over the edge of the jig and then wedge and tighten the hold-down. To cut duplicate parts, drive three screws into the plywood to set the position of the workpiece so you can reproduce it. Set the rip fence so that the jig is right against the blade and push through to cut the taper.

—TIM HANSON, Indianapolis, Ind.



Draw curves with a hose clamp



I like to use turn-key style hose clamps to draw round profiles on the corners of my cutting boards. They are easy to find in hardware stores, and the wing-nut tightener makes it easy to dial in any curve.

This is also great for matching a curve on a piece you wish to duplicate. I use an SAE size 48 clamp (3-in. nominal diameter) for most of the work I do, but with so many sizes available, your options are almost limitless.

—BART BRINKMAN, Post Falls, Idaho

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■ ACCESSORIES

Better hold-down for router tables

THE KEY TO PERFECT EDGE PROFILES on the router table is holding the stock securely against both the table and the fence while you are routing. I typically accomplish this by clamping on a couple of featherboards, but setting them up can be cumbersome. Jessem has simplified my life with innovative roller-type hold-downs that mount in the T-track on my router-table fence.

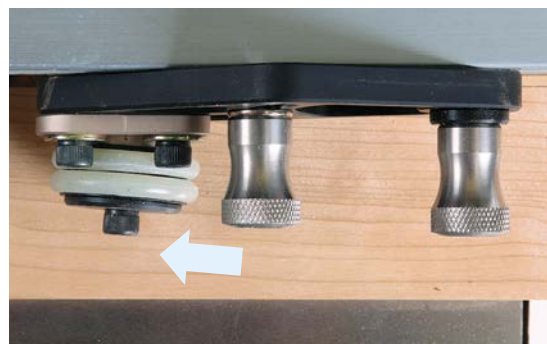
The cool thing about the rollers is that they not only hold the stock to the table, but because the guide rollers are angled 5° toward the fence, they also pull the stock tightly against it. In addition, the rollers spin in only one direction, so they act like a featherboard, preventing the work from slipping backward. The guides are quick to set up and work very well. There is one limitation: They don't provide enough clearance to use with stock that's less than 1½ in. wide. The maximum stock thickness depends on the mounting height of the rollers.

—Michael Pekovich is FWW's executive art director and a longtime professional furniture maker.



Clear-Cut Precision Stock Guides by Jessem Tool Co.

\$100 per pair



Router cleaner. Jessem's new hold-downs rely on rollers. They not only keep stock firmly against the table, but also against the fence, thanks to their angled design (bottom). The rollers also help prevent kickback, because they roll in one direction only.

■ HAND TOOLS

Spokeshave leaves a smooth surface

THE LEE VALLEY CAST ROUND SPOKESHAVE is a close reproduction of the Preston 1374 shave. At 6¾ in. long, it's compact, neatly fitting my small hands and reaching into tight spaces. But it's also comfortable and beautiful. Initially, because of the curved sole, it required a little practice to establish solid contact with the wood to draw a shaving. But after getting the hang of it, I was pleased with the shave and the smooth results I got with it. (It left a smoother cut when skewed slightly.) The blade, made of Veritas's PM-V11 alloy steel, can be removed quickly for sharpening via a slot that fits around the thumbscrew to hold it in place. Loosen the screw and the blade slides out.

—Mario Rodriguez is an instructor at Philadelphia Furniture Workshop.



Cast round spokeshave by Lee Valley

\$59

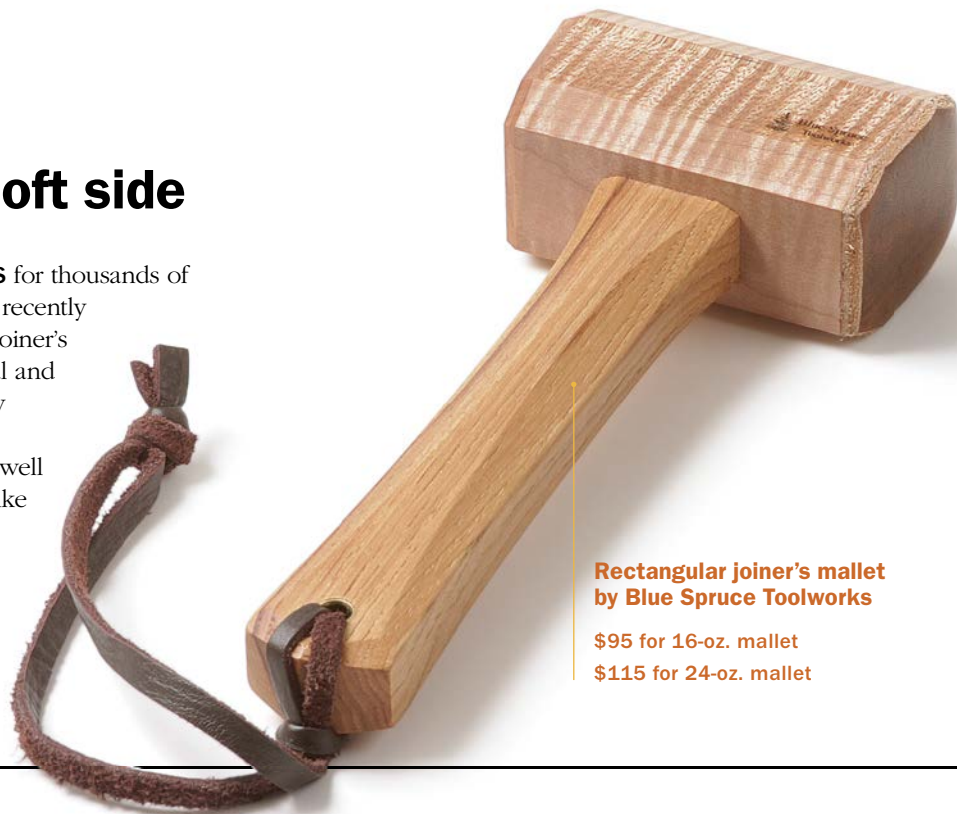
■ HAND TOOLS

Tough mallet has a soft side

MAN HAS BEEN BANGING ON THINGS for thousands of years, but Blue Spruce Toolworks recently elevated the activity with its new joiner's mallet. This wonderfully functional and beautiful tool has a comfortably faceted hickory handle and a tiger-maple head infused with an acrylic resin that adds toughness. The mallet is well balanced (I used the 16-oz. version) and feels like a natural extension of my hand.

One face of the head is capped with leather—perfect for when you need a light touch for tapping joints together.

—John Tetreault is
a deputy art director.



Rectangular joiner's mallet
by Blue Spruce Toolworks

\$95 for 16-oz. mallet

\$115 for 24-oz. mallet

■ ACCESSORIES

Tool-activated blast gates improve dust collection

GRNGATE'S BLAST GATES for dust collection systems not only open when you turn on a machine, but they also start the dust collector, a time- and back-saving system. The tracks on manual gates eventually get clogged, preventing the gate from closing completely and robbing your dust-collection system of efficiency. But with the GrnGate system, after you've turned off the machine, the dust collector runs for an additional 10 seconds to clear the line, which ensures that the gate's track is free of debris so that it can close tightly. When the gate closes, the dust collector eventually turns off.

The gates and dust collector are tied to a control box with one switch that turns on the collector manually without opening a GrnGate blast gate, great for hybrid systems where some of the gates are still manual. Another switch allows you to manually open a GrnGate blast gate that is shared by several tools, or dedicated to a floor sweep.

—Roland Johnson is a contributing editor.



Green retrofit. GrnGate's blast gates can be installed in any dust-collection system. The gates automatically open and close when you turn machines on or off.



Automatic dust gates by GrnGate

\$599 for starter system with three gates

■ ACCESSORIES

Shine light precisely where you want it

EVEN IN A SHOP WITH PLENTY OF BRIGHT ceiling lights, there are always a few places where you can use a light targeted on a small area. In my shop, which has great lighting, those areas are the bandsaw and drill press. Shadows make it hard to see the bandsaw blade and cut line, and to align bits with layout marks on the drill press.

Thankfully, Lee Valley sells an LED worklight with a magnetic base and a flexible gooseneck. The rare-earth magnet in the base (there's one in the included mounting bracket, too) is very strong. The base simply doesn't move after you've mounted it to a ferromagnetic surface like a bandsaw's metal housing.

The LED light is bright, and can be adjusted for a wider or narrower beam. The long, flexible neck stays put no matter how you position it. Both these attributes make it very easy to put light exactly where you need it.

—Matt Kenney is a senior editor.



Perfect task lighting. The flexible gooseneck stays put after you've adjusted it, keeping the bright LED light on target.



Magnetic-mount LED worklight by Cree

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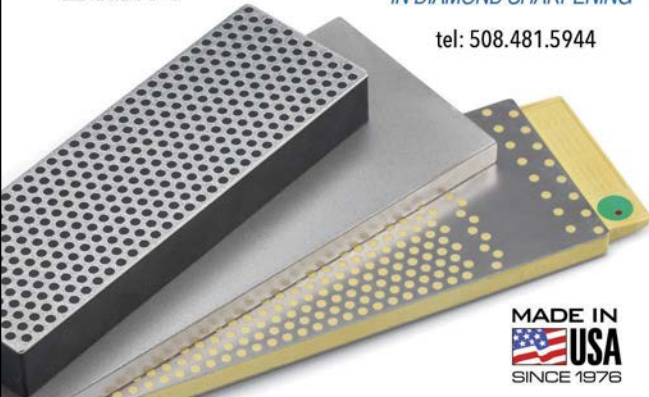
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fundamentals

Your first router

WHICH ONE TO BUY AND
HOW TO GET STARTED WITH IT

BY MARC ADAMS



In the early 1900s Oscar and Rudy Onsrud invented the router, a tool that has revolutionized our craft. Basically a motor with a collet that holds a cutting bit, this simple power tool is incredibly versatile. It can be guided by hand or mounted in a table. A router can be used to dimension stock and shape it in myriad ways, including turning square wood round. It can cut precise joinery and drill holes. With creative fixtures, the router can be used in ways we have yet to imagine. Called a “wonder tool” when it came out 100 years ago, the router still deserves that name.

Wonderful though it can be, the router intimidates new woodworkers. It turns on with a scream, leaving the operator holding onto a gyroscope that spins at 20,000-plus rpm. There are thousands of cutting bits available for it, yet the tool includes no

GO WITH A MIDSIZE, FIXED-BASE MODEL

A 2¼-hp, fixed-base router is powerful yet compact, with simple adjustments and a low center of gravity for excellent control. This versatile workhorse is the first router you should get.



obvious means of guidance. And with scores of routers in many different sizes available on the market—from plunge to fixed to trim—there is the first basic question of which one to buy.

Everyone needs a fixed-base router

In my opinion, a basic, fixed-base router should be the first one you purchase. I've found that the 2¼-hp size offers the best mix of power, affordability, and features. These midsize routers are rated around 12 amps, which won't trip the circuit breakers in your home shop. They are plenty powerful for everything you'll ask of them, yet still relatively light and compact, a real asset when working handheld. But they also work very well when mounted in a router table. At between \$100 and \$200 for a high-quality model, they are one of the best values in woodworking.

To be clear, the base on a fixed-base router actually does move up and down, but it must be "fixed," or set to a specific depth for routing, and it is not adjustable on the fly like the base on a plunge router. That means it can't cut deep mortises. Compared to its taller brother, however, the handles on a fixed-base router are much lower, putting your grip closer to the cutting action. I'll cover a few common tasks here, but to get even more from this versatile tool, see my companion article, "4 Jigs for a Fixed-Base Router," pp. 56-63.

A bit about bits

Although I prefer routers that can use both ¼-in.- and ½-in.-shank bits, I choose the larger bits whenever possible because they give the collet a better grip. Larger-shank bits also dissipate heat and vibration better, improving cut quality. The only downside is that they are a little more expensive.

Router bits keep getting bigger and bigger, with cutters that can range upward of 4 in. dia. Even if you dial down the speed on your router, a bit like that will generate too much force for handheld routing. I recommend that anything bigger than a ¾-in. roundover bit be used in a router table, where you have more control.

Router bits have carbide cutting tips. Carbide is a brittle material, so you want to keep the edges from coming in



Choose a bit with the thicker shank when possible. The router will hold these more firmly. The bigger shanks also flex less, which means less vibration.

CHOOSE 1/2-IN. BITS WHEN POSSIBLE

Router bits come in two sizes, ¼ in. and ½ in., which refers to the diameter of the shank.



The collet grabs the bit. Not every bit has a ½-in. shank, so be sure your router comes with both ½-in. and ¼-in. collet sizes. When installing a collet, make sure its mating surfaces are clean.

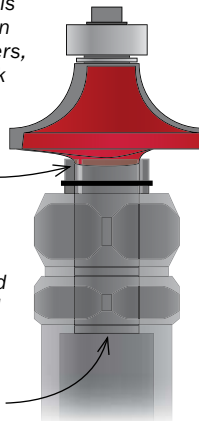
INSTALL THE BIT SECURELY

The last thing you want is for a bit to come loose while it's spinning at 22,000 rpm. Here's how to ensure that never happens.

AVOID THE TROUBLE SPOTS

If you tighten the collet on this rounded section below the cutters, the bit will work loose later.

The collet draws the bit downward as it tightens around it. So if the end of the shank hits the bottom of the opening in the router, the collet can't do its job.



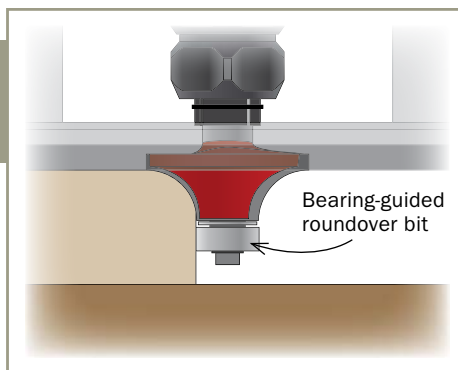
Bottom it out, then pull up a bit. To be sure the collet can do its job properly, push the bit down as far as it will go (left), and then pull it back up ⅛ to ¼ in. (right) before tightening it.



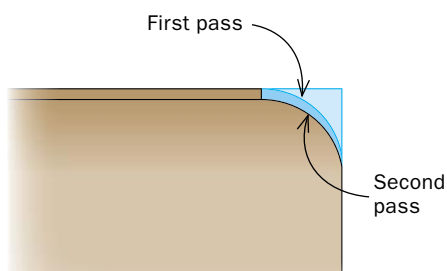
Tighten it firmly. Look for a router with two nuts and two wrenches for tightening the collet as shown. Routers with a spindle-lock button and one wrench are harder to hold onto as you tighten the bit.

BETTER RESULTS WITH BEARING-GUIDED BITS

There are all types of bits with bearings, but the most common are molding bits, which ride the edge of the workpiece and cut a specific profile.



Take multiple passes. With almost every type of router bit, lighter cuts give cleaner results. Adams adjusts the depth to cut away most of this large profile on the first pass (right), leaving a lighter pass to get to final depth (far right).



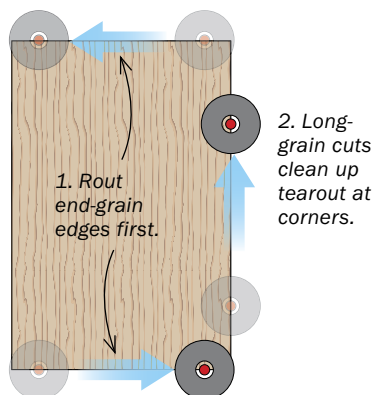
contact with each other or with other hard materials. A piece of wood with a bunch of 1/2-in. and 1/4-in. holes will store bits safely in a drawer or on a shelf.

It's also important to keep your bits free of pitch and grime. I am always amazed at how a simple cleaning improves the quality of the cut. Hardened gunk will build up on the carbide from glue, sap, dust, and overheating. Hot water and dishwashing soap work just fine. Make sure you



ORDER OF OPERATIONS

When routing around the edges of a workpiece, do the end-grain first.



Leave long-grain edges for last. Routing along end grain tends to break off wood at the end of the cut. Long-grain cuts don't have this problem, cleaning up that tearout and leaving clean corners.



remove any bearings first and then use an abrasive pad or brass-bristle brush to scrub away the debris.

Always unplug the router before changing the bit, and verify that the new bit is not loose before plugging back in.

Hold the work firmly

One of the challenges of handheld routing is that the router rides on the top surface of the workpiece, meaning it is difficult to hold that piece down without the clamps getting in the way of the router. Whatever clamping method you go with, be sure to grip the work firmly.

If your workpiece is big enough, you often can clamp from the top, using normal F-style clamps, toggle clamps, workbench holdfasts, or whatever you have. If the router base will run into clamps on top, a more convenient option is to grab from the sides. If you have a traditional workbench, benchdogs work great for holding a wide variety of workpieces without getting in the way. Double-stick carpet tape works well when all else fails.

A router needs guidance

For safe, precise work, a router needs a guidance system, and there are a host of good options. The simplest approach is using bearing-guided router bits. These can be molding bits, which ride the edge of the workpiece, or straight bits, where the bearing rides a pattern of some kind that is attached to the workpiece, ensuring the piece comes out identical to the pattern. Router bases also include holes for a simple edge-guide system, available as an accessory.

The only time you should use a router without guidance is when roughing out a shallow pocket, such as when doing inlay or routing a hinge mortise. These are very light cuts, making it easy to maintain control of this powerful tool.

Know your direction and work in stages

Understanding the forces at play when a bit cuts can make the difference between good control and kickback, and between a smooth, accurate cut and a bumpy or rough one. As you hold a router, looking down, the bit rotates in a clockwise motion. All routers rotate the same way.

When working handheld (vs. on a router table), with the workpiece in front of you, it is best to move left to right. That way the scooping motion of the bit will pull the router into the cut and against its guidance system, be that a bearing, fence, pattern, or edge guide.

If you feed from right to left, called “climb-cutting,” the cutting edge of the bit will be pulling the router in the same direction you are pushing, which can cause it to kick forward, out of control.

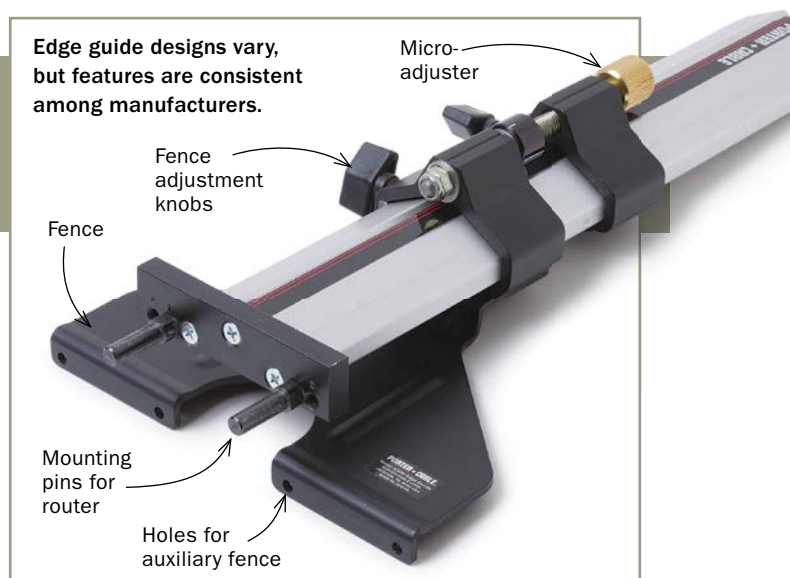
Heavy sanding tends to round over the crisp details you just created, so the less you have to do the better. To get the cleanest results with the router, take light cuts. These generate less heat, chatter, and kickback forces, improving your control and the quality of cut. Complete all but the lightest cuts in stages, instead of cutting to final depth all at once. Another key to clean cuts is to move as steadily as you can, without pausing. □

Marc Adams is a former cabinetmaker and runs the Marc Adams School of Woodworking in Franklin, Ind. Go to MarcAdams.com for a class schedule.

GET THE MOST FROM YOUR EDGE GUIDE

You can buy an edge guide for any fixed-base router. The guide rides the edge of the workpiece like a bearing-guided bit, but offers more versatility, letting you make cuts both at the edge, say for rabbets, or farther in, for dados and mortises.

Edge guide designs vary, but features are consistent among manufacturers.



Improve the fence. An edge guide's short fence halves have holes for screwing on extralong pieces. This auxiliary fence adds control, helping you keep the edge guide in good contact with the work. Flat, stable MDF is great for fences.



Quick rabbets. Teamed up with a straight bit, an edge guide makes accurate rabbets in the sides of a cabinet, to hold the back. Again, make multiple passes for best results. Note that Adams is holding the workpiece with benchdogs, which grip solidly without getting in the way.

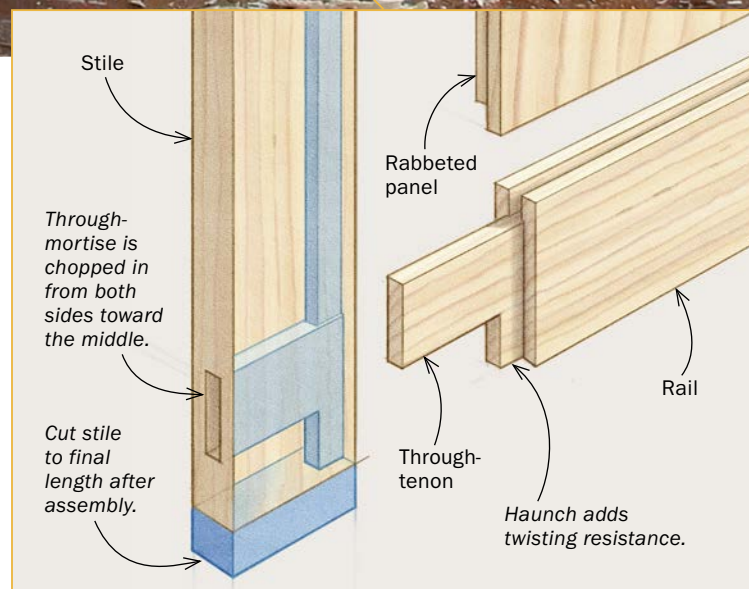
Frame-and-panel doors

HAUNCHED THROUGH-TENONS MAXIMIZE STRENGTH

BY ANDREW HUNTER

I designed the doors for my hutch (p. 64) to be both rock solid and well suited to hand-tool woodworking. I joined the rails and stiles with haunched through-tenons, which deliver maximum strength and a batch of other benefits.

When working by hand, through-mortises are easier to chop accurately than stopped mortises, because you cut them from both sides of the workpiece toward the middle. They also offer the option of adding wedges to the tenons for even greater holding power. The haunch itself not only adds glue surface and increases resistance to twisting, but it also makes the job of cutting grooves for the panels simpler. With ordinary tenons, you need to stop the panel grooves in the stiles so the empty groove isn't visible at the top and bottom of the door after assembly. But the haunch fills that space, so you can use through-





1 MAKE THE MORTISES



Drill and chop. After drilling out the mortise with a brace and bit—drilling holes from both sides so they meet in the middle—Hunter uses a narrow chisel (far left) to chop the ends of the mortise square and clear much of the waste. Then, with a wide chisel (left), he pares the walls, working in toward the middle from both sides.



2 CUT THE GROOVES

Make way for the panel. After through-mortising the stiles, Hunter uses a plow plane to cut the panel grooves in the rails (seen here) and the stiles.



Widen the groove. A few strokes of the paring chisel widens the end of the panel groove to accept the tenon's haunch.

grooves—which can be cut with a plow plane, a simple process—rather than stopped ones, which are more difficult to cut.

Mortises and grooves first

For these doors, I cut the stile joinery in three stages: First, I cut the through-mortises; next, I plowed the grooves for the panel (in both rails and stiles); then I cut the haunched section of the mortises. If your mortises are the same width as your panel groove, you can skip this third step—the haunch will fit right into the groove. Because I wanted my mortises wider than the groove, I widened the end of the groove for the haunch. I left the stiles an inch or two long until after assembly, to avoid splitting the wood during joinery and glue-up. I laid out all the joinery in pencil, but I also scribed around the through-mortises with a knife.

To start the through-mortises, cut a series of closely spaced holes with a brace and bit, drilling from both sides toward the middle. For these $\frac{5}{16}$ -in.-wide mortises, I used a $\frac{1}{4}$ -in. auger bit.

With the drilling complete, use a narrow chisel to chop the ends of the mortise and remove the waste between the

3

CUT THE TENONS



Cheeks, then shoulders. After ripping along the narrow cheeks of the haunched tenon, crosscut to release the waste (left). Then rip the wide cheeks (above).



Quick cleanup. A rabbet plane smooths the cheeks as you fit the joint.

auger holes. Clean up the sides of the mortise with a wider chisel—1 in. or so. Then, with a plow plane, cut the ¼-in.-wide through-groove for the panel, making sure to locate it entirely within the width of the mortise. Once the grooves are cut, widen them at each end to accept the haunches.

To cut the haunched tenon, first rip the narrow cheeks and make crosscuts to remove the waste. Then rip the wide cheeks and crosscut their shoulders. Shave the tenons to an exact fit in the mortises with a chisel or rabbet plane.

Doing the door panels

To avoid wasting material and effort when planing the panels down to their ½-in. thickness, choose stock that is already on the thin side. After cutting the panel to length and width, lay

4

RABBET THE PANEL



Make a tongue. When cutting the cross-grain rabbets, score the panel with a marking gauge (above) to ensure a clean cut. Create the tongue with a rabbet plane (right), working to a depth line by eye. Hunter fits his plane with an L-shaped, shopmade fence to limit the width of cut.



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ASSEMBLE THE DOOR



Put in the panel. Dry-fit the panel (left), making sure it fits snugly at the top and bottom but has room to move across the grain. Then glue up the frame joints (above), using clamp pads to protect the parts.

out the rabbet on the back four edges. With the grain in the panel running vertically, the shoulder of the rabbet should fit tight against the top and bottom of the door frame. This will help keep the door from racking. But leave a gap of $\frac{1}{8}$ in. or so on each side to account for expansion and contraction of the panel across the grain.

I cut the rabbets with a rabbet plane fitted with a shopmade fence. To avoid tearing the wood while cutting the cross-grain rabbets, first score the shoulder with a marking gauge.

Dry-assemble the doors and fine-tune anything that needs it. When it all looks good, finish-plane all the parts. Spread glue in the mortises only, assemble the joints, and put the doors in clamps. You can leave the panel unglued. Wait until the glue has dried a bit to clean up any squeeze-out. Then trim the through-tenons flush, and cut the ends of the stiles flush to the rails.

The doors are laid out for an exact fit to the opening. Once they're assembled, trim them with a handplane to produce a uniform gap all around. Plane the top and bottom from the outside in to avoid blowing out the end grain on the stiles. Then shim the doors in the openings, and mark the location of the hinge mortises already cut in the face frame. Remove the door and mortise it for the hinges, making multiple crosscuts and then paring to the line with a chisel. Before installing the hinges, mount the knobs and glue in stop blocks behind the doors so they will close flush. □

Andrew Hunter builds furniture in Accord, N.Y.

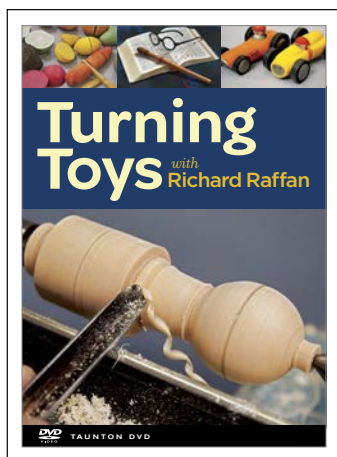


Trim the tenons. When the glue has cured, saw the protruding tenons flush.



Off with the horns. Overlong stiles prevent splitting during joinery and assembly. Afterward, these horns get sawn off flush.

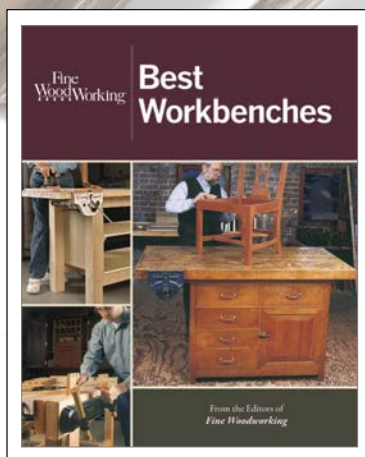
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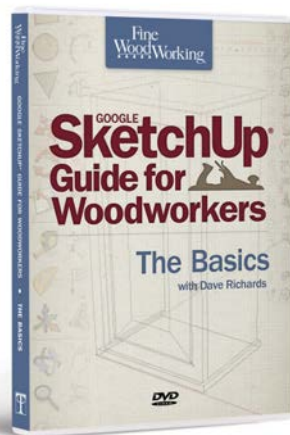
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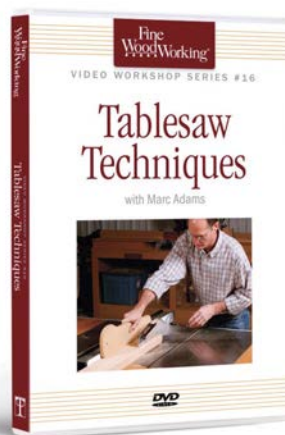


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Stylish Coffee Table with

Low-key angles
and a floating
top elevate a
simple design

BY JACQUES
BREAU

My goal with this project was to create a coffee table with style. While looking for inspiration, I was drawn to the uncomplicated styles of the Danish mid-century period, so I incorporated subtle details like the floating top and pencil-roll edge from furniture pieces I liked. To create nice lines and natural movement, I angled the legs out a bit and gave them a little flare at the bottom, another mid-century trademark. What emerged was a table with elegant details that don't overpower the design.

The base is constructed of rift-sawn solid black walnut. Using rift-sawn wood creates a unified look with consistent straight grain throughout. For a tabletop that will stay flat, I used $\frac{3}{4}$ -in.-thick black walnut plywood, with a pencil-roll edge of matching walnut.

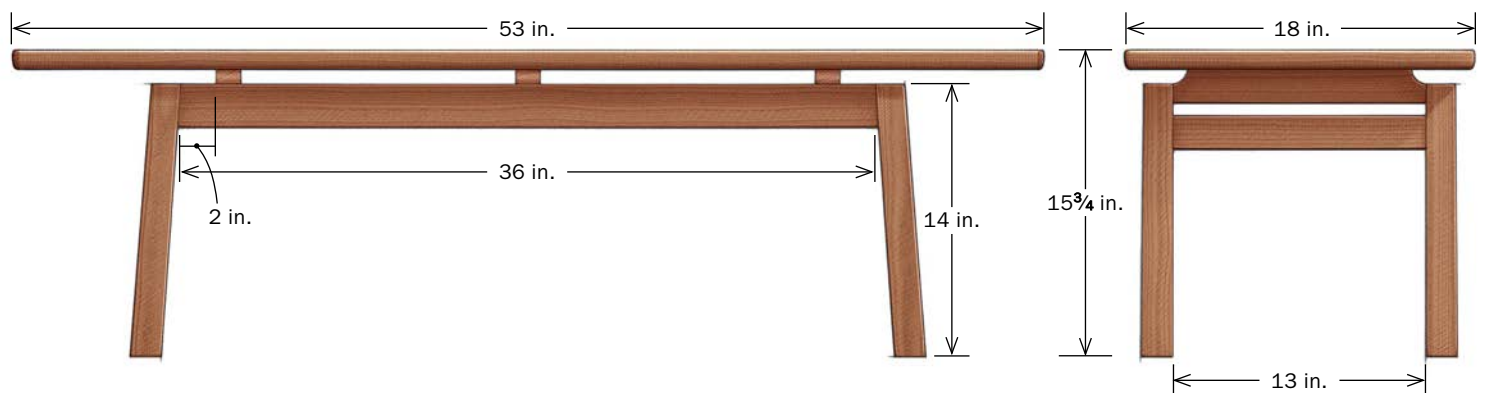
Here I'll show you how to speed up the construction process with slip tenons, cut the angled leg joints in the base, and make it rock-solid by doubling up the mortise-and-tenon joinery.

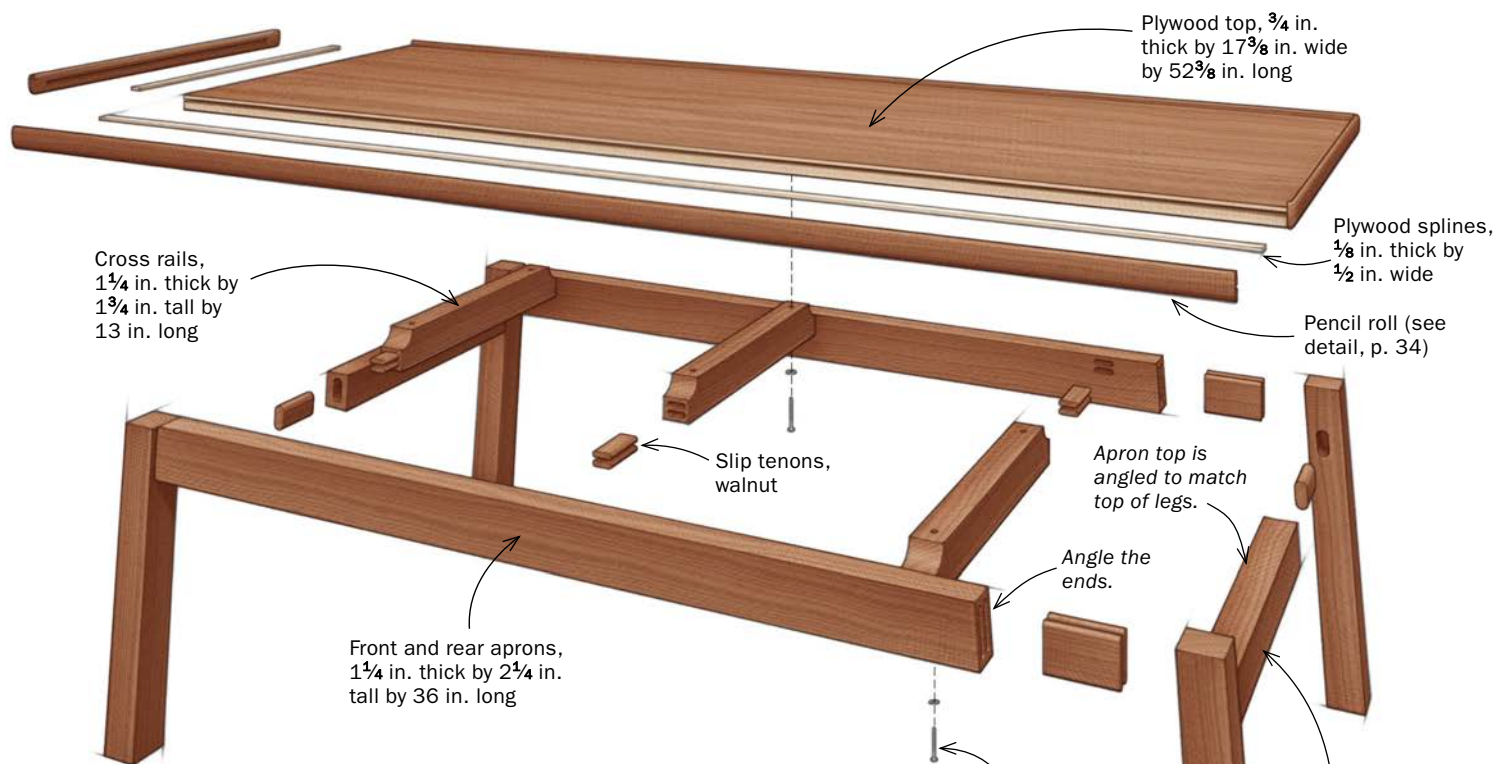
Start with the base

In addition to the aprons and legs, there are three cross rails in the base. Because the inside faces of the legs are flush with the inside faces of the front and rear aprons, the side aprons and the cross rails are the same length, which keeps the design simple.

When milling up the stock for the base, include some extra material to use for setting up the machines for the joinery cuts. The side aprons and cross rails are cut at 90°. The front and rear

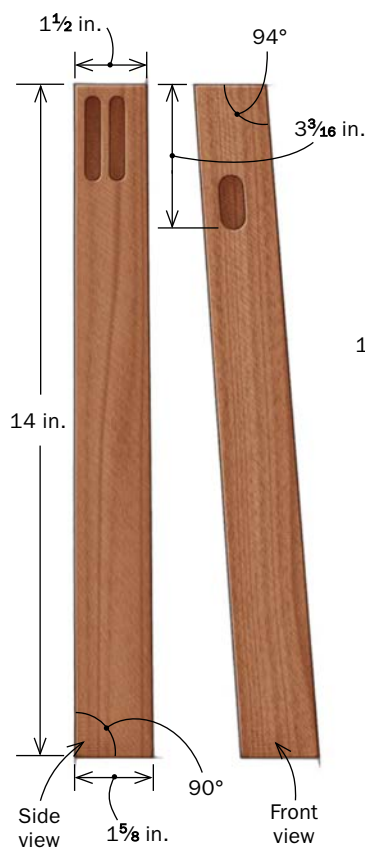
Sleek Lines



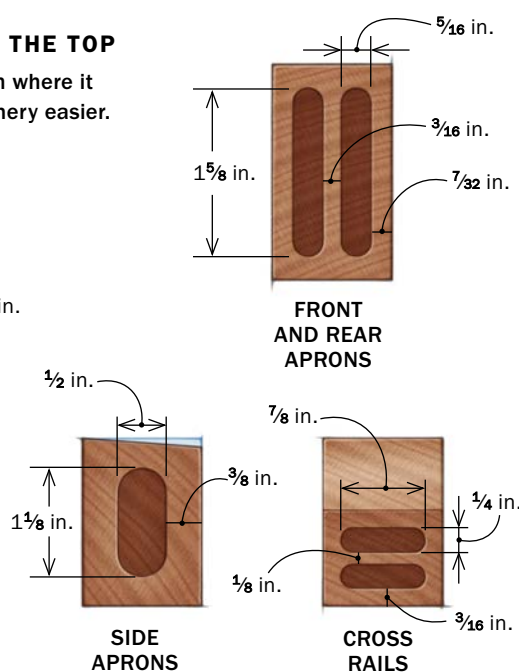


ROCK-SOLID BASE FLOATS THE TOP

Slip tenons give the base strength where it matters and make the angled joinery easier.



LEG PROFILES



CROSS-RAIL PROFILE

aprons and the four legs are cut to length at an angle, using a miter gauge at the tablesaw. To do this, set the blade at 90° and use a sliding bevel gauge to set the miter gauge to 94°. Make some trial cuts in extra material and then check your setup against the sliding bevel gauge. Cut out the parts and label them, and save the angled offcuts for later.

Pain-free angled joinery

Slip tenons make angled joinery easier by eliminating the need to cut and pare angled tenon shoulders. To create the strongest possible table base, the legs are joined to the aprons with two slip tenons, which doubles the glue surface for a big jump in strength. The joinery in this table is so strong that even I could sit on it.

To cut the mortises, I used a horizontal mortiser with an X-Y table, but a router jig uses the same principles to position the twin mortises. Begin by marking out the mortises on the aprons. The front and rear aprons get 3/16-in.-thick double tenons, spaced 3/16 in. apart.

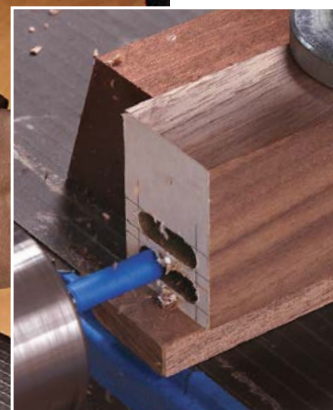
Build the base



Machine the mortise. A horizontal mortiser makes fast work of joinery, and gives exact, repeatable results.



Set up once, cut twice. Set up and cut the top mortise, and using the same setup, slip in a spacer to make the second cut (above). The spacer offsets the workpiece to put the second mortise right where you want it (right).



Add some flare at the bandsaw. Mark and cut the taper on the outer faces of the legs, then skim off the sawmarks with a handplane.



Glue the tenons into the rails first. Applying glue to only the mortise keeps the other end of the tenon clean for the next stage of assembly.

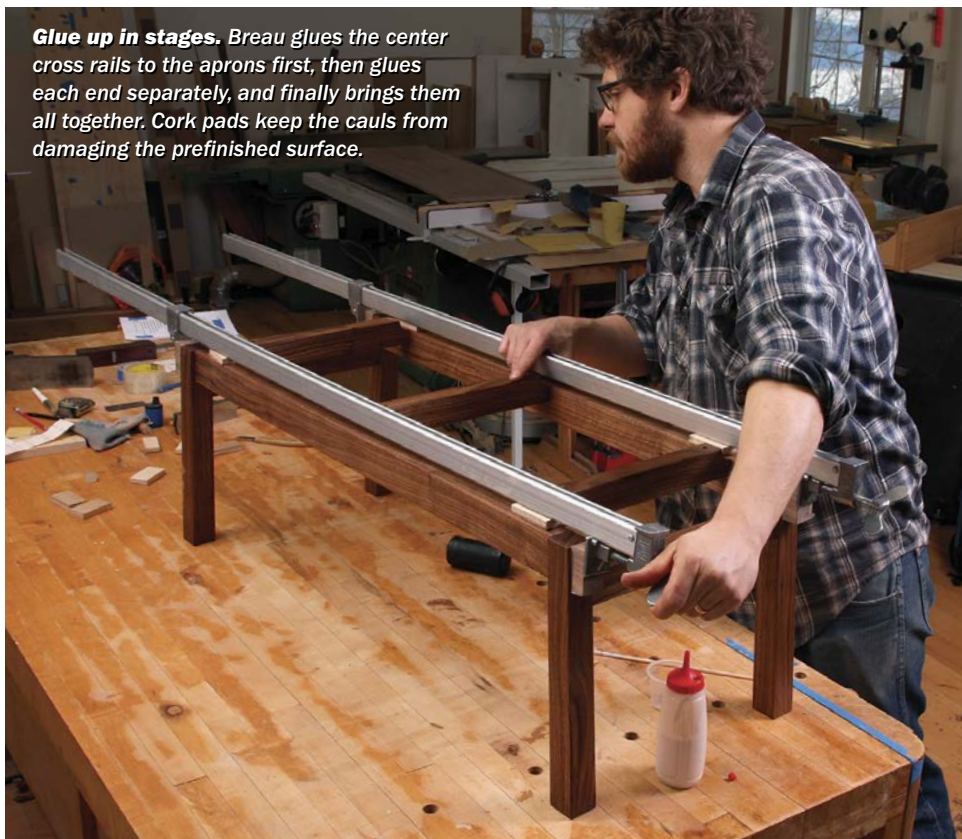
This leaves a $\frac{7}{32}$ -in. shoulder on both sides. The side aprons have a single $\frac{1}{2}$ -in.-thick tenon.

A spacer block lets you cut the double mortises without changing the mortiser settings. To determine the thickness of the spacer, add the distance between the mortises to the thickness of one tenon. In this case, the spacer is $\frac{1}{2}$ in. thick. Cut the outside mortise first, placing the inside face down against the X-Y table. Then insert the spacer between the workpiece and the X-Y table, still referencing off of the inside face.

The cross rails get double $\frac{1}{4}$ -in. tenons with $\frac{1}{8}$ in. between them, cut using a $\frac{3}{8}$ -in. spacer. When laying out the joinery on the ends of the cross rails, center the mortises in the lower inch. This will lift the upper $\frac{3}{4}$ in. of the cross rail above the top of the aprons to give the top its floating look. Next, mill the tenon stock. Cut the tenons a little long, glue them into the rails, and trim them to length once they are dry.

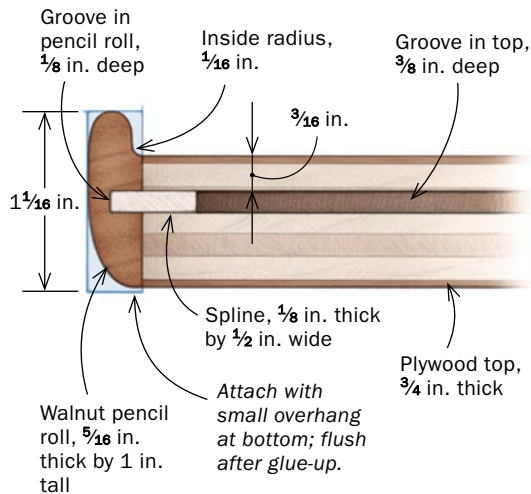
To create the illusion that the top is floating, I radiused the ends of the cross rails using the drill press. Dry-assemble the frame, and mark the top of the

Glue up in stages. Breau glues the center cross rails to the aprons first, then glues each end separately, and finally brings them all together. Cork pads keep the cauls from damaging the prefinished surface.



Edge the top

CUT GROOVES FOR THE SPLINES



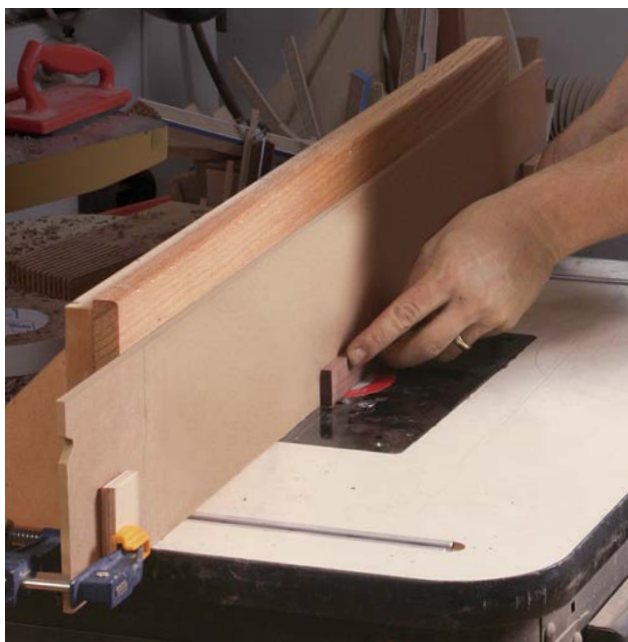
Get your groove on. Start by grooving all four edges of the top using a $\frac{1}{8}$ -in. wide slot-cutter.



A little proud on the bottom. Raise the slot-cutter $\frac{1}{32}$ in. before you groove the pencil roll to create a tiny reveal on the lower edge.



Ends get a stopped groove. Hold the trim in place and make a pencil mark about 1 in. from each edge. Match up those stop marks with the entry and exit points of the slot-cutter to get each stop block clamped in the right place. Tape on a longer auxiliary fence if needed. Test the setup with the router off (right). Be sure to use push blocks for the actual cuts.



apron on the ends of the cross rails. Radius the ends of the rails with a $1\frac{1}{2}$ -in. Forstner bit, using a few offcuts of cross-rail stock as a stop block and backer block to control blowout. Then dry-fit the base, flush the ends of the rails to the aprons using files, and smooth them with a scraper and sandpaper.

The top will be connected through the cross rails with wood screws and flat washers. Mortise the rails for the screw heads and washers at the drill press, using a $\frac{5}{8}$ -in. Forstner bit. Change to a $\frac{1}{4}$ -in. bit and drill the clearance holes.

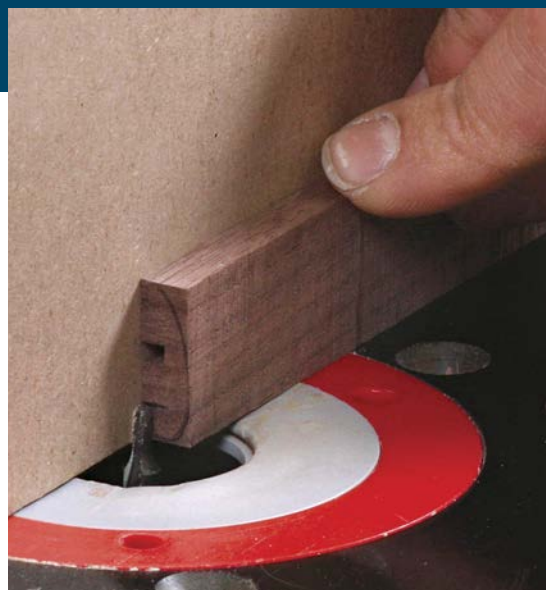
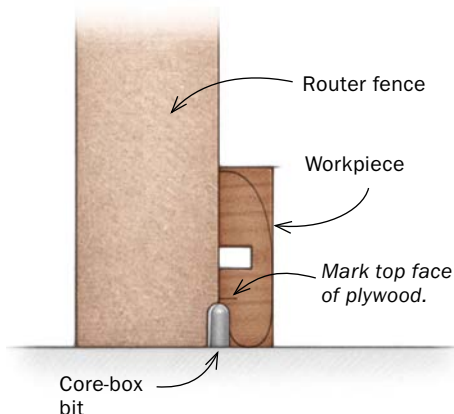
After all the joinery is done, cut a $\frac{1}{8}$ -in. taper on both outside faces of the legs to make them wider at the bottom, and then clean off the sawmarks with a handplane. Save the offcuts to use later as clamping cauls. Plane the top edges of the side aprons to match the top angle of the legs, then dry-fit the front and rear aprons to the legs and plane them flush on top. Then dry-fit the whole base to check the joinery.

Finish and assemble the base

I like to pre-finish my parts before assembly, so I skim all the outer surfaces with a freshly sharpened plane and soften the corners with files. Finish prepping the surface by sanding the entire surface with P600-grit sandpaper, but be careful at this stage not to round over any edges of the joinery. Mask off all surfaces of the joinery with blue tape and pre-finish everything with Danish oil. I wipe on three coats, rubbing in a small amount each time and wiping it dry, leaving behind a consistent, even sheen.

Glue up the base in stages using the angled offcuts as cauls. Start by gluing the three cross rails into the front and rear aprons—make sure to use a flat surface so the rails stay parallel. Next, glue the side aprons to the legs, doing each end separately. After these

ROUT THE INSIDE RADIUS BEFORE GLUE-UP



Leave a little for later. Mark the top face of the plywood on the workpiece, and set the bit height about $\frac{1}{32}$ in. shy of the mark.



Check the fit. After the profile is cut, there should be a little reveal where the pencil roll meets the plywood.

have dried, attach the side assemblies to complete the base. After the glue dries, remove any squeeze-out and finish softening the edges and blending the joinery together. Go over the freshly sanded areas once more with Danish oil.

Add solid edging to the top

For the top, I used $\frac{3}{4}$ -in. walnut plywood. To hide the edges and dress it up, I added a solid-wood pencil roll around the rim. At the corners, I used butt joints, which simplifies the construction and gives the table a distinct look.

Cut the plywood top to size and mill the stock for the pencil roll, making it a little longer and wider than needed. Make some extra stock to use for setup, too.

Get in the groove—The pencil roll attaches with $\frac{1}{8}$ -in.-thick plywood splines. Cut the grooves for it using a $\frac{1}{8}$ -in. slot-cutter in a router table. Start with the top and adjust the bit so that the groove height is about one-third down, or $\frac{3}{16}$ in. from the top of the plywood. This will position the spline in the fattest portion of the pencil-roll edge. Set the depth of cut to $\frac{3}{8}$ in. and rout the groove.

Now groove the pencil-roll stock. Raise the bit height $\frac{1}{32}$ in. and set the cut depth to $\frac{1}{8}$ in. Run the groove down the length of the two long edge pieces; the shorter end pieces have stopped grooves. Position stop blocks by marking the entry and exit points of the slot-cutter on the fence, then mark a line at each end of the workpiece about 1 in. from where the corner of the top will be. This lets you run a groove that's 2 in. shorter than the plywood end. Using these lines as a



reference, position the first stop block on the fence so that the first line on the trim corresponds to the line on the outfeed side of the fence, and the line at the back end of the trim corresponds to the line on the infeed side of the slot-cutter. If your fence is too short for these pieces, tape on a piece of $\frac{1}{4}$ -in. MDF to extend it.

Rout the profile—After the grooves are cut, dry-fit the pencil roll. Make a mark at the top of the plywood, and use that mark to set the height of the bit. I used a $\frac{1}{16}$ -in. radius core-box bit from Whiteside (SC39). The profile for the pencil roll is cut just like the slots, with through-cuts on the long sides and stopped cuts on

Glue the long sides first. Breau uses heavy cauls to distribute the clamping pressure evenly along the pencil roll.

Edge the top continued

SHAPE THE LONG EDGES ...



Smooth things out. It's easier to scrape the pencil roll flush on the long sides (above) before you glue on the ends. To plane the final shape, trace the profile onto the end of the trim and start shaping (right).



the ends. Make a test cut on some extra stock—you want the base of the profile $\frac{1}{32}$ in. proud of the table-top. Once the height is set, carefully mark your lines and set up the stop blocks, just like before.

Attach it—The top is about to take shape, and now the fun really begins. Glue the pencil roll to the long sides first. After the glue dries, flush the bottom edge of the trim with a block plane. Flush and finish shaping the pencil-roll profile on top using a customized card scraper. Shape a scraper by filing a corner to match the profile made by the router bit. When the pencil roll is almost flush, finish smoothing it by working up through sandpaper grits P280, P320, P400, and P600.

Draw the outside profile onto the end of the pencil roll and shape it with a smoothing plane, then trim the ends flush and plane them flat with a block plane to get them ready for the end pieces. Be careful not to damage the inside faces of the pencil roll.

Glue on the end pieces and flush the bottoms, and use your modified card scraper to clean up the pencil roll. To shape a nice radius in the inside corners, use a $\frac{1}{8}$ -in. gouge. Once the inside is done, move on to the outside of the edge. Trim the ends off and flush them, complete the shaping, and apply the finish. □

Attach the top and trim the legs

With the main components assembled and finished, attach the top. Place it upside down and center the base on the top. Mark the screw holes on the top using a drill bit, remove the base, and drill for the screws. Attach the top with the screws and washers.

Jacques Breau is a professional furniture maker who lives in Ottawa, Ont., Canada.

... THEN ADD AND SHAPE THE ENDS



Add the end details. Carefully mark the stopped cut at the corners (above). After the ends are glued on, use a gouge with a $\frac{1}{8}$ -in.-wide flute to clean up the inside corners (right).



File toward the table to flush the ends. Using a file to flush the ends is fast and won't dig into changing wood grain.

Get Sharp the Diamond Way

For speed and versatility,
it's hard to beat diamond abrasives

BY BRIAN BOGGS

DOUBLE-SIDED
DIAMOND STONE
(1,000/300 GRIT)

I've been listening to the debate over the virtues of different sharpening systems since my first days in the shop 31 years ago. The array of opinions broadens with each new stone technology, and I've tried most of them. I still like to explore which system is best for a given job and to retest them over time to see if my conclusions hold true as my techniques and skills evolve. I'm sure I won't end the sharpening debate here. But having multiple options at my disposal, I've watched most of them gather dust as I gravitate to diamond sharpening time after time. There are three main reasons for this.

Speed. Diamond cuts fast and requires virtually no maintenance. My current diamond plate has kept its flatness for five years and still cuts quickly.

Versatility. Diamond seems to sharpen every type of steel well, whereas softer abrasives like ceramic or waterstones don't perform as well on some of the alloys I sharpen, like A-2 steel, or on carbide.

Finally, diamond abrasive is available in paste form in a wide array of grits, allowing me to turn any

A SIMPLE SYSTEM

Boggs does the initial honing for his plane blades and bench chisels on a single reversible diamond stone. He then laps the back of the blade and polishes the bevel on a dead-flat steel plate charged with diamond paste.

STEEL LAPPING PLATE

DIAMOND PASTE

START ON THE STONE

A few strokes to create the bevel. After hollow-grinding the tip of the blade, establish the bevel on the 300-grit diamond stone. If you're doing just a touch-up, you can start on the 1,000-grit side of the stone.



Let there be light—and magnification. A bright, even line at the tip the hollow grind indicates accurate sharpening. When sharpening freehand, a parallel line will form at the heel of the grind (above). To monitor progress, a magnifying lamp is very helpful.

piece of steel, aluminum, brass, or wood into a sharpening or honing tool (see “Diamond paste can sharpen any shape,” p. 40).

While diamond stones may cost more to buy than water- or oil stones, the process is quicker and the maintenance is nil. So I save time—and money—each time I sharpen.

Diamond stones and paste both use industrial diamond particles to do the cutting. In diamond stones, the particles are bonded to a metal substrate. In paste, they are suspended in oil. I’ve used a variety of diamond stones, but have settled on Trend and Eze-Lap stones, which are both excel-

lent. I use paste from Betadiamond.com.

I sharpen in four stages: grinding, truing and sharpening, polishing, and stropping. After grinding the tool on an electric wheel, I create a bevel on a diamond stone. I polish the bevel and the back with diamond paste on a steel lapping plate, and I finish by stropping away the burr on a wooden block charged with paste.

Get sharp on a diamond stone

With a new diamond stone and a good grind on the blade, it should take only a few strokes to create an even bevel at the

tip of the blade. The fewer strokes you take, the less likely you are to round the bevel and waste metal. I sharpen freehand, and I skew the blade as I push forward and back. If you use a honing guide, use your normal approach. Check your progress after the first few strokes. That might be enough to create the bevel.

I typically start on a 300-grit stone and finish with 1,000-grit. But there are exceptions. If I am touching up a tool that doesn’t need a lot of work, I go directly to a 1,000-grit stone. Also, newer stones will cut more aggressively, so if the 1,000-grit stone

is new, I often skip the 300. I use a stone from Trend (\$114) that has 300-grit on one side and 1,000-grit on the other.

You can use either oil or water as a lubricant. I use water with a little dish detergent in it. With oil, you need to clean your hands thoroughly after a sharpening session to avoid contaminating the wood.

When I am happy with the bevel's evenness and camber, I take it to a lapping plate charged with diamond paste.

Paste on the plate

For a long time I used an old Arkansas translucent stone for a honing/lapping plate, but I recently upgraded to a steel



POLISH WITH PASTE

A little dab will do. Using a clean applicator, prepare for lapping and honing by spreading a BB-sized amount of diamond paste on a dead-flat lapping plate.

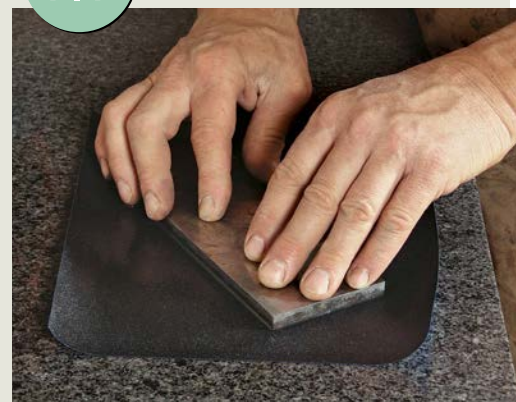


Get the back flat. Boggs flattens the back of his blades on the lapping plate with 4-micron diamond paste and oil. After a new blade's initial flattening, it shouldn't require more maintenance to stay flat than the few strokes used to remove the burr during lapping.



Brighten the bevel. A half-dozen strokes in 3- or 4-micron diamond paste on the lapping plate will bring the bevel to a high polish.

TIP FLATTEN THE PLATE



To get your lapping plate perfectly flat, rub it on 150-grit wet-or-dry sandpaper adhered to plate glass or a granite slab. Keep the glass or stone covered when not in use and reflaten the lapping plate periodically.

STROP ON A BLOCK



Make a flat strop. Plane the top of a hard-maple scrap to prepare the surface for use as a stropping block.



Final polish and deburring. To cap off his regimen, Boggs strops the blade with 4-micron diamond paste lubricated with oil. The diamond particles become slightly embedded in the wood, producing a finer abrasion.

plate available from Lee Valley for \$25. Regardless of the material your plate is made from, you will need a way to maintain its flatness. With a granite plate or a chunk of plate glass and some 150-grit wet-or-dry paper, you can sand any lapping plate to reasonable flatness. Use water as an adhesive and lubricant.

I tend to do all my lapping and stropping with 3- or 4-micron paste (roughly equivalent to a 4,000-grit stone). But if you use a variety of grits, you'll need a dedicated lapping plate for each grit. Diamond particles get stuck in the pores of the metal plate, so once you've used coarse paste, you have a

coarse lapping plate. If you use a honing guide, be sure to clean the wheels before honing and between grits.

Honing the bevel to a polish can be done quickly using diamond paste and WD-40 or 3-in-one oil on your lapping plate. The paste is also available in a water-soluble version, but I use oil because it seems to cut better that way. You need only a tiny bit of paste—maybe the size of a BB—and a few drops of lubricant. I keep my paste in a jar and scoop out a dab with a fresh-cut piece of wood—or my fingertip, if it's very clean—and smear it around the surface of the plate. It's important not to let the diamond paste

get contaminated, so I keep the jar closed. I also keep the plate covered between uses.

I find a lapping plate and 4-micron paste the best way to flatten the back of a blade. Stones always seem to produce a slight rounding. If the back of the blade has not been worked yet, I will spend a fair amount of time flattening it, but once it's flat I shouldn't ever need to re-flatten it. Simply lapping it to remove the burr keeps the back of the blade nice and flat.

Strop for a high polish

As with any sharpening system, a burr is created as you hone each side of the

Diamond paste can sharpen any shape

You can easily create custom lapping blocks and use them with diamond paste to sharpen blades of nearly any shape. Boggs uses steel pipe, sanded smooth, to sharpen a gouge with a mating curve (right). He turns dowels to match other gouges. To sharpen his concave spokeshave blade (far right), he made a lapping plate by doming the top of a wooden block.





On your back. Using your normal sharpening action, alternate between stropping the bevel and the back.



TIP

THE SECRET TO REMOVING THE BURR

After charging the stropping block with paste, swipe the blade firmly through the end grain of the block 10 times or so to remove any remnants of a burr, creating an edge that takes silky shavings.

blade, bending the fragile edge over to the unsupported side. Even though I go back and forth repeatedly on the lapping plate between the back and the bevel of the blade, I have never succeeded in completely removing the burr this way.

To finish the job—and to give the blade its final polish—I use a wood block charged with diamond paste. The diamond grit embeds itself more deeply into the wood block than in the steel lapping plate, making effectively a finer abrasive; the softer the wood, the deeper the diamond grains are embedded and the finer the abrasion. I typically use a block of hard maple.

Using this as a strop will polish the back and the bevel very well. I take a few strokes using my standard honing technique here. Then, to finally get the burr cleaned up, I push the tip of the blade through the end-grain corner of the block with a little added 4-micron diamond paste (see photo, above right).

If you already have a sharpening system that is working, then just add this wood strop and burr-removing trick and you'll enjoy better performance from your tools. If you aren't enjoying your sharpening tasks now, give diamonds a try. □

Brian Boggs makes chairs in Asheville, N.C.





Build Perfect Drawers

Nothing says craftsmanship like a well-made solid-wood drawer, one that's elegantly designed yet strong, rigid, and durable. It must also open and close with little effort, regardless of changing humidity. For me the test is being able to close the drawer smoothly by pushing on one corner

when it's open three-quarters of the way.

The margin of error is slim. Too loose and the drawers will look bad and jam sideways in their openings; too tight and they will stick fast in the summer. Success is the culmination of dozens of careful steps and informed decisions when making both case and drawer.

In *FWW* #241, I explained how I make the chest, with drawer pockets that will stay straight, flat, and uniform. Now it's time to build drawers that are just as solid and stable, made to fit each pocket precisely.

Some very good woodworkers build drawers to fit snugly from side to side, and then plane the sides for the gaps

they want. I go about the process a different way. For 25 years, I built period furniture almost exclusively, often with lipped drawers, where planing the sides was difficult to impossible. That led me to my current method, where the drawers are made to fit perfectly from the get-go, with fine gaps built in and no fitting after assembly. It's a quick, clean approach.

By the way, I make the drawer back exactly the same length as the front, for two reasons: The drawer is less prone to jamming, and the drawer bottom can do its job, bottoming out in the side grooves and holding the drawer square.

Ageless construction

During the early 19th century, furniture makers in America settled on a standard anatomy for drawers, which has proven itself in countless antiques. I construct my drawers in a

TIP

ACCURATE SURFACE PREP

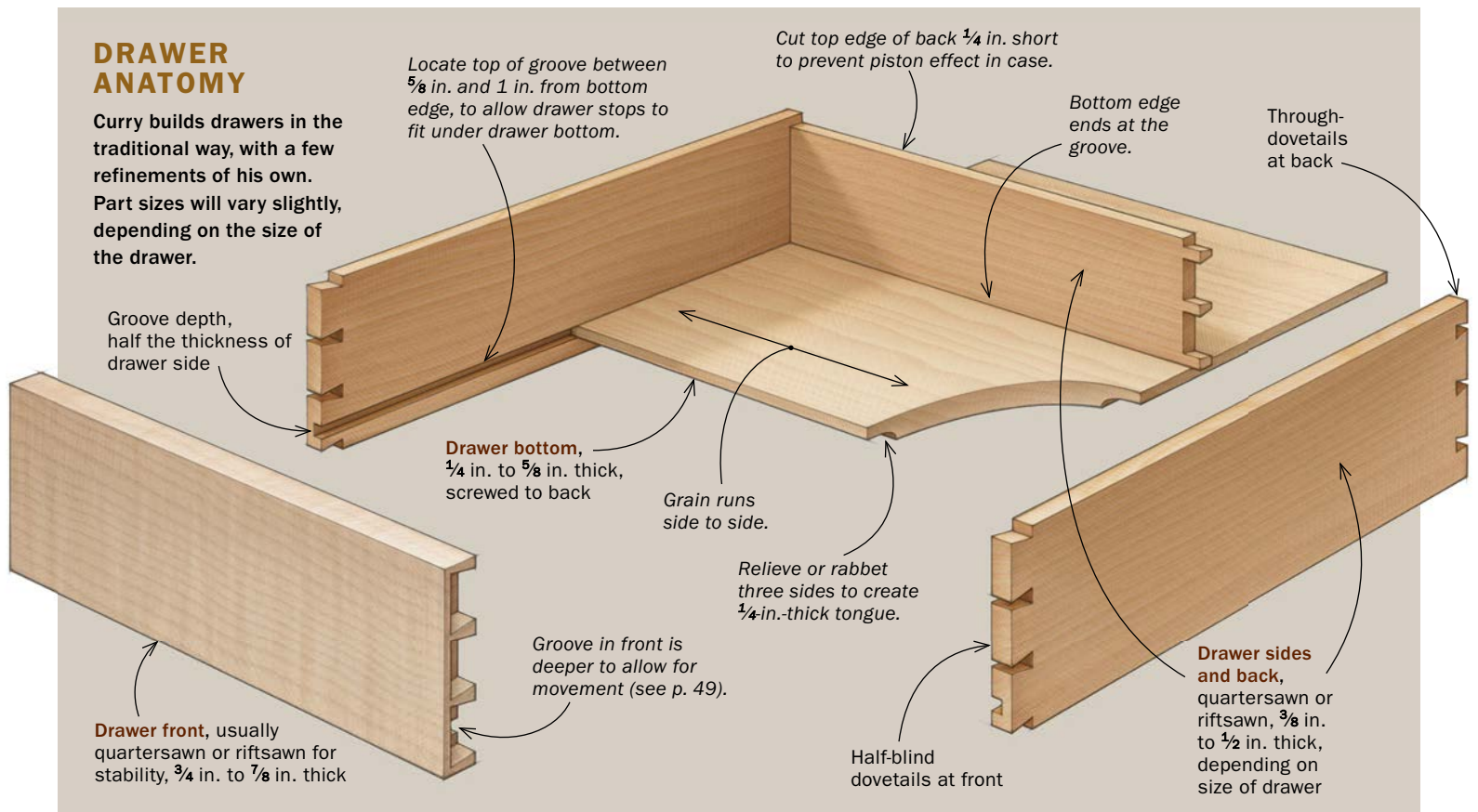


Curry's drawer-making method lets you put the final surface on all parts before assembly, but also relies on precision. To be sure the drawer parts stay uniformly thick for accurate dovetailing, handplane one face (left), and then run the piece through the planer (right) before lightly handplaning the freshly milled side.



BY GERALD
CURRY

Time-tested tips for making drawers that slide smoothly



Start with the drawer front

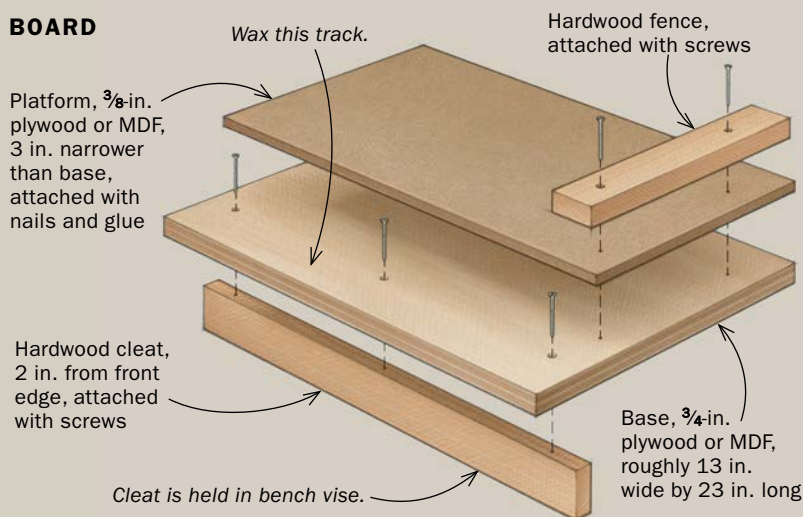
1 FIT ONE END



Eyeball it. After ripping the drawer front to fit the pocket snugly, top to bottom, crosscut one end square and slide it into place (above). A tapered gap (right) means you have work to do (below).

SIMPLE SHOOTING BOARD

A shooting board can be cobbled together in 20 minutes from scraps. It's important that the fence is perfectly square. To help with that, use a square to align the fence as you screw it on.



similar way: half-blind dovetails at the front, through-dovetails at the back, and a solid-wood bottom that sits in grooves and is oriented so that it can shrink and swell without changing the shape of the drawer.

I make drawer sides as thin as I can without sacrificing strength, using $\frac{3}{8}$ -in.- to $\frac{7}{16}$ -in.-thick stock on most drawers, and going up to $\frac{1}{2}$ in. maximum for the very largest ones. This is not just for aesthetics, although thick sides do look clunky, but also because unnecessarily thick sides could swell in thickness enough to cause the drawer to stick.

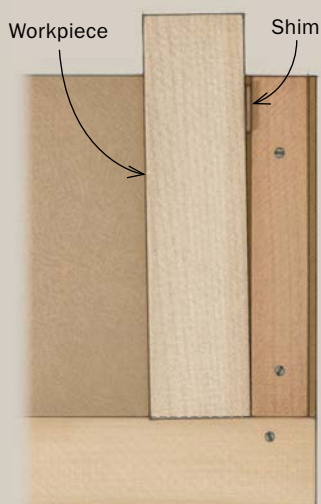
The drawer bottom is rabbeted to fit into $\frac{1}{4}$ -in. grooves in the drawer front and sides, while the back is left short so the bottom can be slid in after assembly. Some people chamfer the edges of the bottom to fit the grooves, but I like the precision of a flat tongue.

A solid-wood bottom is a lot like a door panel. It's going to shrink and swell across its grain, and the drawer design



Shoot to fit. A shooting board makes it easy to fit parts precisely. To change the angle to fit a crooked case, place a thin shim between the workpiece and fence. A light chamfer at the back edge of the workpiece prevents chipout.

ANGLE ADJUSTMENT



must allow that. For a start, the grain must run side to side, even on very narrow drawers, sending the wood movement from front to back. If the bottom expanded sideways, it would push out the sides and cause the drawer to jam. Some woodworkers glue the front edge of the bottom to the drawer front and force the movement toward the back, where they use screws with slotted holes to accommodate it. But I prefer the more traditional method.

I screw the bottom firmly to the underside of the drawer back, sending the movement toward a deep groove in the front. There is no glue applied to the panel anywhere. I prefer this method because it is faster; it lets you fasten the back edge of the bottom more securely, so it doesn't sag; and there is no glue, making it easy to remove the bottom if you have to. It also looks better if you happen to turn the drawer over.

Wood matters, a lot

Here, maybe even more than with the case construction, wood selection is important. The more the drawer fronts and sides expand and contract—top to bottom across their grain—the larger the gap you'll have to leave at the top, and big gaps can get ugly.

Many of us realize that quartersawn grain shrinks and swells about half as much as flatsawn. But less well understood is how much shrinkage rates can vary from species to species. The shrinkage rate for quartersawn eastern white pine is an amazingly low 2.1% (from freshly cut to oven-dried), whereas the rate for quartersawn yellow birch is 7.3%, about $3\frac{1}{2}$ times as much.

2 FIT THE OTHER END



Make it snug. Put the drawer front back in place to mark its length, and then crosscut it for a snug fit.



Shoot the gap. After checking the fit, use the shooting board to plane this second end for an even gap.



The goal. With the far end pushed tight against the opening, you should be able to fit in a matchbook cover at the near end. This is the total gap, which will be split between both ends.

So if you need a $\frac{1}{16}$ -in. gap at the top of the drawer made with the pine, you'd need to leave almost a $\frac{1}{4}$ -in. gap with the birch to allow for seasonal movement. And if you're considering using flatsawn white oak (10.5%), then you'd need to leave a gap that's five times as big: a whopping $\frac{5}{16}$ in. So unless you live in an area with remarkably consistent humidity, wood selection is a big deal.

Good choices for drawer fronts—If you live in an area with large seasonal swings in humidity, like I do, you need to



3 TRIM TO WIDTH

Make room for expansion. If you are building drawers in any season other than summer, build in some room for expansion at the top of the drawer. Calculate the wood movement, and then rip that amount off the top edge of the drawer front, plus the fine gap you want there.

Prep the other parts



Trim the sides. Rip the drawer sides to the same width as the drawer front. Curry marks the end of each piece to keep track of its mating part and orientation.



Square the ends. To make sure you don't build a twisted drawer, shoot the front ends of corresponding drawer sides, two at a time so they match. Re-label them if necessary.



Match the back to the front. After ripping the back narrower (see p. 43), lay the drawer front on it, lining up the top edges. Then scribe the ends of the drawer back to match—both length and angle—and use the tablesaw and shooting board to trim them precisely.

choose the wood for your drawer fronts (and case) carefully. I'm talking not only about species but also grain orientation. I nearly always use rift- or quartersawn stock for drawer fronts, not only for stability, but because I prefer its straight-grained look. When possible, I also choose a species that has a low shrinkage rate. Old favorites like walnut, cherry, and mahogany make great primary woods for the case and drawers. They're attractive, relatively easy to work, and well-mannered. Some less-common woods, such as butternut, sassafras, and red alder, also are easy to work and stable. And

softwoods such as baldcypress, Alaska yellow cedar, and fine-grained Douglas fir are stable and quite attractive, especially when quartersawn. There really are quite a few options, but you should investigate the shrinkage values before deciding.

It's hard to buy rift- or quartersawn wood in most species, so I often cut drawer fronts from the outer edges of wide boards (14 in. to 16 in.). The growth rings on that part of the board are usually about 45° to the face or steeper. I use the flatsawn piece left over in the middle for the drawer rails in the case. Since the edge of this piece is actually quartersawn, it matches up quite nicely with the straight grain and color of the drawer fronts.

Smart choices for the rest of the drawer—Traditionally, furniture makers have used a secondary wood for the drawer interior. This was mostly for economic reasons, but I think it also looks better. And it al-

lows you to choose a wood that might have more appropriate qualities for the role it will play.

My favorite wood for drawer interiors is butternut. It's very stable, easy to work, and attractive. My second choice is eastern white pine. It doesn't look quite as nice as butternut, but it is more stable. In general, softer woods like these tend to be the most stable. They're a bit soft for the sides of large drawers, but it's easy to add a thin piece of a harder wood to the bottom edge as a wear strip. That way you get the stability and workability of the softer wood and the wear-resistance and easier sliding of the harder. Avoid woods like elm, sycamore, and tupelo that have interlocked grain. They'll be difficult to handplane and are prone to warping. Also avoid woods with high shrinkage values like birch, beech, and hickory.

When cutting out the secondary wood for my drawer parts, I use the best-looking quartersawn or riftsawn sections for the sides. I want straight-grained, mild-mannered pieces that will plane smoothly. The next best pieces are used for the backs. If the bottom is big from front to back, I'll glue up quartersawn pieces to reduce movement; if not, I'll use flatsawn stock.

Prepping drawer stock

Start by rough-cutting all of the pieces—fronts, sides, backs, and bottoms—slightly oversize in all directions. I leave at least 1 in. or 2 in. of extra length and about $\frac{1}{4}$ in. of extra width. Mill the wood, starting at the jointer and then thickness-planing the pieces about $\frac{1}{16}$ in. heavy (a bit thicker with wider parts that might cup, like a flatsawn bottom). It's best to plane the same amount off of both faces when possible. This is part of the old adage about

Keep joinery accurate, too

The key here is to aim for flush joints, or pins that are just a whisker proud, so you don't have to plane the drawer after assembly.



Scribe for a flush fit. Set a marking gauge to the exact thickness of the drawer sides (left), before scribing the drawer front (above). Curry cuts his dovetails by hand. Surfaces are already prepped, so he protects them with a piece of softwood when chopping (right), making sure to keep chips out from underneath.



A few steps before assembly.

Take a few extra handplane passes on the bottom edge of the drawer front to keep it from dragging on the case later. Break most of the edges and corners now, too.

Slight gap at bottom



doing the same thing to both sides of a piece of wood. Often, there are moisture differences or drying stresses that will cause a piece to warp if uneven amounts are taken from opposite faces.

After this rough-milling stage, let the pieces sit for a few days on stickers before final jointing and planing. Always allow equal air circulation around each piece to let it acclimate

evenly. If you are resawing thick material, as I often do for drawer sides, it's best to do it well in advance and let it sit around on stickers for a week or more before jointing and planing to final thickness.

Fit as you go

With my method, almost no fitting or cleanup is needed after the glue-up. You simply assemble the drawer and it

should fit perfectly every time. This means you can put the final surface on almost all the drawer parts before assembly, while they are easier to handle.

The key to the process is to fit the drawer front to the opening first, including very fine gaps on both sides, and then build the rest of the drawer to fit that piece.

After rough-milling the drawer front and letting it sit for a

few days, I rejoin one face and thickness-plane the piece down to final thickness, again taking the same amount off both sides. It's very important that the back of the drawer front have absolutely no twist. If it does, that twist will be magnified when the sides are attached, and the only fix— heavy planing on the bottom edges of the drawer—will be obvious in the finished result. If

Assembly tips



Glue the pins only. Curry also chamfers the inner edges of the tails so they don't scrape the glue off. These steps prevent squeeze-out and minimize cleanup.



Keep joints flush and unharmed. Use a hammer to tap the joints home, using a block of soft wood to protect the surfaces and avoid overdriving the tails.



Check for racking. Put the drawer in its pocket immediately to see if the front is flush to its opening (above). If it isn't, give the drawer a diagonal squeeze (right) and recheck it before letting the glue set.

you're going to handplane either side of the drawer front, now's the time to do it. You can't plane the back after the dovetails have been cut without throwing off the fit.

Now you can fit the front to its opening. The squareness of the opening doesn't really matter. However, you must fit each drawer front individually, and a shooting board is the best tool for the job.

After fitting the fronts, lay out the drawer sides and decide where each will go and how it will be oriented. If your drawer sides are bowed at all along their length—and this is very important—make sure to put the bow facing in so the drawer bottom can push it out straight later.

Set the gap—To calculate the gap needed to accommodate the anticipated swelling of

the drawer front, you'll need to be able to predict the seasonal dimensional change for the drawer sides and fronts, across the grain, top to bottom. I covered that in the previous issue (A Closer Look, *FWW* #241). Calculate how big a gap you need at the top of the drawer, and remove that amount from the drawer front and sides.

The grooves are next, and some thought needs to be given to their placement. If the drawer is for a solid-sided case, the stops will need to be at the front of the case, glued to the drawer rails. This means that the bottom must be high enough to clear those stops. Another important consideration is that the groove should be contained within the lowest dovetail—not the pin—so it can't be seen on the side of the drawer.



Finishing touches

If everything has gone well, this drawer won't need much more work. Just install the bottom and apply a coat of finish and some wax.



Bottom slides in. Once the dovetails are dry and set, slide in the bottom (left) and screw it to the back (above). It should bottom out in the side grooves, with room for expansion in the front one.



No fitting, just finish

After assembly and maybe a little paring to trim the pins flush, the fit should be excellent. It is possible to plane the drawer sides to increase the side-to-side gap, but it will hardly ever be necessary.

My favorite finish for drawer interiors—that is everything but the front face of the drawer—is one very thin coat of shellac. It dries in minutes, and ends up quite hard and smooth after light sanding with P400-grit paper. The drawers slide much better with shellac than without it, yet the wood still almost looks unfinished, which is the traditional look for drawer interiors. Other finishes each have drawbacks: Oil stays gummy, varnish takes days to dry completely, and lacquer is toxic and difficult to apply by hand.

After applying the finish and waxing the rub surfaces, insert the drawer in its opening, work it back and forth a few times, and you're done. Furniture-making nirvana. □

Gerald Curry has made furniture professionally for 40 years in Union, Maine.

Attached with brass screws at back, sending all expansion toward the front



Groove is deeper in front for expansion of drawer bottom.



Pare pins if necessary. The chopping action often leaves the joinery a tiny bit proud. A wide chisel pares it flush.



One coat of shellac. Curry applies a thin coat, sanding it lightly and then wiping it with a rag dampened with alcohol, to smooth the surface.



Wax the rub spots and finish the front. Curry applies paraffin wax in just a few places: the bottom edges of the drawer sides, the back corners of the drawer box, and the guide surfaces inside the case. Then he applies finish to the outside of the case and to the drawer front.

TOOL TEST

Spray for Less

New turbine HVLP spray systems are powerful, compact, and affordable

BY TERI MASASCHI

If you've considered setting up a spray system for your shop, turbine-powered HVLP systems are the way to go. They take up almost no floor space when you're not using them, and they virtually eliminate setup compared with compressor-driven systems, providing great results right out of the box.

With a low threshold to getting started, you'll get great professional results in a lot less time, letting you breeze through finishing and move on to the next woodworking project quickly. And if you've always shied away from spray systems because of the high prices, there are some new, affordable systems that will make you reconsider.

In this tool test, we looked at 14 different HVLP spray systems available in the United States, with



The top performers

If you're looking to create professional-quality finishes quickly, these four sprayers won't let you down. They all excelled in finish quality and comfort, and were the most intuitive to adjust.

FUJI SPRAY MINI-MITE 3

\$590

The Fuji had a wider spray pattern than the others, and the pattern maintained a consistent shape, which was impressive. The non-bleeder-style gun has a very comfortable grip and features an easy-to-reach fan-width adjustment knob on the side. As the lowest-priced option of the three Best Overall winners, this system also gets a Best Value award.



APOLLO 835 TURBOSPRAY

\$900

This system boasts plenty of power with high-quality components that did not disappoint. The grip on the non-bleeder-style gun is very comfortable, producing a soft, fine spray with an even pattern that was easy to adjust using a dedicated ring near the air cap on the front. The cup has a protective coating inside to prevent corrosion, a nice feature.



APOLLO ECO-3/E7000 GUN

\$700

This system is a great performer, producing a fine mist with a nicely shaped spray pattern that's convenient to adjust using a knob on the back of the non-bleeder-style gun. The cone-shaped interior design of the cup is a unique feature that keeps the gun from spitting air when it gets low on material, a plus.



EARLEX SPRAYSTATION HV 5500

\$300

Despite its low price, this gun does not compromise on comfort or spray quality. The cup has a protective coating inside to prevent corrosion, and the air cap adjusts with nice action. The air hose connects to the top of the bleeder-style gun, which cramps finger space for the fluid knob below, but the solid performance makes the gun an amazing value.

stationary turbines that connect to the spray gun with a hose. We required that the sprayers be compatible with both water- and solvent-based lacquer, and we tested them using both. Most important, we wanted to see if these spray systems deliver a professional-quality finish.

The guns divide into two different styles. Those that continue to spray air when the trigger is released are called "bleeders," while guns that stop spraying air when you release the trigger are called "non-bleeders." Non-bleeders are nicer to use, because you don't have to worry about where the gun is pointed when you're not spraying, and you avoid the risk of blowing dust into

a freshly sprayed finish. As I used the sprayers, I also evaluated them on the adjustability of the gun controls, ease of loading and cleaning, and how comfortable each gun handle was to hold while spraying.

The proof is in the pattern

The first thing that really separated the guns from one another was the spray test. To achieve a smooth, even finish, a spray gun must produce a fine mist with a symmetrical or slightly tapered fan-shaped pattern in a nice straight line. To test each sprayer's ability to break finish into a really fine mist, I sprayed black-tinted water-based

Features that really matter

SPRAY ADJUSTERS



Conventional controls. Many guns have separate knobs that adjust the fluid volume and the air volume, which in turn control the width of the spray pattern. This traditional system, as seen on the Earlex SprayPort, is straightforward.



Innovative and easy. The gun from the Apollo 835 Turbospray has a dedicated ring near the front that makes it easy to adjust the width of the spray pattern.



Difficult. The spray pattern on the Campbell Hausfeld guns is adjusted by changing the fluid and airflow knobs in tandem with the air cap. The system made it tough to get a nice pattern.

lacquer and black solvent-based lacquer onto white cardboard. The dark finish allowed me to clearly see the shape of each gun's spray pattern, as well as how fine a mist each gun was able to create. Water-based lacquer is much safer and more widely used these days, but it's more difficult to split up into a very fine mist, so it was a challenging test for the sprayers.

The Fuji Spray Mini-Mite 3, Apollo ECO-3, 3M, Lex-Aire, Earlex SprayStation HV 5500, Earlex SprayPort HV 6003, and Apollo 835 systems all did well in this round of tests.

Comfort is critical

When you're holding onto something for an hour or more at a time, comfort can

be a very big deal. There are many good designs among the sprayers tested, so you won't have to compromise on this feature. We tested the gun handles for both small and large hands, and then averaged the scores, but the scores were pretty consistent between the two. The top scorers on comfort were the two Apollo guns, the Fuji Spray Mini-Mite 3, and the 3M.

Spray adjustments should be simple

To test the adjustability of each sprayer, I focused on ease of adjustment, intuitive design that doesn't leave you guessing at which knob to turn, smooth action, and convenient placement of the knobs that doesn't interfere with other gun features.



CAMPBELL HAUSFELD HV2002



CAMPBELL HAUSFELD HV2500



CAMPBELL HAUSFELD HV3000

CUP DESIGN



Coating protects. The Earlex SprayStation and the Apollo 835 Turbospray both have cups with a protective coating inside that guards against corrosion.



Spit proof. The cup from the Apollo ECO-3/E7000 system has a cone-shaped bottom, which helps keep the gun from picking up air when the fluid gets low—a helpful feature.



Watch out for threaded cups. The threads, shown here on the Wagner Flexio 890, are difficult to clean, and once they form a buildup of old finish, they become hard to use.

The SprayPort, the ECO-3 with the E7000 gun, the Fuji, and the Apollo 835 all were simple to adjust, fast and intuitive to figure out, and had overall nice fit and finish, allowing you to turn the knobs with a light twist of the fingers. The controls on these systems also adjusted the spray width from an even, wide pattern down to a small circular one almost effortlessly.

Four sprayers rise to the top

In the end, three systems emerged as Best Overall: the Apollo 835, the Apollo ECO-3 with the E7000 non-bleeder-style gun, and the Fuji Spray Mini-Mite 3. All three had superior quality spray, very comfortable handles, and easy-to-use, ergonomic

HOSE LOCATION



In the way. The hose on the Earlex SprayStation is close to the fluid-adjustment knob underneath, making it harder to turn the knob, and also to spray in tight spaces.



Out of the way. The hose on the Fuji Spray Mini-Mite 3 attaches out of the way at the end of the handle, and has an easy-to-grip coupling that makes it a snap to attach.



EARLEX SPRAYPORT HV 6003



GRACO FINISHPRO 7.0



LEX-AIRE LX-60C

The bottom line: How well do they spray?



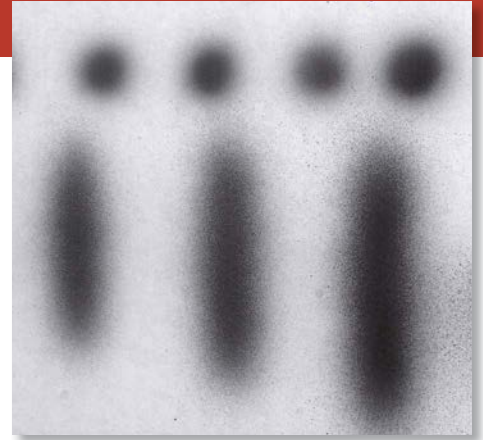
Best test. Masaschi tested each system by spraying dark-colored solvent-based and water-based lacquer onto white cardboard, making it easy to see the size of the spray droplets and the shape of the spray pattern.

adjustment knobs that adjust the spray very nicely.

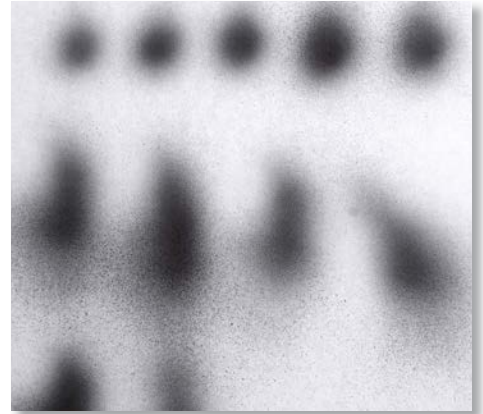
For the Best Value award, the Fuji Spray Mini Mite 3 and the Earlex SprayStation HV 5500 both win. At \$590, Fuji rings in

at about half the price of the Apollo 835 without compromising on features. If you want to start spraying but the Fuji is still a little out of reach, the Earlex SprayStation is even more affordable at \$300, and has a great spray quality, if you don't mind compromising on a few adjustability features. □

Teri Masaschi has been a finishing pro for 45 years and teaches regularly across the country.



Good pattern. You want a tapered, symmetrical spray pattern that makes it easy to lay down an even coat of finish and overlap strokes without leaving lines behind.



Poor pattern. A sloppy or pear-shaped spray pattern makes it almost impossible to blend overlapping strokes together.



ROCKLER HVLP SPRAY SYSTEM



3M 23K-PR01



TITAN CAPSPRAY 75



WAGNER FLEXIO 890

	MODEL	STREET PRICE	EASE OF ADJUSTMENT	SPRAY QUALITY	COMMENTS
AUTHOR'S BEST OVERALL CHOICE	Apollo 835 Turbospray	\$900	Excellent	Excellent	Tested with the A7500 QT non-bleeder-style gun that's comfortable to hold, and easy to use and adjust.
AUTHOR'S BEST OVERALL CHOICE	Apollo ECO-3/E7000 gun	\$700	Excellent	Excellent	Non-bleeder-style gun is comfortable to use and simple to adjust. System produces a nice spray pattern.
	Campbell Hausfeld HV2002	\$250	Poor	Poor	Gun has an uncomfortable handle, and the top-mount hose interfered with spray adjustments. This bleeder-style gun requires the user to adjust three controls to change the spray pattern.
	Campbell Hausfeld HV2500	\$400	Poor	Fair	Gun has the same setup as the HV2002. Produced an asymmetrical spray pattern, and could not produce a fine spray.
	Campbell Hausfeld HV3000	\$460	Poor	Poor	Same gun setup as other Campbell Hausfeld systems. Did not produce a symmetrical spray pattern.
	Earlex SprayPort HV 6003	\$550	Excellent	Excellent	Air and fluid knobs located on the back of a non-bleeder-style gun, making it easy to dial in a nice spray pattern. The system had plenty of power, but the gun was not as comfortable as several others.
AUTHOR'S BEST VALUE CHOICE	Earlex SprayStation HV 5500	\$300	Good	Very good	Great performance with a comfortable bleeder-style gun and simple controls.
AUTHOR'S BEST OVERALL CHOICE AUTHOR'S BEST VALUE CHOICE	Fuji Spray Mini-Mite 3 T-Series	\$590	Excellent	Excellent	Gun has a comfortable handle and a dedicated spray-width adjustment knob. The spray pattern was consistent and impressive.
	Graco FinishPro 7.0	\$900	Good	Good	This gun worked well, but sprays fast and heavy, making it better suited to professionals covering large areas. The non-bleeder-style gun has a comfortable handle and the system packs nicely into the carrying-case-style turbine.
	Lex-Aire LX-60C	\$995	Fair	Very good	Air volume and spray pattern on this bleeder-style gun are both controlled by adjusting the air cap, which was stiff and difficult to turn.
	Rockler HVLP Spray System	\$147	Poor	Poor	Cup mounts to gun with threads, making it difficult to clean. The gun handle is uncomfortable, and the bleeder-style gun could not be adjusted to spray a fine mist. Hose attaches to top of the gun, and often got in the way.
	3M 23K-Pro 1	\$850	Very good	Very good	This non-bleeder-style gun worked well and was comfortable to hold. But it uses a cup system with disposable liners that added inconvenient steps to the process.
	Titan Capspray 75	\$900	Poor	Good	This non-bleeder-style gun produced a nice spray pattern but sprays fast and heavy, making it better suited to professionals covering large areas. Gun was not very comfortable, with overly complicated adjustments.
	Wagner Flexio 890	\$190	Poor	Poor	Convenient on/off switch on the body. Produced a nice spray pattern, but not a very fine spray. There is no hook to hang the spray gun from, and the hose is permanently connected to the gun, so it tips over easily.

4 Jigs for a Fixed-Base

Get more from the most handy router in the shop

It's not uncommon for a woodworker to own several routers—like dollars in the bank, you can never have too many. However, a fixed-base router should be the first one you buy. Even if you own a plunge router, I still think you need a fixed-base model. The standard midsize version is relatively lightweight, easy to manipulate, adaptable to almost any kind of fixture, and can be mounted in a table. Compared to plunge routers, a fixed-base router's center of

gravity is much closer to the cutting action, and so are its handles. This makes it easier to control for most tasks, and it's why most of my jigs are made for this type of router.

As I point out in “Fundamentals: Your first router” (see p. 20), every router needs some kind of positive guidance. The simplest system is a bearing, mounted on the router bit, which rides the edge of a workpiece. This is where most people stop with fixed-base routers, using them with

bearing-guided profile bits to mold the edges of tabletops and drawer fronts. But there is much more these versatile routers can do. Jigs are the secret, and here are a few of my favorites.

Hinged straightedge has setup built in

One way to guide a router is to run the base against a fence. This works best for straight cuts. Many woodworkers use a board with a straight



EDGE GUIDE



CIRCLE JIG

DADO JIG



Article Extra

Learn three simple secrets for easier, safer handheld routing.

Router

BY MARC ADAMS

edge for this purpose. A common job for this fence is trimming the ends of a tabletop that is too wide for your table-saw's crosscut sled. To position the fence accurately, you need to measure the distance between the edge of the router base and the edge of the bit you are using, and then position the fence exactly that distance from your layout line.

My version of a straight fence makes setup fast and automatic. It has a hinged section that exactly equals the



STRAIGHTEDGE

1 Straightedge with a flip-up fence

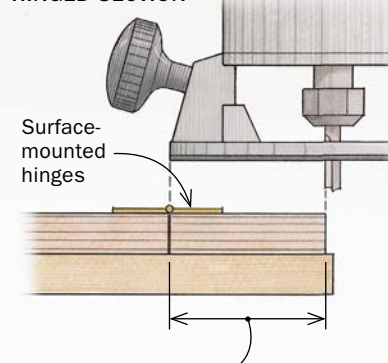
The simplest way to guide a router is by running its base against a fence. Combine that with a straight bit and you can trim the longest edge, such as the end of a tabletop, straight and smooth. Adams's clever variation on a standard straightedge has a hinged section that makes setup fast and accurate.

Rough away the waste. Mark the edge to be trimmed, then cut close to the layout line with a jig-saw or circular saw. Leave $\frac{3}{8}$ in. or less for the router to trim.



Setup is simple. With the hinged section folded down and aligned with the layout line, clamp the back of the jig in place.

SIZING THE HINGED SECTION



Hinged section matches distance between edge of base and bit.



Flip and go. Now flip up the hinged section, and rout along the fence. The cut will line up precisely with the layout line. In case the router base is not concentric with the bit, keep the same point in contact with the fence as you rout.

Surefire jig for dados and dovetails

Adams improved on the standard T-square dado jig with a two-railed version, which ensures that the router stays on track.

MAKE THE JIG

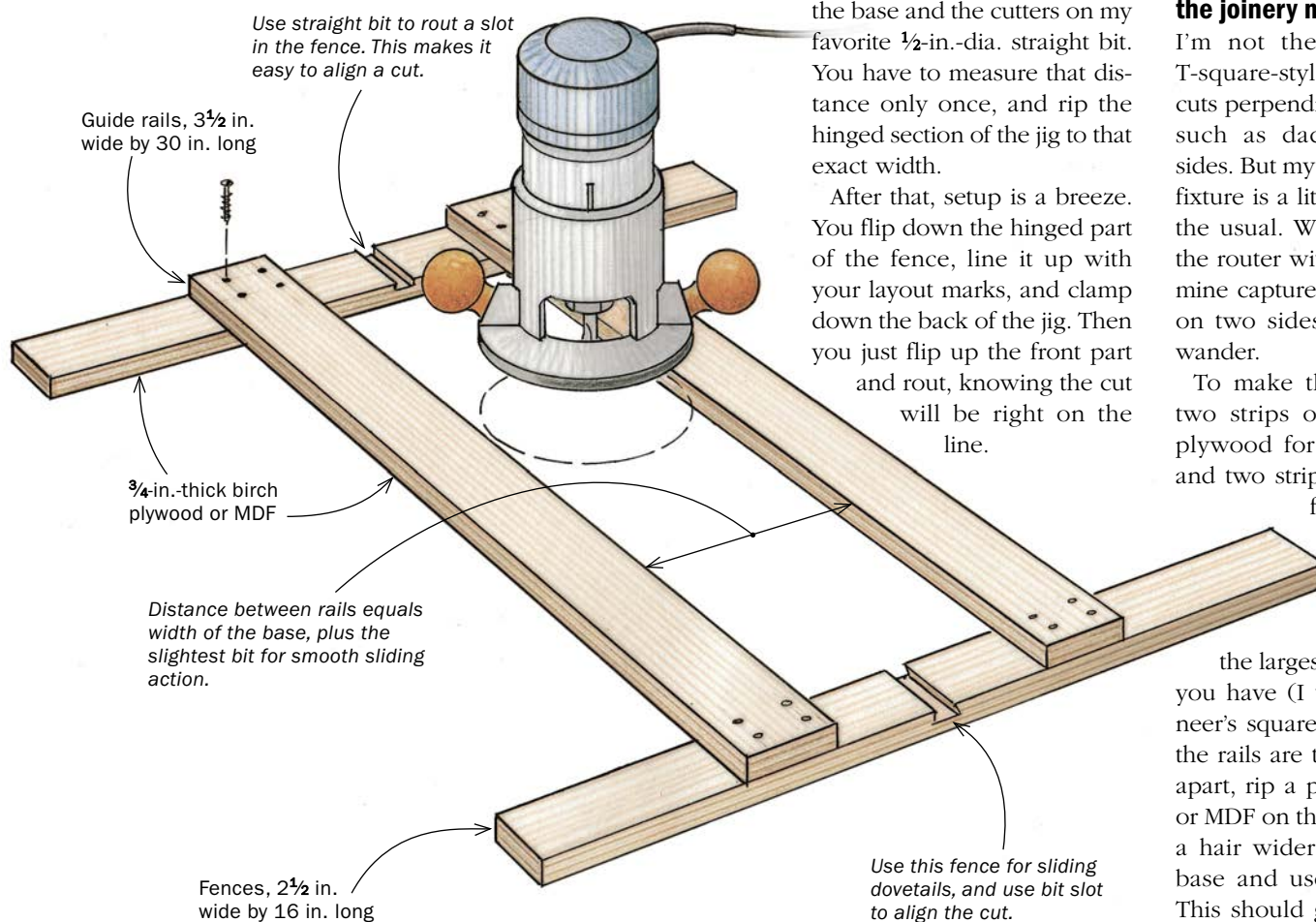


Attach the first rail. Use a large square to line up the first rail with the fence, clamping it in place before drilling holes and screwing it down.



Spacer aligns the rails. Rip a spacer just a hair wider than the base of the router, and use it to clamp the second rail in place. The router should slide easily between the rails, but with no slop.

MODIFIED T-SQUARE FENCE



distance between the edge of the base and the cutters on my favorite ½-in.-dia. straight bit. You have to measure that distance only once, and rip the hinged section of the jig to that exact width.

After that, setup is a breeze. You flip down the hinged part of the fence, line it up with your layout marks, and clamp down the back of the jig. Then you just flip up the front part and rout, knowing the cut will be right on the line.

T-square fence is the joinery master

I'm not the first to use a T-square-style fence to make cuts perpendicular to an edge, such as dados in cabinet sides. But my favorite T-square fixture is a little different from the usual. Where most guide the router with a single fence, mine captures the router base on two sides so that it can't wander.

To make the fixture, I cut two strips of ¾-in. MDF or plywood for the guide rails, and two strips for the fences, front and back.

To ensure that the rails go on square to the fences, use the largest accurate square you have (I used a big engineer's square). To ensure that the rails are the right distance apart, rip a piece of plywood or MDF on the tablesaw to just a hair wider than the router base and use it as a spacer. This should give you smooth



Attach the second rail. The spacer ensures that this rail is parallel to and spaced properly from the first one. Again, clamp the fence to the rail before attaching it.



Now add the second fence. Be sure that the spacer is tight against both rails, and that the fence goes on square. Again, clamp before drilling and driving screws.

DADOES COULDN'T BE SIMPLER

sliding action without any side-ways play.

A back fence keeps the guide rails properly spaced, but it also makes the jig reversible. That's because you always cut a dado in the fence to create a place where you can start a cut. So if you always put the front fence against the workpiece and use the same straight bit to make dados and grooves, the dado in the fence will allow you to precisely align the jig with your workpiece. The same goes for the rear fence, which you can dedicate to a dovetail bit for routing sliding dovetails.

You now have a fixture that will allow your router to cut accurate dados, grooves, and dovetail slots without wandering. And it's easy to clamp on blocks for stopped cuts.

Shopmade edge guide is better than store-bought

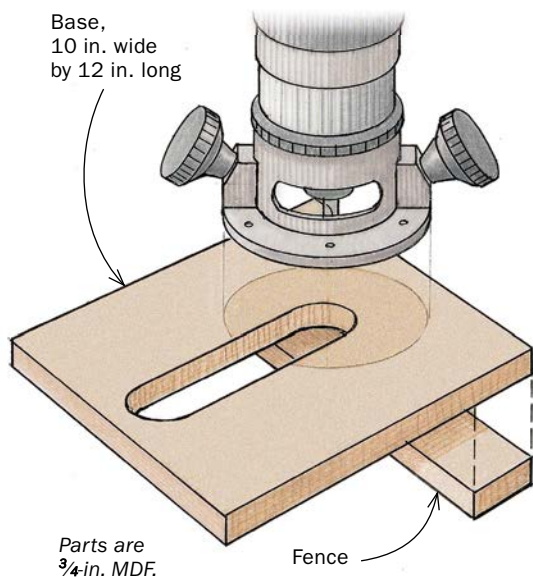
Most router manufacturers sell edge guides, basically a fence that rides the edge of the workpiece and is attached to the



This is the easy part. Line up the dado in the fence with your layout lines, clamp the jig in place, and rout. Make multiple light passes for best results, and clamp bookcase sides together to add speed and ensure matching dados. For wider dados, just move the jig slightly and make another series of passes.

3 Shopmade edge guide is versatile

Adams's shopmade edge guide is easy to set up, stable on the workpiece, and can be tilted into a cut, letting you make stopped cuts with a fixed-base router.



MAKE THE JIG



Cut out the window. Start by drilling two big holes with a 1 3/4-in.-dia. Forstner bit. Remove material between them with a jigsaw.

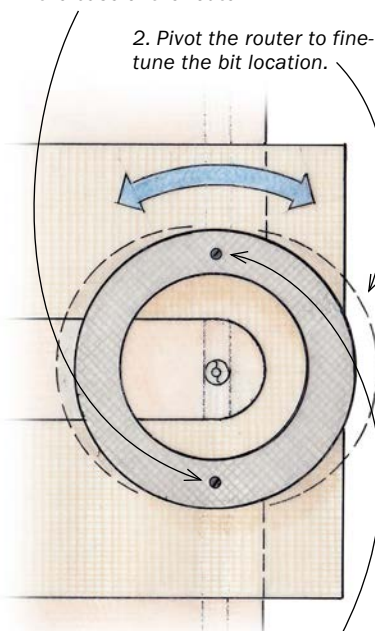


Attach a fence. Glue and nail it in line with the edge of the base.



ATTACH THE ROUTER

1. Put one screw through the base of the router.
2. Pivot the router to fine-tune the bit location.



3. Drive the second screw.

Line up the router with the cut. The router attaches at various points on the jig for various cuts. To do that accurately, look through the jig's window to align the bit with layout lines.

router with long rods that pass through the base. This fixture is used to help make grooves, dadoes, and decorative cuts parallel to an edge.

I make my own edge guides. A shopmade version has a number of advantages. I like the stability of the long fence and the big, flat base, and I find the shopmade version easier to set up. Last, that big base lets me pivot the router down into a cut, so I can use a fixed-base router for stopped cuts, too.

This fixture is not much more than a 3/4-in.-thick piece of MDF, cut to roughly 10 in. by 12 in. long, or longer if need be. It has a big oval window for lining up the bit on the workpiece, and a simple MDF fence on the underside.

To use it, remove the base-plate from your router and attach the router to the jig. Some fixed-base routers have untapped holes in the base so that they can be screwed to jigs like this or to a router table. If

EASY GROOVES

Through-cuts are easy, but this jig also lets you tilt the bit into and out of stopped cuts, like the grooves in the sides of this wall cabinet, which will hold the back.



Watch and tilt. Turn the router on and look through the jig's viewing window to lower the bit as you begin to move the jig along the edge. Later you can reverse direction to make a clean cut up to your stopping point.

there are no unthreaded holes in your router, just drill some. It's easy to drill through the aluminum casting with standard twist bits.

Unlike a commercial edge guide, which has a moveable fence, on this jig you move the router to set up a cut. With the fence firmly against the edge of the workpiece, set the router on top of the fixture, and lower the bit until it just touches the work. Now move the router until the bit is right at your layout line, and screw the router base to the fixture. It takes only seconds.

One jig for arcs and circles

Another of my favorite jigs for a fixed-base router is a circle-cutting fixture. Despite the name, the jig isn't limited to making round tables. It can also cut big holes or any portion of a radius curve. And it's a good tool for laying out curved lines before cutting them with a bandsaw or jigsaw.

Again, there are similar jigs available in woodworking catalogs, but I prefer my shop-made model. It is made to fit a particular router and bit combination, meaning I can drill and label permanent center points for dozens of precise radii.

I made the jig from polycarbonate plastic. The polycarbonate is $\frac{1}{4}$ in. to $\frac{1}{2}$ in. thick, slightly over 6 in. wide, and at least 40 in. long. I choose polycarbonate over MDF or plywood because it slides nicely over workpieces and is very tough, which will keep the pivot holes accurate for decades to come. Also, it is transparent, which lets you see the cut. That can be really helpful, for example, when you need to stop or start an arc in a precise spot or see when you are nearing the end of a template.

Polycarbonate (one brand is Lexan) is practically bullet-proof but can be machined easily with woodworking equipment. Do not use acrylic plastic (such as Plexiglas) for



Rout to the other end. Stopping at the other end is easier. Look through the viewing window to end right at the layout line.

TIP



CURVES, TOO

Add a curved fence to rout an inlay slot near a curved edge. Make the fence and edge match as closely as possible.

4 Circle jig is sturdy and accurate

Adams's shopmade circle-cutting jig is precise and durable, and can be used to rout partial curves, too. It is made from $\frac{1}{4}$ -in.- to $\frac{1}{2}$ -in.-thick polycarbonate, which cuts easily with woodworking tools.

MAKE THE JIG



Lay it out and drill. Use the router's baseplate to locate the attachment holes on the jig, plus the $1\frac{1}{4}$ -in.-dia. center hole for the bit. Leave the protective paper on the polycarbonate for now.



Bandsaw the perimeter. Polycarbonate saws and drills nicely. Smooth rough edges with a sanding block.

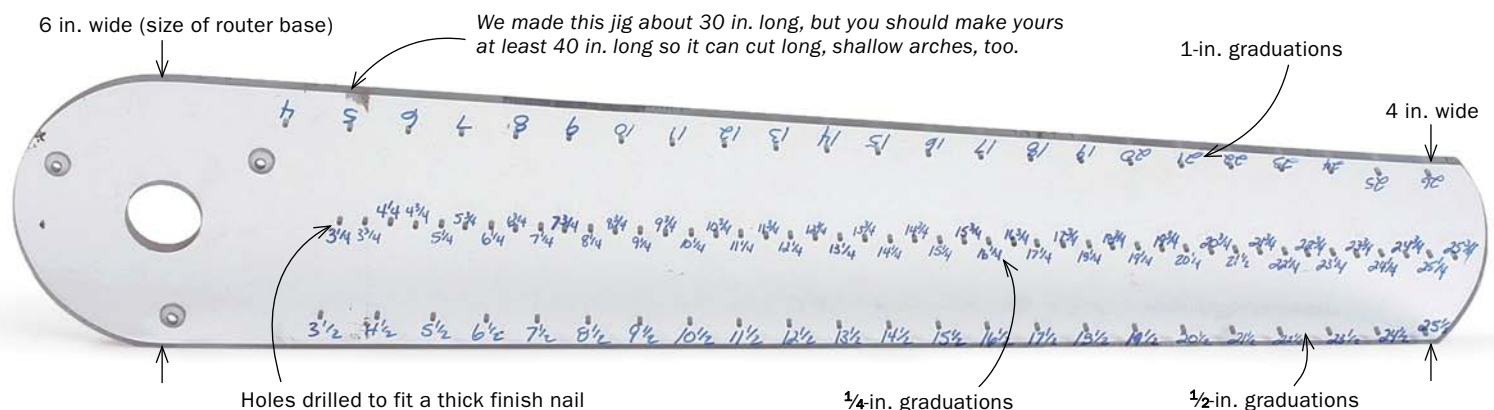


Mount the router to lay out the pivot points. Use a scratch awl, and turn the bit slightly each time, so a cutter is aligned with the mark you are making. The three lines merely space out the pivot points on the jig, so you have room to label them all clearly.



Label it and you're done. After drilling holes to fit the pivot nail, remove the protective paper and use a permanent marker to label each pivot hole. Double-check the distances.

PIVOT POINTS EVERY $\frac{1}{4}$ IN.



this fixture. Acrylic plastic doesn't machine well and is brittle. Polycarbonate is sold at most big hardware stores and home centers, but is even cheaper if you buy a scrap of it from a local plastics supplier.

Clamp down the plastic workpiece when drilling holes in it, especially the big center hole. I find that a $1\frac{1}{4}$ -in.-dia. Forstner bit works best for that.

If you do two important things, this fixture will be very accurate. First, lay out and mark circle radii very carefully on the plate. Then use the same size straight bit each time. I recommend a $\frac{1}{2}$ -in.-dia. bit. Mark that bit size on the jig (use a permanent marker) so you don't forget.

For the pivot points, I recommend using a big finish nail or box nail that has a body diameter of about $\frac{1}{8}$ in.

Rough out the arc first—

Because the pivot point is a nail, it will leave a hole. To rout a circular tabletop, you can mount the jig on the underside. If you must locate the jig on the show face, such as when routing a groove for inlay on the top side (see photo, opposite), carpet-tape a piece of $\frac{3}{4}$ -in. MDF to the workpiece to hold the pivot point. You will need to tape similar blocks of

PERFECT FOR CIRCLES



Set the pivot point. Find the approximate center point on the underside of the table, and bang in the pivot nail so it stays tight throughout the cutting process.



Start with a shallow pass. This lays out the circle for the next step. You'll have to raise the jig and router slightly to get started, unless you are using a plunge router.



Saw away the waste. A bandsaw will work here, if you can support the workpiece, but a jigsaw is easier. Try to stay within $\frac{1}{16}$ in. of the finished edge.



Router at full depth. Lock the router at full cutting depth, but again raise it up before turning it on. Lower it gradually to full depth as you push forward, moving counter clockwise.



Inlay the same tabletop. The same router can plow a perfect inlay groove near the perimeter. Taped-on blocks hold the pivot and jig on the top of the table.

the same thickness to the bottom of the jig to keep it level.

As you cut a full circle, you will be going against the grain in places, so you'll want to pre-cut the circles and arcs close to the line to prevent tearout. Rather than lay out the arc with a pencil line, just take a light pass using the circle jig. That makes it easy to rough away the waste while staying about $\frac{1}{16}$ in. from the final edge.

To cut partial arcs with this jig, such as on templates for curved work, the pivot point

will have to be far away from the workpiece. The solution is to create a workstation. Any large piece of plywood, MDF, or particleboard works well. I use carpet tape to anchor the workpiece and pivot block to the workstation, and add one extra leveling block to the underside of the jig (see photo, right). □

Marc Adams runs the country's largest woodworking school, near Indianapolis. Go to MarcAdams.com for a full list of classes.

ARCHES, TOO



Make a workstation. To rout smooth curved templates, use carpet tape to attach the workpiece to a sacrificial panel of some kind. Attach blocks to the panel and jig as shown to keep it level with the workpiece. Set the bit to rout just slightly into the panel below.



When I'm making furniture for others, I build in all sorts of styles. But when a piece of furniture is for my own house, I go country. Having grown up in New England, I am partial to the simple pine furniture of our northern settlers. This cupboard, with its open top and decorative cutouts on the sides, has its design roots in the 17th century.

Like the original makers, I worked my white pine boards unplugged. Don't get me wrong—I don't build everything by hand. But I really enjoy using hand tools, and when I'm making a piece for myself, I like to indulge a little and skip the machines. The pleasure of the hand-

White pine and
simple joinery
make it a
pleasure to build
with hand tools

**BY ANDREW
HUNTER**

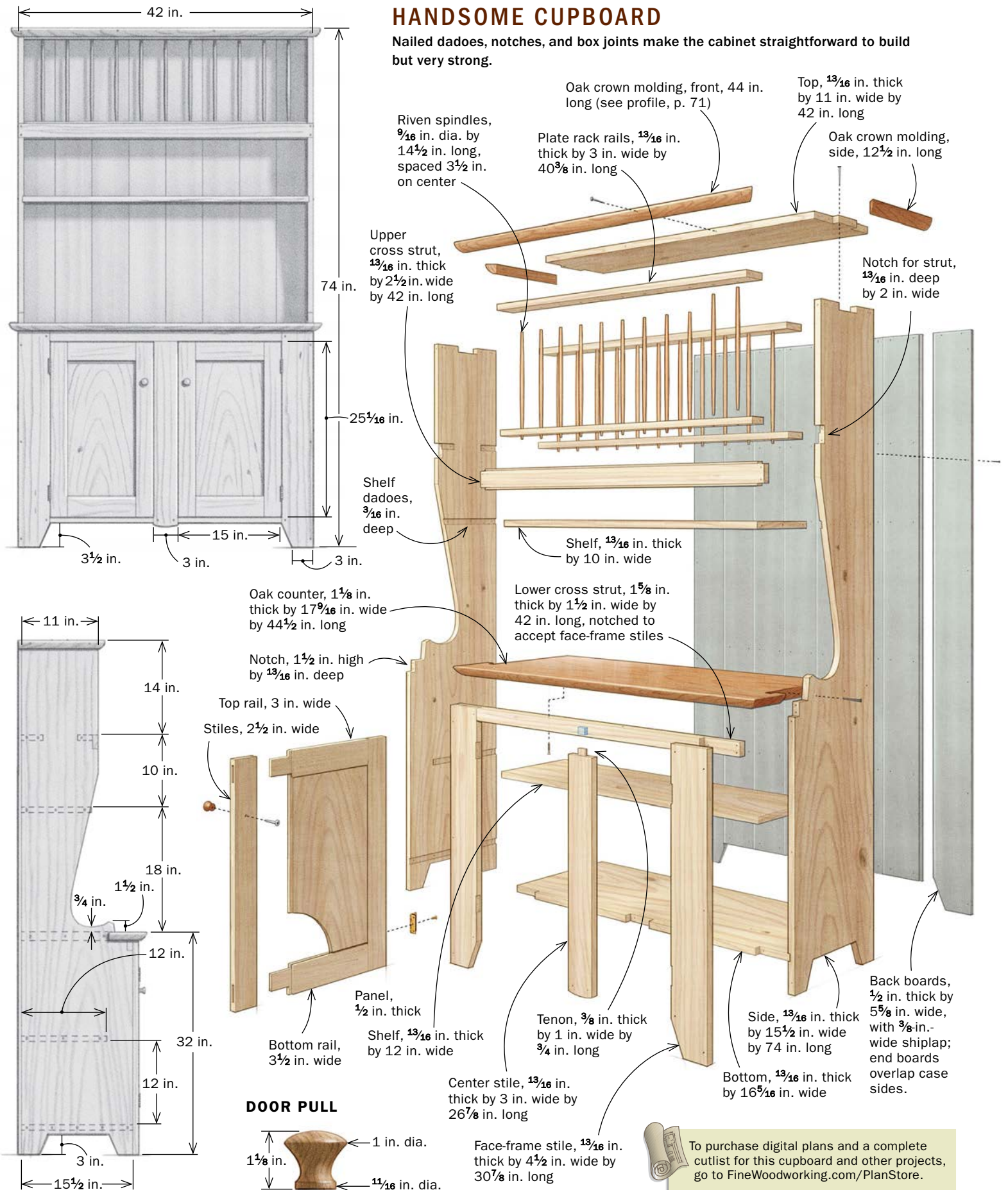
work shows in the finished piece, and it feels good knowing all that has gone into making it.

When building a piece with hand tools, it is best to keep things simple. This cabinet relies primarily on nails for its strength. The box-joined top, along with the dadoed shelves, bottom, and counter, are fixed with nails through the sides, and nailed face frames and cross struts reinforce the structure. With the back boards nailed in place at every horizontal, this cupboard is rock-solid. I use traditional cut nails, and I don't hide them. The exposed nail heads

Make a Country Hutch

HANDSOME CUPBOARD

Nailed dados, notches, and box joints make the cabinet straightforward to build but very strong.



To purchase digital plans and a complete cutlist for this cupboard and other projects, go to FineWoodworking.com/PlanStore.

Joinery by hand



CUT THE CURVES IN THE SIDES

Bowsaw is best. Hunter makes the curved cuts in the sides with a bowsaw. After sawing, he smooths the curves with a plane and spokeshave.



One side mirrors the other. Use the first completed cutout as a template to draw the shape on the other side piece.

are appropriate to the country style, and the contrast between the silky-smooth pine and hard steel looks great.

I used red oak for the counter, upper molding, spindles, and door pulls. I like red oak and white pine paired together. I left the pine without finish, but used tung oil to bring out the oak's rich color.

I painted the back boards with slate-blue milk paint. This allowed me to use inferior boards for the back while creating a uniform background for the dishes on display.

Start with the sides

I began the hutch by ripping and crosscutting all the parts a bit oversize, then milling



DADOES FOR THE SHELVES

Twin kerfs. Using a 90° guide block and a panel saw with a depth line drawn on the blade, make the kerfs that define the width of the dado.



Chisel out the middle. Remove most of the waste with the bevel down. Finish with a long chisel bevel up or a grooving plane.



Depth check. To be sure your dados reach proper depth, make a test piece that easily fits the dado and draw a line on it at full depth.



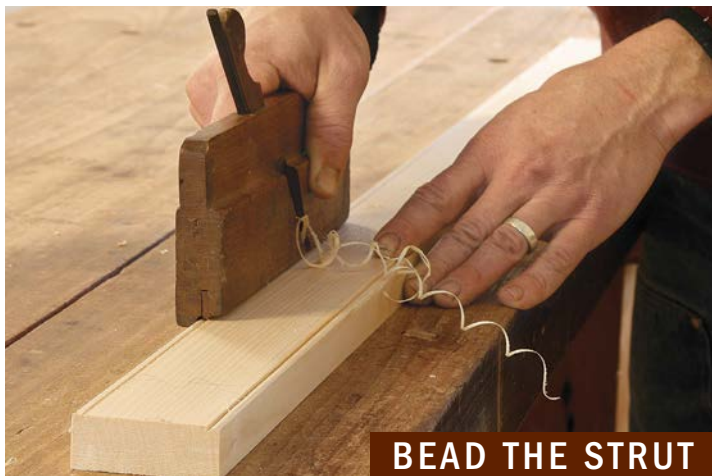
BOX JOINT AT THE TOP

One tab on top. Saw out a pair of notches at the end of the top board to create a central tenon.



Matching notch. With saw and chisel, cut a central notch at the top of each side. Do the chopping and paring from both faces toward the middle to avoid blowout on the bottom face.



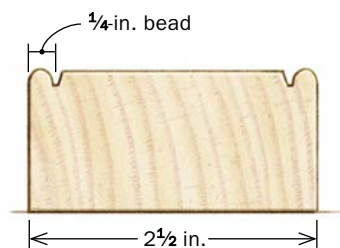


BEAD THE STRUT

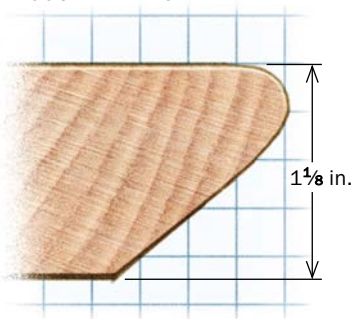


Shape and trim. Use a molding plane or a scratch stock to shape beads on the upper cross strut. Trim the beads back (above right) to fit the cross strut in its notch in the case side.

CROSS-STRUT PROFILE



COUNTER PROFILE



SHAPE THE COUNTER

Handplaned profile. Shape the edge of the counter with a handplane, working to lines drawn on the ends. Next, profile the ends of the counter that extend beyond the case sides.



Side notch. With the profiling finished and the danger of damaging fragile short grain gone, saw and chisel a notch to accept the case side.

them flat. I cut parts to final size only as needed during the build. You can mill your boards by machine, of course, but to see how I flatten rough boards by hand, see *Handwork*, FWW #239.

The curved cutouts in the sides give this hutch its individuality, and you can design a profile to suit your own tastes. I sawed out the bulk of the waste with straight rip-cuts and crosscuts. Then I cut the curve with a bowsaw and cleaned up to the lines with a handplane and spokeshave. I used that completed side as a template to draw the cutout on the second side.

To make the foot cutouts, start with angled ripcuts, use a bowsaw to make the horizontal cut, and clean up with a chisel.

Cut the dados—All the major horizontal surfaces except the top are set into dados in the sides. I used a Japanese panel saw to make the parallel kerfs that establish the width of the dados. The saw's small curved head makes following a guide block simple and lets you start or end a cut in the middle of a board, as with the stopped dados. Once you've made the sawcuts, excavate the waste with a chisel. Clean up the bottom of the dado with a long chisel or grooving plane.

Box joints at the top—To secure the top to the sides, I chose a three-part box joint secured with nails. It provides multidirectional strength not offered by a nailed rabbet, yet is far easier to lay out and cut than dovetails. The single tenon of the top

is easily made with rip- and crosscuts, but the center notch in the side boards needs to be chopped with a chisel.

Notches hold the cross struts—The beaded cross strut at the bottom of the plate rack gets let into notches in the sides. Start those notches with multiple stopped sawcuts to the baseline, then chisel the rest of the waste. The lower cross strut, which is just below the counter and doubles as the top rail of the face frame, is also let into the sides, but those notches can be simply sawn out with a ripcut followed by a crosscut.

Make the shelves and counter

With the two sides finished, start the shelves and counter. To ensure consistency, lay out



FINE NAILING

Perfect nail prep. Get ready to nail by drilling pilot holes. Center the holes by eye in the dadoes and support the wood from below to prevent blowout.

Case construction



Against the wall. Assemble the case on its back, supported on a flat sheet of plywood and pushed against a wall.

the shelves with a story pole and then cut and plane their ends to length. Test-fit the shelves in the dadoes and shave their bottom edges if the fit is too tight. For the counter, make the cutouts at the ends so the counter slides into its dadoes. But wait to cut the small notches that lock over the case sides until you've created the counter's edge profile.

Cut the profile with a smoothing plane. Shape the front edge first, taking straight, continuous shavings from end to end. As you near the profile line, take lighter passes. The final curve will be made up of many facets, which can be left visible or



Counter locks the case. With the rest of the carcass assembled, move it away from the wall and slide in the counter.

Oak gets extra pilots. Prepare for nailing the oak counter by extending the pilot holes in the sides deep into the counter.



scraped smooth. I leave mine unscraped. Repeat the process on the two ends, working from the outside in to prevent blowout. Now cut the small notches.

A place for plates

The plate rack consists of two separate frames, each with riven oak spindles captured between an upper and lower rail. I drilled holes for the spindles with a $\frac{3}{8}$ -in. tapered bit. The slight taper of hole and tenon makes it easier to get a snug fit. I split the spindles from a piece of straight-



ASSEMBLE THE FACE FRAME

Rail reinforces the counter. The top rail of the face frame ties counter, face frame, and sides together. Hunter screws it to prevent sagging.



Flush the face frame. With the face-frame stile set into its notches, trace along the side, then trim the stile to fit, predrill, and nail it in place.

grained firewood and did most of shaping with a drawknife while the wood was still green. Green wood works like a dream, and it only takes a few days to dry the spindles near the woodstove. I wanted a roughly faceted look, so I left the texture right off the drawknife. For a smoother surface you could do some final shaping with a spoke-shave or block plane after the spindles dry.

With the spindles dry, taper their ends and fit them one by one to their holes. After fitting one end of a spindle, insert it in the rail and make a mark $12\frac{3}{8}$ in. up the shaft. Then fit the other end so it seats to the mark. Once all the spindles are fitted, you can trim the ends flush. I let the bottom ends protrude because I liked the way they looked.

I used an antique molding plane to cut the beads on the upper cross strut, but a scratch stock would also work. After you cut the beads, trim them back at each end to fit the strut into its notches. Leave the strut long to prevent splitting when you nail it in. You'll saw the ends flush after assembly.

Cut the face frame for the cabinet

The face frame—the vertical and horizontal members that surround and divide the doors—helps ground the piece visually and adds rigidity to its structure. The top rail of the face frame—the lower cross strut—is twice as thick as the upper strut, because the stiles of the face frame must be notched into it. This strut also has a



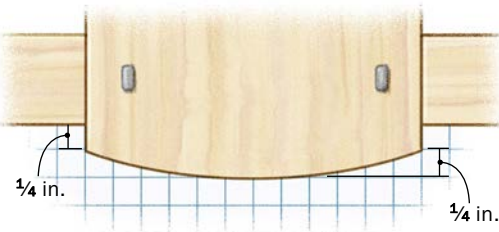
Center stile. Locked in place with a tenon at the top and nails into a notch below, the center stile provides added rigidity along with accurate openings for the doors.

mortise to mate with the tenon of the vertical divider between the doors. Chop this small mortise with a chisel, and make the mating tenon with handsaws and a paring chisel. To create the slight radius at the bottom end of the vertical divider—a small detail that has a big impact on the way the hutch looks—start with sawcuts and fair the curve with a smoothing plane.

I chop notches for the door hinges into the face frame before assembly, which makes cutting them much simpler. Make multiple crosscuts and clean up to the layout line



CENTER STILE



Finishing touches



PLATE RACK

Tapered holes for a tight fit. Using a tapered bit to cut the holes for the spindles makes fitting them easier.



with a chisel. To see how I make the doors themselves, see Handwork, p. 24.

Nail the assembly

With all the parts shaped, it is time to put them together. Begin by pre-drilling through the sides for all of the nails. To be sure you hit your mark, drill from the inside face, centering the bit in the dadoes while supporting the board from below to prevent blowout on the show face.

As with most of my projects in pine, I let the handplane create the finish. No treatment can come close to the sheen left on a soft wood with a sharp blade, and the honest surface gains a beautiful patina over time. So before nailing, finish-plane all of the parts, taking only the finest shavings to ensure that the joints will be tight.

Nailing starts with the hutch on its back. I position a workbench or horses near a wall, put a sheet of $\frac{3}{4}$ -in. plywood on top, and rest the cabinet on top of that. I push one side of the cabinet up against the wall to provide stability while nailing.

Begin assembly with the box joint at the top. Check that everything is square before nailing the top, two shelves, and bottom in place. With the first side secured, spin the plywood and place the nailed side against the wall, then nail the other side.

Pull the cabinet away from the wall and slip in the counter. Because the counter is



Split and shave. Firewood and a splitting ax produce the raw material for the spindles. A drawknife shapes the green wood quickly. Hunter leaves his spindles roughly faceted. You could refine yours with a spokeshave or handplane.



Taper the tenons. Fit the spindle ends one at a time to their holes, planing them to a taper. With one end of the spindles fitted, mark shoulder lines on the opposite end $12\frac{3}{8}$ in. from the face of the rail. Taper the second end until it fits up to that line.





Set and secure the rack. Slide the front plate rack into place and then nail in the cross strut. Hunter drives nails up through the top rail of the rack into the top board of the cabinet.



Leave it long. To avoid splitting, leave the cross strut over-length until the nails are driven in. Then cut it flush to the case side.

oak, drill pilot holes into the end grain to ease the nailing. Use a long bit to extend the holes from the side into the counter.

Next, install the lower cross strut with nails into the case sides and screws up into the counter. The face-frame stiles are next. The tenon at the top of the center stile gets the only glue in the cabinet. Knock it in and then drive the nails at the bottom.

Slide the front plate-rack frame into place and nail through its upper rail into the top board. Then fit and nail the upper cross strut. Stand the cabinet on a level surface and secure the back plate-rack frame.

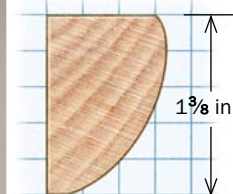
Adding the back—The back is made up of eight boards, shiplapped and painted. The shiplaps are cut with a rabbet plane with a shopmade fence. I brushed on the milk paint in three coats, and waited a few days before I assembled the piece. Since I painted only the fronts of the boards, I wet the backs before each coat to balance the moisture and avoid cupping.

Before nailing the back, square the cabinet one last time and brace it with a diagonal stick clamped to the front if need be. Nail the first plank so one edge is flush with the outside face of the cabinet side. Then work across the back, nailing each board twice to each horizontal, and shave the last piece to fit flush with the outside face of the other side of the cabinet. □

Andrew Hunter designs and builds custom furniture in Accord, N.Y.



CROWN MOLDING



Top trick. When nailing in the mitered molding at the top of the cabinet, Hunter temporarily tacks a scrap or two to the top board to help with alignment.



VIDEO WORKSHOP

Follow every step of this project as Hunter builds this hutch in a members-only video series.

Domino Changes the

Because of its strength, the mortise-and-tenon is one of the most important joints used in furniture making. It's perfect for connecting table aprons to legs, the rails and stiles of a door frame, and chair stretchers to legs. Through the years, I've learned to cut the joint with a variety of techniques and tools, from backsaws and mortising chisels to bandsaws, tablesaws, routers, hollow-chisel mortisers, and manufactured joinery jigs. These tools and methods can work well, but I always thought they involved either too much finicky setup or a lot of test cuts (both in some cases) to produce a snug-fitting tenon with tight shoulders and flush faces.

That's why I was excited when Festool introduced the Domino, a revolutionary handheld

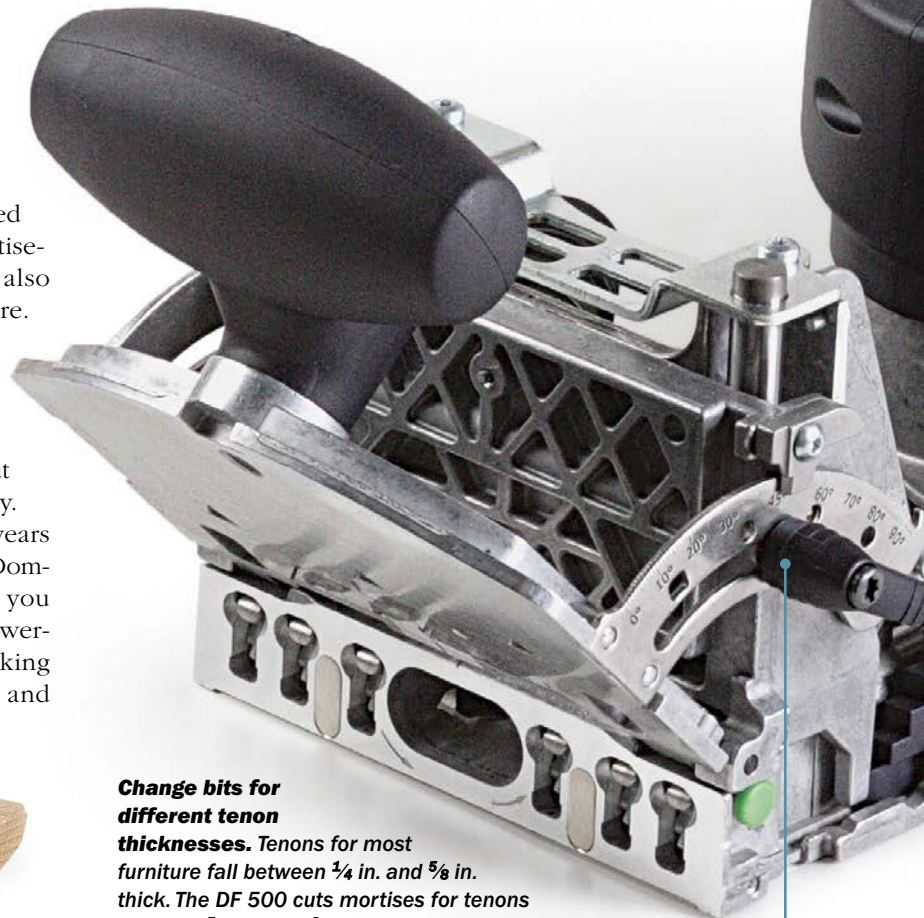
mortising machine, in 2007. The tool has a spiral bit that plunges into the wood to create a perfect mortise with round ends. You cut a mortise on both parts of the joint, and use a ready-made slip tenon, which Festool calls a Domino, to tie the two parts together. It's a very strong joint, and best of all, the Domino is much faster than any other mortising technique I've used, requiring very little setup to get perfect joints.

The Domino has changed not only how I cut mortise-and-tenon joinery, but also the way I design furniture. Because I know that any two parts that touch can be joined with a Domino, I let my creativity run free without worrying about the joinery.

I've learned over the years that if you combine the Domino with a simple jig, you end up with a very powerful tool, capable of making accurate joints quickly and

Tips and techniques for a revolutionary joinery system

BY TIM CELESKI



Change bits for different tenon thicknesses. Tenons for most furniture fall between $\frac{1}{4}$ in. and $\frac{5}{8}$ in. thick. The DF 500 cuts mortises for tenons between $\frac{5}{32}$ in. and $\frac{3}{8}$ in. thick. The XL DF 700 (above) ranges from $\frac{5}{16}$ in. to $\frac{9}{16}$ in. thick. Bits aren't interchangeable between machines.



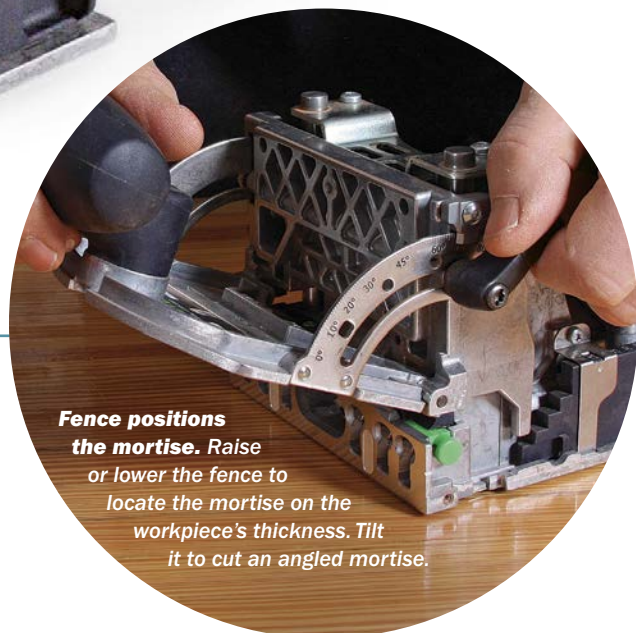
Game



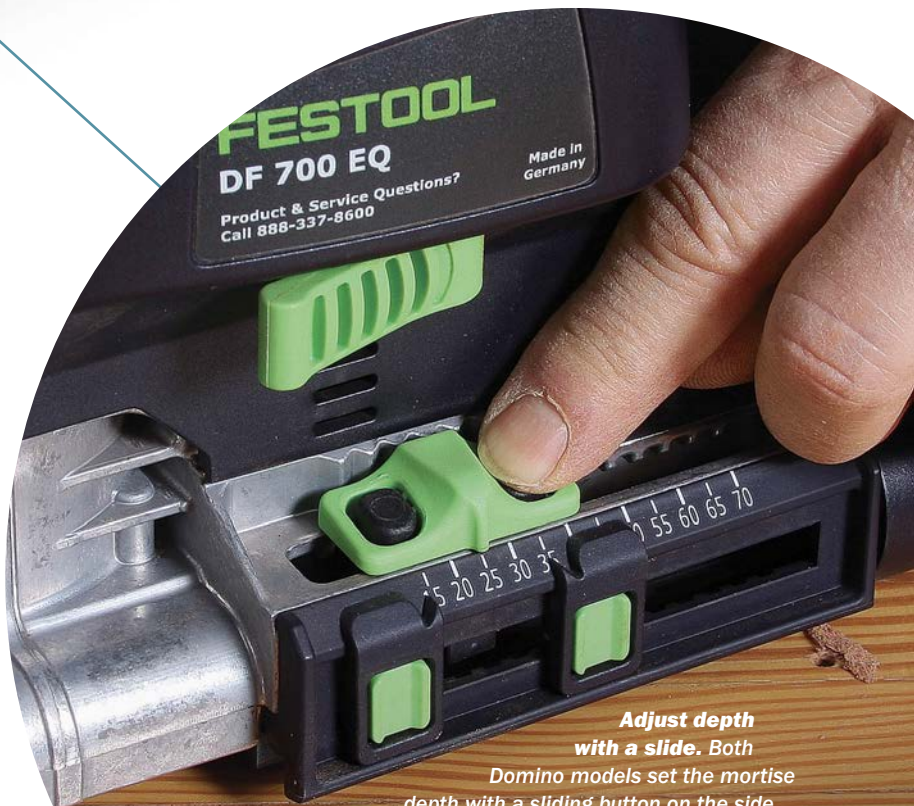
Flip a lever to change the width. You can size a mortise for a tight fit with the slip tenon, or one that includes play, allowing you to adjust the joint after assembly.

Perfect mortise with one plunge

Each Domino model, the DF 500 and the larger XL DF 700, makes it easy to position the mortise on the workpiece. Then it cuts the mortise to precise depth, width, and length in one stroke.



Fence positions the mortise. Raise or lower the fence to locate the mortise on the workpiece's thickness. Tilt it to cut an angled mortise.



Adjust depth with a slide. Both Domino models set the mortise depth with a sliding button on the side. The XL DF 700 can cut mortises between 15mm and 70mm deep ($\frac{9}{16}$ in. to $2\frac{3}{4}$ in., respectively), in 5mm increments.



Tips for better accuracy

For parts to align correctly after assembly, you need a precise layout. For a clean mortise, plunge slowly and use dust collection to clear chips.

Mark both parts at once. Use a sharp pencil (above) for a thin, crisp line to get a more accurate alignment with the sight gauge on the joiner's fence.

Plunge slowly. Push from the back of the machine, not from the handle, and press firmly down on the fence to prevent the machine from dipping.



repetitively without error. Here I'll share the jig and my techniques for using it, along with some basic tips.

For furniture making, get the Domino XL

There are two different Domino models: the DF 500 (\$765) and the larger XL DF 700 (\$1,250). Each one has a spiral bit that plunges into a part to cut the mortise to depth. At the same time, the bit moves from side to side. The result looks very much like a mortise made with a router. But with a router, you must move the tool to create the mortise width and take multiple passes to reach the final depth. The Domino does both at once.

The two models have a similar fence that can be adjusted to change the slot's location on the part's thickness, and tilted to adjust the angle of cut. This allows you to cut a mortise square to a beveled edge or mitered end, for example.

The major distinction between the joiners is the sizes of mortise that they cut. The Domino DF 500 can cut mortises that are 4, 5, 6, 8, and 10mm wide, and 12, 15, 20, 25, and 28mm deep. The larger



Fix for misaligned joints. If the halves of a joint aren't aligned horizontally, adjust the sight gauge right or left, and check with a test joint.

Two tweaks that improve the fit



Cure for tight tenons. Just sand the small lip on the tenon's edge. Don't adjust the tenon's thickness.

More Dominos make stronger joints

There are two ways to handle a big joint: Use more than one slip tenon, or cut a wider mortise for a bigger tenon.

STACK THEM ON THICK WORKPIECES

Flip it. After cutting the first mortise, turn the workpiece over to cut the second. This method lets you cut both mortises without having to adjust the machine's fence.



Plunge again. This time the fence registers on the side opposite the one used to cut the first mortise.



GO SIDE TO SIDE FOR WIDE JOINTS



Spacing is key. Aprons and frame rails wider than 4 in. call for multiple tenons in a row. The distance between them should be at least equal to the thickness of the Domino slip tenon used in the joint.

Make a wide tenon

For parts (like table aprons) that are too wide for one tenon but still under 4 in. wide, overlap two or more mortises and use shopmade slip tenons.



Use stop pins to expand the mortise.

A series of retractable pins on both sides of the bit let you cut a wider mortise. After cutting the mortise in the first workpiece (below), cut one in the mating workpiece, but flip the stop-pin arrangement. Use the first pin on the right, and the second pin on the left.

STEP 1

Cut a centered mortise in the workpiece.



STEP 2

Widen one side.

Use the first stop pin on the left side of the bit, registered against the left end of the mortise.



STEP 3

Widen the opposite side.

Use the second stop pin on the right, registered against the right end of the mortise.



One jig handles any angle

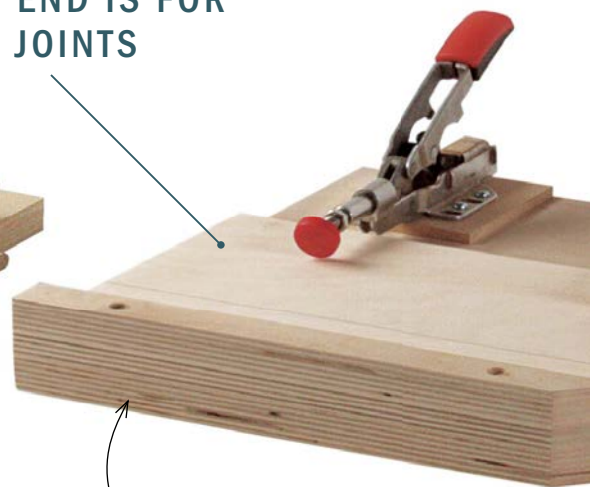
End-grain mortises require that the workpiece and tool be held fast so that they don't shift and ruin the cut. This jig stabilizes both and makes it very easy to cut mortises in the same location in a series of parts.

ONE END IS FOR 90° JOINTS



Guide base attaches to left end of clamping base for 90° joints.

Clamping base



Easy on, easy off. The guide base connects to the clamping base with three dry-fitted Domino slip tenons.

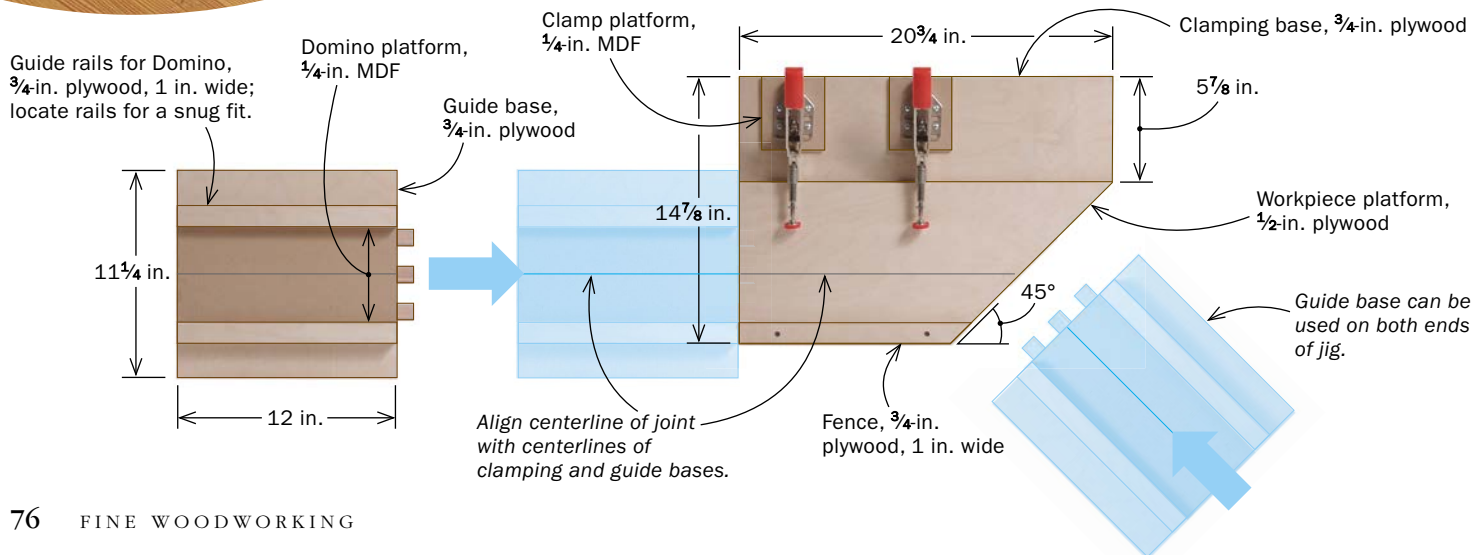


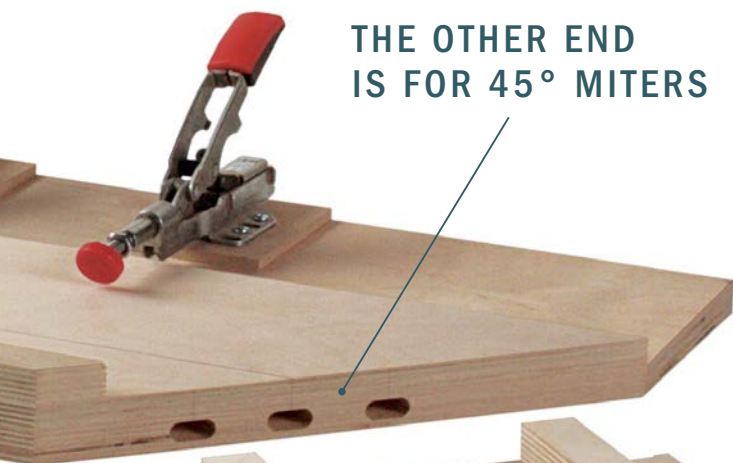
Clamp the workpiece. Add spacer blocks the same thickness as the workpiece, to align the joint's centerline with the jig's centerline.



DOMINO RESTS ON ITS FENCE

The clamping base raises workpieces high enough that the tool floats above the guide base—exactly what you want.





THE OTHER END
IS FOR 45° MITERS

Guide base works on both ends. Moving the guide base to the angled end orients the machine correctly for 45° miters (right). From there, the jig works just like it does for workpieces with square ends (opposite page).



Guide base can also attach to right end of clamping base for 45° joints.



Article Extra

Learn how to use the Domino with Imperial measurements.



Domino XL DF 700 cuts mortises that are 8, 10, 12, and 14mm wide, at any depth between 15 and 70mm (in 5mm increments). You can buy Domino slip tenons to fit all of these mortise sizes. And you have to change bits for tenons of different thicknesses.

The Domino DF 500 is great for smaller projects such as face frames, picture frames, and mirror frames. But its big brother, the Domino XL DF 700, is the right choice for most of the mortise-and-tenon joinery a furniture maker cuts on chairs, tables, doors, and cabinets (it can even be used on bigger projects, such as doors for your home). The one downside of the XL DF 700 is that it is not designed to work

with parts thinner than $\frac{7}{8}$ in. To accommodate those thin parts, you need to attach a riser block to the fence to bring the bit to the correct location. Regardless of which model you're using, you need to hook it up to a shop vacuum or dust collector. Dominos create a lot of chips quickly. If they aren't pulled out of the mortise, the tool won't cut cleanly. □

Tim Celeski is a furniture maker near Seattle.

Separate platform for in-between angles

Wedge and go. For angles between 90° and 45°, make a wider guide base and add a floating platform for the Domino. Use wedges to lock the platform in at the correct angle, making sure the centerlines align at the front end.



readers gallery

WILLIAM SWIGERT

Nashville, Tenn.

Swigert based this Philadelphia tea table (34½ in. dia. by 29 in. tall) on a Garvan carver table he saw at an auction years ago. The solid mahogany piece pays homage to the original with its pie-crust top, C-scroll and acanthus leaf carvings, and ball-and-claw feet, but Swigert added his own touch with the knee carvings. The table also has a tilting top with a brass catch. The finish is shellac. PHOTO: KEVIN MONTAG



DARRICK RASMUSSEN

Carbondale, Colo.

This low rocking chair (26 in. deep by 24 in. wide by 32 in. tall) was Rasmussen's final project at College of the Redwoods and was inspired by a mid-century chair in his parents' home that "always felt just right." The chair is eastern walnut with a leather seat and features double-bridle and mortise-and-tenon joints. The finish is Osmo Hard Oil. PHOTO: JOHN BIRCHARD



STEPHEN TUTTLE

Warriors Mark, Pa.

Tuttle's coffee table (21 in. wide by 48 in. long by 18 in. tall) has a veneered walnut top with holly stringing. The latticework pattern on the top is mirrored in the lower shelf via 12 bent laminations that provide a lightweight and durable storage surface. This 200-hour project was finished with a polyurethane/oil mix.



DESIGN IN WOOD 2014

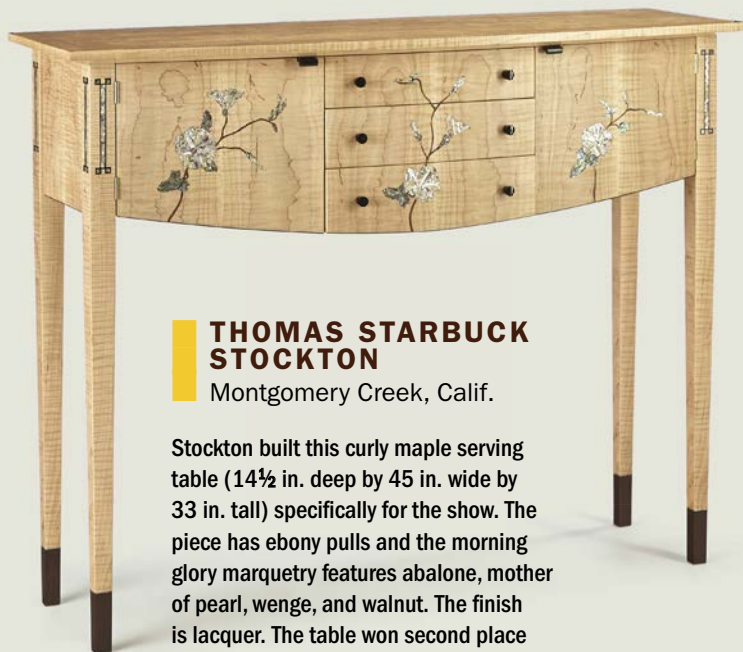
The San Diego Fine Woodworkers Association, in conjunction with the San Diego County Fair, presents its Design in Wood exhibition each year in Del Mar, Calif. More than 300 pieces were exhibited at this year's show, the 33rd. Judges presented more than 90 awards in 24 distinct categories, from period furniture to wood carving. Here are a handful of pieces that caught our eye.



LOUIS J. PLANTE

Ej Cajon, Calif.

Plante's Greene and Greene-inspired hall table (15 in. deep by 54 in. wide by 37 in. tall) earned the President's Award in the novice category. It is made of walnut, mahogany, and cherry, with lacewood drawer fronts and wenge and rosewood accents. The finish is lacquer.



THOMAS STARBUCK STOCKTON

Montgomery Creek, Calif.

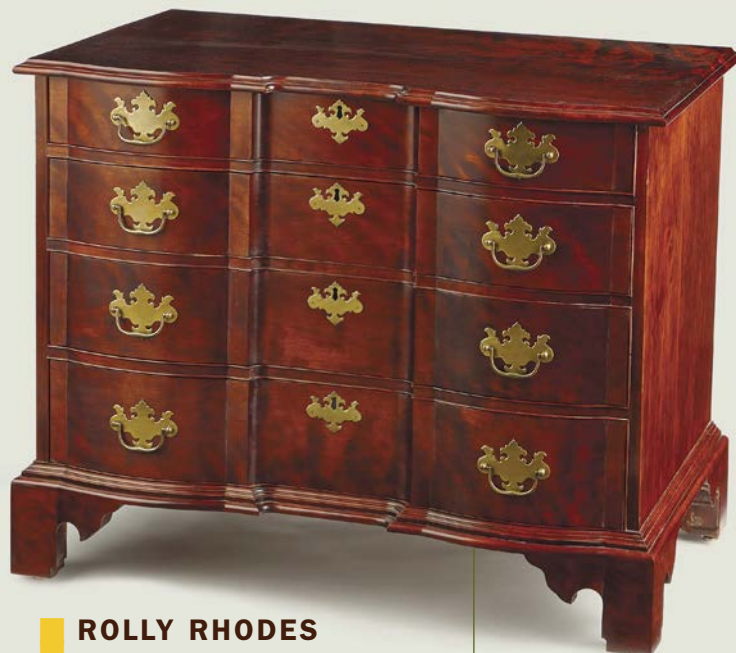
Stockton built this curly maple serving table (14½ in. deep by 45 in. wide by 33 in. tall) specifically for the show. The piece has ebony pulls and the morning glory marquetrie features abalone, mother of pearl, wenge, and walnut. The finish is lacquer. The table won second place for marquetrie/veneering in furniture and special awards for design and finishing.



REUBEN FOAT

San Diego, Calif.

Designed by computer and executed by CNC router, Foat's walnut-and-plywood chair (18 in. deep by 18 in. wide by 28 in. tall) was conceived while Foat was sitting on the bleachers at a rodeo. Later, he fleshed out the design and built the chair while teaching a CNC joinery class. The finish is wipe-on polyurethane.



ROLLY RHODES

Bakersfield, Calif.

Inspired by the work of 18th-century New England furniture makers such as John Townsend, Rhodes's block-front chest (22 in. deep by 38 in. wide by 30½ in. tall) received the Society of American Period Furniture Makers award at the show. The primary wood is cherry and the secondary wood is poplar. The finish is aniline dye and lacquer rubbed out with 0000 steel wool.

JAKE HOCKEL

Philadelphia, Pa.

Hockel's sideboard (13 in. deep by 44 in. wide by 36 in. tall) was the second piece he made while attending College of the Redwoods in Fort Bragg, Calif. When resawing the red oak used for the carcass, Hockel said he was amazed by the medullary rays in the wood, so he designed the sideboard to highlight the grain. He also used madrone, Mendocino cypress, and elm in the piece. The finish is shellac. PHOTO: DAVID WELTER



ANDREW COLLEY

Omaha, Neb.

The simple utility of traditional Japanese tansu cabinetry inspired this cabinet (16 in. deep by 50 in. wide by 24 in. tall). The piece was built with white oak and laminated cedar and finished in Danish oil. Colley left the drawer interiors unfinished to take advantage of the aromatic cedar.

PHOTO: JON HUSTEAD



GREG LAIRD

Albion, Calif.

Laird designed this ash dining set for use in an apartment or small home. To reduce the footprint, the chairs (15 in. deep by 16 in. wide by 28 in. tall) nest completely under the table (38 in. deep by 22 in. wide by 30 in. tall). The set was finished with water-based polyurethane and shellac.

PHOTO: DAVID WELTER





GEOFF BIRTLES

Toorak, Victoria,
Australia

This cabinet on stand (10¼ in. deep by 13 in. wide by 48 in. tall) was Birtles's first foray into curved joinery, with curves in the dovetailed carcass and in each drawer front. The carcass and legs are wenge, the drawer fronts are fiddleback maple, and the drawer boxes are Huon pine, native to Tasmania. Another challenge for Birtles was using the dark, hard wenge, which required extra care during markup and dulled his planes incredibly fast. He used a French polish on the case and drawer fronts, and finished the outside of the drawer boxes with shellac and wax. The interiors were left unfinished to retain the scent of the pine.



HAL METLITZKY

Claremont, Calif.

Metlitzky used more than 3,000 individual pieces of wood to make this turning (11½ in. dia. by 6½ in. tall), including yellowheart, chakte viga, satine, holly, hard maple, rosewood, kingwood, black walnut, and stained birch. Aptly named "Bird of Paradise," the piece has an air-brushed lacquer finish.



MARK BELLONBY

Mason Neck, Va.

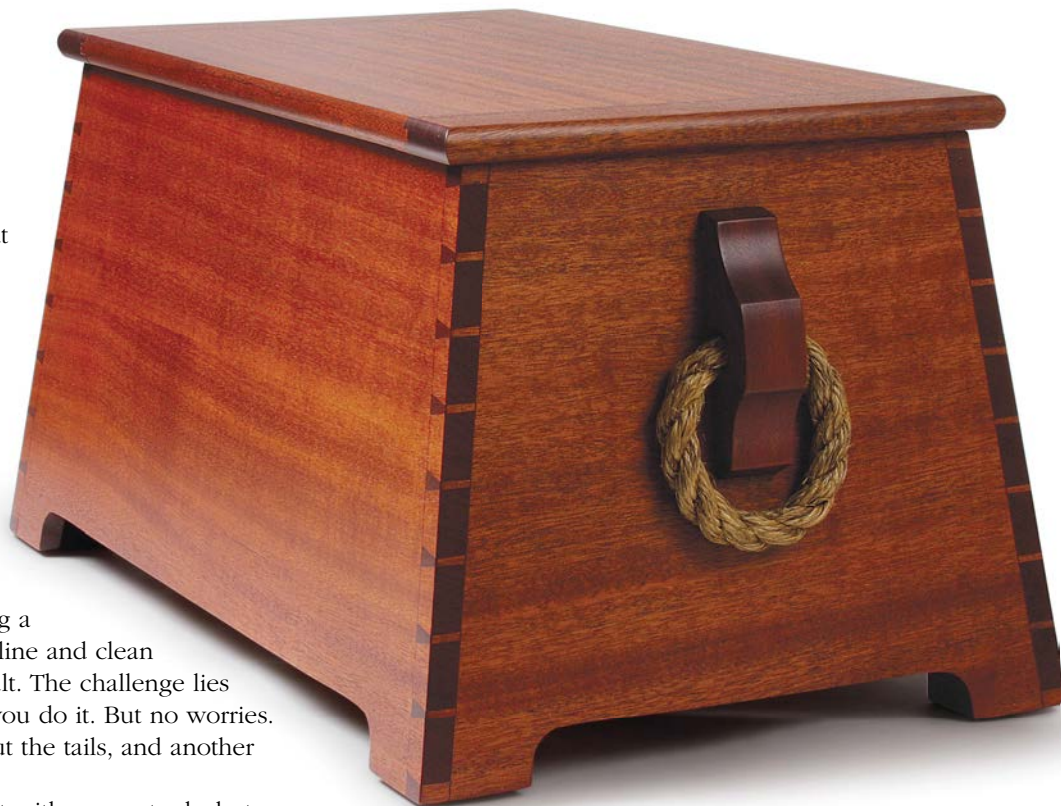
Bellonby built this dresser (18 in. deep by 36 in. wide by 53½ in. tall) as his daughter's wedding gift. The carcass is Baltic-birch plywood with walnut and ebony veneer and the marquetry panels are framed in holly, backed by Karelian birch, and have mother-of-pearl accents. Bellonby sprayed on eight coats of lacquer to complete the project.



One of the great things about woodworking is that becoming proficient in one technique opens the door to more advanced techniques. The dovetail joint is a great example. After you've mastered the basic version, you can attempt more complicated variations. I'll illustrate how to make compound-angle dovetails, like the ones that join the sloped sides of this chest.

Making a compound-angle dovetail joint is not much different from making a standard dovetail joint. You cut to the line and clean out the waste, which really isn't difficult. The challenge lies in the layout, especially the first time you do it. But no worries. I'll show you a great trick for laying out the tails, and another one for paring to the angled baseline.

I know you can make a dovetail joint with power tools, but in this instance, hand tools are the best option. Because of the



Compound-angle dovetails

SIMPLE JIGS EASE THE LEARNING CURVE OF THIS CHALLENGING JOINT

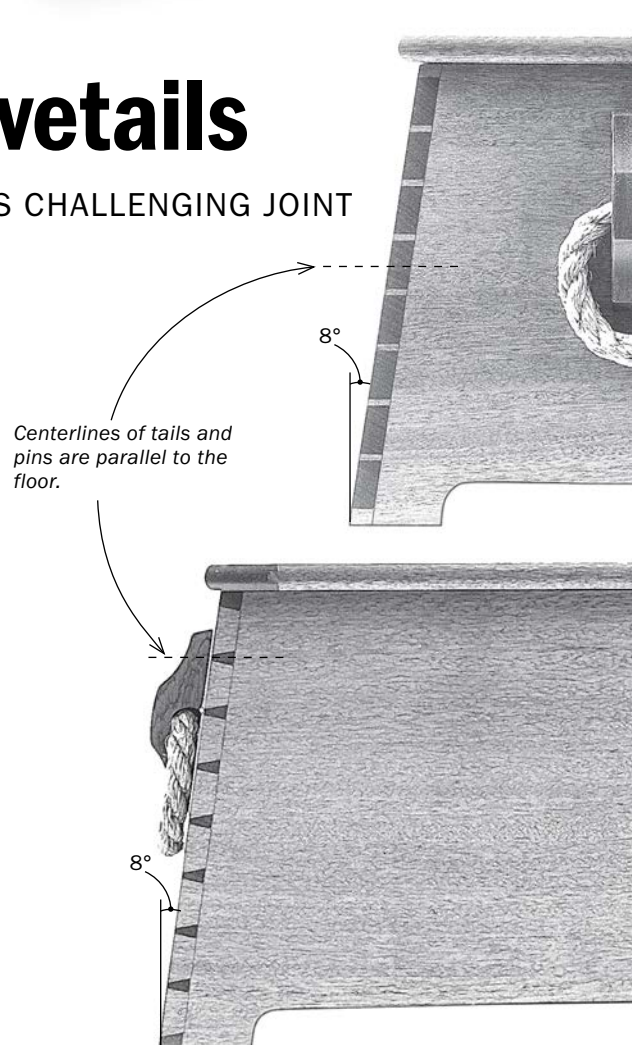
BY CHRIS GOCHNOUR

compound angles involved, setting up a machine or power tool for the work would be tedious and too time-consuming.

Start with a compound-angle butt joint

All dovetail joints begin as butt joints. On this chest, because the case sides slope inward 8° , the ends of all four sides are angled across their width and thickness. So when you cut the sides to length on the tablesaw, both the blade and miter gauge must be angled. Determining the correct angles can be difficult. Fortunately, there is an easy way to set up your saw to cut the ends, a technique I learned from Steve Brown ("Compound Angles Without Math," *FWW* #158). Simply cut the slope angle— 8° in this case—onto one edge and both ends of a block of wood about 2 in. thick by 3 in. wide by 10 in. long. Then set the blade and miter-gauge angles directly from the block.

Before making the compound-angle crosscuts, rip the case sides to final width with the blade set to the slope angle. Keep in mind that the top and bottom edges are parallel to one another. So, if you cut the top edge with the outside face up, cut the bottom edge with the outside face down.



Super trick for compound miters

A simple setup block with beveled edges makes it easy to set up the tablesaw to make the compound-angle cuts.



Bevel the top and bottom edges of each side. Angle the blade to match the slope angle. The top and bottom edges must be parallel to one another, so flip the board over to cut the opposite side.

Now you're ready for the crosscuts. Place the setup block's long angled edge on the sawtable. Raise the blade and put one of the angled ends against the blade's plate (see photos, right). Adjust the blade to the same angle as the setup block's end. You also will need to pivot the block forward and back until it's flat against the plate. Now set the angle of the miter-gauge fence. Hold the block with its end flush against the saw plate. Loosen the miter-gauge head and adjust it so that the fence is against the block. Lock the gauge's head at this angle.

Cut one end on each side with this setup. For the opposite ends, move the miter gauge to the other side of the blade and adjust the angle of the head. Save offcuts to use as clamping cauls.

Lay out and cut the tails

With all of the parts cut, lay out the tails. Begin by scribing baselines on all four sides. Then clamp one tail board in a bench vise with its outside face toward you. Lay out the tail spacing on the end grain, marking it with a small dot, rather than lines. Set a bevel gauge to 82° (to match the edges) and use it to draw a line across the end grain at each layout point.

The angled sides of the tails on the face of the board must be laid out relative to the side's top and bottom edges, not to the angled end. First, I make a 6-in.-square template from 1/4-in.-thick MDF. Two opposing edges of the template are angled to match the slope of the tails. I then clamp a fence to the side 3 in. from the end and perpendicular to the edges. Butt the template against this fence and finish laying out the tails.

MAKE A SETUP BLOCK



Bevel the block. With the blade still set to the slope angle, bevel each end of the block (left). Then bevel one edge (below left).



Article Extra

Learn how this setup block makes compound angles easier.

PUT IT TO USE



Reset the blade. Set the block's beveled edge on the table and adjust the blade flush to the block's end grain.



Angle the miter gauge. Bring it tight against the block's back edge.



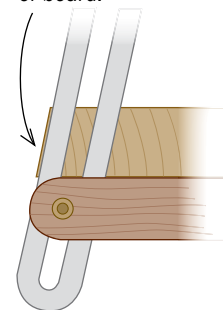
Cut the sides to length. Cut one end on each side. To cut the other sides, move to the other side of the blade. You have to reset the miter gauge and flip the side, so the opposite edge is against the gauge.

Two jigs tackle the tails

Lay out the tails' shaped sides with a shopmade dovetail marker. And use a guide to help pare the baseline parallel to the end grain, which is necessary for a gap-free joint.

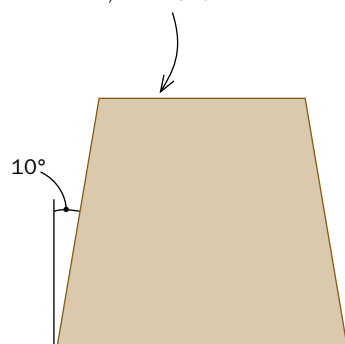
Lay out the tail spacing on the end grain. Use a bevel gauge set to the same angle as the top and bottom edges of the side.

Set bevel gauge parallel to edge of board.



DOVETAIL MARKER

MDF, 1/4 in. thick



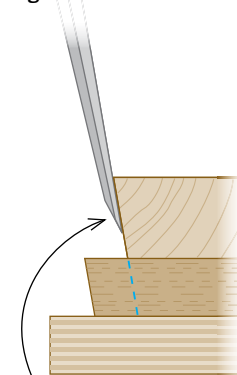
Use a jig for the sloped sides. After clamping a straightedge perpendicular to the top and bottom edges, butt a shopmade dovetail marker against the straightedge and mark one side of every tail (above left). Flip it for the second side (above right). This gives you the opposing angle needed to complete the layout.



Cut tails one board at a time. Because of the angles involved, you can't gang the tail boards. When you clean out the waste, be careful that you don't cut into the high side of the angled baselines.



Clean up the baseline. Use a chisel guide with a beveled edge (should be parallel to the end grain) to maintain the correct angle on the baseline.



Edge of chisel guide is beveled 8°.

Clamp the tail board in a vise, and cut along the waste side of the lines. Remove the waste with a coping saw. Remember that the baseline is angled slightly. So, when defining the tails and cutting out the waste, don't cut into the high side. Pare to the baseline (see photos, left).

Lay out and cut the pins

After you've cleaned up the tails, you can transfer them to the pin board. Put a spacer board on your benchtop, just behind and parallel to the vise jaws. Position the pin board in the bench vise with its angled end up and face

Pins are a snap

The pin board's end grain is slightly beveled, so getting the tail board to rest flat on it can be tricky. But once it's there, you can transfer the tails and cut the pins as you normally do.



Clamp the boards to transfer the tails. An offcut between the pin board and clamp creates a square surface for clamping (above). Arrange the clamp heads so that they sit on the tails and don't interfere with the transfer (right).



Mark the pins on the face, too. The lines are parallel to the top and bottom edges. To set the gauge angle, put the gauge's body on the side's face (top photo, opposite).



Use the chisel guide again. For the cabinet to come together square, the baseline must be parallel to the end grain, as it is on the tail board.



Side offcuts are perfect clamping cauls. Gochmour tapes strips of pine to the cauls, which are soft enough to deform when clamped over the protruding pins.

out, flush with the spacer. Now move the spacer board back 18 in. Rest the tail board, outside face up, on top of the pin board and spacer. Align the tail and pin boards, and clamp the tail board in place. Now, transfer the tails to the pin board with a marking knife. Remove the tail board and extend the knife marks down the board face with a sharp pencil. These lines should be parallel to the pin board's edges, so mark them with a bevel gauge set to 82°.

Cut and clean up the pins just as you did the tails. When that's done, begin the assembly with a dry-fit to verify the fit is right. Get clamps and angled cauls (use the angled cutoffs you saved) ready for the glue-up. Tape a piece of soft pine to the edge of each caul so that it can compress around slightly protruding pins. Use a slow-setting glue. Assemble the joint, clamp it, and check for square by measuring diagonally. □

Chris Gochmour is a professional furniture maker in Salt Lake City, Utah.

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how they did it

Tradition with a twist

BY JONATHAN BINZEN

FRAMEWORK FITTED TO CURVY CASE

The **carcase**, made of white oak, is joined with biscuited miters.

TOP VIEW

Top of case

Bottom of case

In John Lee's chest of drawers (see the back cover), every rule of joinery and wood movement is carefully observed—even as traditional notions of design are cast aside. Lee joined the case with miters and fitted a framework of drawer dividers into it with sliding dovetails. The drawers have hand-dovetailed boxes and applied solid white-oak fronts that are individually shaped to fit the contours of the case. To see more of Lee's rule-bending work, go to johnleefurniture.com.

The **vertical dividers**, dovetailed into the case, are cut on an angle to match the offset curves of the top and bottom of the case.

The snaking **horizontal dividers** are notched into the vertical dividers and dovetailed into the case sides.

FALSE DRAWERS HELP WITH SHAPING

Faux MDF drawers support the drawer fronts for marking and texturing.

TOP VIEW

Solid-oak drawer front

Faux drawer

Solid-oak blanks are set in place against the faux drawers and the case contours are marked around their edges.

Drawer fronts are removed and **rough-shaped** to the perimeter lines with an Arbortech grinding tool.

After rough shaping, drawer fronts go back in the case for texturing and sandblasting (see p. 90).

how they did it continued

BIG JIG FOR TEXTURING

Sliding trammel jig guides the router. Texturing is done using a core-box bit. The case is supported by wooden boxes on the floor.

The **horizontal beam** slides back and forth and also travels up and down to follow the curved sides of the jig, which are cut to match the case curves.

For texturing and sandblasting, the **drawer fronts** are shimmed tightly in place and spot-glued to the faux drawers.

CURVED AND TAPERED COVES ON TOP

Because the carcass is wider at one end, the coves must taper, too. Each **cove is cut in two passes**, using a core-box bit. The pattern is rotated slightly for the second cut.

MDF pattern guides the router.

FITTING DRAWERS INTO A RADICAL CASE

The **coves** in the case sides are not tapered.

Commercial undermount **drawer slides with push-latch feature** eliminate the need for pulls.

Solid-oak faces are screwed to drawer box.

Hand-dovetailed drawer boxes are angled in front to match curve of case.

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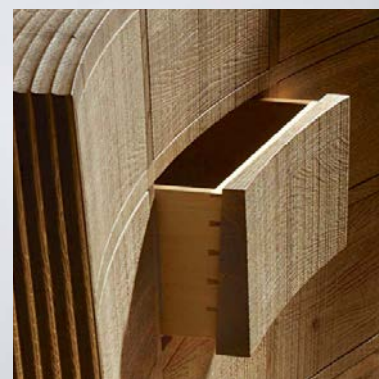
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Twisted and Textured



Even before he learned to walk, John Lee was a constant presence in his father's woodshop, where he would stand for hours in a playpen and watch his father work. By age 3 or 4, he had projects of his own under way. Four decades on, working full time in a shop he built behind his father's house in County Meath, Ireland, Lee uses traditional techniques to create extremely innovative furniture. His chest of drawers in solid European white oak not only curves but also twists and tapers, requiring that each of its 20 hand-dovetailed limewood drawer boxes be joined at a different angle and fitted with a uniquely shaped



applied front. Inspired by driftwood and erosion, Lee textured the chest with routed coves that taper as they wind across the top, and with rough, routed striations on the face of the cabinet that are etched right across the dividers as well as the drawer fronts. To increase the appearance of natural weathering, he sandblasted the exterior of the piece. Still boyish in his enthusiasm for woodworking, Lee now walks his own path through the craft.

—Jonathan Binzen

Photos: Roland Paschhoff

How They Did It Turn to p. 89 to see how Lee crafted the curved framework of this cabinet and used a big jig to add the texture.



Slide Show See more of John Lee's extraordinary furniture in an exclusive audio slide show.