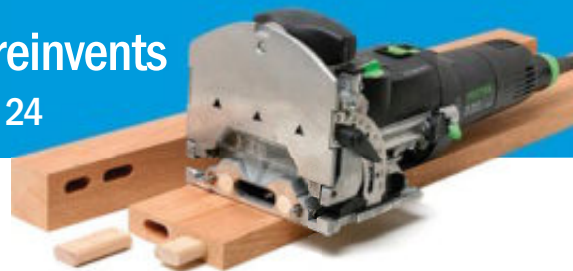


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New tool reinvents
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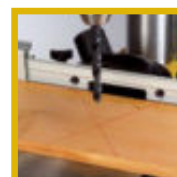


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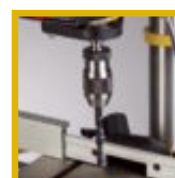
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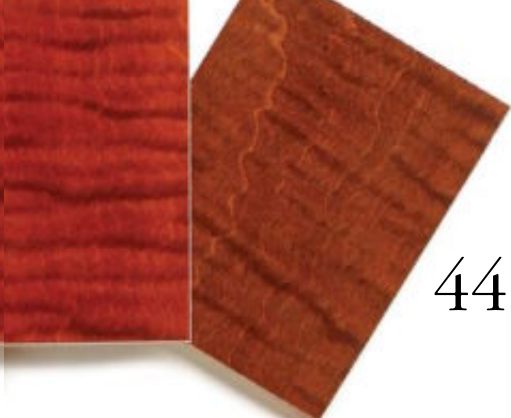
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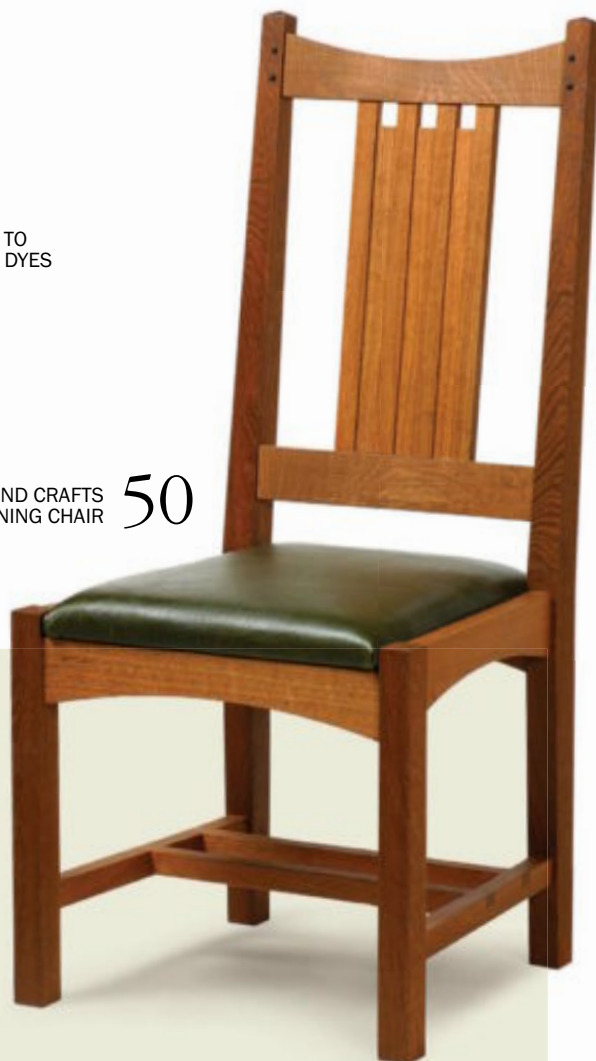


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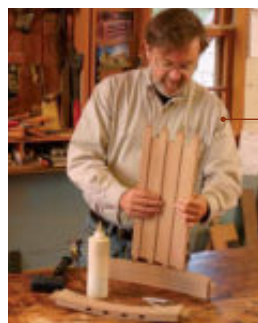


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VIDEOS

Making an Arts and Crafts Chair

Watch Kevin Rodel ("Arts and Crafts Side Chair") construct and assemble the curved back splat on his chair.

Easy Dovetail Layout

Gary Rogowski demonstrates an alternative method for laying out dovetails (Fundamentals) with a ruler and simple math.



AUDIO SLIDE SHOW

Pro Portfolio: Second Life as a Woodworker

Architect-turned-furniture maker Miguel Gomez-Ibanez (back cover) talks about changing careers and the period furniture that inspires him.



Thomas Starbuck Stockton
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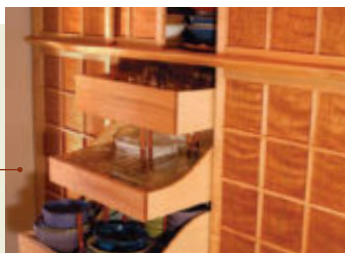
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Talking Shop with Brian Boggs

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contributors

Kevin Rodel (*"Arts and Crafts Side Chair"*) has been building custom furniture at his shop in midcoast Maine since 1986. Specializing in the Arts and Crafts style, he is co-author with Jonathan Binzen of *Arts & Crafts Furniture: From Classic to Contemporary* (The Taunton Press, 2003). He is also a part-time furniture instructor at the Center for Furniture Craftsmanship in Rockport, Maine, and at Colby College in Waterville, Maine.



Toby Winteringham (*"Precision Jig for Precise Joints"*) has been a professional woodworker for more than 25 years and works near King's Lynn in Norfolk, eastern England. Several of his pieces have won awards for design and craftsmanship. His other interests include photography, motorcycling, and playing the tenor sax. You can view his work at www.tobywinteringham.co.uk.

Richard Oedel (*Master Class*) has been working wood since he was a teenager, and for the past seven years as a professional. He is a graduate of the North Bennet Street School and has interned with Jere Osgood and John LaGattuta. He moved his shop this past year from Salem, Mass., to Boston, where he shares a new 5,000-sq.-ft. space with the Fort Point Cabinetmakers, all graduates and faculty of the North Bennet Street program. Federal furniture is one of his specialties.



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



Contributing editor **Gary Rogowski** (*"Router-Table Basics"*) runs The Northwest Woodworking Studio in Portland, Ore. He recently moved the school into a 100-year-old warehouse in the middle of Portland's Central Eastside Industrial District. The move wasn't easy—several tons of machinery had to be relocated, and the formerly neglected space needed a complete remodel. His students and his beagle, Jimmy, approve of the move.

Teri Masaschi (*"Dyes Can Do It All"*) is one of the most sought-after speakers on wood finishing. She spent 16 weeks on the road last year giving classes at woodworking schools and clubs, and has promised herself that she'll spend more time at home this year. This may be difficult: Her book, *Foolproof Wood Finishing* (Fox Chapel Publishing, 2006,) seems certain to put her even more in demand.



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Spotlight

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December 2006
p. 46



WATERBORNE LACQUER: BRUSH OR SPRAY?

In "Waterborne Finishes Come of Age," Chris Minick's best-value pick, Hydrocote Resisthane Plus (pre-catalyzed lacquer), looked like the solution to my brush application problems, because it was rated excellent in that category.

I went to the Web site of my closest retailer, Highland Hardware, and was ready to order when, for no particular reason, I decided to read the detailed product information. At the end, in fat letters, was a warning not to apply this product with a brush because of fast drying time. I called the manufacturer, who confirmed that the product was neither designed nor recommended for brush application.

—NEIL GORDAN, Charlotte, N.C.

Chris Minick replies: Not to worry. These waterborne finishes don't dry any faster than shellac. Dry time is dependent on wet coating thickness. If you brush on any finish (waterborne or otherwise) too thin, it will dry too fast to flow out properly. However, if you apply a 4- or 5-mil wet coat (standard brushing thickness), these waterbornes will flow out like any finish. As with shellac or brushing lacquer, you can't dally or overwork the wet finish. Put it on quickly and let it flow out by itself. Just because a waterborne finish was designed for spray application does not mean it cannot be applied with a brush. I haul lumber in my '89 Honda Prelude, though it wasn't designed for it.

Steel City bandsaw review

I would like to clarify a few points regarding our 18-in. bandsaw (reviewed in Tools & Materials, *FWW* #189). Roland Johnson stated that the upper blade guide mounting bracket was not at 90° to the blade, creating a twist in the blade between the upper and lower guides.

When we designed this saw, we added many new adjustment features to combat the common bandsaw problems that we observed in the marketplace. Misalignment in the blade guide is one of those problems. But we forgot to really clarify these adjustments in the manual.

This has caused some confusion for end users. We have revised the manual (the new version was to be posted on Steel City's Web site by mid-January).

Johnson also stated the saw table had a .012-in. crown in the middle. This is not a defect and the remedy is simple: Loosen the bolts holding the aluminum quadrants to the table, tighten the lock knobs, and then retighten the quadrants.

The .024-in. disparity at the blade slot when the alignment pin was removed is to be expected and is not indicative of poor quality control. The table will move when the alignment pin is removed,

but once the pin is reinserted, the table surfaces will again line up perfectly.

Johnson also noted that the thumb-screws securing the guides are too small. On this we agree and have since upgraded them to a larger size.

Although we try to set up the saws as accurately as possible at the factory, some fine-tuning generally is required after assembly. We regret that our manual did not adequately outline the procedures required to perfectly tune the saw.

—JIM BOX, technical supervisor,
Steel City Tool Works

Roland Johnson replies: I stand by my review, with the exception of the misalignment of the upper guide post. Under deadline pressure, and using the manual I had on hand, I missed the fact that there are setscrews where the rack-and-pinion system attaches to the bandsaw frame. Adjusting these will indeed correct the misalignment.

I rechecked the bandsaw table. Loosening and reattaching the trunnions



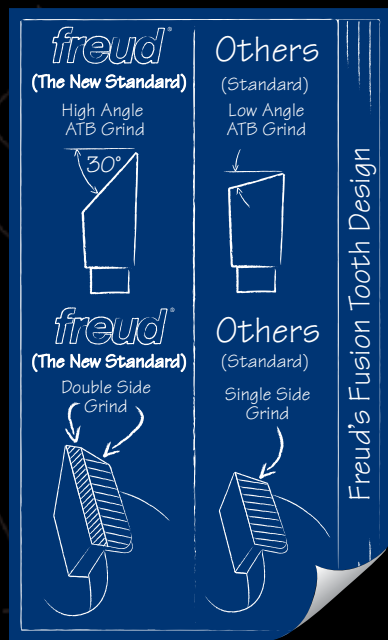
Remedy for guide-post misalignment. Setscrews on the mounting bracket allow you to adjust the alignment of the Steel City bandsaw's upper guide post.

does not remove the crown from the cast-iron top. It does, however, affect the disparity at the blade slot, actually making it worse when the trunnions are locked down. The crown and the misalignment suggest that there were stresses in the cast iron when the top surface was machined and the slot milled. Also, the table is too thin and would benefit from reinforcement ribs in its underside. The

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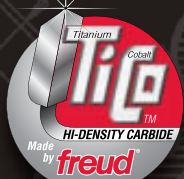
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alignment pin's purpose should be to keep the table level at the blade slot when a heavy workpiece rides over the top, not to overcome misalignment. The two bandsaws that I have in my shop show no movement between the table sides when the alignment pin is removed.

It's the user, not the tools

In "Set Up Shop for \$5,000" (*FWW* #188), Asa Christiana has done a nice job of explaining that carefully chosen tools can last a lifetime, and that one doesn't need every bell and whistle in order to make fine furniture. However, I am afraid that a \$5,000 shop with top-rated tools is beyond the grasp of most young woodworkers. This article may serve as a deterrent to those who must acquire tools based on current needs and a limited budget.

Many years ago, my first purchases were a few hand tools and a handheld jigsaw. I made each additional purchase to complete a specific project, and most purchases coincided with the annual February tool sale at Sears. Most tools were of modest to introductory quality, and I use nearly all of them today. My shop is quite complete (for my methods of work) and with it I have completed a large number of elaborate projects including beds, dressers, tables, cabinets, chests, and bowls, as well as myriad home improvement projects.

—JERRY WRIGHT, Camillus, N.Y.

Chuck converts routers for table use

As Roland Johnson pointed out in "Tool Test: Routers for Router Tables" (*FWW* #189), only a few routers allow bit changes from above the tabletop. Our product, the Eliminator RC Quick-Change Chuck, makes it possible for other popular routers, too. One hand on the bit, the other hand on an Allen wrench. That's it.

—JOE MARMO, J.P. Walsh and J.L. Marmo Enterprises, Springfield, Va.

Timber frame on a tight budget

Eric Foertsch's timber-frame shop (Shop Design, *FWW* #188) is a real beauty and will inspire him as he works. I am a great fan of reusing barns, a fast-disappearing type of structure in the American landscape (click on "Barn Again" at www.

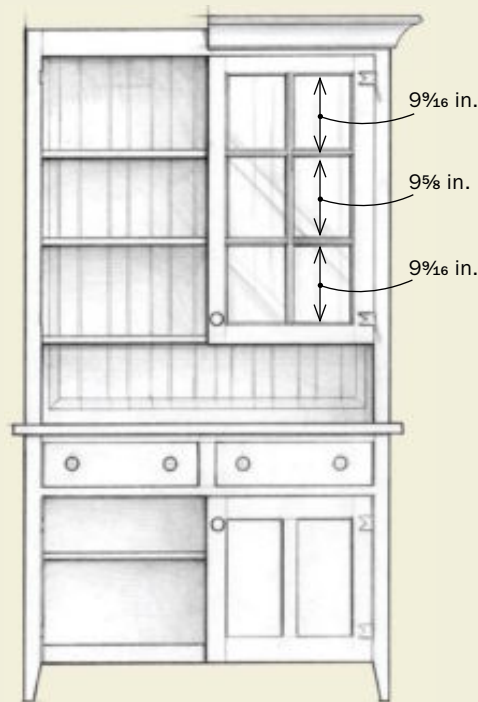
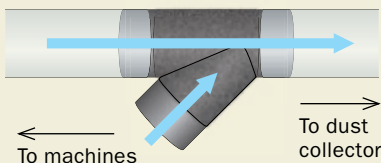
CORRECTIONS

Country hutch

In the country hutch project in *FWW* #189, the dimensions given for the spacing of the two horizontal muntins were incorrect. The correct spacing from the top and bottom of the door frame is $9\frac{9}{16}$ in. The distance between the muntins is $9\frac{5}{8}$ in.

Dust collection

Drawings depicting optimal layouts for ducting in "Dust Collection Demystified" (*FWW* #188) showed a few of the Y-connectors facing the wrong way. They should always face this way with regard to the direction of airflow:



agriculture.com for news about this area). But I find it hard to believe that he could have a historic building erected and clad with modern, energy-efficient materials, and a hardwood floor, for \$35,000.

—RICK INTRES, Ashfield, Mass.

Eric Foertsch replies: By working alone and devoting all of my spare time to the project over the course of a year, I accomplished a lot for very little. I was the general contractor, framing crew, electrician, heating and cooling contractor, roofer, siding contractor, flooring and drywall finisher, and painter. The barn frame and the timber-framer's labor cost me roughly \$23,000. All the other materials cost about \$11,000. The flooring, for

example, cost me 35 cents per sq. ft., but I had to rip every piece and mill it into tongue-and-groove flooring.

The mock-up that wouldn't leave

My wife has a warning for woodworkers' spouses about the article "Fine-Tune Designs Before You Build," by Gary Rogowski (*FWW* #189). I built a sturdy corrugated cardboard mock-up of a desk for my wife's office. After a year and a half, she is wondering if I will ever build the real thing.

—GARY DEAN, Prince George, B.C., Canada

Clarification

In "Dust Collection Demystified" (*FWW* #188), we tested a number of specific dust collectors to estimate what can be expected from products of their sizes and types. Since the emphasis was on the categories and not the specific brands, we neglected to cite the specific models tested:

Single stage: 1.5 hp, General 10-105; 2 hp, Jet DC1200A; 3 hp, Woodtek 961-339

Cyclone: 2 hp, Oneida Super Dust Gorilla; 3.5 hp, Penn State Industries Tempest

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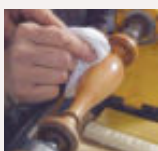
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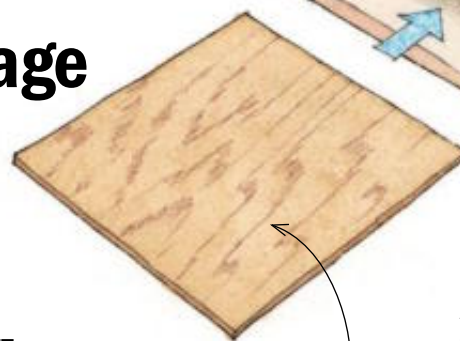
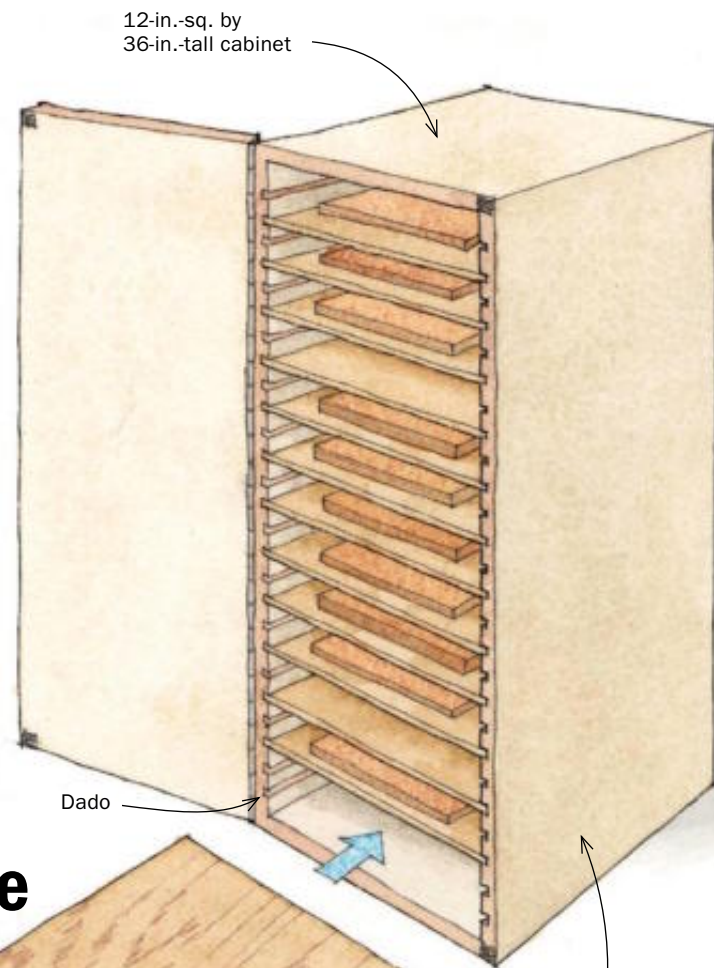
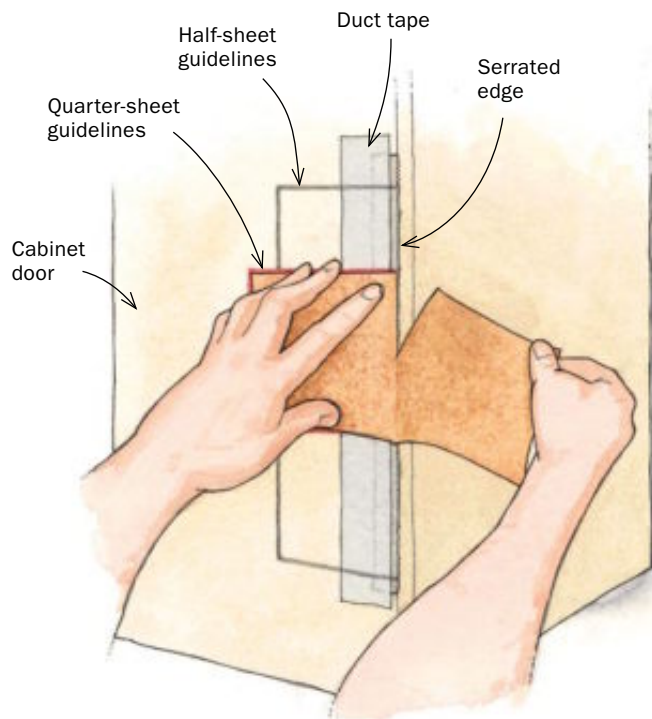
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1/4-in.-thick plywood shelf slides in dado.

Best Tip Sandpaper-storage cabinet with built-in cutter



A woodworker for more than 25 years, much of that time spent running a full-time professional shop, Bill Duckworth is a former associate editor for *Fine Woodworking*. This cabinet is mounted on a wall where it's within easy reach of his workbench.

I HAVE A 12-IN.-SQ. BY 36-IN.-TALL CABINET with about a dozen adjustable 1/4-in. plywood shelves. The shelves ride in dados and pull out for access to the contents, making them the perfect place to store sheets of sandpaper. The sheets stay flatter and aren't as likely to curl on humid days.

To make the cabinet even more useful, I saved the serrated edge from a roll of plastic wrap and used duct tape to apply it to the outside edge of the cabinet door. The serrated edge makes it easy to tear full sheets of sandpaper into halves or quarters.

Also, I used two permanent markers (one black, one red) to draw lines on the front of the door. Using the lines as a guide, I can quickly position the sandpaper and tear it to the right size.

—BILL DUCKWORTH, Woodbury, Conn.

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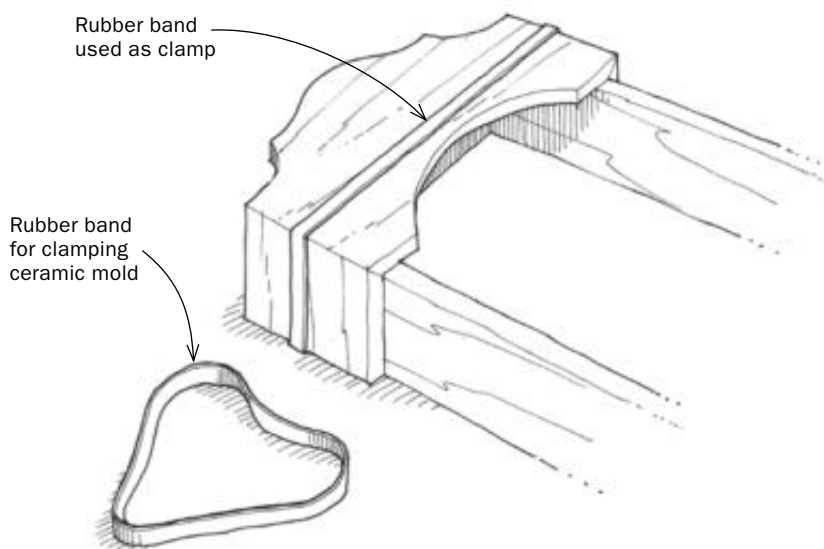
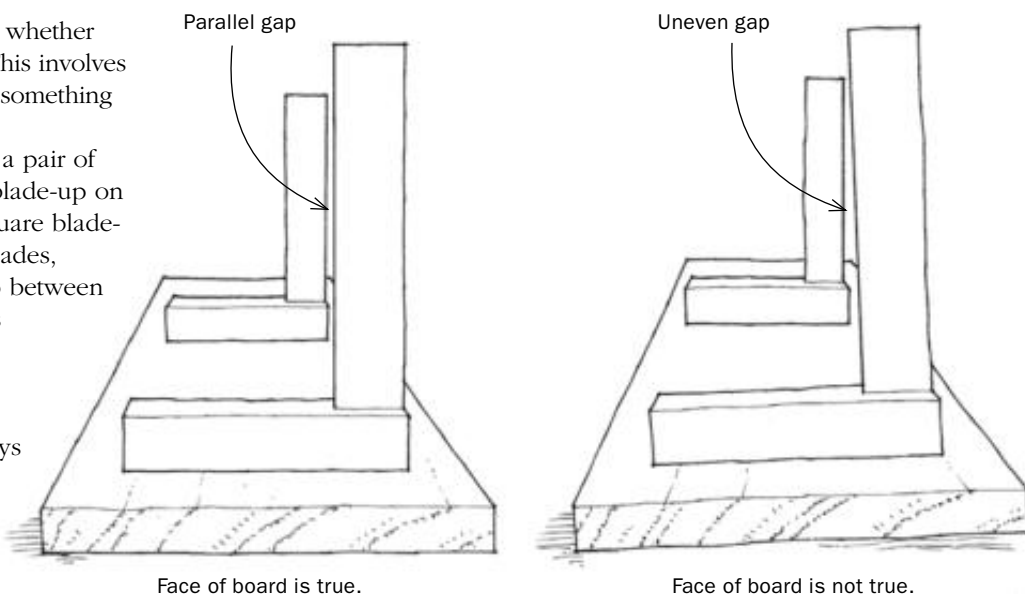
Use engineer's squares as winding sticks

Winding sticks are commonly used to check whether the face of a board is true along its length. This involves visually judging the alignment of two sticks, something that some woodworkers find difficult.

A simple and reliable alternative is to use a pair of engineer's steel squares. Place one square blade-up on one end of the workpiece and the other square blade-up on the other end. Sight along the two blades, moving your head until there is a small gap between the blades. If the gap between the blades is parallel, the face is true.

It is best to use engineer's steel squares, as they are certified true inside and out. Traditional carpenter's squares are not always true on the inside. A pair of 4-in. squares is ideal for most purposes, though larger sizes may be better for very long boards.

—BOB HULLEY, Sonning, Berkshire, England



Clamping with ceramic-shop rubber bands

In my high-school woodworking shop, we've discovered some great uses for the large rubber bands sold by ceramic-supply stores and typically used to hold ceramic molds together. They work great for clamping boxes, segmented bowls, and other small but awkward assemblies, such as the clock pediment shown in the drawing (left). We use heavy-duty ($\frac{3}{32}$ -in.-thick by $\frac{5}{8}$ -in.-wide) bands available in a variety of lengths from 3 in. to 9 in. They can be ordered from Aardvark Clay Supplies (www.aardvarkclay.com); bags of assorted sizes sell for \$4.50 per pound.

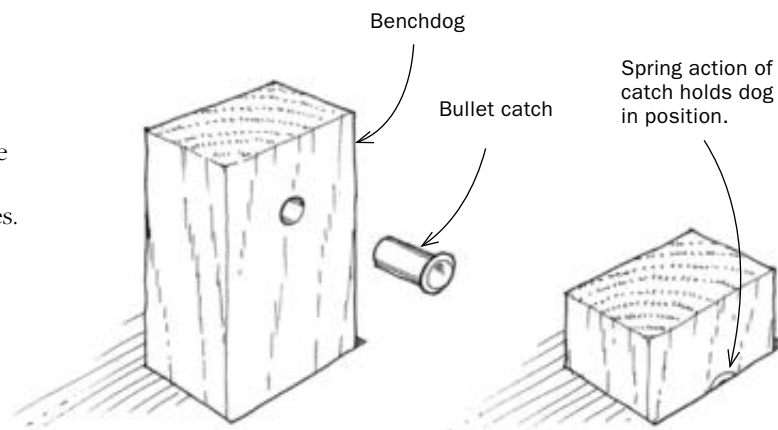
—BOB HAZARD, Granada Hills, Calif.

Improve a benchdog with a bullet catch

A benchdog that's too skinny will fall into the dog hole. One that's too fat is hard to adjust. I solved the problem with a bullet catch, an inexpensive item available at hardware stores.

When using a bullet catch, you'll want the benchdog slightly undersize in thickness, so it slides easily in the hole. Then, drill a hole in the side of the dog and install the catch. The spring inside the catch holds the dog in position at any elevation. Use a pair of catches for especially long dogs.

—ROBERTO BIANCO, Napoli, Italy



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Belt-sander blade grinder

This jig is great for reestablishing the bevel on a chisel or plane blade. It can be used with almost any stationary belt sander. The tool heats up less than on a grinder, so you're unlikely to burn an edge. Also,

the 4-in.-wide belt grinds the entire blade evenly, unlike other setups where you must move the blade back and forth.

The fixture costs about \$10, mostly for the tool rest (a chromed steel drawer pull from a hardware store). To make the jig, bolt two 1-in.-thick blocks onto the steel frame of the sander flush with the top of the sander bed. Drill holes in the blocks to receive the legs of the tool rest (drawer pull). To make sure each leg hole is the same depth, use a drill press with the same depth setting for both sides. The height of the tool rest over the belt should be around $\frac{3}{4}$ in.

To make the blade holder, cut a 3-in.-long section of steel angle and drill and tap for bolts. Make a steel top plate the same length to lock down the blade

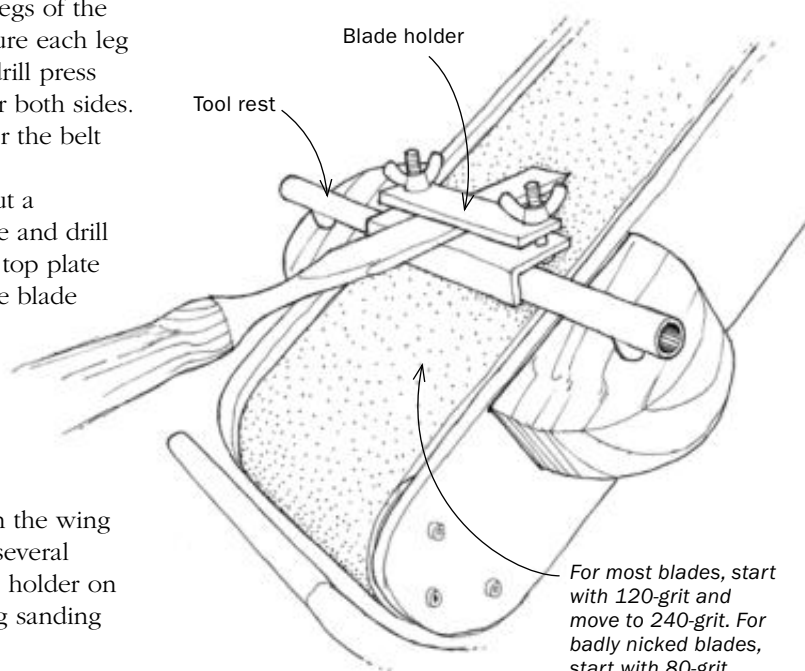
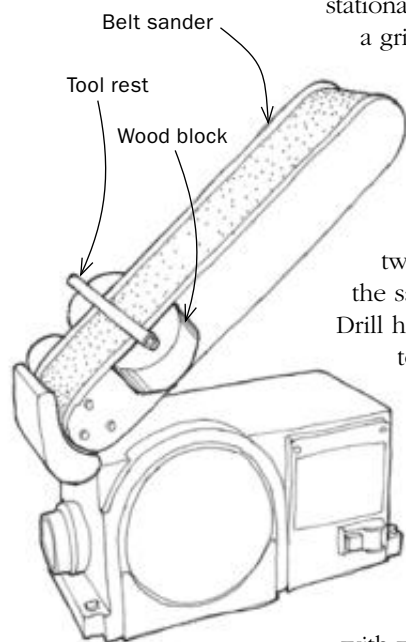
with wing nuts. Position the wing-nut bolts toward the front edge so that they don't interfere with the tool rest.

To use the jig, insert the blade in the holder and, with the blade square to the holder and projecting the right distance to give the correct bevel, tighten the wing nuts. To assist in setup, I made and use several blade-adjustment blocks. Place the blade holder on the tool rest and pivot it onto the moving sanding

belt. Be sure to use light pressure. The sanding belt should be moving toward the blade. The blade will heat up gradually. When it feels warm, quench the end of the blade in water. I move the blade sideways along the tool rest to wear the abrasive belt evenly.

I've found it best to tilt and fix the bed of the belt sander at about 45°. This will direct the sparks downward and away from you. One final tip: Be sure to clean out any sawdust before grinding metal to prevent the sparks from igniting the sawdust.

—DEREK COHEN, Perth, Australia



For most blades, start with 120-grit and move to 240-grit. For badly nicked blades, start with 80-grit.

Brazed thumbscrew offers extra strength

My jigs often have adjustable parts. To lock them in place, I use a thumbscrew made from a stove bolt (also called a round-head machine screw) and a flat washer. The thumbscrew is so sturdy that you can place a rod or screwdriver through the washer for leverage.

File the sides of the washer to fit in the bolt slot. Also, file a flat on the circumference of the washer where it fits into the slot. Then, with the washer in the slot, use a propane torch and silver braze rod (also called silver solder) to join the parts permanently.

To protect the bolt threads while brazing, thread a nut onto the bolt and tighten it up to the head. Then, with the nut as a holding point, clamp the bolt in a machinist's vise. After applying flux and brazing the parts, remove the nut from the bolt. This cleans any residual flux and oxide away from the bolt threads.

Clean the joint with a rotating steel brush. If you want it to look especially good, add one more step and polish it to a high shine.

—JOHN GONSER, Grand Rapids, Mich.

1. File washer.



Flat washer

2. Grind flat.

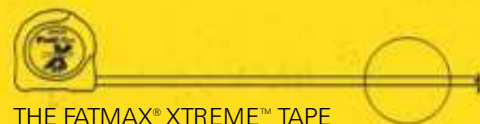


Stove bolt

3. Braze.



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■ INNOVATIONS

Festool joiner makes mortise-and-tenon joints as easy as biscuits

True innovations in portable power tools are rare. The random-orbit sander, the biscuit joiner, cordless technology—the big leaps forward are few and far between. Festool, a German company, stands out in recent years for reinventing a number of old faithful tools. Readers will recall the plunge-style circular saw with the ingenious guide track, as well as a high-end cordless drill that accepts three different heads.

Festool's latest innovation—the Domino Joiner—may be the company's most significant. Available in April, this tool looks and operates like a biscuit joiner, but the Domino uses a spinning *and* oscillating (wobbling side to side) bit to cut a full mortise in a single plunge. The system employs different-size beech slip tenons. Though the largest tenons are only $\frac{3}{8}$ in. thick by $\frac{7}{8}$ in. wide by 2 in. long, the uniformly machined mortises and perfect-fitting tenons added up to very strong joints—strong enough for cabinet doors, drawers, face frames, many chairs, and all tables just shy of dining size.

But the real sizzle here is speed. I assembled an entire table, with two slip tenons at each joint (32 mortises in all), in about half an hour, with perfect alignment of parts. I can't think of a way to do this faster with the same strength and results—not even close.

The downside for some woodworkers will be the price, estimated at \$700 for the basic kit with one 5mm-dia. cutter, and another \$200 for a starter kit that includes all four of the carbide-tipped cutters (5mm through 10mm) and more than 1,000 beech tenons in various sizes.

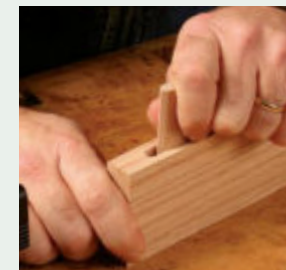
Adjustments are a joy on this tool. Settings for depth and width of cut (oscillation) are precise and easy. As with a biscuit joiner, you reference off a movable



FEATURES



Simple, precise setup. A movable fence (left) has detents at common angles and a series of vertical stops. Alignment pins on the front of the tool (right) locate mortises a set distance from the end or edge of a workpiece.



Missed opportunity? Domino can be dialed in to cut three mortise widths, but there's only one tenon width available. Wider tenons would allow for beefier construction applications.





front fence to get different slot locations and angles. The Festool's movable fence is nicely designed, but we had two problems with it. One of its pivot pins dropped out, and had to be reinserted and tightened. Worse, though, part of the clamping mechanism broke. With lots of people using the tool, we can't say for sure that it wasn't user error, but a close examination of the break reveals a thin cast section that must withstand considerable pressure if someone overtightens the fence. Festool replaced the front half of the machine, and there have been no problems since. Bottom line: Don't overtighten the clamp handles on the fence; they don't require much pressure.

I have only two other quibbles with the tool. While it oscillates to three mortise widths—up to 1¼ in. wide—tenons come only in the narrowest width. The extra room eases assembly when the mortises are used in rows, but Festool is missing an opportunity to provide more substantial tenons. Also, alignment pins in the front that reference off the corner of a workpiece to make layout unnecessary are too far from the edge of the mortise for my liking, leaving room for twist at the corner of a frame, for example.

Chairmakers will like the accessory that supports narrow parts to allow end-grain mortises at various angles.

Dust collection is critical with this tool; the airflow keeps the motor cool and clears the chips so that the cutter doesn't bind in a deep slot. Also, clamp the workpiece, hold the unit down firmly, and let the tool cut. You'll need to plunge slowly into the hardest woods.

Overall, the Domino is an impressive tool that could change your woodworking. For more information, visit www.festoolusa.com.

—Asa Christiana is the editor.

HOW TO USE THE DOMINO



1 **Mark the center of the mortise.** As with a biscuit joiner, these marks will guide the tool.



2 **Set the depth of the cut.** It should be a bit deeper than half the tenon length to allow for glue.



3 **Hold steady and plunge slowly.** Align the center mark on the fence with the mark on the workpiece.



4 **Insert the tenons and assemble the joint.** You'll get a perfect fit in minutes.

■ ACCESSORIES

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The Orbital Station is hardly high-tech, but it worked with a few different models of random-orbit sanders. Each one slipped into the holder quickly and easily—even



Adjustable yoke holds most random-orbit sanders. The upper portion of the sander slips into the yoke while the bottom end of the sander rests against a pair of rubber bumpers.

while it was on—and it was just as easy to remove. The station also can hold a sander that's attached to a vacuum hose. The stainless-steel yoke can be manipulated to accommodate several models of palm sanders and even laminate trimmers.

The Orbital Station sells for \$36 (plus shipping). For more information, call 413-625-6063 or go to www.orbitaltoolstation.com.

—Tom Begnal is an associate editor.

FineWoodworking.com

Watch a video demonstration of the Domino Joiner and inspect its components up close.

■ HAND TOOLS

Woodjoy shave leaves a flawless finish on end grain



While general-use shaves excel at cutting face grain, low-angle shaves excel at working end grain. The new #85 spokeshave from Woodjoy falls into the latter group.

The Brazilian-cherry body is 12 in. long and has a 5/32-in.-thick, 2½-in.-long, A2 steel blade and a brass sole. The blade is hollow-ground on the bottom, making it easy to flatten and sharpen. When razor-sharp, the low-angle blade will leave a slick finish on the end grain of even the softest woods, including white pine.

Cutting depth is adjusted by moving the sole; the mouth opening by moving the blade. The sole and the blade have countersunk slots for the screws that secure them to the body. I found that because of this, both move slightly off their settings when the screws are tightened, making adjustments tricky. The #85 costs \$95 and is available from www.woodjoytools.com.

—Curtis Buchanan is a chairmaker in Tennessee.



Easy sailing on end grain. The Woodjoy low-angle shave leaves a smooth surface in its wake.

■ ACCESSORIES

Turn on tool and vacuum simultaneously

The i-socket switch is an adapter that turns on a shop vacuum or dust collector automatically when a tool is fired up. Simply plug the i-socket into a 15-amp/125v outlet, then plug the tool and vacuum into their designated slots, making sure the vacuum switch is in the on position. When you turn on the tool, the vacuum will run; turn off the tool, and the vacuum shuts down after a 7-second delay to clear out the hose. The i-socket sells for \$34 and is available from www.woodcraft.com.

—Tom McKenna is an associate editor.



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ESSENTIALLY A MOBILE BASE, General's Hoverpad floats a machine on a ⅛-in. to ½-in. cushion of air. It comes in two sizes—18 in. by 24 in. (model 10-824, \$165) and 29 in. by 29 in. (model 10-929, \$265)—with all the necessary fittings to attach to a compressor. The smaller model is rated to lift up to 600 lb.; the larger, up to 1,200 lb. A 500-lb. load will need between 2.5 cfm and 3.5 cfm at about 90 psi, while heavier loads require 5 cfm to 6 cfm at around 120 psi. We tried the 29-in.-sq. model, using it to move a floor-standing hollow-chisel mortiser that weighs about 360 lb. In areas where our shop floor was smooth semigloss paint, the Hoverpad worked great. In areas where the floor was rough or pitted, the Hoverpad did not work. General says the pad requires a hard, airtight floor surface and recommends you do a suction-cup test before buying. If the suction cup sticks to the floor, even slightly, the Hoverpad will fly. If it doesn't stick, you'll need to treat or cover the floor in some way to make a suitable, airtight runway. For more information, visit www.general.ca.

—T.B.



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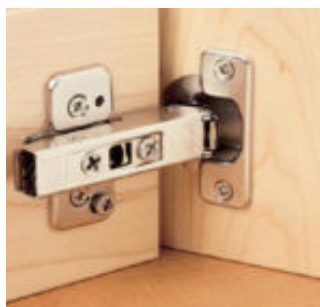
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Laying out dovetails

BY CHRIS GOCHNOUR

Striking a perfect blend of form and function, dovetail joints add great interest and detail while enhancing the structural integrity of a case, box, or drawer.

Cutting dovetails can become second nature after plenty of practice with saw and chisel. Dovetail layout, on the other hand, is where I see students get frustrated. Here are the key steps in laying out a basic through-dovetail joint, with tips on creating an attractive joint that is sturdy enough to last generations.

How to balance aesthetics and strength

Several factors go into the design of a dovetail joint. These include the size and spacing of the tails and pins, and the slope of the tails (see drawings, below).

Most dovetail joints begin and end with a half-pin on the outside, with the rest of the space subdivided into multiple pins

and tails. This creates plenty of long-grain glue surfaces as well as mechanical strength to tie the elements together.

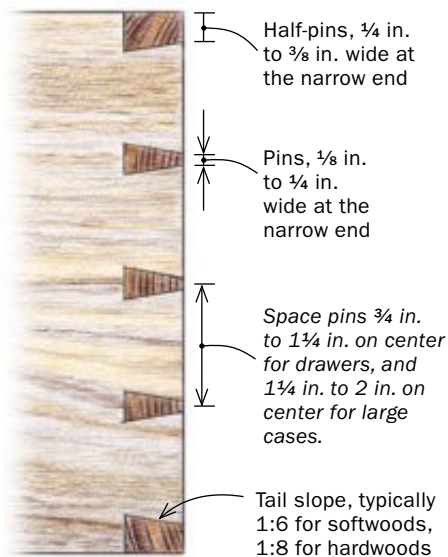
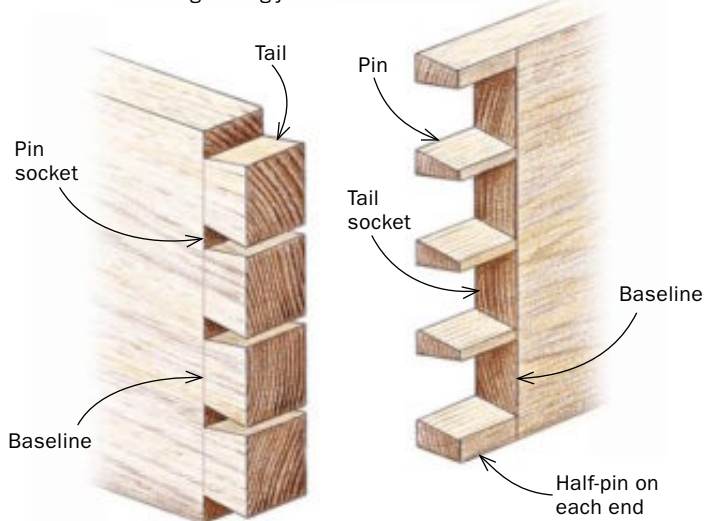
A common practice is to span the joint with pins and tails of equal proportions. Although it's structurally very sound and typical of machine-cut dovetails, this joint has little design appeal. A better method is to span the joint with tails that are larger than the pins (see right drawing, below). This is a common practice with hand-cut dovetails and also can be done on the bandsaw or tablesaw, as well as with the better machine-dovetail systems.

I recommend sizing the half-pins on the outer edges from 1/4 in. to 3/8 in. at their narrow end. Interior pins range from 1/8 in. to 1/4 in. wide and can be spaced anywhere from 3/4 in. to 2 in. on center, depending on the application.

Last, it's important to choose an appropriate slope, or angle, for the tails.

Anatomy of a strong joint

Dovetails provide not only mechanical strength as the pins and tails interlock, but also plenty of long-grain-to-long-grain glue surfaces for a long-lasting joint.



PIN AND TAIL DIMENSIONS

TIP



Sizing pins for router-cut dovetails. If you plan to cut dovetails with a router, the minimum pin width will be dictated by the diameter at the base of the bit.

Set the tail spacing

Gochnour lays out and cuts the tails first. His method uses the narrowest dimension of the pins, and simple math, to divide the tail board evenly.



1 **Mark the pin width.** Stack both tail boards in the vise. After laying out half-pins, mark the pin width on one end.

That slope is what draws the pin board up tight during assembly. More slope pulls the joint together efficiently; too little slope may require clamps or other aids to pull the joint together, much like a box or finger joint requires clamping pressure in two directions. Partly a matter of preference, the traditional ratio is 1:6 for softwoods and 1:8 for hardwoods; the reason being that the fibers of softwoods can compress more easily and therefore require a bit more angle to ensure that the pins are drawn tight to the tail board.

Keep the layout process simple

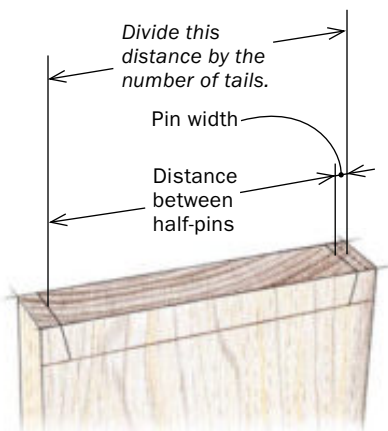
When laying out dovetails, use as few steps as possible. Begin by marking out the orientation of the pin and tail boards: inside and outside faces, top and bottom, front and back. Remember that tail boards generally make up the sides of drawers and cases, and the fronts and backs of chests; pin boards are usually the fronts and backs of drawers, tops and bottoms of cases, and ends of chests.

Scribe baselines—With the orientation of the tail board and the pin board established, scribe the baselines on both using a marking gauge. Set the gauge to the exact thickness of the pin board and scribe the tail board on both faces and edges. Setting the gauge to the pin board's exact thickness means there are no proud pins to interfere with clamping



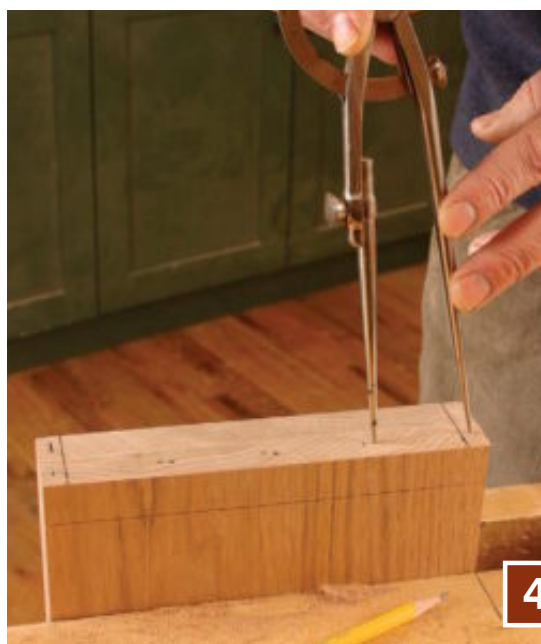
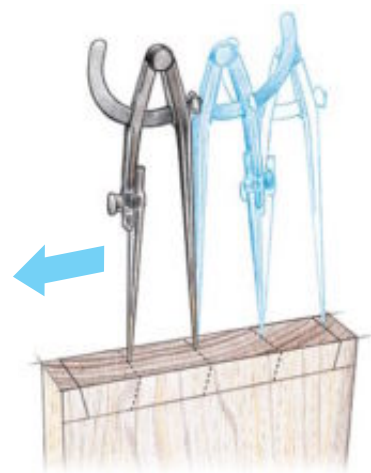
2

Measure from the half-pin mark on one end to the pin-width mark on the other. Divide that distance by the number of tails; adjust the dividers to this dimension.



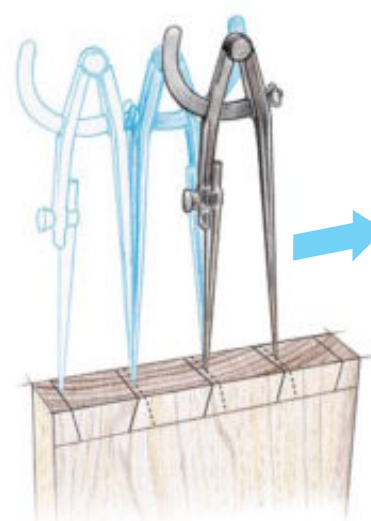
3

Mark the left edges of the tails. Place one point of the dividers on the right half-pin line and walk the dividers across the end grain.



4

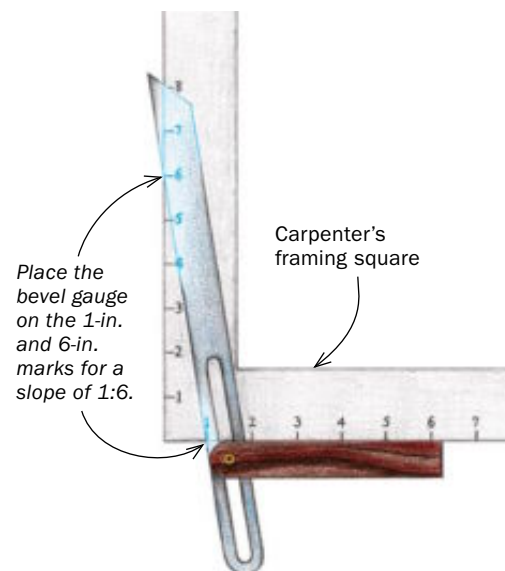
Mark the right edges of the tails. Repeat the process beginning from the left half-pin line.



Mark the tail board



Mark the widths of the tails on the end. Set the pencil point into the depressions from the points of the dividers, slide a square up to the pencil point, and draw lines across.



Set a bevel gauge to the desired slope. Lay a bevel gauge across a carpenter's framing square to set the slope.

and leaves little to trim flush after glue-up. After scribing the tail board, scribe the inside and outside faces of the pin board in the same way.

Determine tail spacing—Though some woodworkers will argue that it's best to lay out and cut the pins first, I prefer to work the tails first for a few reasons. First, I can lay out and cut more than one tail board at a time. Second, I find it easier to align, hold, and transfer the tails to the pin board because the pin board can be held securely in a vise and the tail board can lay horizontally, easily registering on the pin-board ends. Last, any adjustments or fine-tuning during assembly will be done to the pins, and it is much easier to trim and fit the open, right-angled pins than the tight, angular confines of the tails.

Clamp both tail boards in a shoulder vise so that they are

2 in. to 3 in. above the benchtop and square to it. Measure and mark the half-pins across the ends of the boards and perpendicular to the faces. Now divide the tails based on the number

that you want and the pin sizes between them (see drawings and photos, p. 30).

For example, say you want four tails with $\frac{3}{16}$ -in.-wide pins and two $\frac{3}{8}$ -in. half-pins. Lay out the half-pins $\frac{3}{8}$ in. from both edges, then make a mark on the end of the tail board $\frac{3}{16}$ in. past the half-pin mark on the right side (this distance is based on the width of the full pins). Then measure from that mark to the half-pin mark on the left side. Say that distance equals $6\frac{1}{2}$ in. Because you want four tails, divide the $6\frac{1}{2}$ in. by 4, which equals $1\frac{5}{8}$ in. Now adjust a set of dividers with the points $1\frac{5}{8}$ in. apart.

Lay one point of the divider on the right half-pin and walk it across the board end until you pass the half-pin on the left. If



Mark the tails on the face. Use the bevel gauge to draw in the tails on the face of the board.



TIP

Saddle markers speed the process. A dovetail saddle marker allows you to draw the lines on the end and face of a board in one step and with one tool. These jigs come with preset slopes, or you can make one based on your preference.

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Learn Gochmour's no-hassle approach to keeping track of your work, or watch as Gary Rogowski demonstrates an alternate layout method.

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your math has been done correctly, the divider should be $\frac{3}{16}$ in. past this mark. Now put one of the divider points on the left half-pin mark and walk back across the board end to the right.

Mark out the tails—The divider technique will leave a series of impressions spaced appropriately, in this case $\frac{3}{16}$ in. apart. Place a sharp pencil in each impression, slide a square up to the pencil, and square a line across the ends of the boards.

Next, set a bevel gauge to the appropriate slope (see drawing and photo, p. 32) and mark the face of the tail board. A dovetail saddle marker can be handy here because it allows you to draw the two lines across the top and down the face quickly and without misalignment. Dovetail saddle markers generally come with one of two slope ratios, 1:6 or 1:8, and are available from a number of sources, such as www.leevalley.com.

Now you're ready to cut the tails and remove the waste. The

Mark the pin board



Use the tail board to mark out the pins. Line up the baseline of the tail board with the inside edge of the pin board. Now use a marking knife to transfer the tail locations clearly to the pin board.

end-grain cuts must be absolutely perpendicular to each face of the board. Otherwise, during the next step the information transferred from inside the boards will not match the outside, causing problems.

Transfer layout to the pin board—With the tails laid out, cut, and pared, secure the pin board in the shoulder vise, with its outside facing you and its end $2\frac{1}{2}$ in. to 3 in. above the benchtop.

Place the tail board with the outside face up on the end of the pin board. Use a spacer to keep the tail board level (see the photo above). Line up the baseline of the tail board with the inside edge of the pin board. If the tail's baseline overlaps the pin board's inner edge, the tails will be too tight. If the baseline is proud of the pin board's inner face, the pins will be too small, resulting in a loose joint.

Holding the tail board securely—use clamps if needed—knife in the tails clearly on the pin board. Extend the marks perpendicularly down the pin board's face to the baseline. Now you are ready to cut the pins and complete the joint. □

HAVE FUN WITH DOVETAIL LAYOUT

Mastering the basics of dovetailing opens the doors to many design options, allowing you to increase the strength of the joint as needed or add visual pop. Each of these designs works with the layout process described in this article.



ADD PINS AND TAILS

This joint has enough pins to ensure that the joint is sound, but not so many that the joint is laborious to execute. The 1:6 slope of the tails ensures that the pin board is drawn up tight during assembly.



INCREASE THE SLOPE OF THE TAILS

This joint has a unique visual appeal and a great ability to draw the pins up tight. It also leaves a lot of short grain on the tails, creating a potential weak spot.



ADD PINS AT THE ENDS

The outer edges of a joint are the most susceptible to failure. Fortifying the edge with an extra pin is a great way to strengthen this potentially weak corner. It looks good, too.



ALTERNATE TAIL WIDTHS

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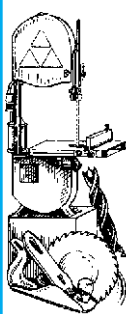
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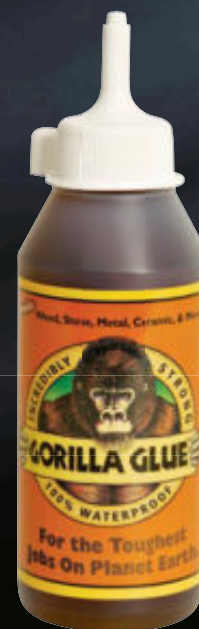


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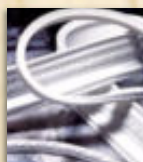
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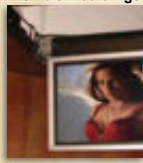
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Building Bookshelves to Last

How to support loads of any size and weight for years to come

BY JEFF MILLER

Everyone can use a few more shelves. Indeed, in many homes, an available shelf can be as difficult to find as the TV remote. So if you build a set of bookshelves, they'll probably be filled as soon as the finish dries.

Bookshelves can work in any room. You can make them free-standing or built-in. They can be big or small. And they can take any form, from simple screwed-together and painted plywood for use in a utility room, to sophisticated formal library shelves made from beautiful hardwoods.

A shelf should look good

A successful bookshelf design must achieve a balance between appearance and function. A shelf with the perfect look might not be adequately strong. That often means making changes as you work out the design.

A good approach is to start by writing out a wish list that summarizes your ideal shelf design. The list should include the shelf depth, a factor determined by the width of the books going on the shelf. Next, choose a shelf length (bookcase width). Then, choose a shelf thickness— $\frac{3}{4}$ -in. stock is readily available, but let your eye make the final determination. After that, decide if you want the shelves to be fixed, adjustable, or some of each. Finally, choose a joint or mounting system that offers the look you want.

The design process is just beginning once you've worked out your bookshelf



design “brief.” Now you must determine if your initial choices will be strong enough. If not, you’ll have to make some design changes. But before we get to that, it helps to understand how a shelf reacts to load.

Sag is the main enemy

As the load on a shelf increases, the weight eventually reaches a point where the shelf bends, or sags. The same factors that affect appearance also affect shelf sag: the thickness, width, and length of the shelf; the wood species used; and the method used to mount the shelf.

As a general rule, our eyes won’t notice sag if it’s less than $\frac{1}{32}$ in. (0.031 in.) per foot. With time, even if the contents don’t change, a shelf’s initial sag could increase by 50% or more as the wood fibers “tire.” Wood engineers call this “creep.” To be on the safe side, design shelves to limit any initial sag to no more than 0.02 in. per foot under a load of full-size books.

In extreme cases (loading a bookcase with your anvil collection, for example), shelves can deflect so much that the wood actually fails. This is not a common worry. More common, especially on long shelves, is that sag causes the effective length of the shelf to become shorter, causing it to slip off the shelf supports. Or, too much weight on a long shelf can cause some adjustable shelf supports to crush the wood fibers in the case sides. As a result, the supports tilt downward.

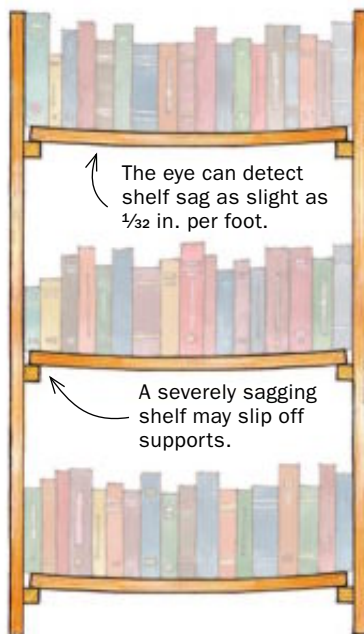
Fixed or adjustable

The method used to mount a shelf affects how much it will bend under a load. All else equal, a fixed shelf will bend less than an adjustable shelf. That’s because on a well-secured fixed shelf, the ends resist both tilting and being pulled inward by the sag (see pp. 40-43 for fixed- and adjustable-shelf options).

Be aware that fixed shelves aren’t immune to failure. With enough weight (perhaps adding your spouse’s anvil collection to your own on the same shelf) and its consequential sag, even fixed shelves can fail at the ends. When that happens, the shelf curves and effectively shortens, the ends pull free, and everything can head south in a hurry.

Jeff Miller builds furniture and teaches woodworking in Chicago.

Design shelves for maximum load



You don’t need to guess at how much a shelf is going to sag. The chart below provides a quick way to determine if your shelf will be sag-free. If the chart doesn’t work for your shelf, you can use the Sagulator, an online program that makes it easy to determine sag. Both the chart and the Sagulator assume unfixed shelf ends. Fixed ends sag less.

The chart is easy to use. It provides the maximum shelf-weight limits (in pounds per foot) and works for most designs. You need to know the thickness of the shelf ($\frac{3}{4}$ in. or 1 in.) and its length (24 in., 30 in., 36 in., or 42 in.).

If the expected load exceeds the weight limit shown in the chart, you’ll have to make compromises. To do that, use the Sagulator

(www.finewoodworking.com/sagulator).

An answer of more than 0.02 in. per foot of shelf means you need to put less load on the shelf; use a stronger wood; make the shelf thicker, wider, or shorter; or add wide edging. With the Sagulator, you can adjust those values and calculate a new sag number.

Approximate shelf loads:

Hardcover books (9 in. by 11 in.), 20 lb. per ft.

Magazines (9 in. by 11 in.), 42 lb. per ft.



Material makes a difference.

Some shelf materials resist sag better than others. Red oak is one of the better ones, eastern white pine less so. MDF makes a weaker shelf.

SHELF WEIGHT LIMITS (pounds per foot*)

TYPE		LENGTH			
Species	Thickness	24 in.	30 in.	36 in.	42 in.
RED OAK	$\frac{3}{4}$ in.	49	21	9	5
	1 in.	116	47	23	12
	$\frac{3}{4}$ in. with 2-in. edging	112	47	21	12
POPLAR	$\frac{3}{4}$ in.	42	17	8	4
	1 in.	101	41	20	10
	$\frac{3}{4}$ in. with 2-in. edging	97	39	20	10
EASTERN WHITE PINE	$\frac{3}{4}$ in.	33	14	6	3
	1 in.	74	32	15	8
	$\frac{3}{4}$ in. with 2-in. edging	76	32	14	8
FIR PLYWOOD	$\frac{3}{4}$ in.	32	13	6	3
	$\frac{3}{4}$ in. with 2-in. edging**	96	39	18	9
MDF	$\frac{3}{4}$ in.	9	4	2	1
	$\frac{3}{4}$ in. with 2-in. edging**	73	30	14	7

*Based on 11-in.-wide shelves **Edging is red oak; other edgings are the same wood as the shelf.

Fixed shelves sag less and strengthen the case

Fixed shelves attach to the sides of a case with either wood joinery, hardware, or a combination of both. Unlike adjustable shelves, fixed shelves help strengthen the entire case. And because they are attached to the case sides, fixed shelves sag less.



DADO

Strength: Good

Appearance: Good (excellent if using a stopped dado or if covered by a face frame)

A dado joint effectively houses the ends of the shelf in a long notch, providing some mechanical strength. Because a dado joint produces mostly end-grain surfaces, adding glue increases the strength only nominally. The attachment strength of a shelf can be improved further by combining Confirmat screws (see sidebar, right) with either a dado joint or a rabbeted dado joint. The screws keep the ends of the shelves in the dado, and the dado adds extra shear strength.



RABBETED DADO

Strength: Good

Appearance: Good (excellent if using a stopped dado or if covered by a face frame)

A minor variation on the dado joint is to rabbet the ends of the shelf to fit into a narrower dado. The main advantage is the ability to fit the joint more easily, especially if the shelf thicknesses are inconsistent. This joint is useful when working with hardwood plywood, a material that typically measures less than $\frac{3}{4}$ in. thick. In this case, a dado cut by making a single pass with a $\frac{3}{4}$ -in.-dia. straight router bit ends up too wide. However, with a rabbeted dado, you cut a narrow dado first, then the rabbet for a perfect fit.

CONFIRMAT SCREWS ADD STRENGTH

I'm not a fan of screwing shelves in place with the typical tapered woodscrew. They rarely hold up long-term. That said, I have found a specialized screw that works much better. Called a Confirmat screw, it has a thick body with sharp, deep threads. It's mainly used with particleboard, melamine, and MDF, but it also holds well in solid wood. When used in a dado or a rabbeted dado, the joint strength is excellent. Confirmat screws require a pilot hole and a shank hole. A special bit is available that does the drilling in one step (see "Sources," p. 43).



Rabbeted dado starts with a dado. A T-square jig helps cut a dado across the side. The slot in the jig is just wide enough to accept the bearing of a top-mounted bearing-guided straight bit.



Mark and cut the rabbet. First, mark the rabbet location on the end of the shelf (left), then use a bearing-guided rabbeting bit to cut the rabbet (above).



BISCUITS

Strength: Fair

Appearance: Excellent

It's easy to fix a shelf in place using a biscuit joiner. And, because the biscuits are hidden when assembled, there is no joinery, support parts, or hardware to distract the eye. Use at least two biscuits on each end of the shelf. Add a third biscuit if there's room. The jig shown at right is a good one to use here. Invest a few minutes making it and you'll be rewarded many times over by the time saved.



JIG SPEEDS BISCUITING

A jig for cutting slots in the sides makes it easy to locate shelves accurately. The jig has just two parts: a cleat and a fence. The cleat keeps the end of the fence square to the side. Centerlines for the slots are marked on the end of the fence. With each new set of shelf slots, the fence is crosscut to a shorter length. Toss the jig when done.



SLIDING DOVETAIL

Strength: Excellent

Appearance: Very good (excellent if stopped, or covered by a face frame)

A sliding dovetail adds considerable mechanical strength, but sliding a 10-in.-long dovetail into a tight-fitting slot before the glue sets up is a challenge. Using a fairly slow-setting epoxy glue will help considerably. Epoxy is a slippery glue that helps get this type of joint together without excessive expansion and stress. See p. 74 to learn how to cut a sliding dovetail.



SCREWED CLEATS

Strength: Very good

Appearance: Fair

Screwed cleats let you add shelves without too much fuss, but they come up a little short in the appearance department. With the exception of the hole closest to the front, all of the holes in the shelf should be slotted to accommodate wood expansion. For the same reason, if you wish to glue this joint, bear in mind that you should glue only the front inch or so.



Clamp and cut. Clamp the jig to the case. Cut one set of slots, then use the jig to cut the same slots on the other side. Crosscut the fence to the next shelf position, and repeat until all slots are cut.

Adjustable shelves add versatility

Adjustable shelves make it easy to change the spacing as needs change. But there is a structural cost: These shelves do nothing to hold the cabinet sides together. So, on taller bookcases it's a good idea to have one fixed shelf to help anchor the case sides.



SHELF PINS

Strength: Good (very good with sleeves)

Appearance: Good

Shelf pins come in a wide variety of shapes, sizes, materials, and finishes. My favorites are the machined solid brass ones from Lee Valley. I also like the very small round pins by Häfele for smaller cases. Shelf pins also come with special clips for securing the shelves or for holding glass shelves. Sleeves are a great way to recover from poorly drilled holes. Stamped sleeves (short tubes with a flared and rounded-over end) tend to look like shoelace eyelets when installed in a cabinet. Solid brass machined sleeves look better, even though they accentuate the row of holes in the case sides somewhat. Some sleeves are threaded for specially threaded shelf pins.



Sleeve adds refinement and strength. You can improve both the appearance and strength of a shelf pin simply by slipping a brass sleeve into the pin hole.

A JIG FOR PIN HOLES



Shelf-pin holes in a jiffy. Thanks to this shop-made jig, Miller quickly drills shelf-pin holes that are the same depth and perfectly spaced.



HIDDEN WIRES

Strength: Good

Appearance: Very good

These bent-wire supports fit into holes drilled in the case sides. A stopped kerf cut in the ends of the shelf slips over the support, hiding the hardware. Structurally, this means the end of the shelf is thinner. This affects the shelf's shear strength, but will have little effect on sag.





WOODEN STANDARDS

Strength: Very good

Appearance: Very good

Wooden shelf standards have been around in various styles for generations. They are easy to make and add an interesting look to almost any bookcase. The style shown in the top-left photo (I call it zig-zag) is one of the more common forms.

Another style (I call it half-moon) is shown in the lower left photo. To make a pair, you'll need a piece of stock that's at least double the width of each standard. Scribe a lengthwise centerline along the stock, then lay out the shelf spacing by making a series of evenly spaced marks along the centerline. Use a spade bit or a Forstner bit to drill a through-hole at each marked centerpoint. Finally, using a tablesaw, rip the stock down the middle. The net result is a pair of standards, each with a series of half-moon shapes.

Make the cleats just loose enough to slip in and out with ease.



METAL STANDARDS

Strength: Very good

Appearance: Fair

It's hard to beat metal shelf standards for ease of installation. Just run a pair of dadoes down each side of the case, and nail, staple, or screw the shelf standards into place. Shelf supports usually just hook into place, although one new version has brass support pins that screw into threaded holes in the brass standards. In general, shelf standards seem out of place on finer furniture. But they are great for utilitarian pieces, and even in larger bookcases, where any support system will be pretty much invisible once the shelf is full of books.

ZIG-ZAG SUPPORT IN THREE STEPS



Start with stock wide enough to make four standards. Using the tablesaw, make a vertical cut at each shelf location (1). An auxiliary miter-gauge fence with a location pin in front (much like a finger-joint jig) makes it easy to position the stock for subsequent cuts. Follow with 45° cuts (2) after relocating the location pin. Remove the triangular waste piece, then clean the resulting flat with a chisel. Rip the stock to create four standards (3).

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Dyes Can Do It All

Color bare wood without blotching,
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BY TERI MASASCHI

Coloring wood strikes terror in the hearts of most woodworkers. After spending six months building a piece, potentially ruining it in an hour is a definite cause for anxiety. Much of this caution stems from bad experiences applying typical hardware-store wood stains to bare wood. These mostly pigmented stains can cause results that are too dark, blotchy, and muddy. Far from enhancing the wood, the effect is to ruin the appearance.

Rather than throw out the baby with the bathwater and forswear ever coloring wood, switch to dyes. Like pigments, dyes also are called stains, but instead of lying on top of the wood like a pigment stain, they penetrate the wood. This ability enhances wood by

TYPES OF DYES

Dyes come in three main groups: as powders to be mixed with water, alcohol or mineral spirits; in ready-to-use form as a non-grain-raising liquid; or as concentrates to be added to clear finishes. Each group has different uses and characteristics.

POWDERED DYE

NON-GRAIN-RAISING DYE



offering figure-revealing transparency. Dyes come in a range of colors from subtle wood tones to brilliant primaries, and they can be applied to bare wood, combined with clear coats, or used as touch-ups. Dyes come in powdered form, concentrates, and ready-to-use liquids. The trick is to know where and how to use each type.

Dye bare wood for the greatest change in color

Whether you are seeking the rich tones of antique cherry or vibrant color on a more contemporary piece, you'll get the most impact by applying a dye to unfinished wood. However, this is something of a high risk, high reward situation.

Water-soluble dyes are your first choice—The most commonly available dyes are powders dissolved in water. Often termed aniline dyes (although no longer made from this product), water-soluble dyes provide great flexibility in how they can be mixed and also how they can be used.

Water-soluble dyes can be brushed, ragged, or sponged on, or sprayed with a spray gun or a plant mister. Their slow drying time means they can be manipulated with a damp cloth to correct uneven color, which makes them suitable for applying to large areas such as tabletops. They come in a greater range of colors than any other type of dye, and if you can't find the perfect color you can blend two or more dissolved colors. Unlike many finishing products, dye powders have an almost infinite shelf life if kept in the dark.

The main disadvantage of water-soluble dyes is their tendency to raise the grain: Any water, whether clear or dyed, will raise the grain when applied to bare

PICK A COLOR, ANY COLOR

While most woodworkers reach for a wood tone to give their pieces a more distinguished or aged appearance, brighter colors play an important role. Walnut and mahogany are often dyed yellow before adding a shade of brown to bring out the color contrasts in the wood. Contemporary furniture makers use bright colors as accents, or to make the whole piece stand out.



DYE CONCENTRATE

TYPE OF DYE	SAMPLE BRANDS	BEST USES	LESS THAN IDEAL USE	TOPCOAT COMPATIBILITY	COMMENTS
Waterborne dye powder	W.D. Lockwood, J.E. Moser, TransFast	Applied to bare wood	Tinting other dyes or clear finishes	All finishes. Seal with shellac before a waterborne finish.	Widest range of colors; cheapest dye
Oil-based dye powder	W.D. Lockwood, J.E. Moser	Tinting oil-based finishes	Dyeing bare wood	Will color-lift. Seal with shellac.	Best for tinting oil-based products
Alcohol-based dye powder	W.D. Lockwood, J.E. Moser	Touching up color	Dyeing bare wood	Will color-lift. Seal with shellac.	Use concentrates for tinting shellac.
Non-grain-raising dyes	Solar-Lux, Mohawk Ultra Penetrating Stain	Dyeing bare wood	Tinting other dyes or clear finishes	All finishes. If shellac, spray first coat (gun or aerosol).	Add retarder for large surfaces; add reducer for lighter tones.
Dye concentrates	TransTint, Wizard Tints, Sherwin-Williams	Tinting all clear finishes	Staining bare wood (must be mixed)	All finishes. If shellac, spray first coat (gun or aerosol).	Expensive but goes a long way

Dyeing bare wood gives the boldest results

WATERBORNE DYE



Raise the grain. Before applying a waterborne dye, the wood grain must be raised. Wipe the surface with a cloth dampened with distilled water. After the wood is dry, lightly sand the surface with P220-grit sandpaper.

Dissolve and strain the dye. Waterborne dyes should be dissolved in hot water in the ratio of 1 oz. of dye to 1 qt. of water. The easiest way to measure smaller amounts of dye is using a plastic medicine cup (top right). After the mixture has cooled, pour the liquid through a fine paint filter to remove any grains of undissolved dye (bottom right). Waterborne dyes can be applied with a cloth, sponge, paintbrush, spray gun, or plant mister (far right).



wood. To get around this problem, raise the grain before applying dye. First, dampen the sanded surface with a cloth moistened with distilled water. Avoid tap water, as any minerals may react with tannin in the wood. Allow the wood to dry and then de-whisker the surface by lightly hand-sanding with the grain using P220-grit sandpaper. If you raise the grain and then smooth the surface, the dye will not raise the grain as much.

The typical mix suggested by the supplier is 1 oz. of powder to 1 qt. of hot (not boiling) distilled water. Because you are unlikely to need a quart of dye, the easiest way to measure fractions of an ounce is to use the plastic measuring cup that comes with liquid cough medicine (also available at pharmacies). These cups measure volume, not weight; to account for this, fill slightly beyond the desired level when pouring in the dye powder.

Allow the mix to cool, then strain it through a fine paint filter, or a plastic funnel lined with cotton cloth or a coffee filter.

If you add way too much powder to the water, eventually no more will dissolve and you will end up with sludge at the bottom of the container rather like a pigment stain. If a dye this concentrated is applied to the wood, it will leave a powdery residue. Remove this residue with a cloth after it dries, or you may have a problem when finishing over it.



NON-GRAIN-RAISING DYE



Apply fast-evaporating dyes quickly. Non-grain-raising (NGR) dyes need to be applied fast to avoid overlapping streak marks (above). However, you can blend away uneven NGR color by wiping the surface with a damp cloth (right).

Dyes for bare wood that resist fading—Another type of dye suitable for bare wood is classified as a metallized or premetallized dye. Commonly known as non-grain-raising (NGR) stains, their biggest benefit is superior lightfastness compared to waterborne dyes. Away from intense light, waterborne dyes work fine, but NGRs are better near a sunny window (for more on lightfastness of dyes, see *FWW* #187, pp. 120-21). A second advantage is that there is no need to raise the grain before applying an NGR dye.

NGRs come ready to use in a blend of ethanol, methanol, and retarder. Common brand names are Solar-Lux, Mohawk Ultra Penetrating Stain, and Super Penetrating NGR stains. This same dye is also available as a concentrate under brand names TransTint, Wizard Tints, and Sherwin-Williams Dye Concentrate. You can use these to tweak the color of the non-concentrated NGRs to augment their rather limited range of colors. To dilute NGRs, it is best to use a purpose-made extender.

The easiest way to apply NGRs for even color tone is with a spray gun. Applied by hand, they are more troublesome because of their rapid evaporation. On a large project, it is difficult to work fast enough to maintain a wet edge and avoid streaking, and at the same time achieve an even color density. To deal with streaking, you can add 10% of a purpose-made retarder to slow down the drying time, and while the stain is still damp, to some extent you can even out the color with a water-dampened cloth.

Tint a clear finish for added flexibility

So far we have covered dyeing bare wood only, but you also can add dye to a clear finish. You'll save a little time by



Spray NGR dye for best results. With the gun set up to apply a fine spray, you can apply thin layers of color until you achieve the look you want in an even density.

For subtle color, tint the finish

Dyes are often used to bring out the best in figured woods, but what if you don't want to alter the overall color of the piece? The board on the left had an alcohol-based dye applied to the bare wood, and was then clear coated. While the figure is enhanced, the overall tone has darkened considerably. The board on the right was finished with Danish oil tinted with an oil-based dye dissolved in mineral spirits. The figure pops but the overall color is almost the same.



DYE APPLIED TO BARE WOOD

DYE ADDED TO CLEAR FINISH

OIL-BASED FINISHES



Dissolve oil-based dyes in mineral spirits first. After the powder dissolves, add the mixture to the clear oil finish of your choice (right).

applying the dye and finish in one step, but the main advantage is a more subtle shift in color. The result is comparable to the filters placed in front of lights in theaters, casting a delicate hue over the whole set.

A wonderful use for tinted oil finishes is on highly figured woods. Most people use oil to pop the stripes in tiger maple, for example, but if you apply a tinted oil, it will make the stripes much more pronounced without coloring the whole board as much. To tint an oil-based finish, it's best to use an oil-based dye powder, although somewhat confusingly the powder must be dissolved in mineral spirits and not oil before being added to the clear finish. This mixture will thin the finish, so use as little mineral spirits as possible.

The best tinting agents for shellac, lacquer, and waterborne finishes are the concentrated NGRs. Drop by drop, these bottles of powerful color can transform a tone rapidly. From clear shellac, you can make buttonlac, garnet, orange, or even green shellac.

SHELLAC, LACQUER, AND WATER-BASED FINISHES



Add dye straight to the finish. A drop or two of concentrated dye can alter a clear finish to almost any color you want.

HOMEMADE GARNET SHELLAC

A few of drops of medium walnut and a drop of Bordeaux added to clear shellac (left) will produce a color similar to that of garnet shellac (right).



A dye for perfect touch-ups



Blend away a blemish. With a piece of glass as a palette, use an artist's brush to blend a dab of shellac and an alcohol-soluble dye powder. Apply the dyed shellac to the colorless area for an invisible repair.

Other benefits from tinting a clear coat include correcting the overall tone of a project, or, in combination with a base dye, creating a deep, rich color on woods like maple that are normally difficult to darken.

A special dye for touch-up work

Occasionally while leveling a clear coat you might sand through some dye to the uncolored wood below. If you restore old furniture, you will come across areas of missing color. In both cases, a third type of dye powder excels at covering up mistakes and blemishes. Dip the end of an artist's brush into a 1-lb. cut of shellac and immediately pick up a bit of alcohol-soluble dye powder. Mix the two on an impermeable surface

such as a plate or a piece of glass to create your touch-up "paint" to fix areas of color loss.

Don't be afraid of dyes

The message to first-time users: Definitely try dye. As with all new products and techniques, there is a learning curve, so try them out on sample boards before attempting the final project.

When you've mastered the art of applying dye to your work, whether as a base color, a tinted clear coat, or just a touch-up technique, you will know that you have joined the ranks of professional finishers. □

Teri Masaschi is a professional finisher who lives near Albuquerque, N.M.

Finishes may lift the dye



Keep the dye out of the finish. If you brush on a waterborne finish over a waterborne dye, you are liable to dissolve some of the latter. The solution is to apply a coat of shellac between the two.



How to seal an alcohol-based dye. Brushing shellac over an NGR dye is liable to dissolve some of the dye. The solution is to spray on a light coat of shellac with either a spray gun or an aerosol.

SOURCES OF SUPPLY

DYE POWDERS, SOLAR-LUX, WIZARD TINTS

Woodworker's Supply
www.woodworker.com
800-645-9292

TRANSTINT, DYE POWDERS

Homestead Finishing
www.homesteadfinishing.com
216-631-5309

MOHAWK STAINS

Wood Finisher's Source
www.woodfinisherssource.com
888-822-0974



■ ■ ■

Arts and Crafts Side Chair

With templates for
curves and joinery,
you can make a
roomful of chairs

BY KEVIN RODEL

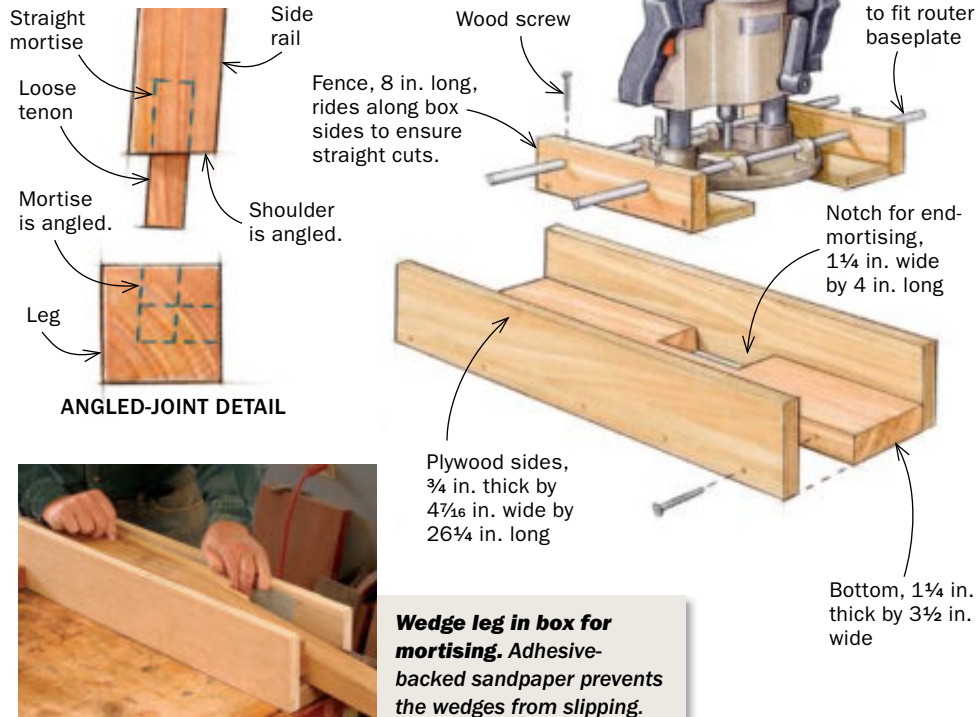
■ ■ ■

I designed this chair in 1993 for a design competition sponsored by the Maine Arts Commission. My intention was to design a chair that would be sturdy, comfortable, and clearly derivative of Arts and Crafts styling, but still compatible with contemporary interiors. Since then I have made many of these chairs with very little design change, including one set ordered by Disney Films in 1999 for the movie “Bicentennial Man.” This version is made of white oak, though I’ve made the same chair in cherry and walnut.

Because I wanted the chair to function either as a dining chair for long, leisurely meals or as a reading chair for a desk or library table, an upholstered seat was a must. The degree of back slope, depth of seat area, arch or curvature of the back rest, and other critical dimensions also contribute to the comfort. I use jigs to duplicate curved and angled parts, as well as to

Router box simplifies mortising

This jig allows you to cut angled and straight mortises in the legs with a plunge router. It also allows for mortising for the loose tenons in the ends of the side rails.



create accurate angled joinery. These jigs will come in handy if you decide to build a set of chairs.

Shape the back legs using a template

First, trace the back legs on the stock using a full-size template made from 1/4-in.-thick Masonite. Rough-cut the legs to shape using a jigsaw or bandsaw, being careful to leave the line. The only cuts that should be exactly to the line at this point are the top and bottom cross-grain cuts.

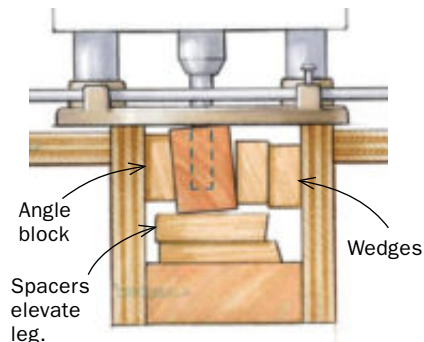
For final shaping, mount the back legs in a template-routing jig (see photos and drawing, p. 51) that works with both legs. Use a large-diameter, bearing-guided straight bit (1/2 in. or more). Amana makes a 1 1/8-in.-dia. by 1 1/2-in.-long bit with a top-mounted ball-bearing guide (part No. 45468) that allows you to shape the leg in one pass.

Once you have both rear legs shaped, cut the front legs to length. Now you're ready to lay out and cut the mortises.

USE AN ANGLE BLOCK FOR SIDE-RAIL MORTISES



Angle block orients the leg at 85.5°. Set the block against one side of the leg before adding the wedges. Then cut the mortise with a plunge router.



USE THE BOX FOR END GRAIN, TOO

The front and back rails meet the legs at 90° and have standard tenons. But the side rails meet the legs at an angle. Instead of cutting angled tenons, mortise for slip tenons.



Start by angling the ends of the rails. Cut the side rails to length at 85.5°, paying careful attention to the orientation of the angle cuts.

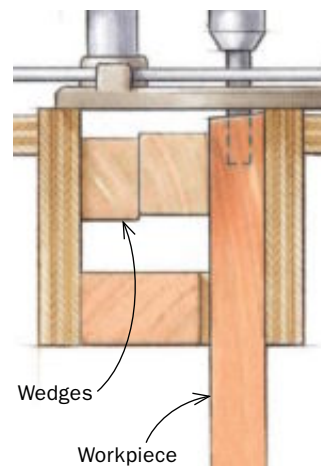
Angled mortises made easy

It is certainly easier to cut right-angled, 90° mortises and tenons. But to conform to the body, the chair must have some angled joinery. I've limited the angled joints to the side rails and the lower side stretchers.

The easiest and most consistent way to cut the angled joint is to bore the mortise in the leg at the required angle. Then you can simply crosscut the ends of the adjoining rails at the same angle, cut a straight mortise into the end grain of the rails, and glue in a slip tenon.



Square up the mortises. Use a chisel and mallet and pare to the line.



Mortise the ends of the rails. These mortises are easily cut by wedging the rail vertically in the router box.

The angled mortises in the front and rear legs can be cut using a plunge router and a router mortising box (see photos and drawings, facing page). You can use the mortising box, a mortiser, or chisels to cut the straight mortises.

Now add the decorative details on the rear legs. Taper the outside faces on the bandsaw and plane to the line. Cut the shallow pyramid heads on both the front and rear legs. Finally, cut the mortises for the square pegs in the crest rail.

Side rails meet the legs at an angle

With the legs complete, begin working on the seat rails—front, back, and side. The rail-and-seat structure takes the brunt of the load, so use care when fitting the tenons.

The front and back rails meet the legs at 90° and have standard tenons. The side rails, which are angled into the front and back legs, are attached with slip tenons.

Cut the side rails to length at 85.5° at the shoulder line (left photo, above). The rail should look like a long, thin parallelogram, not a trapezoid. Next, lay out and cut the mortises on the ends for the slip tenons (see photos and drawing, this page) using the router box. After mortising, fit and glue the loose tenons into the side rails.

Template ensures consistent curves in all of the chair rails

You want the arches in the rails to be consistent, so cut them to shape using templates made of ¼-in. Masonite. You'll need three templates for the seat-rail arches: one



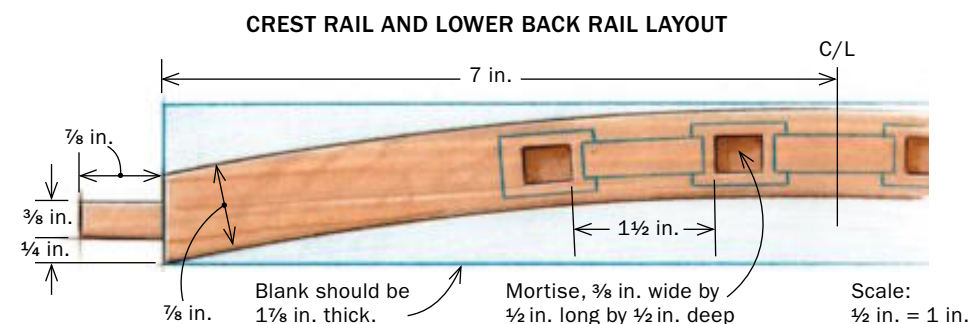
Glue the loose tenons in the side rails. The tenon should fit with a bit of hand pressure. If you have to beat on it with a mallet, the fit is too tight; if it drops out, it is too loose.



Now rout the side-rail arches. Rough-cut the curve on the bandsaw. For consistency, screw a router template to the tenons, and secure the assembly to the bench for routing.

Make the back-rest assembly

The rails of the back rest are curved on the front and back faces, and the crest rail is arched on its top edge. Both rails are mortised to hold the back splat, a curved assembly of narrow strips.



CUT THE JOINERY BEFORE SHAPING THE UPPER RAILS



Cut the tenons and the inside curve of the rails before mortising. Mark the locations of the back-splat mortises using a template and drill them out on the drill press (left). A curved fence helps support the tall workpiece. Next, following the lines marked from the template, square up the mortises (right).



Arch the top of the crest rail next. Re-use the rear seat rail template to trace the arch along the top of the crest rail, then rough out the shape on the bandsaw.

each for the front, sides, and back. Use the templates to draw the arch on the seat rails, then use a bandsaw to remove most of the waste. Now use a bearing-guided straight bit to template-route the arches.

The two curved back rails require a few more steps than the seat rails. Mill up extra-thick blanks and cut the offset tenons on the ends. For consistency, it helps to make a template showing both the inside and outside curves of the rail (see drawing, left). Trace the concave curve first, then remove the waste with a bandsaw, and clean up the surface using a spokeshave or sandpaper. If you prefer, you can use the template to make a jig to clean up the surfaces using either a router or shaper. Now use a marking gauge to scribe the 7/8-in. thickness of these rails, referencing off the just-milled front faces.

Before shaping the crest and bottom rails further, lay out and cut the four small mortises for the back splat (see photos, left).

The next operation is to arch the top of the crest rail using the same method and template used to shape the back seat rail (save the cutoff). Finally, cut the convex curves of the crest and bottom rails on the bandsaw, just leaving the line. Clean up these faces with a disk or belt sander.

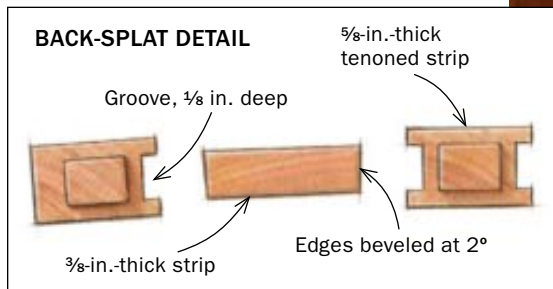
Back splat serves as the focal point

The back splat is a curved assembly of 1-in.-wide strips, with three 1-in.-sq.



Finally, cut the curves on the backs of the top rails. Leave the scribe line, and clean up the surfaces with a belt or disk sander.

MILL AND GLUE UP THE BACK SPLAT



Tenoned strips are grooved on both sides. Cut and fit the 5/8-in.-thick strips into the mortises in the rails, then rout the 3/8-in.-wide groove, 1/8 in. deep, into their edges. The outside strips are grooved only on the inside edge.



Bevel the thin strips. After ripping the 3/8-in.-thick strips to width, joint a 2° bevel on their edges to allow the splat to curve.



Use the crest rail and the bottom rail to guide the glue-up. Apply glue with a syringe to avoid squeeze-out. Do not glue the splat to the rails yet. Once the back splat has dried, go ahead and glue it to the crest and bottom rails, then assemble the rest of the chair back.

openings at the top, that conforms to the shape of the crest rail and the back rail. For this element, you'll need two blanks, 3/8 in. and 5/8 in. thick and wide enough to cut the required number of strips.

Dry-fit the crest rail and the back rail into the legs and measure vertically between them. Add 1 in. to that measurement for the 1/2-in. tenons, and cut the 5/8-in.-thick blank to length. Now cut 3/8-in.-thick tenons on each end, rip the board into four 1-in.-wide strips, and then cut the remaining tenon shoulders on the strips. Next, cut the grooves for the 3/8-in.-thick strips, beginning 1 in. from the top shoulder line, and square up the top edge with a chisel.

Now cut the 3/8-in.-thick blank to the same length as the grooves, rip it into strips, and joint a 2° bevel along each edge of the thin strips. Sand all the parts to P220-grit, and glue up the back splat using the crest rail and bottom rail as glue-up jigs. To avoid squeeze-out, use a glue syringe to apply the glue.

Glue up the front and rear assemblies

While the back-rest assembly is drying, glue up the two front legs and the front

seat rail. Notch the tenon on the front rail to give clearance for the side-rail tenons. Be sure the legs are parallel with no toe-in or splay as you clamp up the assembly. Reinforce the joints with a 3/16-in.-dia. dowel hidden on the inside face.

When the glued-up back splat has cured, remove the crest and back rails, apply glue to the mortises, and glue these parts together. To help with the clamp-up, use the arch cutoff as a caul.

Allow this assembly to dry, then glue it and the back seat rail to the rear legs. Again, reinforce the rear seat tenons on the inside with a 3/16-in.-dia. dowel. While you are at it, install the 3/4-in. pegs in the tops of the rear legs through the 1/4-in.-sq. peg

FineWoodworking.com

Watch Rodel mill and assemble the back-splat elements for this chair.

Fit the lower stretchers

The lower stretchers help stabilize the chair against racking forces. The side stretchers attach to the legs with slip tenons, and the cross stretchers connect to the side stretchers via half-lapped dovetails.



Cut the rear shoulders first. The rear shoulders of the stretchers are angled 85.5° horizontally. In addition, they must be angled vertically to match the leg taper. Start by dry-clamping the chair, and set a bevel gauge to the vertical angle (left). To cut the rear shoulder on the tablesaw (right), tilt the blade to 85.5°, then use the bevel gauge to set the angle of the miter gauge.



Creep up on the fit. Reset the miter gauge to 90°, leaving the blade tilted to 85.5°, and cut the front shoulders. Leave each stretcher a little long and take light cuts until the ends align with the mortise locations.

holes to reinforce the crest rail mortise-and-tenon joint.

Install the lower stretcher assembly

The lower stretcher assembly not only helps stabilize the lower part of the chair against racking forces, but the exposed dovetail joints also add a decorative twist. The side stretchers connect to the legs with slip tenons, and the cross stretchers are attached to the side stretchers with half-lapped dovetails.

With the chair dry-fitted and clamped together on a flat surface, measure and cut the lower stretchers to width and thickness. The side stretchers meet the legs at compound angles with slip-tenon joinery. The mortises are already cut. To cut the compound angle on the ends of the stretchers, set a bevel square to the angle formed where the inside face of the rear leg and



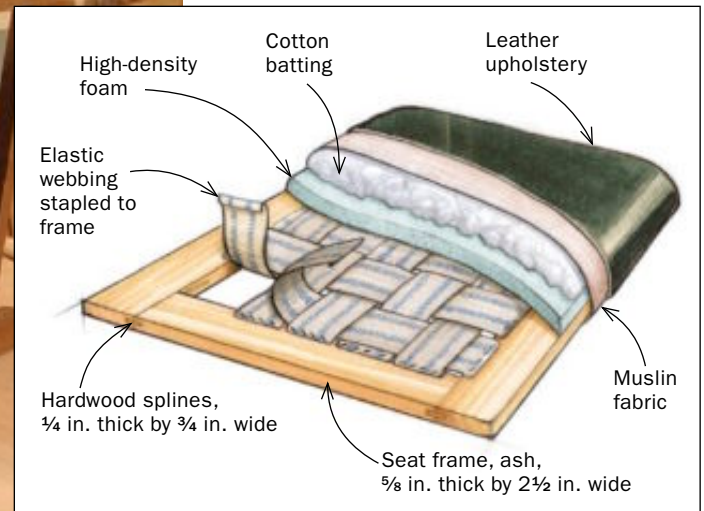
Install the cross stretchers after glue-up. Cut the half-lapped dovetails on the cross stretchers, then scribe them onto the side stretchers.



Screw in the corner blocks. The blocks help reinforce the corner joints and serve as anchors for the seat frame.

SLIP SEAT COMPLETES THE CHAIR

The chair has a leather-upholstered seat, installed after the chair has been fumed and finished. The frame is screwed to the corner blocks between the rails.



the flat surface meet. Set the tablesaw's miter gauge to that angle, set the blade to 85.5° (double-check that angle with another bevel gauge), and cut the compound angle on the rear end of one stretcher. To cut the opposite stretcher, reset the miter gauge past 90° to the same angle in the other direction. Now cut the forward ends of the stretchers at 90°—with the miter gauge at 90° and the blade still at 85.5°—sneaking up on the length until they just fit.

Next, cut a 3/8-in.-wide mortise, centered in the end grain of each stretcher and about 3/4 in. deep. Dry-fit the slip tenons. When the fit is perfect, glue up the chair.

While this glue is setting, you can mill up the two cross stretchers. Once the stock is milled to width and thickness, locate where each cross stretcher will meet the side stretchers. Cut each one to length, leaving them about 1/8 in. extralong on both ends.

Hold a cross stretcher in place, and locate the shoulder cut by scribing a line on the underside where it meets the side stretcher. Cut a half-lapped dovetail on each end of each cross stretcher. Set the cross stretchers in place, then scribe and cut out the

dovetail slots in the side stretchers using a handsaw and chisels. Once the dovetail sockets have been cleaned out, glue the cross stretchers in place.

After the glue has set, sand all the stretchers flush on their upper faces, and go over the chair thoroughly for any residual glue squeeze-out and touch-up sanding. Finally, make up the corner blocks and screw them to the inside corners, flush with the upper edges of the front and rear seat rails. Add an additional screw hole up through the body of the corner blocks before attaching them. This will be used to attach the upholstered slip seat to the chair.

The very last item before finishing is installing the pyramid-shaped decorative pegs in the crest rail. I use ebony, but any hardwood species will work.

This white-oak chair is fumed (for more on fuming, see my article in *FWW* #126, pp. 46-49) with a topcoat of Tried & True linseed oil. The seat is upholstered in leather purchased from Dualoy Inc. (www.dualoy.com). □

Kevin Rodel is a furniture maker and teacher in Brunswick, Maine.



Jointer/Planer Combo Machines

JOINTER

Although their tables are somewhat short, these machines can joint stock up to 12 in. wide, a boon for a small shop.

Wide jointer, heavy-duty planer, one small footprint

BY ROLAND JOHNSON

PLANER

All these machines can take deep cuts in hardwoods with no snipe.

JOINTER TO PLANER IN 60 SECONDS (MORE OR LESS)

It takes only 50 to 80 seconds to change these machines from jointer to planer or vice versa. On most, you first move or detach the jointer fence. Next, pivot the jointer tables up and out of the way (see inset photo). Then pivot the dust hood over the cutterhead and crank the planer bed to the desired height. To change from planer to jointer, lower the planer bed to accommodate the dust hood in its lower position, lower and lock the tables, and replace the fence. The time needed for either changeover directly relates to how much cranking it takes to reset the planer bed.



FineWoodworking.com

See the jointer-planer changeover in real time.

Working in a small shop can be a challenge, given the large tools woodworkers tend to accumulate. I'm always rearranging my tablesaw, bandsaw, jointer, drill press, workbenches, and dust collector to optimize space and give myself room to work.

Combination jointer/planers—commonplace in Europe but still a rarity in the United States—maximize available space because they use a single cutterhead for two operations. The jointer bed typically is designed to swing up and out of the way, providing access to the planer bed below. An integrated dust hood pivots to accommodate both operations.

These machines also present some questions: Do you pay a premium for a combo, compared with separate machines? Do you sacrifice performance, or is a combo machine equal to the sum of its parts? How different is a combo from the machines most of us are accustomed to using?

To answer those questions and others, I looked at the four jointer/planer combinations that are moderately priced and readily available. All use a 12-in.-wide cutterhead, with jointer beds ranging from 50 in. to 59 in. long. Each manufacturer offers larger, pricier machines, but they are not practical for many hobbyists. One well-known brand, Laguna Tools, is not represented; its redesigned jointer/planer wasn't available in time for this review.

The basic questions, answered

All four combo machines delivered excellent results in my tests. Using maple, white oak, and cherry, I face-jointed and edge-jointed long, wide boards without difficulty, and planed boards with no snipe. These

combo machines don't sacrifice performance, and they don't command a steep premium. Costs range from \$2,500 to \$4,400, not much more than a pair of conventional machines. An 8-in. jointer costs



MINIMAX USA FS 30 SMART

www.minimax-usa.com
866-975-9663

List price: \$4,400

Power: 230v, 4.8 hp

Jointer bed length: 59½ in.

Footprint: 64 in. by 36 in.

Weight: 650 lb.

Changeover time: 50 sec.

Cutterhead: Torsa standard.
Replacement knives, \$45 per set. Euro-style cutterhead guard, \$275.

MiniMax has the fastest changeover

The MiniMax USA has two standout characteristics: It has the same type of swing-away cutterhead guard found on conventional jointers, and it comes with Torsa knives as standard equipment. These disposable knives are extremely easy to change and are held in place with wedges and centrifugal force, so they need no fussy adjustments, as conventional knives do.

This machine has other strong points. It takes less than a minute to change modes. That's mainly because the planer bed must be lowered only 3¾ in. (38 cranks) to accommodate the dust hood. The 59½-in. jointer table is one of the longest. It also has the best fence, mounted to a bracket attached to the end of the infeed table. When you switch from jointing to planing, you just lift off the fence in one motion and stow it nearby. (Fences on the others must be loosened, slid to one side, and locked there.) It's also the only one with a stop to prevent it from deflecting sideways under lateral pressure.

I found two small drawbacks. One, the MiniMax has two dust-collection ports, so you have to remove and reattach the dust-collector hose at every changeover. Two, the crank that moves the planer bed works counterintuitively—clockwise to lower, counterclockwise to lift. It fooled me for a while.



Easy off. The MiniMax fence lifts off, easing the changeover from jointing to planing. It's also the easiest to set for angled jointing.



Quick change. Torsa knives, standard on the MiniMax, are the easiest to change because they index themselves perfectly.

Hammer is well-built

The Hammer is very nearly the equal of the MiniMax USA. It's a well-engineered, well-made machine that's a pleasure to use. Its \$3,582 list price makes it worth serious consideration.

One useful feature on the Hammer is the gravity-actuated stops that prevent the jointer tables from dropping. I also like the height of the jointer tables. At 33 $\frac{5}{8}$ in., they're 2 in. lower than the MiniMax and 1 $\frac{3}{8}$ in. lower than the Rojek. For me, the reduced height made it easier to work around the Euro-style cutterhead guard.

Cartridge knife inserts—the only type available for the Hammer—are nearly as easy to change as Tersa knives. You loosen a set of locking screws, remove the cartridge, reverse or replace the disposable knife, reinstall it in the cutterhead, and tighten the lockscrews—with no adjustments needed.

On the negative side, the Hammer has a shorter jointer table than two of the others. Changeover takes a little more than a minute and entails 75 turns of the crank to move the planer bed.



Crossing the bridge. The Hammer and the Rojek have a T-shaped guard. It takes a little practice to learn to maneuver over the guard when jointing.



HAMMER A3 31

www.felder-usa.com
866-792-5288 (East Coast)
800-572-0061 (West Coast)

List price: \$3,582

Power: 230v, 4 hp

Jointer bed length: 55 in.

Footprint: 61 in. by 27 in.

Weight: 660 lb.

Changeover time: 1 min. 3 sec.

Cutterhead: Quick-change cartridge. Replacement knives are \$31 to \$57 per set.

Other accessories:

Jointer-table extension, \$160
Handwheel with digital readout for planer height, \$67



Pretty quick change. Double-edged cartridge knife inserts are easy to change and reset without having to make lots of tiny adjustments.

as much as \$1,700; a heavy-duty planer costs \$800 to \$1,200. A conventional 12-in. jointer—a behemoth next to these combos—costs about \$4,000 all by itself.

How different are they?—Combos aren't radically different from conventional jointers or planers, but it takes time to get used to them.

You have to change some shop practices to use these machines effectively. It's much more productive to do all the jointing for a piece, then change over to do all the planing. Of course, sometimes you have to joint and plane a single piece, or joint an edge when the machine was last used in planing mode. When you do, you'll encounter

an unfamiliar setup step that may seem tedious, especially at first (see "Jointer to planer in 60 seconds," p. 58).

If you're accustomed to a jointer with a massive cast-iron fence and a swing-away guard over the cutterhead, these combo machines will seem very different. Most have a sliding cutterhead guard, often

Rojek offers no-frills performance

This is a moderately priced, no-nonsense machine that performs well. The jointer table is a generous 59 in. long. But the Rojek lacks some of the refinements of the MiniMax and the Hammer.

For one, its standard cutterhead knives, held in place with traditional jackscrews and locking gibs, take time and patience to install accurately. Rojek supplies a decent dial indicator to help set the knives. You can also outfit the machine with a Tersa cutterhead, an option that I recommend.

For another, the 315 must be plugged in to change the knives. A switch setting lets you override a motor brake and rotate the cutterhead; it doesn't work if you unplug the machine. I dislike that type of design because of the chance—however remote—that you could accidentally start the machine.

The third big shortcoming is changeover time. I averaged 1 minute, 20 seconds, time spent mainly moving the planer bed the 7½ in. (90-plus cranks) required to accommodate the dust hood.

There were other, minor annoyances. The power switches, on the left end of the front panel, are in a slightly inconvenient position for planing because you have to reach around the forward-tilted tables to hit the switch. And the instruction manual is the worst of the lot.

ROJEK MSP 315

www.rojekusa.com
800-787-6747

List price: \$3,100

Power: 230v, 5 hp

Jointer bed length: 59 in.

Footprint: 60 in. by 47 in.

Weight: 569 lb.

Changeover time: 1 min. 20 sec.

Cutterhead: Four-knife cutterblock standard. Replacement knives, \$90 (Tersa knives, \$99). Optional 3-blade Tersa head, \$356

Other accessories:

Planer-bed extension, \$179

Jointer extension, \$190



The opposite way. The Rojek's jointer tables tilt to the front, unlike the tables on the other machines. When planing, you have to reach around the tilted outfeed table to reach the power switch.



No quick change. To loosen the gibs holding the Rojek's knives in place, you need a hammer and a block of scrap. Fine-tuning the knife adjustments takes patience.

called a bridge guard, which is designed to let stock pass beneath it when face-jointing a board. (Only the MiniMax has a swing-away guard.) Bridge guards are adjustable, so you can move them away from the fence for edge-jointing.

I had to get used to passing wide stock beneath the bridge, then reaching over

it with my push blocks as I moved the stock to the outfeed side of the cutterhead. But once I'd mastered those moves, I appreciated having a guard that covered the cutterhead completely.

The fences on these jointer/planers are aluminum extrusions. They hold the angle you've set resolutely, but most can

flex slightly under lateral pressure (the MiniMax fence has a stop to prevent flexing). That doesn't affect the accuracy of the jointing.

The bottom line

All the jointer/planers are well-made machines that perform their two tasks very



Rojek's low-cost alternative

This is a slightly smaller, simpler version of the Rojek MSP 315. The jointer beds are fixed, not pivoting, a design that makes it harder to set the cutterhead knives properly. Controls, cutterhead, and fence are essentially the same on both machines.

Changing from jointer to planer means raising or lowering the planer bed and moving the dust hood. When planing, the hood covers the cutterhead and a bolt holds it to the fence. When jointing, the hood rests on the planer bed, which you raise to press the hood in place. The changeover is fussy and takes a little over a minute.

The dust-collection setup trades simplicity for effectiveness. Plenty of large shavings miss the hood, littering the planer bed and surrounding nooks and crannies. Cleaning out the mess quickly becomes tiresome. The other machines have better systems.

Because the jointer bed doesn't swing out of the way, the overhanging outfeed end intrudes when you're feeding stock into the planer. It's an annoyance, but not a hazard. The 310 has a jointer bed that's barely 50 in. long. Extensions, a \$190 option, also fit the 315.

ROJEK MSP 310M

www.rojekusa.com
800-787-6747

List price: \$2,500

Power: 230v, 3.6 hp

Jointer bed length: 49½ in.

Footprint: 52 in. by 36 in.

Weight: 534 lb.

Changeover time: 1 min. 9 sec.

Cutterhead: Four-knife cutterblock standard. Replacement knives, \$90 (Tersa knives, \$99). Optional 3-blade Tersa head, \$356

Other accessories:

Planer-bed rollers, \$179

Jointer extensions, \$190



Hangover. The Rojek's jointer table limits your access and view when planing.



Dust collection one. For jointing, the dust hood fits underneath the cutterhead and is clamped in place by the planer table.



Dust collection two. For planing, the dust hood sits on the jointer table over the cutterhead, held with a bolt in the fence. This low-tech design isn't very effective.

well. Some small design details account for the differences among them. The boxes on these pages give the specifics.

The Hammer is clearly the best value at about \$3,600. It's a well-made machine that's a pleasure to use, and its knives are easy to change. But its fence isn't quite as handy as the one on the MiniMax.

The Rojek machines are the least expensive. They perform the basic functions of planing and jointing, but are a little more awkward to use.

The best overall—but only by a nose—is the MiniMax, mainly because it has the best overall fence design. It's the easiest to handle when changing from jointer to planer

mode, and the easiest to adjust for different angles. A standard Tersa cutterhead is another plus, as is the machine's quick changeover time and long jointer fence. But at \$4,400, the MiniMax is also the most expensive jointer/planer tested. □

Roland Johnson is a contributing editor.

The Miter Joint for Casework

This surprisingly strong joint gives furniture clean, flowing lines

BY DAVID HYATT

Many woodworkers are familiar with the miter joint as used in picture frames or on a solid edging that wraps around a tabletop. However, this joint is also a useful and attractive means of joining the body of a cabinet. Whether constructed from plywood or solid stock, this clean, simple joint shows no core or end grain, and can be particularly appropriate in enhancing clean lines on furniture.

Unlike many woodworking joints, the carcass miter with its long, straight cuts lends itself to easy production with a variety



Clean lines and no end grain. Miter joints allow the grain to flow uninterrupted around this small cabinet.

Miters on the tablesaw



Simple on a left-tilt saw. Here, the thin point of the first miter runs against the rip fence.

of power tools. Although the joint can be reinforced with splines or biscuits, accurately cut mitered surfaces are strong enough for most locations using glue alone.

Cut miters with a tablesaw or router

The fastest and easiest way to cut miters is on a tablesaw, but you'll need a sharp blade to get a smooth, accurate cut with no burning or tearout. With veneered materials in particular, check the entire surface of the tablesaw and outfeed table for bumps that will scratch the thin surface.

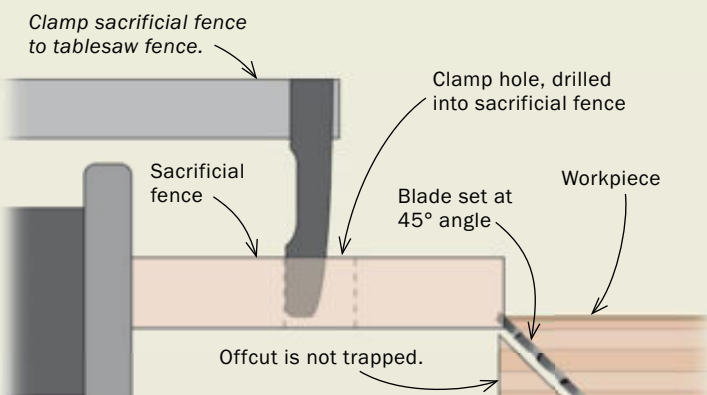
Use a slow, steady feed rate to reduce burning and tearout. Be vigilant about the last few inches of the cut; it is easy to twist the workpiece slightly and make a curved edge that will not fit properly with its counterpart. Also, make sure that the workpiece is pressed down firmly on the tablesaw. If the workpiece is at all warped, it will be difficult to cut a good joint.

Easier on a left-tilt saw—If you own a left-tilt saw, cut the workpiece roughly to size, tilt the sawblade to 45°, and cut the first miter with the inside of the workpiece face down. Then simply spin the workpiece 180° so that the mitered cut is against the fence. Make a series of cuts until the blade cuts the top of the workpiece to the correct width, and complete the cut.

Possible on a right-tilter—On a right-tilt saw, the procedure is slightly different. You could just relocate the rip fence to the

RIGHT-TILT SAWING WITH A SACRIFICIAL FENCE

A simple auxiliary fence and a precision setup make it safer and easier to cut case miters on a right-tilt tablesaw.



Using a right-tilt saw. When cutting the miter on the second side, to prevent the thin point of the first miter from burrowing under the rip fence, attach a sacrificial fence and cut the miter as shown. Hyatt uses a rubberized glove for better control.

left of the blade, but there isn't as much capacity on that side for wide workpieces. To cut miters safely with the rip fence in normal position, first cut the piece to its finished width, then tilt the blade and cut the first miter with the inside of the workpiece face up. If you then turn the workpiece 180° and run the sharp, mitered edge along the rip fence, that edge will try to burrow under the edge of the fence. At best you will get an inaccurate cut; at worst, kickback.

The best solution is to run the edge you are mitering against the rip fence. This will let you cut with the inside of the workpiece face down. To make this cut safely, clamp a sacrificial fence of medium-density fiberboard (MDF) to the rip fence, positioning the MDF so that its bottom surface is about 1/8 in. below the top of the workpiece. Then draw a pencil line along the edge of the MDF fence at the level where the top of the workpiece will make contact. Adjust the position of the rip fence and the height of the blade to a setting where the cut just meets that pencil line. This should ensure that the miter extends the full thickness of the workpiece, but doesn't reduce its width. You will want to make test cuts on a spare piece. With this setup, the offcut will fall away freely under the sacrificial fence.

Cut clean miters with two types of router bit—Although it takes longer to create miter joints using a router, the resulting cut is cleaner than one made on a tablesaw.

To cut miters with a router, first cut the workpiece to its final size. Next, to reduce strain on the router, not to mention the quantities of dust it will create if you are working with MDF, tilt the sawblade to 45° and remove the bulk of the waste, leaving a 1/16-in. shoulder at the corner of the miter.

It is safest to use a chamfer bit in a router table. Because the miter will extend the full thickness of the workpiece, the bearing will have no surface to run against. Instead, the workpiece will be guided by the router-table fence alone. Set the bit height to leave a sharp corner on the workpiece.

A third way to create miters is with a specialized locking miter bit that produces a strong joint with a large glue surface and interlocking parts. Because the height of the bit and the location

Miters on the router table

A CHAMFER BIT MAKES PERFECT MITER JOINTS

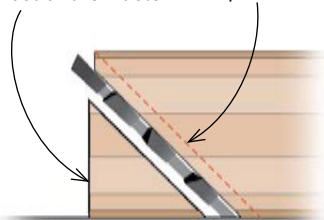
It takes longer to create miter joints using a router, but the cut is cleaner than one made on a tablesaw.



Remove the waste on the tablesaw, then finish with a router bit. Use a router table, where the workpiece can be guided by the fence, not the bearing.

To reduce strain on the router, use the tablesaw to remove most of the waste.

Final routed profile

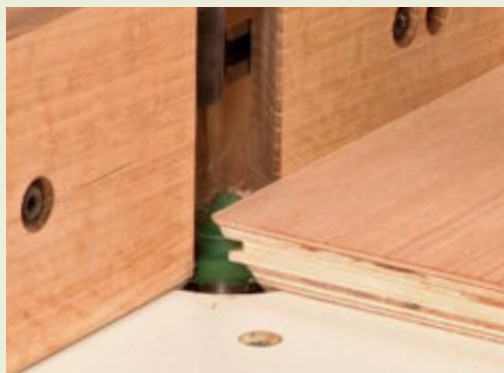
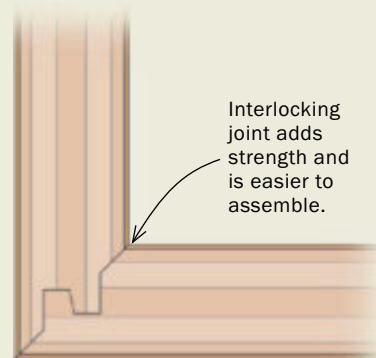


A LOCKING MITER BIT

This router bit offers a specialized variation of the joint: the lock miter. It produces a strong joint with a larger glue surface and self-aligning parts.



Interlocking joint adds strength and is easier to assemble.



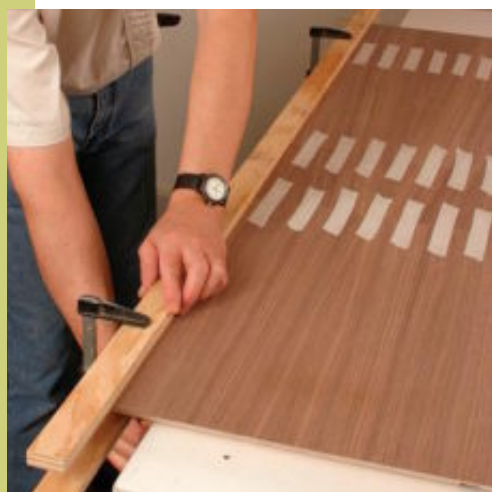
One setup, two different cuts. When using a locking bit to create miters, one piece of each corner is run through the bit horizontally (above), while the adjoining piece is run vertically (right).



Use the tape trick for easy assembly



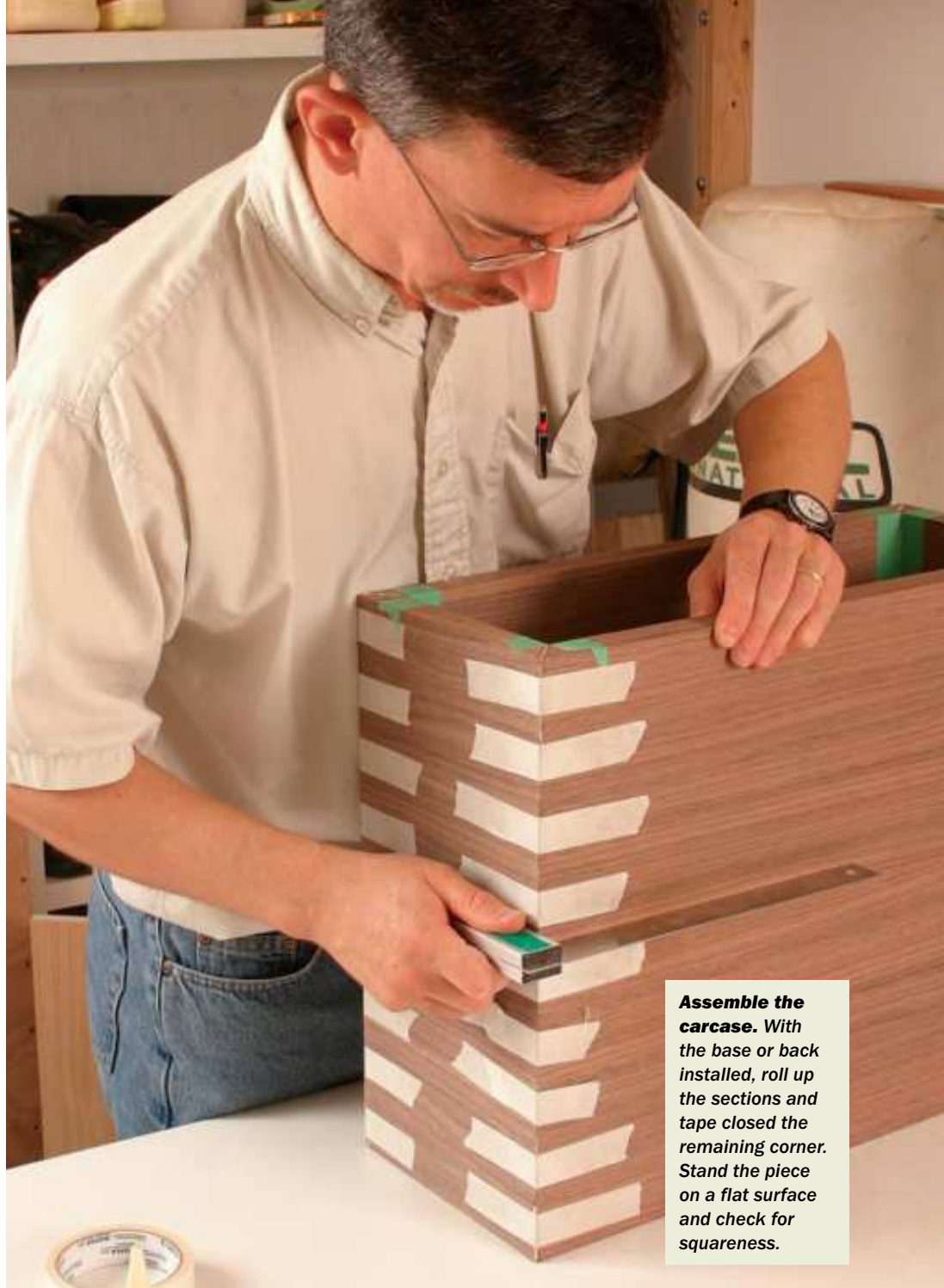
Tape the sections. With the inside of the carcass face down, stretch masking tape across the joints to draw them together. A straightedge at the top aligns the sections.



Flip the boards over. To turn over the sections together, clamp a strip of wood on each side of the top edge.



Glue the miters. Tape the areas adjacent to the inside of the miters to make squeeze-out easy to remove. Apply glue with a roller.



Assemble the carcass. With the base or back installed, roll up the sections and tape closed the remaining corner. Stand the piece on a flat surface and check for squareness.

of the fence must be set exactly, a locking miter bit can be used only in a router table. The pieces should be cut to their final size, and then run past the bit either vertically or horizontally to create the matching sections for each corner.

Assemble the carcass by rolling it up

The best way to assemble a mitered box or carcass is by gluing it all at once. Masking tape makes this possible. Place the four components in line in the sequence front/side/back/side, with the top edges

toward you and the outside face up. Use a straightedge to align the top edges and slide the panels together so that the sharp edges of the miters are touching.

Tape together the three touching joints by stretching short pieces of masking tape across them to create tension, and draw the seam together tightly. To make the assembly stiff enough to flip over to expose the faces of the miters, clamp a strip of wood on each side of the top edge of the panel.

With the inside of the carcass now face up, insert any bottom or back piece and



Reinforce the corners. While the glue is soft, run the shaft of a screwdriver up and down the edge to round over the corners slightly. This closes small gaps and makes veneered corners less prone to catching and tearing.



Peel off the tape. After the glue has set, remove the tape. Pull it across the grain to lessen the chances of pulling away wood fibers.

do a dry run by rolling up the sections. If all is well, lay the sections open again, and run strips of masking tape along the inside edge of each miter joint. The tape will be carefully peeled away after the glue has begun to solidify, removing almost all squeeze-out.

Use a small roller or brush to apply glue to both sides of each miter joint. Then slowly roll up the assembly and apply masking tape to the final, untaped joint. Set the assembly on a flat surface and check that everything is square. Stubborn

joints can be drawn together with band clamps. If you use the locking miter bit, the joints can be clamped with no need for masking tape.

Two ways to reinforce vulnerable corners

Plywood veneer lends itself to miter joints because they conceal the core, but the outside corner of veneered surfaces can chip or sand through easily.

One way to overcome this problem is to burnish the joint. You can use a burnishing tool, but any smooth metal rod such as a

screwdriver shaft will do. Use the tool to rub the sharp corners of the miter joints after the glue has grabbed, but before it dries completely. The sharp edge will be pushed back on itself and will form a small roundover, and the glue will help solidify the burnished corner when it hardens.

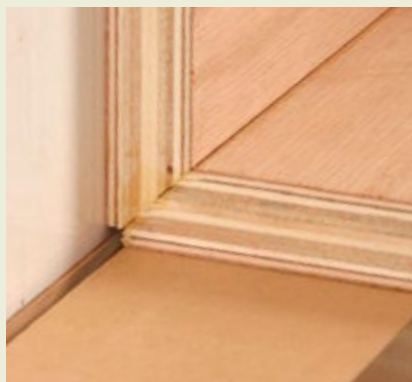
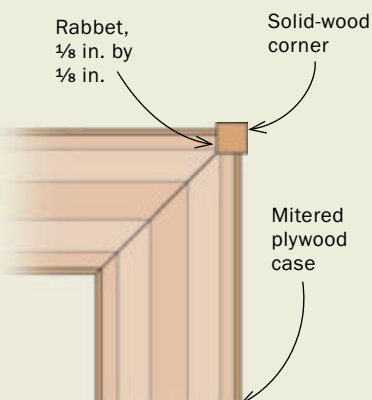
As soon as the joints have dried to the point that they can be handled safely, carefully peel off the masking tape. It's a good idea to peel away the tape in one direction so that it won't pull up the grain of the wood. Burnish the joints several more times as the assembly dries. This process usually will eliminate any gaps in the miter joints that were the result of slight inaccuracies in machining or where the joint was not completely pulled together during clamping. Continue to be very careful when sanding the corner after it has dried or you will sand through the veneer.

Another way to strengthen a mitered corner is to insert a strip of solid wood. It will be almost invisible if the wood and the veneer are the same species and the strip is $\frac{1}{8}$ in. square or less. To create a contrasting design element, use a different species. Once the miter joint has dried, use the tablesaw or router to cut a small rabbet in the corner. Glue on a solid strip that is slightly larger than the rabbet and clamp it with masking tape. When dry, plane and sand it flush with the sides and round over the corner with no danger of sanding through the veneer. □

David Hyatt is a woodworker near Vancouver, B.C., Canada.

SOLID-WOOD CORNER FOR ADDED DURABILITY

To strengthen a mitered corner, a strip of solid wood can be inlaid into it. For an almost invisible joint, use the same species as the sides.



Rabbet the corner. Cut a $\frac{1}{8}$ -in.-sq. rabbet in each corner using the tablesaw or router.



A solid-wood corner. Plane and sand the strip of wood flush with the veneered sides. The corner can then be slightly rounded without risk of cutting through the veneer.

Router-Table Basics

Are you getting the most from this workshop fixture?

BY GARY ROGOWSKI



Contrary to what some woodworkers believe, a router is not the quickest way to ruin a piece of wood. In fact, when mounted underneath a flat table, a router is one of my shop's most versatile and reliable tools.

I began using router tables in the 1970s, shortly after seeing one for the first time and not long after I became a woodworker. The idea was an instant winner: a table or cabinet with a router mounted upside down underneath so that the bit stands straight up through a hole in the surface. The table's broad, flat top and square fence support the work and provide reference surfaces for accurate cutting. It's also easy to clamp blocks to the table for stopped cuts.

The tool's combination of easy use and accuracy has helped transform woodworking, especially for the small shop. With a properly set up table, a woodworker can produce hundreds of feet

of molding in a single shop session. The user also can cut rabbets, dados, and other joinery, and—with the help of templates—can easily replicate shaped furniture parts.

There are a great many things that a router table can help you accomplish. Here are the techniques I turn to time and again for great-looking and accurate results.

Don't bypass the basics

When setting up and using a router table, you'll want to pay attention to a few basics.

Take care to set up the table at a comfortable height that lets you see and control the work. The older I get, the taller I like mine. On store-bought models, check that the mounting insert is flat and level with the table surface. Shim it with leveling screws or pieces of masking tape; if it's not level, you won't get a consistent

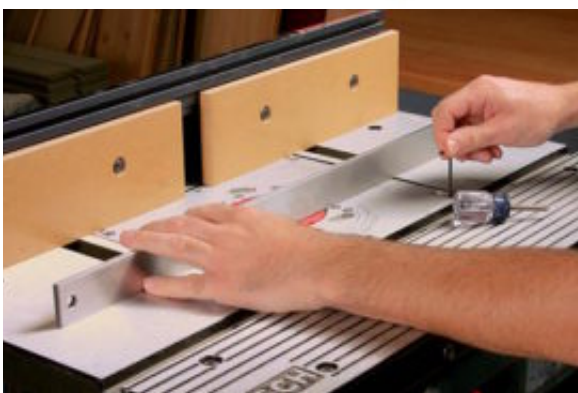
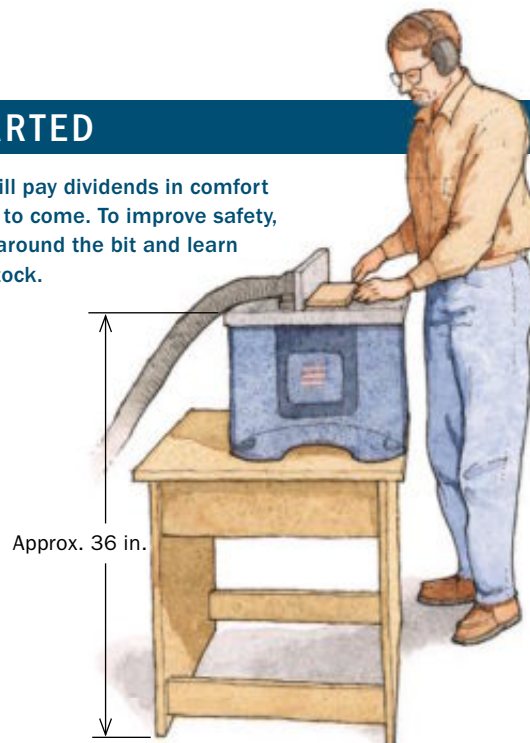


GETTING STARTED

Time spent on setup will pay dividends in comfort and accuracy for years to come. To improve safety, minimize the opening around the bit and learn the right way to feed stock.

GET THE RIGHT HEIGHT

Place the router table at a height that allows you to see and control the work comfortably. A good starting point is around 36 in. to 38 in.



Make sure the insert holding the router is level with the surrounding table. Many store-bought tables are equipped with insert plates that hold the router in the table. Most can be shimmed or adjusted with setscrews.

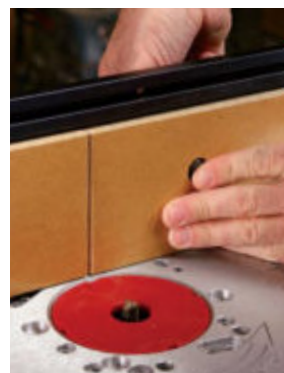
depth of cut. The fence should be flat, straight, and square to the worksurface.

Always make sure that the fence opening is closed as tightly as possible without interfering with the bit. This will ensure the best support for the stock as it passes the cutter.

When feeding stock past the bit, bear in mind a couple of things. First, keep the stock between you and the bit; in other words, don't trap it between the bit and the fence. Move the wood from right to left (into the bit's rotation). The rotating bit will try to pull the work into the fence or into the bearing on the bit, giving you good control and better accuracy. For most operations, you'll feed the work into the bit with your right hand and use your left to hold the piece snug against the fence or table as you move it past the bit.

For safety's sake, never put your hand over the bit area, even if there's wood covering the bit. Bits have been known to drill their way through a board. Also keep your hand away from the exit point on a through cut. Use a push stick with smaller boards and use featherboards with thin stock.

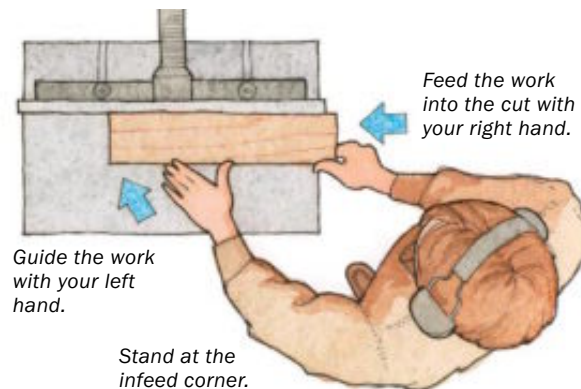
In hardwoods, keep the depth of cut around $\frac{1}{8}$ in. per pass. This avoids burning the stock and saves wear and tear on bits. You can make a deeper pass in softwoods. You'll need to experiment with feed rate, but remember the general trade-off: A slower pass yields



Adjust the fence opening to fit the bit. A narrow gap around a partially exposed bit reduces tearout (left). For a fully exposed bit, close the fence completely so the stock doesn't dive into the gap (right).

PROPERLY FEED THE WORKPIECE INTO THE BIT

The work should move from right to left, so the bit's rotation pushes it into the fence.



Guide the work with your left hand.

Stand at the infeed corner.

MOLDING

Moldings are the most common use for a router table. A few important tips will ensure burn- and chatter-free results.

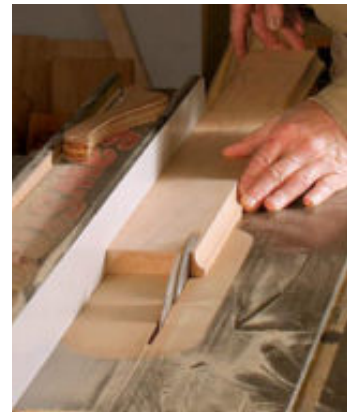


Align the fence with the bearing. For a full-depth cut, the stock should ride the bearing without being pushed away from the fence. Adjust the bit height to make a series of passes.



Wide stock is better.

When possible, cut molding profiles in wide stock to keep your hands safely away from the bit. A heavier workpiece is also less prone to chatter. It's easy then to rip the molding strip from the wider board.



a cleaner cut (especially in tricky grain), but a quick pass avoids burning the stock. End grain is especially susceptible to burning.

Making molding is easy

The router table is great for cutting molding because of its large reference surfaces and because its fixed bit allows you to bring narrow stock to the cutter. Making such cuts with a handheld router is nearly impossible, either because the work is too small or the bit is too large for handheld operation.

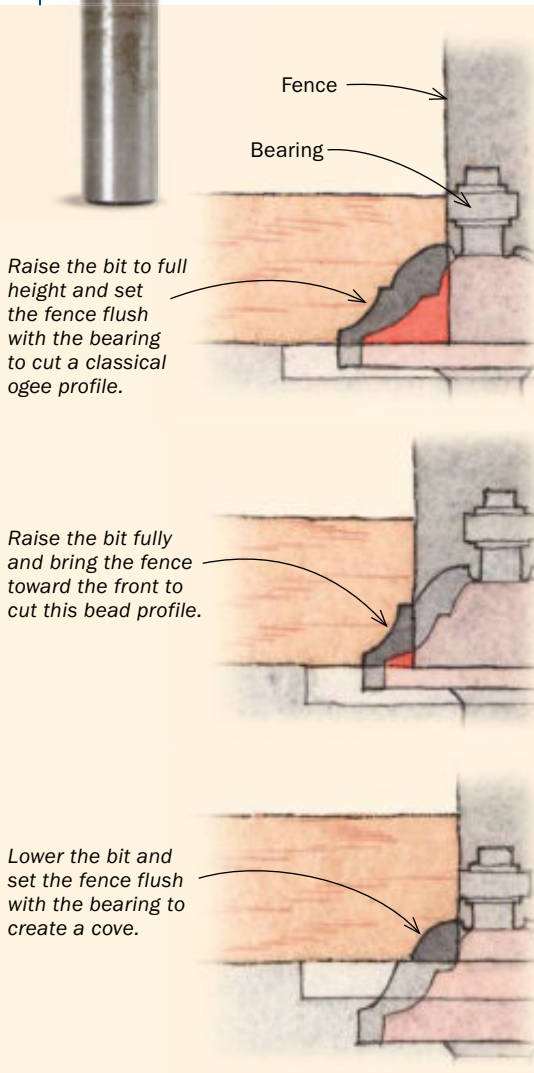
When cutting molding in thin stock, use featherboards to hold the work to the table and fence. This keeps your hands clear of the cutter and makes for a more consistent cut—long, thin stock has a tendency to bow. An alternative is to mill up wider stock, cut the molding profile in the edge, and then rip it to size on the tablesaw.

ONE BIT, MANY PROFILES

A router table's moveable fence and bit give the user a lot of creative freedom. To see this flexibility shine, chuck up your favorite profiling bit and experiment a little. Interesting things are bound to happen.

The advantages are probably most obvious with a multiple-profile bit: Raise the bit and cut a bead on a narrow edge. Move the fence in or out to set the depth of the bead. Lower the bit and cut a double ogee in wide molding stock.

The same principle applies to simpler bits. Roundover, cove, or chamfering bits can cut edge treatments of varying depth and height, with or without small steps (called fillets).



Raise the bit to full height and set the fence flush with the bearing to cut a classical ogee profile.

Raise the bit fully and bring the fence toward the front to cut this bead profile.

Lower the bit and set the fence flush with the bearing to create a cove.

Most edge-forming bits come fitted with a ball bearing on the shank that limits the depth of cut. For a full-depth cut, be sure to align the fence with the front of this bearing to avoid bumping the stock out as it runs up on the bearing.

It's also possible to cut several different profiles using a single bit by altering the bit height and/or setting the fence to expose varying portions of the bit.

Master straight cuts for basic joinery

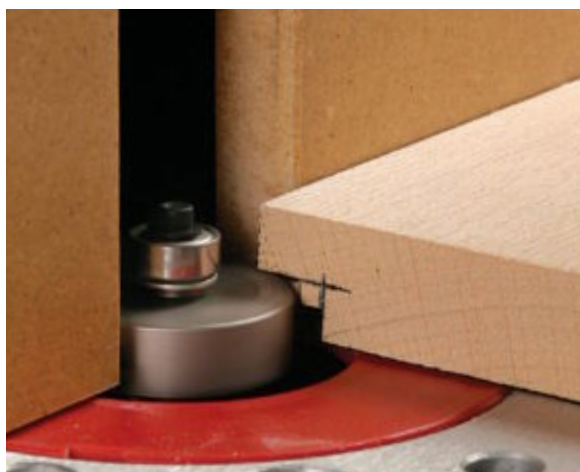
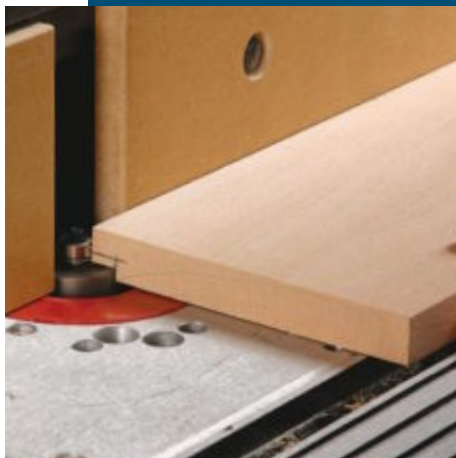
A router table easily makes cuts parallel to an edge using straight bits, which means it is ideal for cutting joinery based on rabbets, dados, and grooves.

Rabbets—With the stock face down on the table, bit height determines the rabbet's depth and fence position controls the width, so a bearing-guided rabbeting bit is not necessary. Don't worry about the fence being parallel to any edge of the router table—the only important issue is the distance to the outside edge of the bit. If you're cutting rabbets deeper than 1/8 in., adjust the bit height to take one or more intermediate passes.

Similarly, when making end-grain rabbets to fashion tenons, set the fence distance to make the proper shoulder cut and adjust the bit height to gradually remove stock from each face. You can speed up the process by first bandsawing away the bulk of the waste. Don't trim too heavily with the router. Remember that any adjustment in bit height will be effectively doubled if you're trimming both sides of the tenon to keep it centered. One way to avoid trimming too much at one time, especially when sneaking up on a snug fit, is to

RABBETS

Rabbets are easy on all but the largest panels. For accuracy, be sure to keep the workpiece pressed against the table as it passes by the bit.



Cut rabbets in passes. Set the fence at the shoulder width and raise the bit incrementally.

TENONS

To cut tenons on the router table, use the fence as a stop and the miter gauge to keep the stock square.

Set the fence to the tenon's full depth and work toward it in several passes.

Take several passes over a straight bit to cut the tenon.

Tenon



A tenon is a pair of end-grain rabbets. Any cross-grain cut will tear out as the bit exits the wood. Avoid this by using a sacrificial board on the miter gauge to support the fibers at the end of the cut.

DADOES

Like rabbets, dadoes are easy on the router table in all but the largest panels. Keep the workpiece pressed down to cut an accurate depth.



Router fence keeps dado cuts straight. For dadoes that are near the edge of a workpiece, use the fence to guide a clean and straight cut.



Remove the fence for interior dado cuts. A miter gauge with an attached fence keeps the cut straight.

CUT A DADO WIDER THAN THE BIT

If you need a custom width or have a limited bit selection, you can get multiple widths simply by adjusting the fence between passes. But if you're making a lot of repetitive cuts, it's quicker to use a spacer between the fence and the workpiece. Make the first pass with the spacer in place and the second without it. The spacer's thickness should match the width you want to add to the cut.



add a paper shim under the stock. If the fit is still too tight, then remove the shim and make another pass.

Dadoes—You can use a router table to cut dadoes in short stock to support shelves or as part of a dado-rabbet joint for light carcass construction. Again, be sure to back up the cut to prevent tearout. The router table can't handle very wide or very long workpieces. As with rabbets, make multiple passes for deeper cuts. Be aware that most plywood is thinner than standard bit sizes, but special undersize bits are available. You also can use a smaller standard bit and make multiple passes (see photos, left).

Grooves—The router table can cut straight grooves in the edges of relatively thin stock, such as rails and stiles for a frame-and-panel door or tongue-and-groove joinery in slats for a cabinet back. With a straight bit, cut grooves with the stock held on edge. Or you can cut long grooves and tongues faster and more cleanly with a horizontal slot cutter, keeping the work flat on the router table and centering the grooves and then resetting the bit height to cut shoulders for the tongues.

Clamp blocks to the fence for stopped cuts

Stopped cuts are used in a variety of ways, such as housing drawer bottoms or hiding joinery for shelving or drawer dividers. A router table is ideal for cutting these joints because its fence is the perfect attachment point for stop blocks that define the limits of the cut.

First, mark your stock to indicate the end points of the stopped cut. Next, mark the diameter of the bit on the fence. The cut begins with the work braced against a stop that is clamped to the right-hand side of the fence. To locate this stop, set the workpiece so that the mark indicating the start of the cut is aligned with the mark on the fence at the left-hand side of the bit. Now clamp a stop block to the fence at the trailing end

of the board. The procedure for locating the left-hand stop is essentially the reverse of this.

Start the stopped cut, pushing the workpiece tightly into the rear stop and gradually lowering it onto the bit. Then move it along the cut until you reach the other stop. Push against the forward stop and fence as you rotate the board up and out of the bit. Use a chisel to square the ends of the cut to the marked end lines.

Cut cross-grain first when raising a panel

To raise a panel on the router table, I use a straight rabbet cut; others make a traditional raised-panel bevel. In either case, make the cross-grain cuts first, then the long-grain cuts. This ensures that the long-grain cuts will remove cross-grain tearout. For thicker panels, make a series of passes to get to the final depth.

There are a number of specialized panel-raising bits for use in the router table. Some profiles come in large-diameter sizes only. Be careful using these bits—dial down the speed to keep vibration and wear-and-tear on your router to a minimum. Hold the workpiece flat to the table when passing it by the bit.

A better choice is a vertical raised-panel bit. These bits have a smaller diameter because the profile runs vertically. With this cut, you hold the workpiece upright against a tall auxiliary fence while the bit is captured inside the fence.

Start with a straight bit for sliding dovetails

Sliding dovetails are typically used for shelf support or drawer construction. For a 1/2-in.-wide sliding dovetail, first remove some waste from the female cut with a 1/4-in. straight bit. Set up the fence so that the 1/4-in. bit is centered exactly in the dado, and use a backer board

GROOVES

The router table offers excellent support for small workpieces such as door parts. Use push sticks to keep fingers out of harm's way.



Through grooves. Set the fence to position the bit in the middle of the stock. Then run the piece once in each direction. Any slight error will be mirrored, ensuring a perfectly centered groove.



Stopped grooves. Mark the outside edges of the bit on the fence. Measure from there and clamp the stop blocks in place. Lower the work onto the bit. When you reach the front stop, brace against it and raise the work. If your bit has no center cutter, move the work back and forth until you're down to depth.



PANELS

A vertical panel-raising bit is lighter than the horizontal type, reducing vibration and wear on the router when raising a panel.

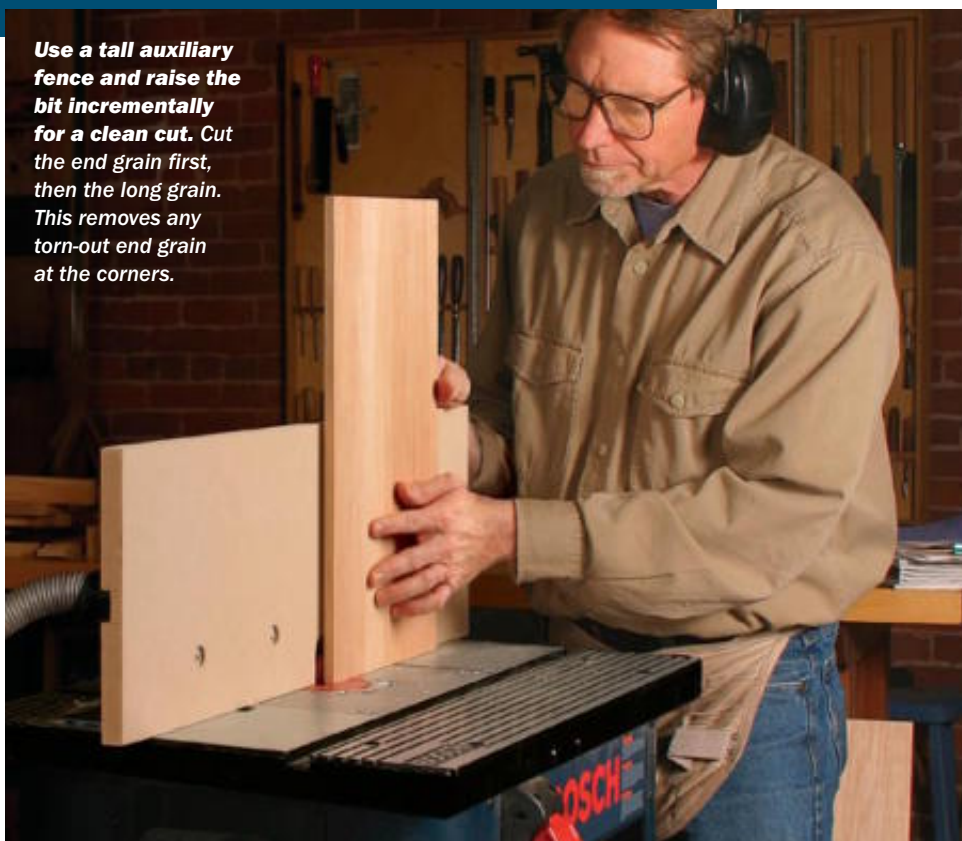


To avoid tearout, make cross-grain cuts first.



Finish with long-grain cuts.

Use a tall auxiliary fence and raise the bit incrementally for a clean cut. Cut the end grain first, then the long grain. This removes any torn-out end grain at the corners.



SLIDING DOVETAILS

If the sliding dovetail is at or near a corner, such as on a drawer, the router table handles both parts perfectly.

QUICK DRAWER JOINT

A sliding dovetail joint is easily made with a straight bit and a dovetail bit.

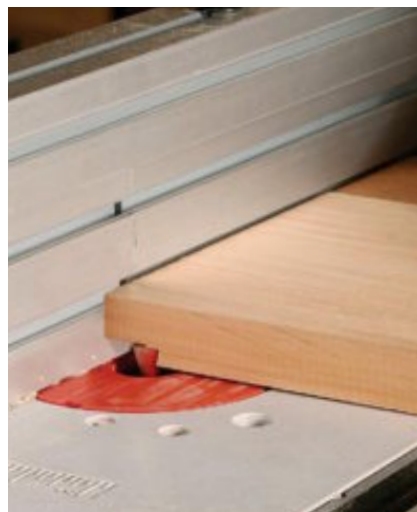


Start the socket with a straight bit to hog out the waste. Switch to a dovetail bit and cut the socket in one pass (above). Don't change the bit height. Cut the tail with the bit set into the fence, cutting each side in turn and sneaking up on the fit (right). Use a backer board to eliminate tearout.

if it is a through cut. Then mount the dovetail bit to the full depth of cut and make that pass. It will be centered where you need it. Keep the board flat as it goes over the bit. The matching cut is made with the board held vertically against the fence, without changing the bit height. Move the fence to capture most of the bit, and then adjust the fence to take light cuts until the boards just fit together by hand. The joint tends to jam, so tap the pieces apart carefully with a hammer.

A CLOSE RELATIVE

The rabbeted dovetail is a half-version of a sliding dovetail, reinforced with dowels.



A well-dressed rabbet wears dovetails. Use a dovetail bit to cut a pair of mating rabbets for an elegant corner joint.



A carcase joint—the rabbeted dovetail—is easily made with a dovetail bit. Use the bit to cut two mating end-grain rabbets to form a corner. The joint is an attractive way to attach a light-duty drawer front, but it has little mechanical strength. I add dowel pins.

To make the first cut, hold the board flat to the table and put a backer block behind it to prevent tearout. Again, the matching cut is made without adjusting the bit. The bit is captured in the fence so that only a



TEMPLATE ROUTING

A template makes it easy to duplicate curved pieces exactly. The bit's bearing follows the template as the cutter trims the workpiece to match.

Sandwich the workpiece in a jig with a template clamped to the top. Be sure to cut close to the final shape on a bandsaw first, so that the router bit need take only a light pass.



portion peeks out. Holding the workpiece vertically against the fence, move it across the bit. Check the fit and adjust the fence accordingly.

Templates simplify shaping multiple parts

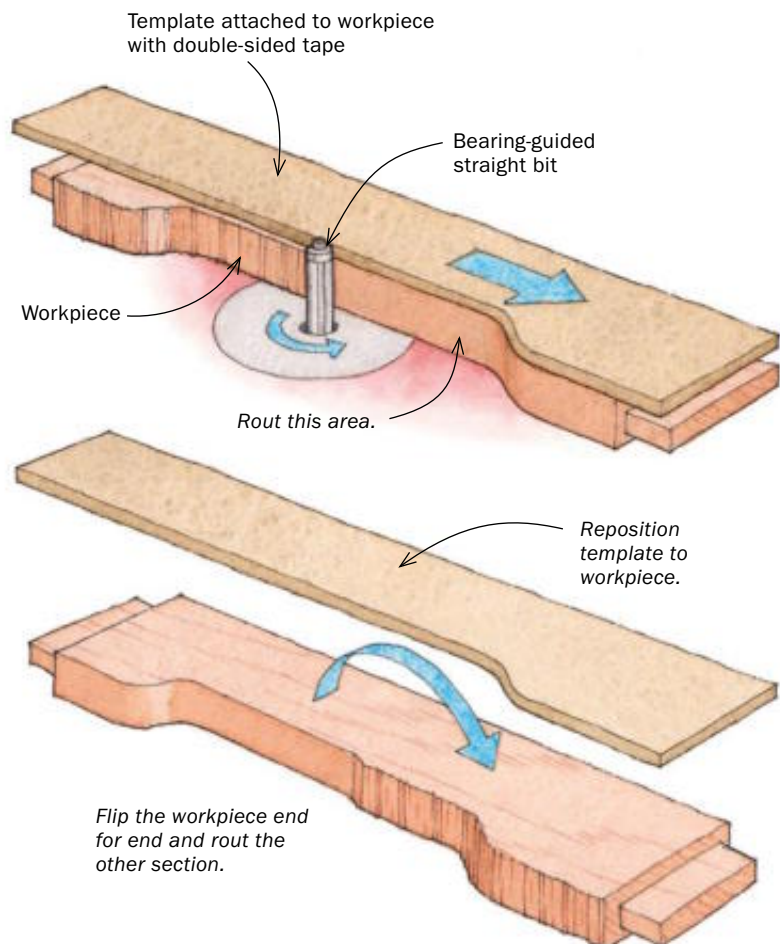
The ability to make curved and shaped parts is essential to fine woodworking, and the router table offers the fastest and most repeatable approach. You'll need an accurate template. Draw or trace your design on a sheet of thin stock such as $\frac{1}{4}$ -in. plywood. Trim away the waste on the bandsaw, staying about $\frac{1}{16}$ in. proud of the lines. Then trim carefully to the lines with a spokeshave, spindle and/or drum sander, or files, rasps, and sandpaper. Any imperfections in the template will be reproduced in the finished piece, so be sure to produce a smooth edge that matches the layout lines.

Before template routing, cut the workpiece close to its final shape on the bandsaw so that you're taking only a light pass with the bit. Templates should be fastened securely to the workpiece with brads, double-sided tape, or clamps. I use quick-action clamps to lock my work and template to a holder. I pass the entire assembly past a bearing-guided, flush-trimming bit to clean up the part. Set the bit height so that the bearing on the bit rides against the template. If the curve is symmetrical, there may be areas where you are cutting against the grain. This can cause major tearout. With my clamping system, I can rout the curve halfway, stop, flip it over, and then rout the other side of it, always cutting downhill or with the grain. □

Gary Rogowski, a contributing editor, runs *The Northwest Woodworking Studio* in Portland, Ore.

AVOID TEAROUT WHILE TEMPLATE ROUTING

Flip the workpiece end for end to avoid routing uphill and tearing out the grain on the wood.



Choosing and Using Casters

What casters work best in which workshop applications, and how to build two versatile bases

BY JOHN WHITE

Small shop or large, most woodworkers find it makes sense to put some machines and fixtures on wheels. Whether it carries a benchtop planer, a worktable, or a wood rack, a rolling workstation not only frees up space; it helps you line up your tools—and your materials—more efficiently for specific jobs.

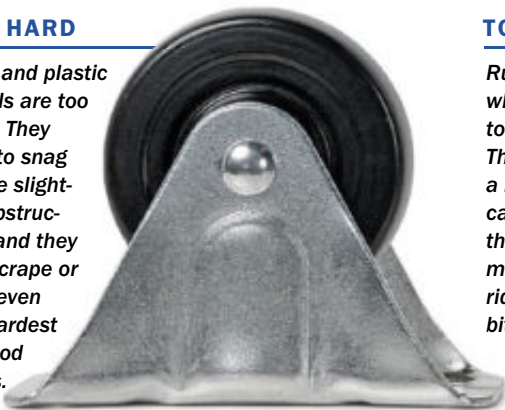
However, if you're like me, you know these little wheels can also cause big problems. They can leave a power tool restless, fidgeting when you want it to stand still. Poorly designed or poorly loaded, they can make their cargo tippy. They can stop on a dime—or a sliver of wood—while you're gliding from A to B; and they can wreak havoc on your shop's new hardwood floor.

So how do you get the most out of a set of casters? Simple. Choose the right ones for the job at hand, and mount them properly on the base of the tool or fixture

WHAT TYPE OF WHEEL?

TOO HARD

Steel and plastic wheels are too hard. They tend to snag on the slightest obstruction, and they can scrape or dent even the hardest of wood floors.



TOO SOFT

Rubber wheels are too soft. They have a low load capacity and their "give" can make what's riding on them a bit tippy.



JUST RIGHT

Urethane wheels are just right. They're soft enough to climb over small obstructions, yet hard enough to keep the load stable.



WHAT SIZE?

Use this chart to decide how big the casters should be for your specific job.



LOAD WEIGHT	TYPICAL USE	Smooth Floor		Rough Floor	
		WHEEL DIAMETER	RATING	WHEEL DIAMETER	RATING
Less than 200 lb.	Thickness planer, drill press, miter saw, sanding station, furniture dolly	4-5 in.	75 lb.	5 in.	75 lb.
200-400 lb.	Large cabinet, tool cart, small clamp rack, assembly table	5 in.	150 lb.	5-6 in.	150 lb.
More than 400 lb.	Large clamp rack, sheet goods rack	5-6 in.	250 lb.	6 in.	250 lb.

they support. Casters come in a wide variety of sizes and styles, but for most workshop applications you need only consider those most commonly offered in woodworking catalogs. Here's what you should know.

Key factors: rolling, steering, stopping

You'll find casters with a range of tire materials, from soft rubber to rock-hard steel or plastic wheels. My advice is to stick with Mr. In-Between: urethane. It's the same material used for skateboard wheels. Tires made of this synthetic material have enough "give" to climb over wood chips; they have a good load capacity for their size and cost; they're stable; and they hold up well.

Bigger is better—Although they are pricier, larger wheels roll easier and can handle more weight. I've found that any wheel under 4 in. dia. catches too easily on cracks or seams in a floor, or on the small wood chips and even sawdust that always seem to be underfoot. For most applications, a 4-in. or 5-in. wheel will work well, although you may need to go to a larger diameter to handle very heavy items, like a lumber rack. If your shop floor is plywood or hardwood, choose larger-diameter and wider wheels to prevent floor damage.

Casters have a rated capacity for the weight they can handle, but, like power-tool horsepower ratings, caster load ratings are suspect. To avoid problems, choose a set of casters that, combined, are rated to handle

they support. Casters come in a wide variety of sizes and styles, but for most workshop applications you need only consider those most commonly offered in woodworking catalogs. Here's what you should know.

SWIVEL OR FIXED?

Swivel-based casters (left) offer the most mobility. They allow you to turn the load in any direction. Fixed-base casters (right) keep you on the straight and narrow. They eliminate side-to-side movement, allowing only front-to-back.



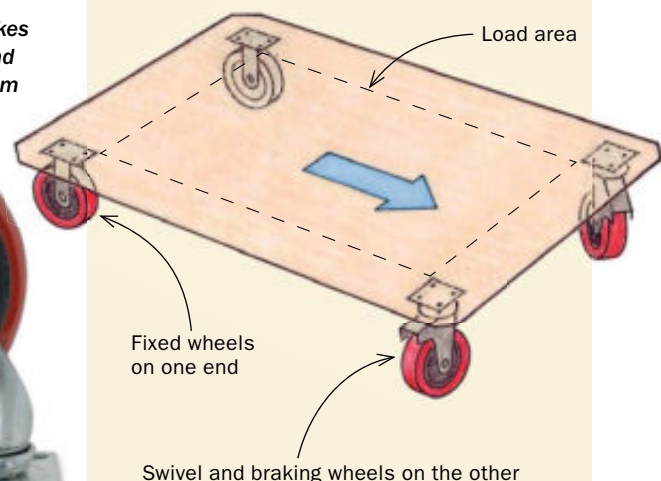
BRAKE OR NO BRAKE?

Brakes help stabilize the load. If you need a caster-mounted tool or assembly table to stay put, you need brakes on at least two of the casters. Single-lock brakes (below, left) keep the wheels from turning on their axles. Double-lock brakes (below, right) do that too, and also keep swivel casters from swiveling.



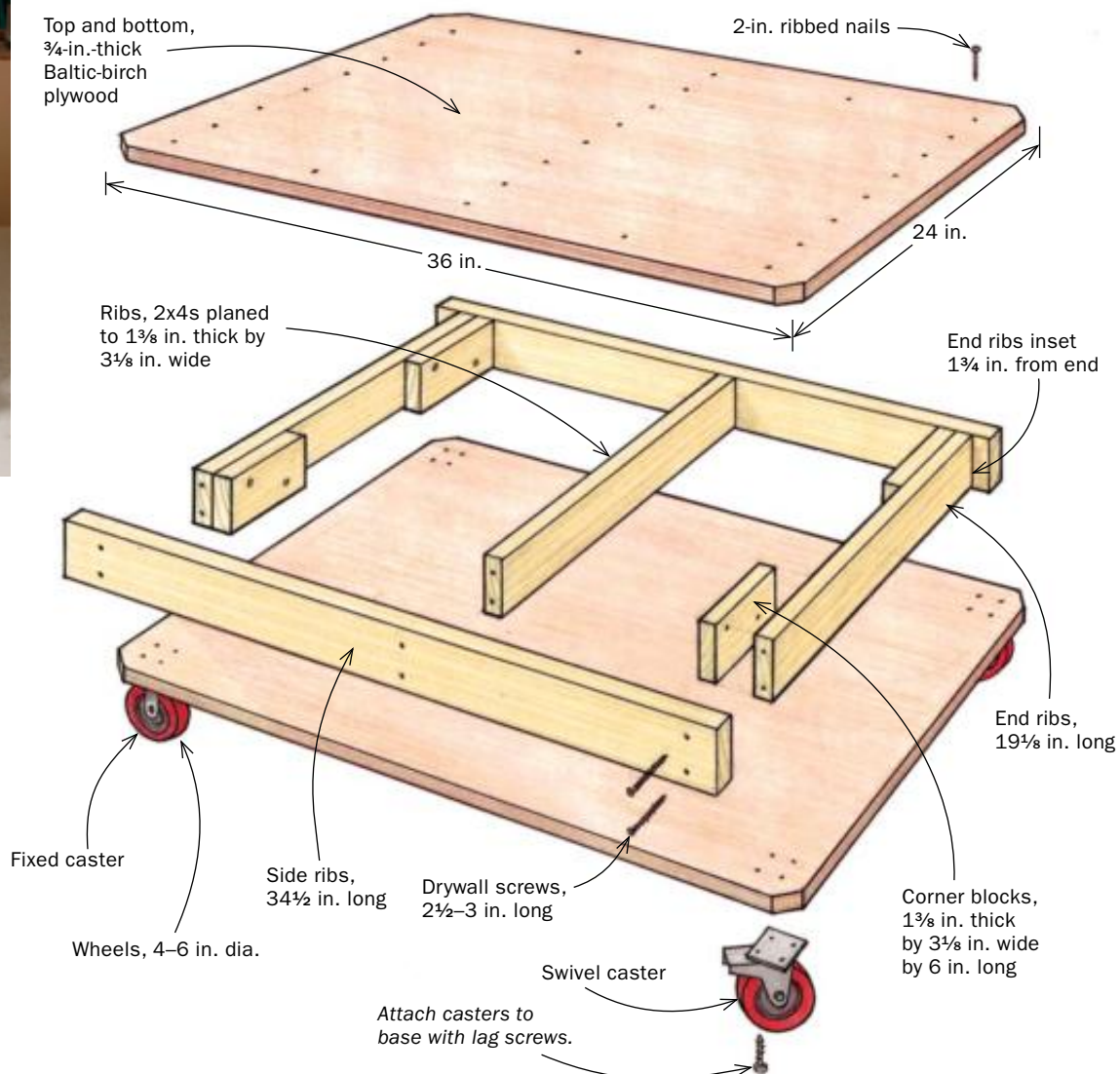
THE "SHOPPING CART" SETUP

By far the most common configuration is two fixed casters on one end or side and two swivel casters on the other. This gives the unit both movability and stability (think shopping cart). The platform base should be about 6 in. wider and longer than the base of the load it carries, so the footprint of the wheels, even at their innermost positions, is not narrower than the load base.





Platform base



Use a torsion-box base for furniture dollies, assembly tables, tool carts, floor-standing machines, and shop fixtures such as clamp and sheet-good racks. For stability, install the casters as close to the corners as possible. Here's a common 24-in. by 36-in. base, but yours should be sized to your needs.

MAKE A PLATFORM BASE

Attach corner blocks to support casters. Corner blocks on this basic torsion box provide a structure where the casters are attached. White attaches the blocks with countersunk 2-in. drywall screws.



Seal the "skin" with adhesive. Before attaching the base top and bottom, apply a thin bead of construction adhesive to the frame. Nail on the plywood "skins" with 2-in. ribbed nails, spacing them about 4 in. apart.



at least 50% more weight than they'll actually support. Overloading casters will make them hard to roll, even harder on your floor, and quick to wear out.

Combine fixed and swivel—Your next consideration is whether to use fixed or swiveling casters. In 99% of shop applications, you should use two fixed and two swivel casters, the same arrangement used on shopping carts. The pairing of the two types makes it easy to steer the unit around the shop. With swiveling casters on all four corners of a base, the table or machine they support will be difficult to steer and less stable when parked.

The opposite setup, fixed casters on all four corners, obviously can't be steered. But it is useful in situations where a machine or fixture would only have to be pulled straight out from a wall and then pushed back when it was no longer needed.

Double-lock is best—The final consideration is whether to use casters with brakes; and, if so, whether to use the single- or double-lock type. A single-lock brake only prevents the wheel from spinning on its axis, leaving a pivoting caster free to shift from side to side. A double-lock brake stops the wheel from spinning and from swiveling on its pivoting caster. For carts and racks, either no brake or a single-lock brake is all you need. For casters under worktables and machines, use double locks to create a more stable, shift-free surface.

The best double-lock models use a foot pedal that projects over the wheel and bears directly on the tire. The other type of brake, a small lever that pivots on the caster's axle bolt, is hard to set and usually fails to lock the wheel solidly.

Now attach them correctly

None of the above means anything, of course, unless the casters are attached to a base that can support them and the load they'll carry. The base must be strong and stable, while allowing access to the brake mechanism and leaving room for the swiveling casters to pivot 360°. All of these conditions are best met with a base whose casters are as close to the corners as possible. I've come up with two simple base designs, one for platforms and the other for cabinet-style units. The designs are easy to build, locate the



PLATFORM BASE IN ACTION

The platform base is sturdy enough to carry the largest of work-shop loads. White uses 4-in. casters for medium-size loads such as this project rack (above). He uses 5-in. casters under the base supporting his sheet-goods rack (right).



When the load is large, use two bases. Moving a large piece of furniture or equipment might require two platforms. Use turnbuckles to link the sides with the fixed casters, leaving the swivel wheels on the ends for maneuverability.



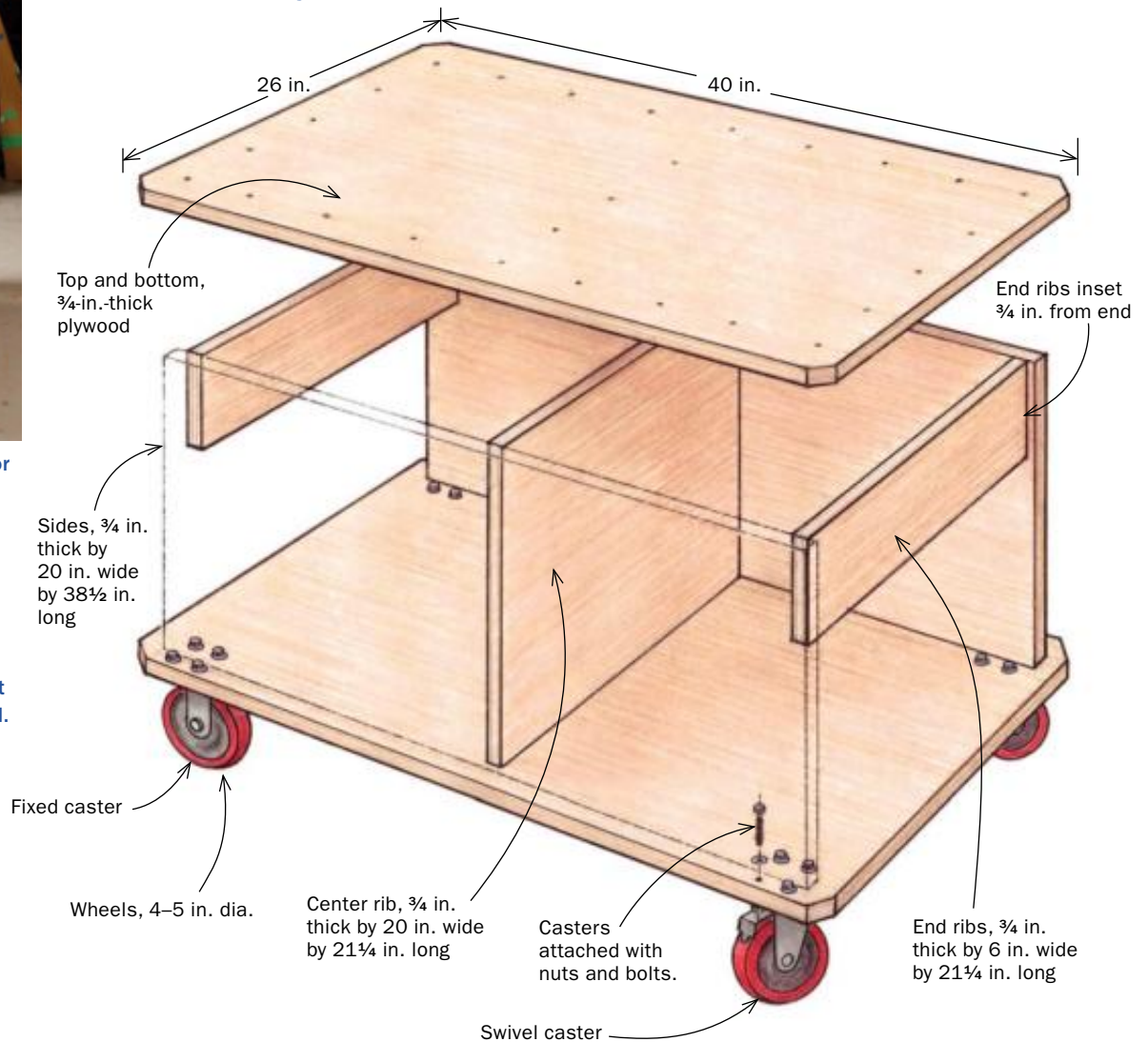
Attach the casters. White uses 1½-in. lag screws to attach the casters securely to the base. Typically, the corner blocks will support lag screws for only three of each caster's mounting holes, but that's enough.



Cabinet-style base



Use this cabinet-style base for bench-mounted tools, such as thickness planers, drill presses, and miter saws. It's made entirely of Baltic-birch plywood. This 26-in. by 40-in. base is sufficient for most benchtop tools. Once again, modify measurements to suit the size of the base you need.



MAKE A CABINET-STYLE BASE

Simple butt joints suffice.

There's no need to put the cabinet base together with dadoes, rabbets, or even glue. Just make sure the edges are square, mark the screw locations carefully, predrill and countersink the holes, and attach with 2-in. deck screws for a better grip in the plywood end grain. (Note: To prevent splitting, predrill the holes all the way into the plywood end grain. Use a tapered bit, or start with a bit narrower than the screw diameter, then widen the hole in the surface piece only.)



casters properly, and are adapted easily to almost any workshop application.

Building a platform base—The platform-style base is basically a torsion box in which the thickness of the plywood skins requires only a few cross-braces to create a very stiff assembly (see photos, pp. 78-79). The plywood top and bottom faces overhang the 2x4 frame slightly to simplify the construction and to allow beveling of the corners. The frames are assembled with drywall screws or nails and the plywood is attached with construction adhesive and nails. The casters are attached with lag screws drawn into the frame and corner blocks. This base can serve as built as a platform for furniture or tools, or it can have racks for clamps or lumber attached.

Building a cabinet base—The second design is for a cabinet-type base that could be used as a stand for a benchtop power tool or as an assembly or outfeed table, with storage underneath. The heart of the design is the inset sides that place the weight of the sides and top directly over the centerline of the casters and allow the casters to be right out at the edge of the bottom panel for the widest and most stable base. Built from cabinet-grade plywood, the base is sturdy and very simple to construct; all of the elements are just simple rectangles joined by drywall screws. To prevent the box from racking, each of the open ends of the cabinet will need either a face frame or a rib supporting the top. Once the basic box is built, any combination of drawers, open compartments, and doors can be added to suit the unit's function.

When choosing the dimensions for either style of base, keep in mind that the actual footprint of the casters will be narrower than the platform. This can make the unit tippy unless you add a few extra inches to the width of the base to compensate. For instance, if a tool stand resting directly on the floor would be stable at 18 in. wide, the equivalent unit on casters will need to be around 24 in. wide to be as stable. □

John White is the shop manager for Fine Woodworking.



CABINET BASE IS VERSATILE

White dedicates one cabinet base to his downdraft table (above), which carries its own shop vacuum. Another serves as a platform for several machines. In addition to the thickness planer, White uses this type of cabinet base to support both a router table (right) and a drill press.



Attach casters with bolts. Because the bottom is one piece of plywood with no corner blocks, the cabinet-base casters are attached with bolts and nuts, not lag screws. White uses a locking compound or nuts with nylon inserts to keep the bolts tight.

SOURCES OF SUPPLY

Grizzly Industrial Inc.
800-523-4777
www.grizzly.com

Hartville Tool
800-345-2396
www.hartvilletool.com

Rockler
800-279-4441
www.rockler.com

Woodcraft
800-225-1153
www.woodcraft.com

Woodworker's Supply
800-645-9292
www.woodworker.com

Precision

The miter shoot allows you to plane components for a perfect fit

BY TOBY
WINTERINGHAM

“What’s that?” asked Peter Korn, looking at the thing clamped in the tail vise of my bench. The object was a screw miter shoot that I use on almost every project. Korn, director of the Center for Furniture Craftsmanship in Maine, had come to my shop to invite me to teach at the school. When I accepted, he asked if I would bring my miter shoot. “No,” I replied, “but I’ll make one for you while I’m there.”

In my workshop, students make a miter shoot as their first task. It teaches them the importance of accuracy, care, and respect for tools, and they leave with a jig that will benefit them throughout their careers.

The miter shoot consists of two working surfaces aligned at 45° and 90°. The former is used to true up miter joints; the latter, to square up tenon shoulders and cheeks.

I can’t claim credit for inventing this tool. As a student at the Royal College of Art in

GOOD FOR MORE THAN MITERS

Although the jig is known as a miter shoot because it can be used to trim joints at precisely 45°, the opposite side is set at 90° and can be used to fine-tune mortise-and-tenon joints.



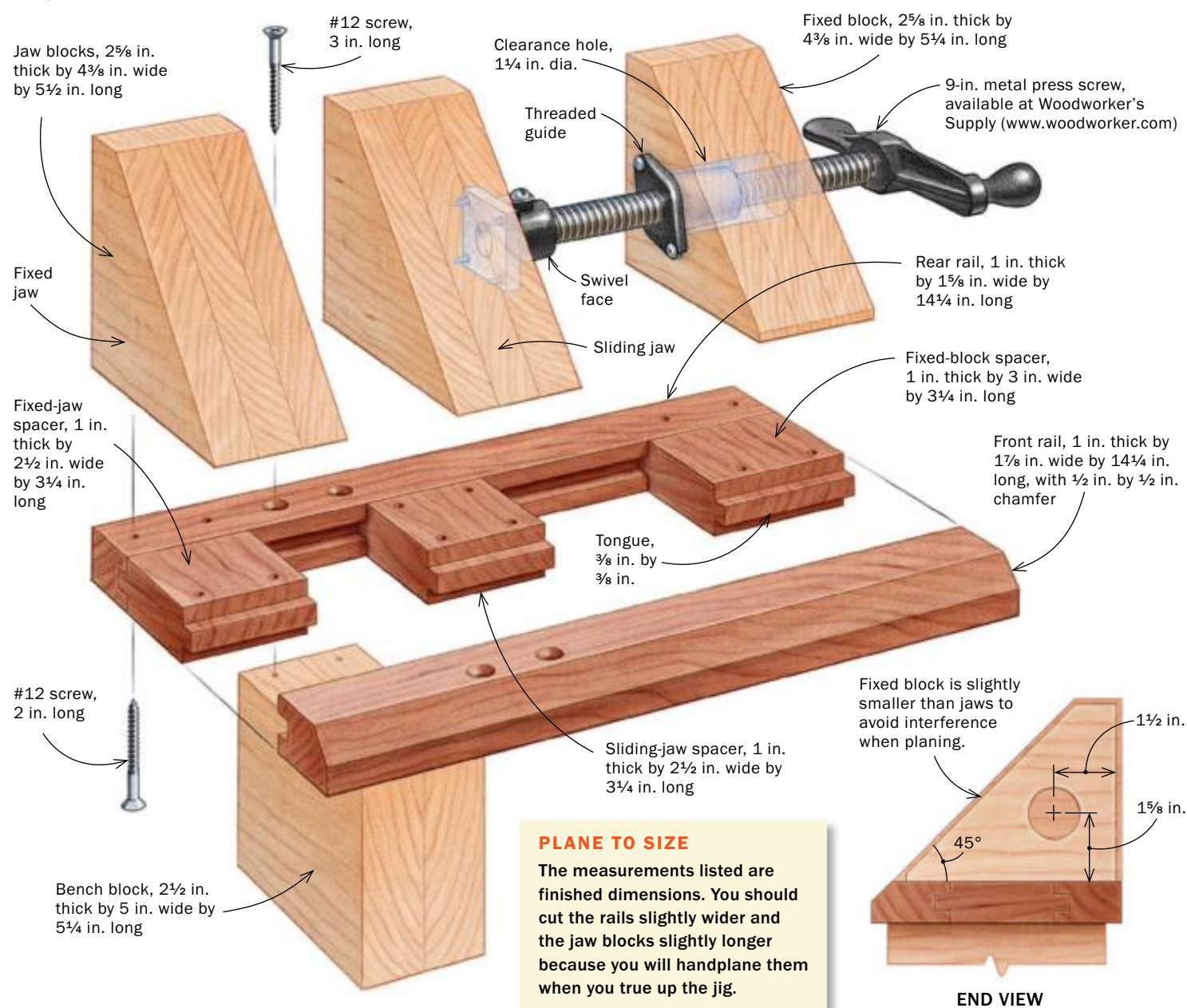
Master the miter. Use the shoot to true up parts for miter joints. The base prevents tearout on the outside edges.



Tame your tenons. A shoulder plane can be used on its side (left) to trim a tenon’s cheeks. Used vertically (right), it can trim and square the tenon shoulders.



Jig for Precise Joints



London, I discovered a decrepit one gathering dust under a bench. Even in poor condition, the jig was so much better than a bench vise for trimming miters that I decided to build one for myself.

The base has a sliding block

The shoot consists of a metal press screw attached to a fixed block; a pair of wooden jaws, one of which slides along a tongue-and-groove base; and a block attached to the underside of the base that mounts in a bench vise. I quickly realized that the

secret to this tool is accuracy: The sliding jaw must run smoothly on the base with no sloppiness. Time invested in construction will pay dividends during use.

The base consists of two rails separated by three spacer blocks. The middle block slides up and down the rails. The easiest way to cut the tongue-and-groove joinery is with a rabbeting bit in a router table, but you also could use a dado blade on the tablesaw. In either case, the three spacers must start out identical in length to keep the rails parallel. Then take a thin shaving

off the shoulders and the cheeks of the center spacer, just enough that it will slide while keeping the fit snug. A little wax on the final assembly also helps. When you are certain that you have the right fit, glue the end spacers to the rails with the sliding spacer between them. After glue-up, plane the base perfectly flat.

Fit the jaws and install the metal screw

Although you can make the fixed block and the two jaws from any tight-grained 12/4 or 10/4 hardwood, it is cheaper to

1 MAKE THE FRAME AND ATTACH THE FIXED JAW



Dry-fit the base. Before you glue the two end stretchers to the rails, check that the center stretcher will slide freely but with minimum play.

Create the jaw blocks. After flattening and squaring the laminated stock for the jaws and the fixed block, make the 90° and 45° crosscuts. You might have to screw on a piece of scrap to handle the short blocks safely.



laminated three pieces of 4/4 wood. This also results in less wood movement. After the glue has dried, mill and handplane the sections perfectly true and square—the sides must meet at exactly 90°. Then make the 45° and 90° cuts on the miter saw or the tablesaw, leaving the jaws slightly oversize. Later you will handplane them flush with the base.

On the drill press, drill and countersink holes on the underside of the base for attaching the jaws and the fixed block. On the top of the rails, drill holes for the bench block (see drawing, p. 83). While at the drill press, drill a hole in the fixed block to accept the threaded guide of the press screw. I locate the hole just below center—nearer to the rails to lessen the chances of the jaws skewing on narrow pieces. Don't install the guide just yet.

Both blocks and jaws are attached to the base with long woodworking screws. Because I don't use glue, I can dismantle the miter shoot if it needs adjustment. The easiest way to attach the fixed block to the base is to clamp the block in a vise, then clamp the base to the block. Extend one hole into the block, drive in a short screw, and use a good square to make sure that the block is perpendicular to the long sides and the face of the base. Complete the other three holes one at a time, installing long screws and constantly checking the block for squareness. Finally, replace the first screw with one of the correct length.

Repeat these steps with the fixed jaw. If the fixed jaw is aligned correctly, you can clamp the sliding one to it while fitting its screws. It is still worth checking as you go, because screws tend to pull one way or another. I set the sliding jaw just over the



Attach the fixed block and fixed jaw. With the block held in a vise, insert a short screw into the block through predrilled holes in the base (left). Check that the block is square to the base (right), and then insert longer screws into the three remaining holes before replacing the first screw.



Add the hardware. Detach the fixed block from the base, insert and screw on the threaded guide, then reattach the block.

2 ADD THE SLIDING JAW AND SCREW

Attach the sliding jaw. After you have screwed the fixed jaw to the base, clamp the sliding jaw to the fixed jaw and screw it to its sliding spacer.



Add the swivel face. Screw the threaded rod through the guide to see where to attach the swivel face to the sliding jaw.



Screw on the bench block. A block of wood, screwed to the two rails of the base, holds the miter shoot in a bench vise.

edge of the sliding block so that the jaws make contact but the spacers don't.

Lightly hammer the threaded guide into the fixed block and secure it with screws. Insert the threaded rod, screw on the removable swivel face, and place it against the sliding jaw. Find the location that allows the rod to run true. If there is any angle, the thread will bind as the jaw slides.

Attach a large block to the back of the miter shoot, screwed through the top and bottom rails. This allows the miter shoot to be clamped in either a tail or front vise with either the 90° surface or the 45° surface

faceup. Finally, use a handplane to true up the jaws in line with the base, keeping the surfaces flat and square. Again, the secret is accuracy; so take your time.

How to use your miter shoot

Take care when you first use the tool. In time, you'll get a feel for the crucial last stroke of the plane that brings the workpiece level with the miter shoot, and will avoid the next pass that planes the surface of the shoot. Used correctly, the surfaces of the jaws do not get worn quickly. I only true up mine once a year.

To true up tenons, fit the workpiece between the jaws with the shoulders fractionally proud of the surface. A few strokes with a shoulder plane will clean up the shoulders and bring them to an even height. Then, with the plane on its side, check that the tenon's faces are square.

Miter joints will lose their terror now that you can plane each component flat and true without the risk of tearout. □

Toby Winteringham is a woodworker in Norfolk, England. You can see his work at www.tobywinteringham.co.uk.

3 SQUARE THE JAWS



True up the miter shoot. After the tool has been assembled, the two working faces of each jaw must be planed flush with the base while keeping them flat and square.



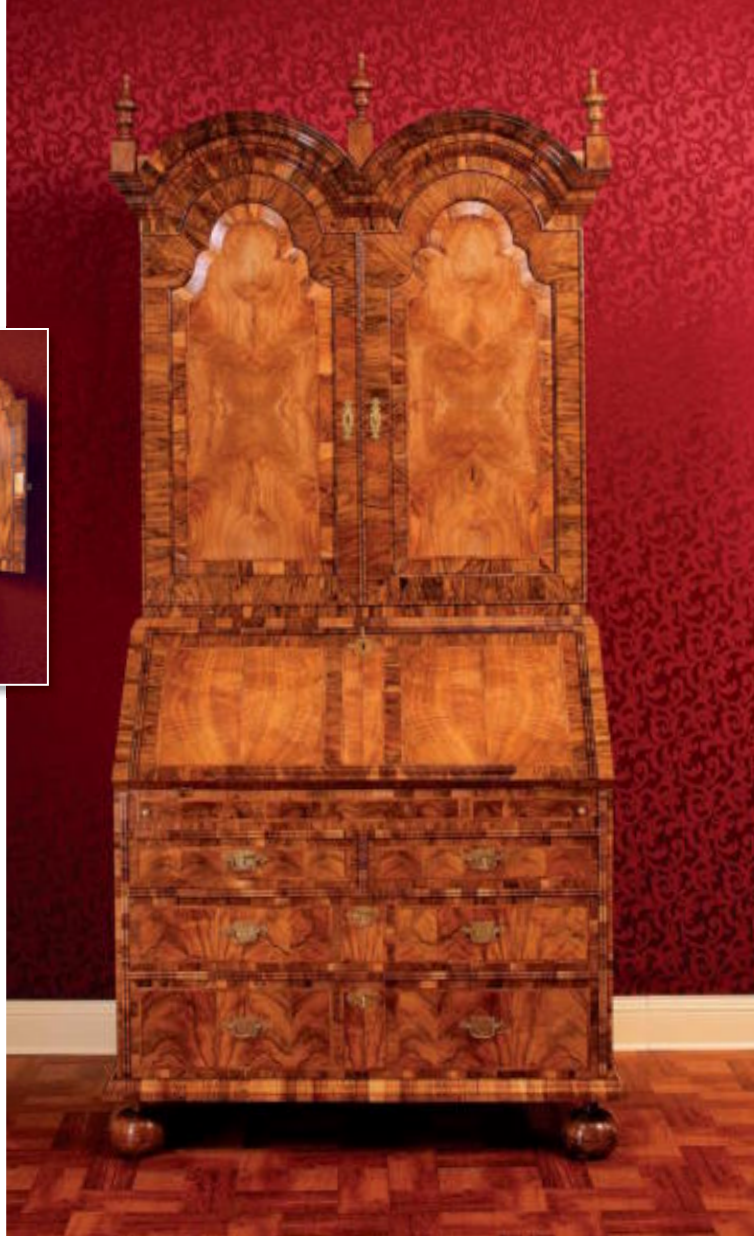
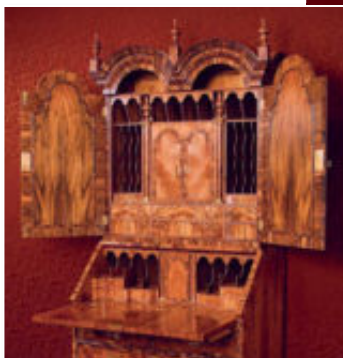
Check the angle. Use a good combination square to check that the face of the miter shoot's jaws are at 45°.

readers gallery

JOHN KETTMAN

Snoqualmie, Wash.

Kettman reproduced this Queen Anne bureau cabinet from photographs of the 1710 original. In an effort to authentically replicate the piece, he employed the tools and techniques of the 17th and 18th centuries; he estimates that 90% of the cabinet is handwork. Instead of a router, Kettman used molding planes for all the details, and rather than use commercial veneers, he resawed his own on the bandsaw. Made of English walnut, oak, and pine, the cabinet is 21 in. deep by 42 in. wide by 92 in. tall. It took nearly 2,000 hours to complete. The finish consists of more than 15 coats of hand-rubbed shellac.



JIM AND LAURA McCAUL

Danbury, Wis.

The McCauls live in a lake house in the woods, and the natural surroundings influence their furniture collaborations. This hall table (18 in. deep by 60 in. wide by 36 in. tall) and mirror (28 in. wide by 38 in. tall) are part of a series with a marsh theme. The table apron and mirror feature Laura's tiles, which are created using a version of a Native American process called blackware and are fired outdoors in a three-barrel kiln that burns wood scraps and sawdust from Jim's workshop. The solar kiln-dried walnut is finished with a washcoat of amber shellac followed by multiple coats of a tung oil/varnish mixture and wax.

MARK DOOLITTLE

Palmdale, Calif.

Doolittle designed this piece (2 in. deep by 24 in. wide by 24 in. tall) to reflect his interests in marine biology and nature. Starting with a single 2-in.-thick slab of amboyna burl, he used rotary and hand tools to carve layers that correspond to the color shift from heartwood to sapwood, creating an effect that resembles nested bowls. The bubinga base is finished with a burnt-umber glaze coat and sprayed polyurethane; the burl is finished with a Danish oil base followed by several coats of super-blond shellac.



GREG SMITH

Fort Bragg, Calif.

Long interested in Chinese furniture, Smith had noticed that when wood is turned to resemble bamboo, it typically is done in a very symmetrical way. He thought it would be interesting to make the legs of this stool look more like real bamboo, with crooked and irregularly spaced nodes, and tapered thinner toward the top. He turned and carved the faux bamboo elements from merbau. The seat panel is narra, turned on a lathe, then grooved on a tablesaw for a "planked" appearance. The design has five legs for better visual balance. The stool (13 in. dia. by 22 in. tall) is finished with shellac and wax.



KEVIN L. AMEY

Cochranville, Pa.

Amey built this entertainment console (26 in. deep by 75 in. wide by 47½ in. tall) to hold a large television, stereo equipment, CDs, tapes, and DVDs. The pocket doors in the middle can be opened and tucked out of the way for an unobstructed view, and feature false drawers for a symmetrical facade. Amey carved the acanthus-leaf trim under the top. The finish is precatalyzed lacquer.



MARK KOONS

Wheatland, Wyo.

It took nearly 2,000 hours over 10 years to fully develop the design and build this chair. Koons scaled and proportioned the chair to accommodate a wide range of body types and to permit many postures in relaxed but alert conversation. The beech chair (20 in. deep by 25 in. wide by 32 in. tall) is made up of nearly 200 pieces, mostly tapered veneers for lamination. It is finished with milk paint and Ceramithane, a waterborne acrylic urethane. The upholstery is kangaroo hide.



JIM WANER

Odessa, Texas

Waner makes furniture from logs salvaged after east Texas tornadoes or otherwise destined for the fireplace. This Queen Anne lowboy (20 in. deep by 32 in. wide by 31 in. tall) was made from a large mesquite stump that he removed from his sister's property. The design inspiration came from a Norman Vandal lowboy. The finish is lacquer.



JEFFREY PATRICK

Anchorage, Alaska

This cherry-and-ash cabinet (20 in. deep by 44 in. wide by 34 in. tall) was designed in collaboration with Sandra Ramsey Assoc. The clients presented a poor photocopy of a case that had a silver, corduroy-like surface. On the shallow flutes of Patrick's interpretation, he eliminated tarnishing issues by substituting palladium leaf for silver leaf. The ash borders around the doors and aprons are ebonized, and the rest of the piece is finished with CAB (cellulose acetate butyrate) lacquer.





CHRIS MANN

Arlington, Va.

Mann made this jewelry box during a 12-week program at the Center for Furniture Craftsmanship in Maine and named it "Icebox" after its design inspiration (mid-century refrigerators). He assembled the box (8½ in. deep by 28 in. wide by 6 in. tall) so that the grain wraps around it. All the roundovers and pulls were shaped by hand. The maple was bleached, then finished with a lacquer-based sanding sealer and wax.



PETER SCHULTHEISS

Farmingville, N.Y.

Schultheiss, a retired math teacher and a member of the Long Island Wood Turners Association, learned about segmented turning by studying a Dale Nish book while recovering from hip-replacement surgery. The segmented vase (13 in. dia. by 19¾ in. tall, left) is made of 2,017 pieces of bubinga, figured hard maple, and wenge. The open-segmented piece (10½ in. dia. by 5¼ in. tall, right) is made of exactly 100 pieces of Peruvian walnut and maple. It won Best in Show at the 2006 Long Island Woodworking Show. Both pieces are finished with tung oil. PHOTOS: JERRY MAZZOLA, PERFECT IMAGE PHOTOGRAPHY



GLEN GUARINO

Cedar Grove, N.J.

When building this highly sculptural hall table, Guarino found himself sharpening his tools nearly every 15 minutes. The crux of the matter was the wood itself: Purpleheart is very hard and dulls tools quickly, making it tedious to work and requiring a lot of patience to shape with spokeshaves and scrapers. Guarino employed stacked lamination and used lag bolts to strengthen the joints. The table (15 in. deep by 68 in. wide by 34 in. tall) is part of a collection of 20 pieces Guarino made for one house. The finish is tung oil.

PHOTO: RICHARD RUSSO



Attention Students

To recognize and support the work of students, *Fine Woodworking* will showcase current student work in a future Readers Gallery. Eligibility extends to full-time students enrolled in the 2006-07 school year in a high school, college, or university program as well as woodworking, art, and design schools. The deadline for submissions is May 15, 2007. Send student entry forms (available at www.finewoodworking.com) and photos (unaltered digital images, prints with negative, or slides) to Readers Gallery, *Fine Woodworking*, 63 S. Main ST., Newtown, CT 06470, or email fwgallery@taunton.com.

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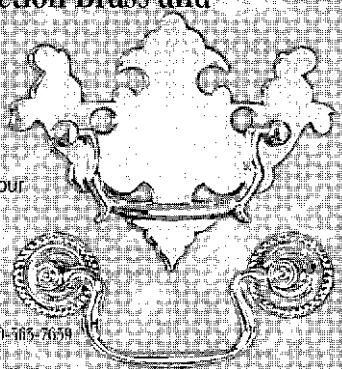
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READER SERVICE NO. 81

Strong shutter joints

Q: I need to make shutters for our vacation home on an island off the coast of North Carolina. The climate is warm and moist, and the shutters will be large and heavy (about 2 ft. by 5 ft. each). I intend to paint them. What's the best affordable wood for the project? And how should I join the frames for lasting strength?

—J. SCOTT, Irvington, N.Y.

A: SINCE WATER RESISTANCE, PRICE, AND

WEIGHT are considerations, I'd advise you to go with cedar rather than, say, teak or ipé. (Avoid poplar; even though it takes paint well, it just won't last outdoors.)

The shutters will be hefty, so mortise-and-tenon joints are your best bet for joining the frames. The tenons should penetrate about two-thirds of the way into the stiles—at least 1½ in. if the stiles are 2 in. wide. For the tightest fit, drive screws through the stiles into the ends of the rail tenons. Deck screws are best for this end-grain situation. First, counterbore to within ½ in. or so of the tenon ends, then predrill the stile holes larger than the diameter of the screws. Don't drill pilot holes in the tenons. Plug the counterbores after assembly.

If you glue the joints, you might want to leave one top-and-bottom set on each shutter unglued. That way, if you need to replace a slat or panel, you can just drill out the plugs, remove the screws, and disassemble the shutter.

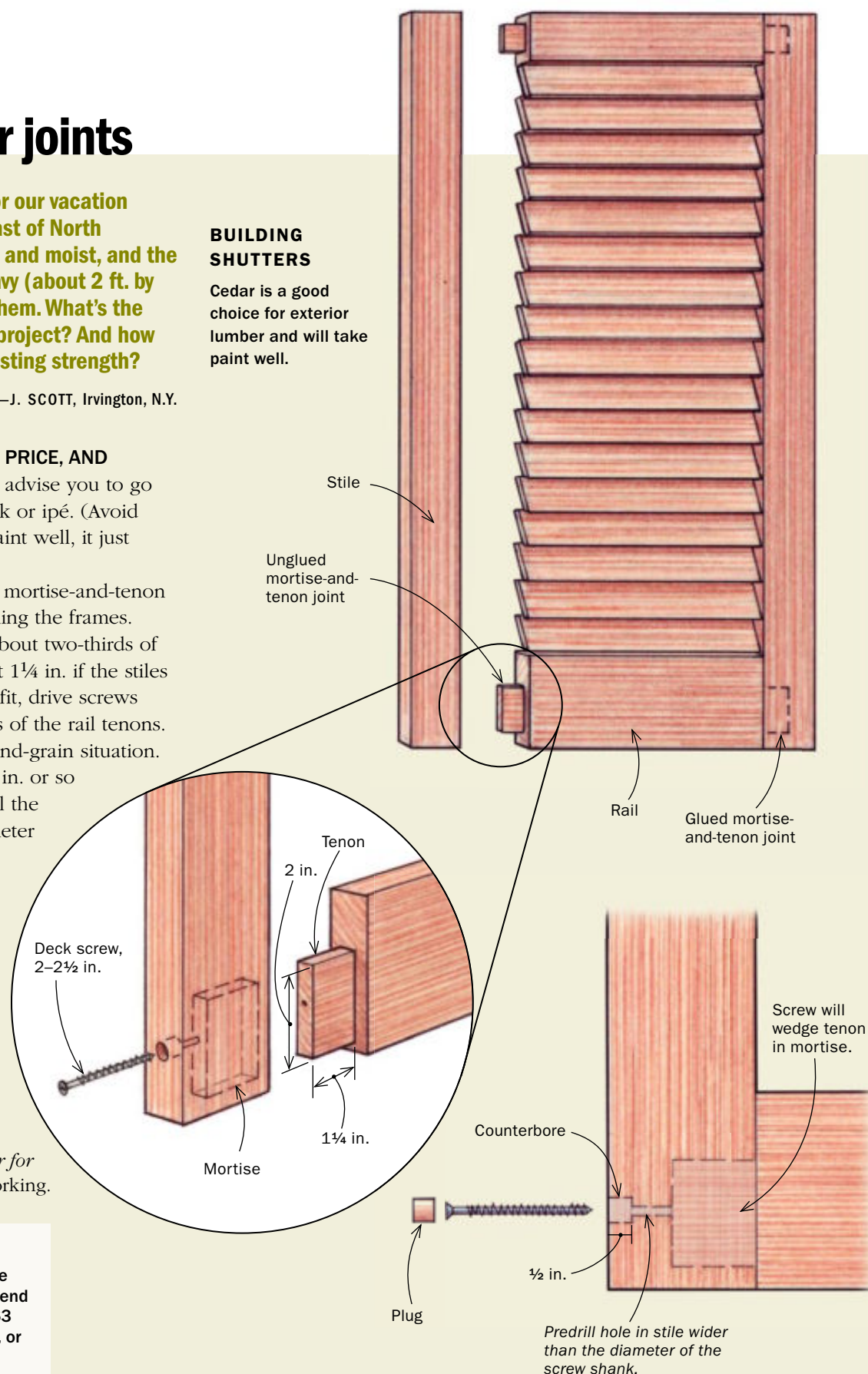
—John White is shop manager for Fine Woodworking.

Ask a question

Do you have a question you'd like us to consider for the column? Send it to Q&A, *Fine Woodworking*, 63 S. Main St., Newtown, CT 06470, or email fwqa@taunton.com.

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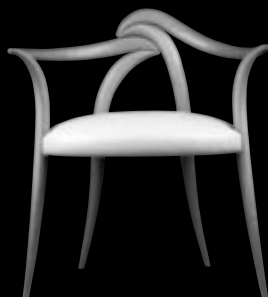
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READER SERVICE NO. 1

Dilute shellac to stain veneered plywood



Matching color. When the door is done, its frame and panel should look more like twins than distant cousins.

Q: I am building a vanity and using 1/4-in. cherry-faced plywood for the door panels. Trying to finish the panels without splotchiness, I first used a clear shellac and then a stain. But the shellac apparently worked too well, because the stain doesn't seem to penetrate. I've tried both liquid and gel stains. I got good results using the same technique for the solid-wood door frames. What gives with the panels, and how can I stain them correctly?

—J. KNAPP,
Clinton, Conn.

A: THE VENEERS USED IN TODAY'S PLYWOOD are extremely thin and the glue used is very dense. The result is that the shellac you used to partially seal the solid wood has almost completely sealed the plywood in the same way as it did the solid wood.

Next time, on scraps of the solid wood and plywood, apply one strip of pure shellac, one strip of shellac cut in a 1:1 ratio with denatured alcohol, and one strip of shellac cut in a 1:2 ratio. When dry, scuff-sand with P320-grit sandpaper, and apply stain. Then judge both boards to see which shellac cuts give the best match.

—Jeff Jewitt is a frequent contributor of finishing articles.



Cut the shellac. Thin the shellac by half with denatured alcohol for one cut, and then by half again for the second.



Prepare the sample boards. Apply the pure shellac and the two dilutions to the solid wood and plywood left over from the frame and panel. Then apply the stain and find the best match.

Replacing gouge handles

Q: I recently inherited a set of gouges, most of which have splits in the handles. How do I go about making a new set of handles? All of the gouges have ferrules.

—TERRY MELIA, Cardiff
by the Sea, Calif.

A: THE WOOD SHOULD BE A dense, tough species such as hickory, ash, or—my favorite—boxwood, which is very smooth to the touch.

The handle should be about the same length as the “business” end of the gouge.

Drill a 1/8-in. hole at the center of one end to a depth slightly longer than the tang, then mount the blank between lathe centers.

Turn the blank down to the largest diameter of the intended handle.

At the end with the drilled hole, turn a “bed” to the length

and diameter of the inside of the ferrule. If the ferrule isn't salvageable, you can make one from brass or copper pipe or tubing.

Remove the blank from the lathe and fit the ferrule snugly over the bed. Remount the blank on the lathe, and turn the handle to its final shape.

Remove the handle from the lathe and enlarge the pilot hole until you can insert the tang up to the last 1/4 in. or so. Hold the tool shank in a vise and drive the handle onto the tang with a wood mallet.

—Fred Wilbur is a professional wood-carver in Lovington, Va.



Size the ferrule. Use calipers to measure the inside diameter of the ferrule (top). Turn the ferrule base on the handle to the same thickness.



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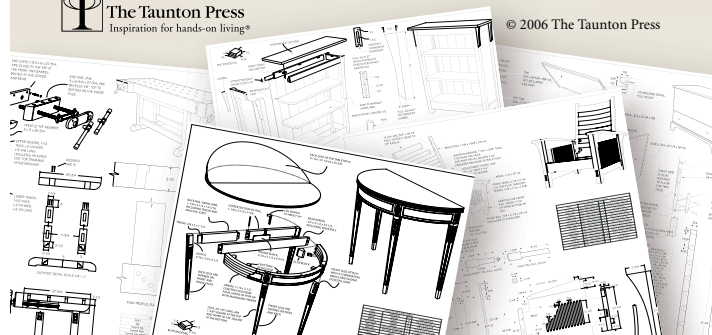
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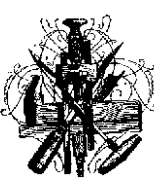
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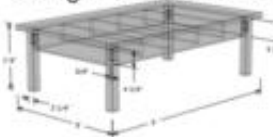


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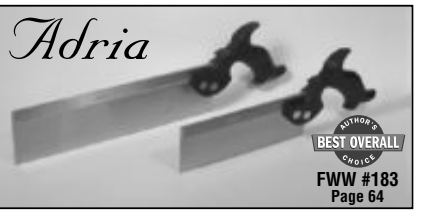
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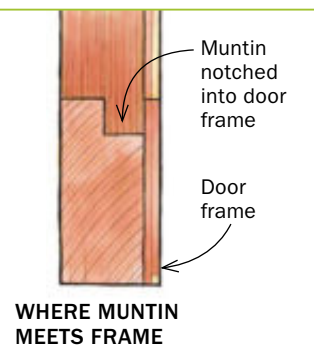
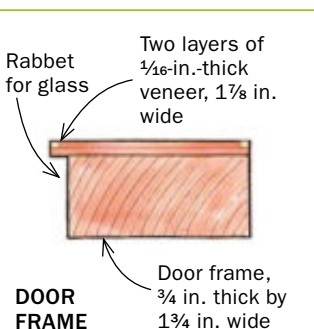
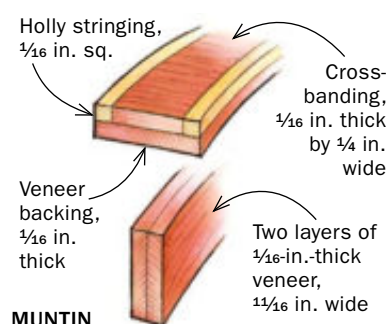
BY RICHARD OEDEL

American use of glass-paned doors with curved dividers, known as muntins, first appeared in the 1750s. These early muntins were thick and chunky, like exterior window panes. However, by the beginning of the Federal period, the muntins on furniture were graceful and elegant, influenced heavily by the designs of Sheraton and Hepplewhite.

Making these doors has always been a time-consuming task, but when executed well they elevate any piece. My method is centered on a template. It acts as a jig when cutting and assembling the ribs; it serves as a guide when attaching the muntin faces; and it is used to tie the muntins into the door frame. This method works for any design, so go ahead and create your own unique divided-light doors.

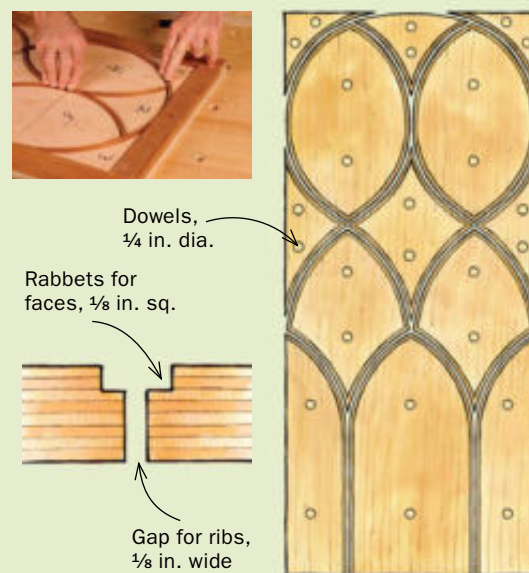
MULTIPURPOSE JIG

Start with a full-size drawing of the doors. Life will be much easier if all the muntins are the same radius. Next, build some strong door frames. Mine are $\frac{3}{4}$ in. thick by $1\frac{3}{4}$ in. wide with mortise-and-tenon joints. Cut a piece of $\frac{1}{2}$ -in.-thick plywood the same size as the inside of the frame, and mount it (using dowels an inch in from the corners) on a backer board of $\frac{3}{4}$ -in.-thick plywood that is just larger than the outside of the frame.



JIGSAW-PUZZLE JIG

Oedel uses a router to cut the $\frac{1}{2}$ -in. plywood into individual templates, which are doweled into the backer board.





Lay out the template. Draw the design onto the $\frac{1}{2}$ -in. plywood, making sure to mark the center points of the arcs. Some of these points are off the main panel, so you will have to clamp on side panels.

1. BUILD THE TEMPLATE FOR THE MUNTINS



Rout a groove. Place the door frame onto the template assembly. Place $\frac{1}{4}$ -in. shims under the $\frac{1}{2}$ -in. plywood to bring it flush with the frame. Use a laminate trimmer on a radius jig with a brad inserted the correct distance from the center of a $\frac{1}{8}$ -in.-dia. straight bit (Onsrud #52-244). First cut $\frac{1}{4}$ in. deep, cutting into the frame where the ribs will go (left). Then remove the door frame, attach the side panels, and cut the grooves whose center points are off the main panel. Next, number the template sections and connect each one to the backer panel with dowels before routing through the $\frac{1}{2}$ -in. plywood. To create a recess for the muntin faces, cut a channel $\frac{1}{8}$ in. deep with a $\frac{3}{8}$ -in.-dia. bit straddling the existing groove (right). Last, on the router table, cut a $\frac{1}{8}$ -in.-sq. rabbet on the straight edges of the jigsaw pieces that adjoin the frame. This will accommodate the overhang of the frame's face veneer.

2. LAMINATE THE RIBS



Create the rib stock. To make the form for the curved ribs, use the laminate trimmer at the same setting used on the template, and cut a 220° arc in some $\frac{3}{4}$ -in.-thick medium-density fiberboard (MDF). Go beyond 180° because the last 2 in. of the curved rib generally must be cut away. Use $\frac{1}{8}$ -in.-thick tempered Masonite as cauls. To minimize springback, tape the ends of the dried ribs at about the correct diameter. Make extra ribs; you will spoil some during the fitting.



Rip the ribs to width. Cut both edges of the ribs on the tablesaw using a jig with a similar radius so that their width is $\frac{1}{16}$ in. less than the thickness of the unveneered door frame.

3. MAKE THE CROSSBANDED FACES



Assemble the muntin face stock. The form is three layers of MDF routed to the same radius as the rib form but with only about 90° of arc. Assemble the mahogany segments in the middle and work toward the ends. To ensure there is no gap, sand slight bevels to give the segments an invisible wedge shape. Because of the many small parts, Oedel uses hot hide glue and clamps with waxed cauls.



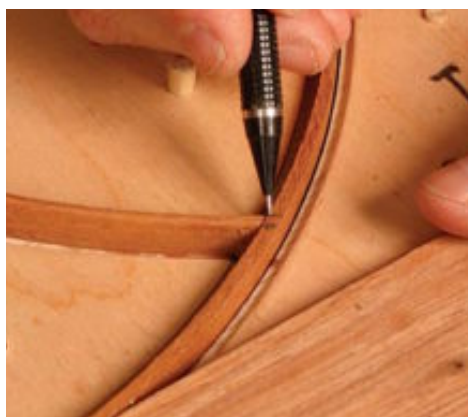
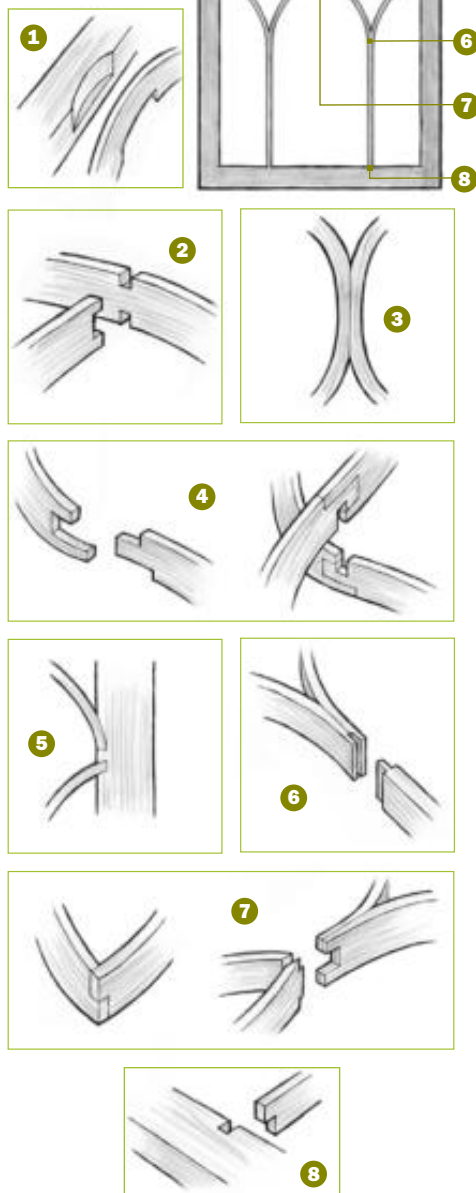
Rip away the individual faces. Glue a curved extension piece to the edge to make it easier to handle when ripping. Use a thin-kerf blade to slice the banding into $\frac{1}{16}$ -in.-thick pieces.



Reinforce the face material. Glue a backing of $\frac{1}{16}$ -in.-thick mahogany veneer onto and perpendicular to the thin face banding. When the glue is dry, slice away the overhang of the backing veneer with a knife, or use a scrollsaw and a sanding block.

4. ASSEMBLE THE RIBS AND VENEER THE DOOR FRAME

The ribs require a variety of joints where they intersect and where they meet the frame. Before placing the door frame around the template jig, use a carving gouge to deepen the $\frac{1}{4}$ -in. grooves cut by the trimmer (1), to within $\frac{1}{16}$ in. of the back of the frame. This gives you a solid surface to push the ribs against so that they are level with the surface of the door frame. Where the rib ends enter the frame, notch the frame (5, 8).



The template now acts as an assembly jig. It holds the rib stock in place while you measure, cut, and glue the ribs together. The circle at the top might require a scarf joint, but most of the other sections can be cut from one piece of rib stock. Always do the measuring and scribing while the rib is in the fixture groove, because the ribs have a fair amount of springback. A block of wood with a $\frac{1}{8}$ -in. rabbet helps hold curved sections of rib while cutting the joinery (right).



A merger of equals. Where two ribs come together and then separate, use the template to mark the center point, and then align that mark with the center of the form used to laminate the rib stock. Trim the stock until at the apex of the curve one lamination is just removed.



Glue the ribs in place. Due to the number of joints, either use a slow-set epoxy or do sections at a time with yellow glue. Make cauls that will reach across the door frame to hold the ribs at the correct depth, cutting holes above the joints so that you can inspect them. Wax the base of the cauls. When dry, take the cauls off and finish-sand the ribs and the inside of the frame.



Veneer the door frame. Apply two $\frac{1}{16}$ -in.-thick layers of veneer, oriented perpendicular to each other for strength, to match the $\frac{1}{8}$ -in. thickness of the muntin faces. The face of the frame is outlined by holly stringing applied before cutting the face veneer to length. To prevent warping, veneer the back side of the frame with one layer of $\frac{1}{16}$ -in. veneer.



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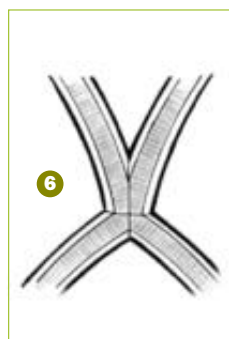
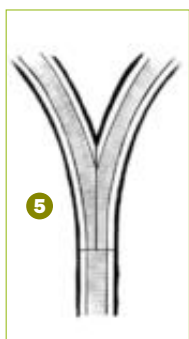
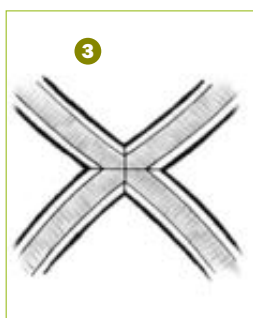
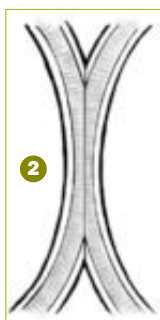
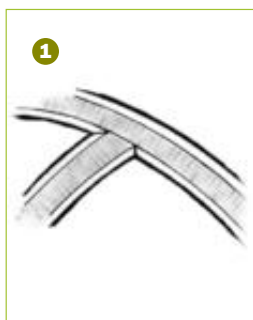
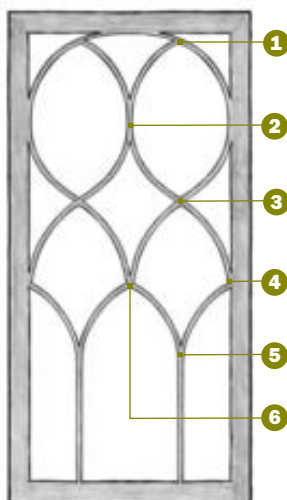
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5. ADD THE MUNTIN FACES AND SIZE THE GLASS PANELS

Disassemble the template by pushing the dowels all the way through, removing the $\frac{3}{4}$ -in. backboard, and pushing out the puzzle pieces one by one. Reassemble the template, placing small $\frac{1}{4}$ -in.-thick shims under each piece to bring them flush with the top of the ribs. You can now measure and cut the muntin faces to length, using the shallow channels in the template as a guide.



Where the muntin meets the frame.

Where the facing intersects the frame, cut flats on the curved muntin faces. Use a small MDF jig with a $\frac{3}{8}$ -in.-wide curved groove made using the original laminate-trimmer setup. Slide the jig across the tablesaw to cut the banding at the correct place.



Slice away the holly. Remove the holly stringing on the frame where the muntin face connects, and also where two sections of muntin join. If you need to join two pieces of the muntin face for a long section, use thin cloth on the back side, and bevel the joint so that you do not see the joint line in the holly.



A template for muntin joinery. To achieve seamless unions, it is sometimes easiest to create an MDF replica of the joint and use it to cut the muntin faces to size.



Apply the muntin faces. The entire face should be assembled dry, then glued piece by piece. Use a fairly thick epoxy, as gaps between the ribs and the faces need to be filled and the pressure is minimal. Use the same cauls you used for the ribs, but add extra so that every section receives uniform pressure.



Make cardboard templates for the glass.

Each piece should drop into the corresponding space without touching the ribs. Take the cards to a local glass supplier. Plain window glass will work fine, but for a truly authentic feel, use restoration glass. To secure the glass, Oedel uses a tiny drop of Phenoseal clear caulking in several places on the back of each muntin face.

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Botanical

One day in 1996, Miguel Gomez-Ibanez came upon a show in Boston by furniture makers from the North Bennet Street School. Gomez-Ibanez had been an architect for 20 years, but that day he decided his future lay in furniture. “What intrigued me,” he says, “was to exercise that kind of mastery—and to make something that would outlive me.” Within a year, Gomez-Ibanez had sold his practice and enrolled at the school. Since graduation he’s built furniture in a range of styles, but he gravitates to the 17th and 18th centuries. His desk-on-stand in



Pro Portfolio Visit FineWoodworking.com to hear Gomez-Ibanez discuss his work.

Letter Box

walnut and ebony is based on furniture of the William and Mary period, but not on any particular piece. He derived the marquetry patterns on the outer doors and drawers from garden designs of the era and executed them in Carpathian elm, oak burl, and mother-of-pearl. The botanical alphabet inside the desk was painted by Joseph Reed. Now that Gomez-Ibanez can exercise the mastery he admired at that furniture show 10 years ago, his path has circled back to North Bennet Street: Last summer, he became executive director of the school.

—Jonathan Binzen