

GET ORGANIZED WITH A VERSATILE ENTRY BENCH *p.36*

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with twin-blade
joinery* *p.28*

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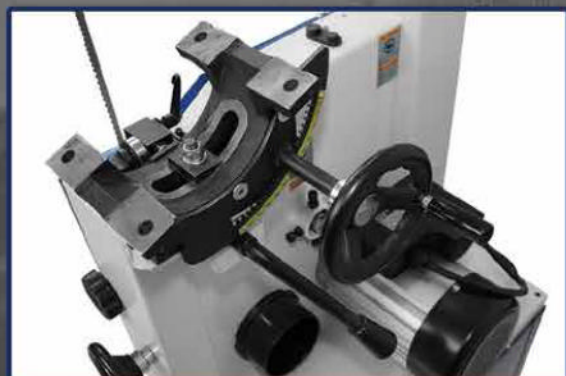
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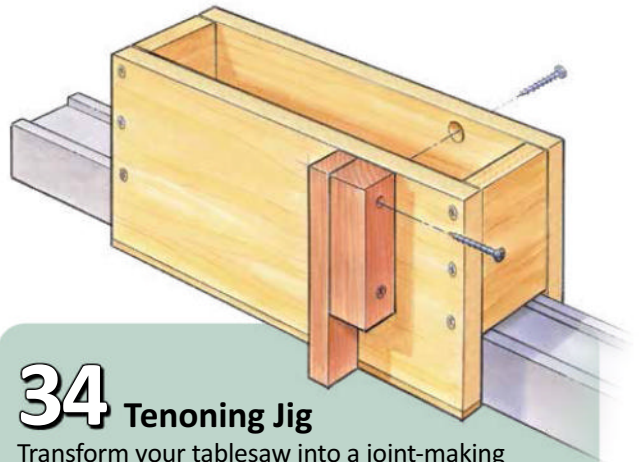
24 Make Some Mantelpiece Shelves!

Exploit empty wall space with attractive display shelves you can create from both stock and shop-made moldings. Building these shelves is a great way to get big impact from a small amount of lumber.



36 Get Organized with an Entry Bench

This durable design provides a comfortable seat with plenty of storage below. We include instructions on how to build and install drawers in the top tier of openings. Personalize your bench with your favorite painted finish for the base and solid wood top.



34 Tenoning Jig

Transform your tablesaw into a joint-making machine. Paul Anthony's design is sturdy, accurate, easy to use and straightforward to build. A must-have jig for any saw with a Biesemeyer-style fence.

48 Double-Duty Dollhouse

Most dollhouses are quickly outgrown. Not this model. Architectural details provide the right residential qualities, but the rooms are ready to hold more grown-up items when the time comes. This is a great gift that's sure to keep on giving.



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Contents: Projects

60 Peg Racks

Put wall space to work with simple, elegant racks you can make in different sizes and styles. Woodworking refinements you can add include beaded edges and routed keyhole slots that hide mounting screws.



Contents: Tools & Techniques



28 Twin-Blade Joinery

This innovative tablesaw technique will enable you to cut tenons, tongues, and spline slots – faster and more accurately than ever before. Get started with a pair of identical blades, zero-clearance inserts, and the expert advice in this article.

43 Jig-Maker's Toolkit

Jigs are essential to improve the accuracy and efficiency of many woodworking operations. To make them, it helps to have the right materials on hand. Our toolkit includes all the essentials, from materials and adhesives to hardware and hold-downs.



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Contributors



"I've always been interested in woodworking," explains John Hartman, the artist whose drawings have graced the pages of *Woodcraft Magazine* for nearly eight years.

"After graduating from the Kansas City Art Institute, I found myself admiring the technical drawings in *Fine Woodworking* and *Scientific American*, while applying my woodworking knowledge to restore and rebuild grand pianos. My

first published drawings actually appeared in *Piano Technician's Journal*, a magazine for people who tune and repair pianos."

The hand-drawn rendering style that John developed for his piano publication soon caught the eye of other magazine editors, eventually bringing an end to piano repair work. "Now that pianos are gone, I'm putting my tools to use building furniture and restoring our 19th century house and Victorian carriage house studio," he says. Recent projects include a garden gate, a kitchen island, and wooden storm windows.

John lives in Beacon, New York, located on the Hudson River about a 2-hour drive from Manhattan. It's worth noting that John's contribution to *Woodcraft Magazine* goes beyond technical drawing. He provides valuable input on the layout and the contents of our issues. We're very grateful for his contributions.



Geoffrey Noden has been working wood for almost 40 years. The first American graduate

of the John Makepeace School for Craftsmen in Wood in Dorset, England, Noden now builds custom furniture in Trenton, New Jersey. He is also the inventor of the Adjust-A-Bench and the Inlay Razor. For more info, visit adjustabench.com, inlayrazor.com, or geoffreynoden.com.



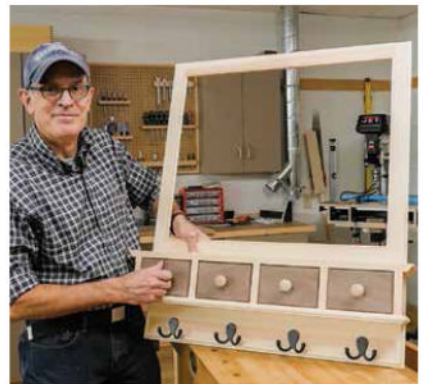
Andy Rae is an award-winning furniture-maker whose career spans several

decades. He has authored a number of books on woodworking, including *Furniture and Cabinet Construction* and *Working Wood* (both by Taunton Press). He makes his home in the mountains of western North Carolina.

On the Web



Keyhole secrets. Keyholes aren't just for peeking through. By routing keyhole slots in the back of a peg rack, you can slide the rack into place on the wall and keep the installation screws hidden. Check out a short video that explains the secret to routing keyhole slots.



Project preview. Want an early look at a useful project that we're preparing for a future issue? Tim Snyder shows off the prototype of a wall organizer that combines a bulletin board, small drawers and a peg rack.

Staff blog. Stop by our little corner of the web to go behind-the-scenes at *Woodcraft Magazine*. Our staff blog includes insights from all team members on topics that sometimes venture beyond woodworking. You'll find something fun and informative at woodcraftstaffblog.wordpress.com.

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Have you ever had to justify a new tool purchase with the promise of special projects and future savings on stuff you can build rather than buy? I've sure had to play this card before. If you answered "yes" a moment ago, you're going to love this issue. We've got some "build rather than buy" savings you can take to the bank. Andy Rae's entry bench is a great example (p. 36). When planning this project, we found many versions of this popular piece of furniture in home furnishing catalogs and furniture stores. But prices were sky high on most factory-made benches, and the build quality wasn't close to what a woodworker can achieve.

The same goes for mantelpiece shelves (p. 24) and peg racks (p. 60). Home furnishing catalogs are full of these items. But if you're like me, you can't bring yourself to pay \$45 or so for a "fancy display shelf" or "rustic peg rack" made from materials you could buy for less than \$10. As woodworkers, we've got what it takes to build it better, and for much less. Just as importantly, we can (and usually do) customize our projects based on some important considerations: style preferences, the materials we have available, special features we want to incorporate, and the

dimensions required to fit a project into a specific space. When you buy factory-made furniture and furnishings, none of these design variations are possible. You're stuck with the same products that hundreds of other people can acquire.

Whether you pursue woodworking as a hobbyist or professional, the ability to transform raw lumber into unique projects is something to celebrate. The knowledge that we share on the pages of the magazine and on our website provides the information and inspiration to exceed the quality and character of mass-produced products. "Sure, I can build that, but my version will be better." It's what we do.

Stay tuned, and don't hesitate to share your ideas for projects and techniques that you'd like to see in the magazine.

—Tim Snyder



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Advice for tackling tough projects

I generally enjoy Woodcraft magazine, but as a novice woodworker, I find some projects are not detailed enough for me to build. For example, I like the Arts & Crafts TV cabinet presented in issue #67, but not all the construction steps are fully explained. This project, as well as others in past issues, assume that the woodworker is more accomplished. I find this frustrating.

-Jack Folkerts, via email

Thanks for sharing your feelings about the magazine. You're right, Jack; some of our projects are too big or complex for a novice woodworker. It would certainly be possible for us to expand a project like the TV cabinet beyond its current 8-page length, in order to cover every step in the build process. However,



let's consider the trade-off: 2 or possibly 3 articles would have to be omitted from the issue. So readers who didn't want to build this project would miss out on the Ulu Knife & Chopping Block, the scraper article and possibly more. Because our aim is to deliver the maximum value to all our readers, we always have to make tough decisions about what

to include in an issue and (thus) what to leave out. It's never easy.

The TV cabinet is definitely an advanced project, requiring several specialized jigs, plenty of clamps, and an expensive lumber order. Tackling this project as a novice woodworker is pretty ambitious. If you haven't built other projects that involve frame-and-panel construction, fitting and hanging inset doors, and pattern routing, I'd recommend learning these important techniques on smaller projects first. Even advanced woodworkers appreciate the value of testing techniques and newly built jigs on scrap stock or small projects before cutting into costly cabinet-grade hardwood.

Keep the faith—we're going to keep publishing plenty of projects and useful techniques in future issues.

—Tim Snyder

Small world of woodworking



Tim,
The South African school blazer you wore in the last issue (#68, Dec/Jan '16, p. 8) caught my attention. I am based in Pretoria and play in my workshop while other family members watch TV. My woodworking has progressed from furniture to bicycles (see photo). I haven't used stinkwood in a while.

Best regards,

Jules Field, Pretoria, South Africa

Jules:

Thanks for your email and for giving us a look at your impressive wooden bicycle. Woodworking is much better than watching television, no matter where you are in the world.

—T. S.

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Best way to use a rest?

In Paul Anthony's "Chisel Rescue" story (#68, Dec/Jan '16), I noticed that when grinding the bevel, he did not take advantage of the tool rest's angle-adjustability. Is there some reason why he chose to register the chisel against the edge of the rest, rather than laying it flat?

Adam Guthrie, Vestavia Hills, Alabama

Adam, the answer is "friction." Laying a chisel flat on the rest creates a lot of metal-to-metal contact. Add to that the grinding detritus that gets trapped between, and you can get a pretty rough side-to-side slide as you grind. In my experience, this can translate to an irregular bevel. Instead, registering the chisel against the edge of the rest (see photo) minimizes friction to almost nothing, allowing greater focus and control of the wheel-to-bevel contact.

—Paul Anthony



Making great jigs better

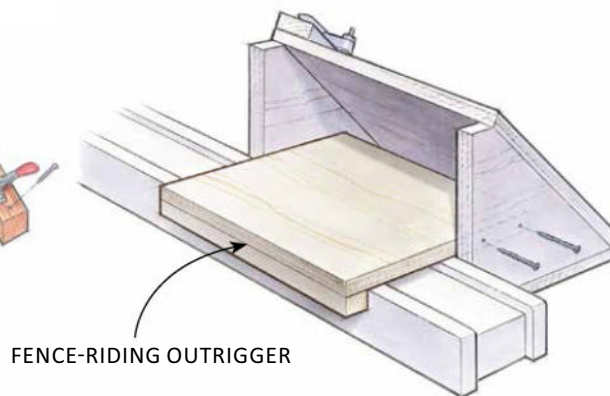
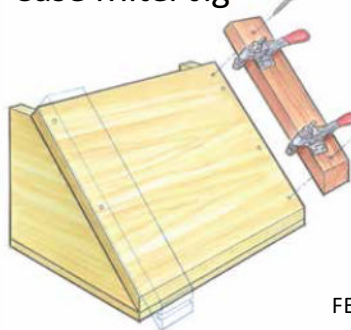
Paul,
Great article on splined miters in the Dec/Jan '16 issue. The "Twin-faced Tablesaw Jig for Splining Frames" is brilliantly designed to ensure perfectly aligned left and right hand miters.

What I like about jigs like this is that they use the fence as a guide rail, as I did when making a tenoning jig and a tapering jig. I think the case miter jig on page 60 could use this "over the fence" guide feature as well since it would eliminate any chance of the jig cocking into the running blade. It only has to happen once to spoil your day!

Russ Svedson, via email

Russ,
Thanks for the good words and the thoughtful feedback. Yeah, I thought Joe Hurst did a great job on the "Splined Miters" story. Like you, I'm a big fan of saddle-style jigs that ride the fence. (In fact,

Case Miter Jig



the twin-faced jig shown is from my "Complete Illustrated Guide to Tablesaws" book.) As you note, saddle-style jigs won't wander into the blade and ruin a cut. I also like that you can quickly and safely drag them back to set up the next cut, again without fear the jig will hit the blade. That said, I like Joe's dual-purpose case miter jig, and there's no reason you couldn't attach a fence-riding outrigger to it, as shown in the drawing above right.

—P.A.

How to reach us.

Email editor@woodcraftmagazine.com, or write to Woodcraft Magazine, 4420 Emerson Ave., Suite A, Box 7020, Parkersburg, WV, 26102-7020. Please include your full name, address, and phone number. Published letters are edited for length and clarity.





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Bosch JS1220 Cordless Jigsaw

Weighing in at just 3.3 lbs., the Bosch JS1220 has the same features found on full-sized jigsaws, including orbital and straight-line cutting modes, an adjustable base, a no-scratch overshoe/baseplate, and an LED light, but in a palm-sized package. The 12V, 2 Amp-hour Li-Ion battery can't compete with a corded saw for marathon-sized projects (like notching stair stringers), but I found the run-time/1-hour charger combination more than adequate for general woodworking, such as cutting templates or making double-sink cutouts, for example. If you need more run time, buy another battery.



The saw's compact size permits greater maneuverability in tight spots, but the flyweight status opens up other possibilities. This easy-to-grip saw is good for older woodworkers wrestling with bouts of tendonitis, and junior woodworkers with smaller hands.

Tester: Joe Hurst

For ordering and pricing information, see the Buyer's Guide on page 66.

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Whether you're setting up your dado blades, measuring depth of a groove or ensuring the mortise and tenon have a snug fit. No other tool can perform as many fractional functions as quickly and accurately as the Starrett 1202F-6 fractional slide caliper. The yellow scale measures fractions and the white scale measures decimals. Nothing says you care more about your work, than a Starrett tool on the job.



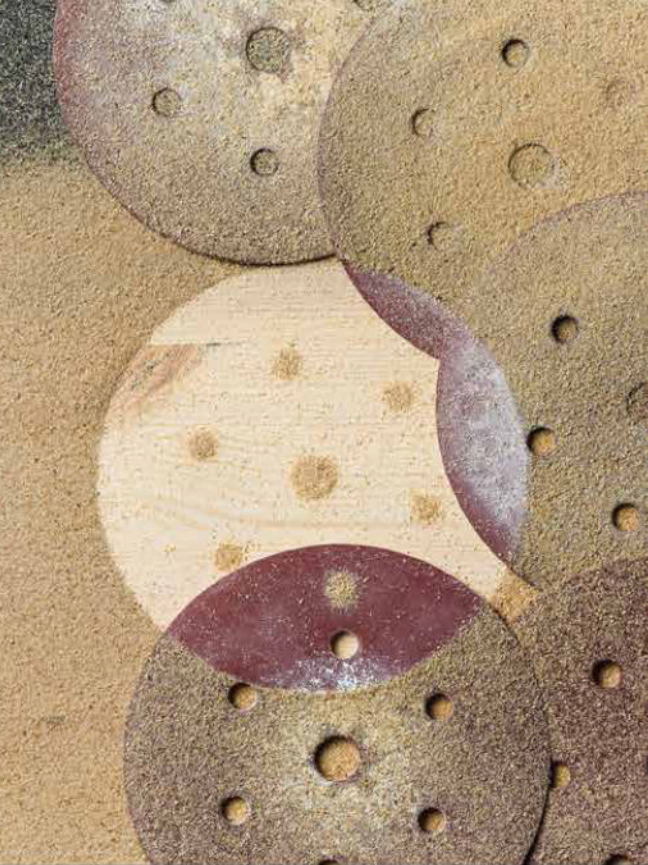
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Hot New Tools

3 heads are better than 1 *Arbortech angle grinder accessories*

Arbortech's array of carving and sanding accessories can turn a right-angle grinder into a versatile woodworking machine. The 2½"-long shaft on the Contour Random Orbit transforms a grinder into a detail sander with the ability to reach into turned bowls or hollow areas that might be out of reach of larger sanders. The flexible sanding pad molds to the surface shape without digging in or burning the work.

Sporting a pair of carbide teeth, the TURBO Shaft is an easy-to-control accessory for freehand carving and lettering. When used with a template, the integral, adjustable collar can serve to effectively control the desired cutting depth.

If you're looking for a tool for freehand carving and sanding, check out the Mini TURBO Kit. Although it lacks the random-orbit feature, this

Random-orbit
sanding

Carbide-tooth
carving

multi-function
shaft can be
outfitted with
either the carbide
cutters or sanding head.

For more control, the carbide-tipped cutter can be attached to the grinder without the shaft.

Carving and
sanding

Tester: Ben Bice



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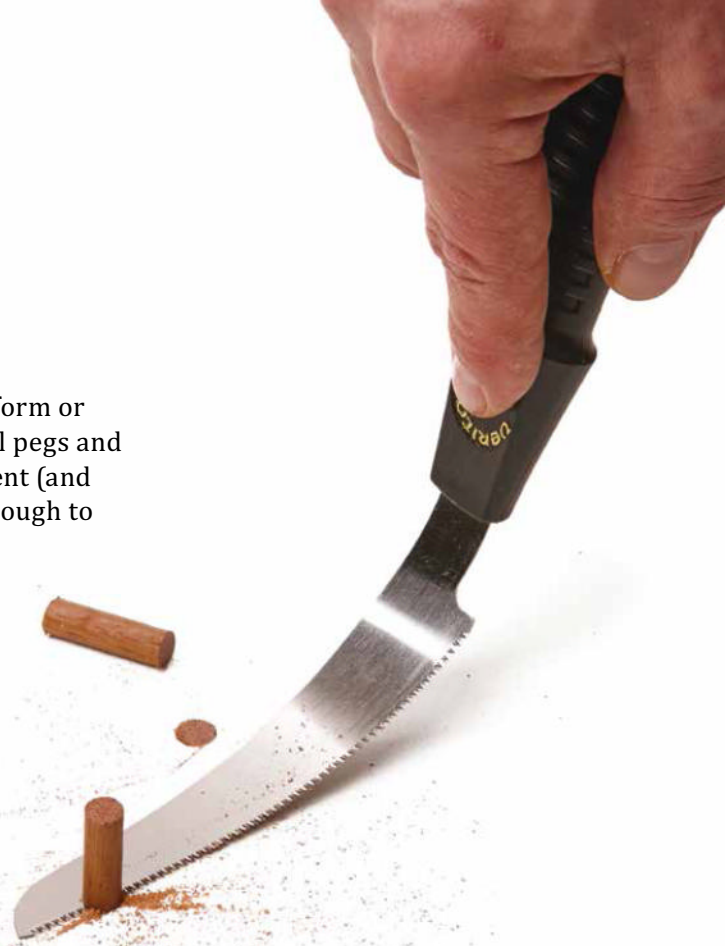
No-set advantage

Veritas Detail Flush-Cutting Saw

By now, most woodworkers own a flush-cut saw in one form or another and already appreciate this tool's ability to level pegs and exposed joinery. What makes this 26 tpi pull saw different (and I think, better) is its beefier blade. While still flexible enough to tackle flush cuts, the blade better resists diving which can either scratch the surface or stop short of leveling it. The tapered blade enables the saw to fit into spots inaccessible to wider blades. Since the teeth lack any set, the saw can be used from either side without scratching.

The most surprising attribute is how well this no-set saw follows a line. When it's not trimming pegs, it may become your go-to tool for all sorts of small-scale joinery.

Tester: Joe Hurst



The Viper™ Scraper

The perfect accessories for the Dust Deputy!®

Cleans while you're using it. All of the waste goes into your vacuum.

Ideal for:
Lead abatement
Boat refinishing & repair
Hardwood floor installation & refinishing
Paint, stucco & textured ceiling removal

Clean Air to Vac

Attach hose to Dust Deputy® inlet.

Shown with optional Bigfoot Bucket Grip™. Keeps your bucket from tipping over on angled surfaces or when it's over weighted!

Made in the USA

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Turn Ordinary Dust Collection Into EXTRAORDINARY Dust Collection!

Pays for itself in filter replacement costs alone!

Dust Deputy® Deluxe

Clean Air to Vacuum **Dust In**

99% of Dust Here

Vacuum Not Included

- Cyclone design separates 99%+ of wood waste before the filter. Helps maintain consistent airflow.
- Easy to empty bucket. No more dumping out your vacuum!
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Other Dust Deputy® models available. Check online.

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Hot New Tools

More grit

Norton ProSand Multi-Air Sanding Discs

Norton has found a way to get more from less. Suitable for use with any 5" random-orbit sander, Norton's ProSand hook-and-loop pads sport a unique pattern of tiny laser-cut holes that create a "vortex effect" to draw debris away from the work more efficiently than the larger, evenly spaced holes found on other discs. The obvious advantage to smaller holes is that the discs have more abrasive surface to contact the work. According to Norton, this additional grit can shave sanding time by 30%. Another plus: You don't need to align the disc's hole pattern to your sanding pad.

In use, the discs went the distance. The steatited ceramic alumina abrasive cut without

clogging while the fiber-reinforced backing resisted tearing. I only wish the discs were color-coded (like Norton's 3X sandpaper) to make it easier to identify different grits.

Tester: Joe Hurst



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Tips & Tricks

TOP TIP

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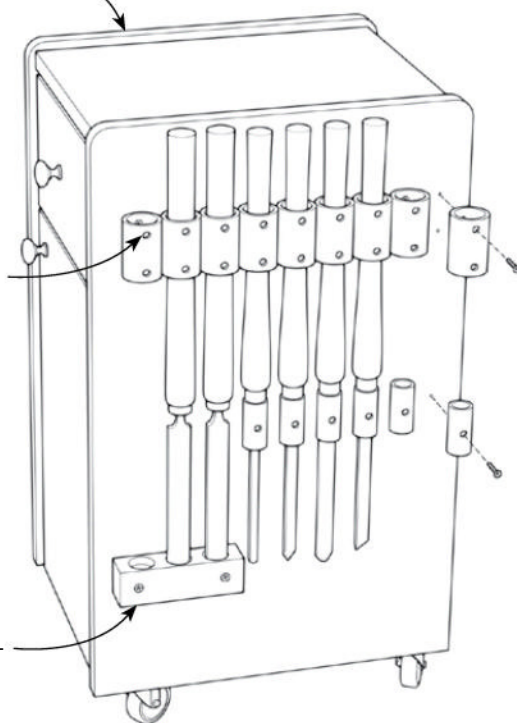
I found the lathe tool rack in the issue #66 Tricks column interesting, but the sharp-end-up orientation of lathe tools always makes me nervous. For safety, I mount my tools cutting-edge-down within short lengths of PVC pipe. The diameter of the lower length of pipe, which supports the tool, is slightly less than the diameter of the tool's ferrule. The tool handle sits inside a larger diameter pipe. In those cases where the blade is as wide as the ferrule, the cutting edge rests on a wooden block. I mounted this "rack" on the side of a mobile cabinet that includes a drawer and plenty of storage for drill bits, calipers, and other turning accessories. The unit has served me well for years.

—David Taft, Harpswell, Maine

Mobile cabinet for lathe accessories

Drill large hole for access to mounting screw.

Use support block for wide-blade tools.



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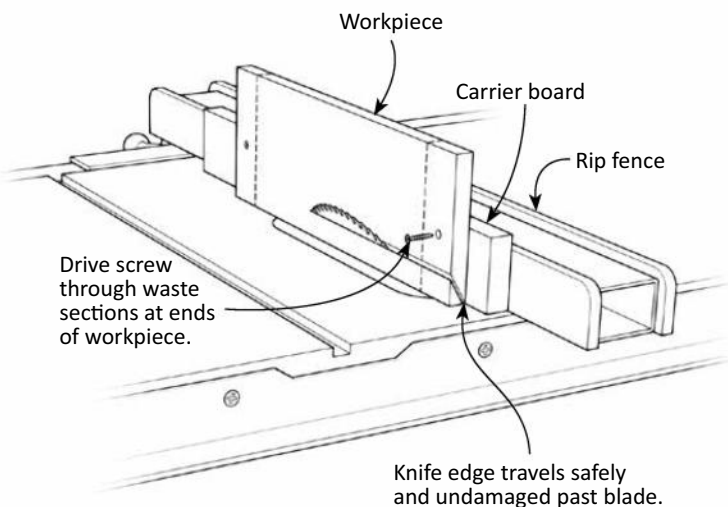
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Ripping knife-edge bevels

Ripping a knife-edge bevel of less than 45° is challenging because you can't feed the board on-the-flat since the blade won't tilt that far. Instead, you have to feed it on its edge. Unfortunately, this can be awkward and, because the work exits the blade traveling on the knife edge, it's subject to damage. In these cases, I use a thick, squarely dressed carrier board to do the job safely and securely. Although you can clamp the workpiece to the carrier board, I prefer the less cumbersome approach of making the workpiece a bit oversized in length, then screwing it to the carrier board at both ends. Afterward, I cut away the screw holes.

—Paul Anthony, senior editor

A better eraser

A typical rubber eraser tends to smear pencil lines on wood and other materials. There's a much better tool for the job: a plastic eraser. Available at art or office supply stores for a buck or so, it erases pencil lines cleanly without leaving streaks that might lead to other layout errors or finishing problems.

—Aaron Blackwell, Tucson, Arizona

Illustrations: Christopher Mills

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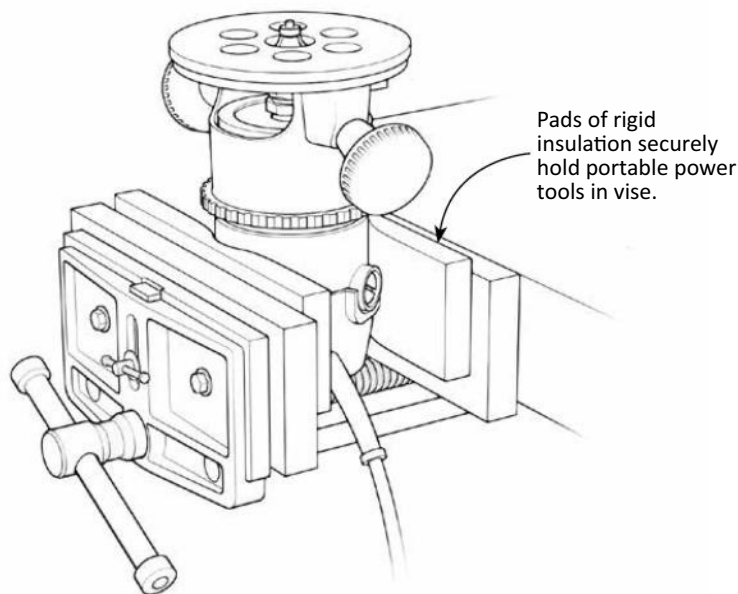
Dado King
WOOD Magazine

Code WC
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Vise pads for power-tool mounting

It can be difficult to rout or sand small workpieces with portable power tools. In those cases, it's best to take the work to the tool instead of the other way around. But what do you do if you don't have a router table or stationary sander? Well, you could construct a custom platform of some sort for your router or sander, but there's an easier approach. I just cut some appropriately sized pads from $\frac{3}{4}$ "-thick rigid insulation and squeeze the tool in my vise between the pads. The soft, but firm material conforms to the tool, holding it very securely without damaging it. If necessary, knife out any sections on the pads to accommodate large protrusions, and make sure not to block any tool vents.

—Roger Townshend, New Britain, Connecticut

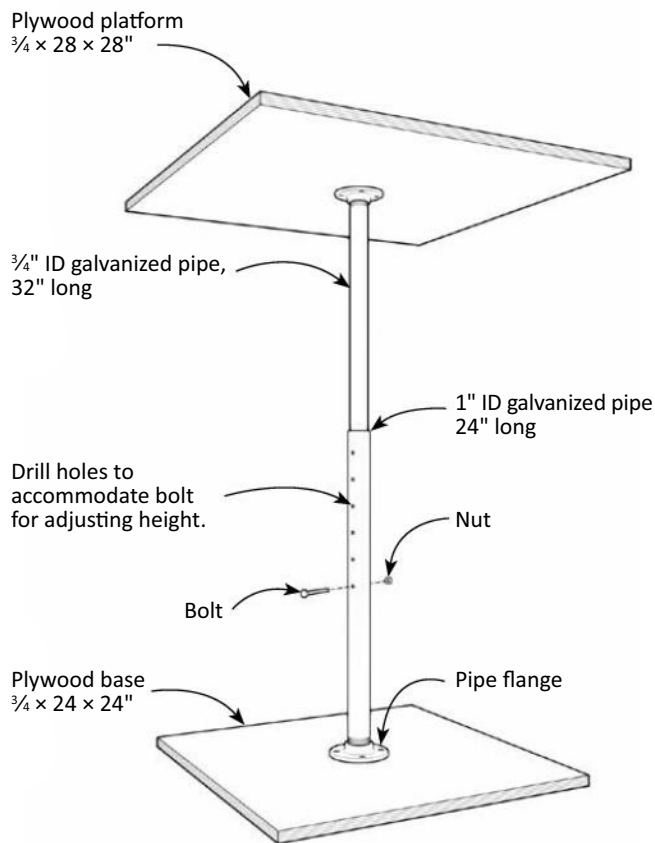


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Finishing turntable

When faced with spray-finishing a half-dozen Windsor chairs, I realized that I needed a rotating platform. When I remembered seeing a design for a turntable built around the concept of one pipe slipped inside another, I headed to the hardware store to buy the parts, and found that $\frac{3}{4}$ " ID galvanized pipe can nestle nicely inside 1" ID galvanized pipe. (But double-check, because some pipe diameters vary.) I had one end of each pipe threaded, and bought the appropriate pipe flanges and mounting screws, along with a $\frac{3}{16}$ " $\times$ 2" bolt.

Back at the shop, using a scrapwood V-cradle at the drill press, I drilled a row of $\frac{7}{32}$ "-dia. holes through the larger pipe, screwed each pipe flange to a piece of $\frac{3}{4}$ " plywood, and slid the pipes together. Voila! A turntable! To adjust the height for comfortable spraying of smaller pieces, I simply slip the $\frac{3}{16}$ " bolt into the chosen pipe hole, where it serves as a rest for the bottom of the $\frac{3}{4}$ " ID pipe.

—Marlon Rappaport, Newport, Rhode Island

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Make Some Mantelpiece

Combine stock and shop-made molding to create display shelves fit for all kinds of curios

By Tim Snyder



It might be the New England Yankee in me that can't stand to see wall space that hasn't been put to good use, whether it's in the kitchen, bathroom, hallway, or bedroom. Mantelpiece shelves dispel such discomfort and provide a double dose of beauty in the bargain. You get to display cherished objects on a shelf that has its own beauty in the form of contours and shadow lines.

The mantelpiece moniker comes from the ornate molding treatments that have traditionally framed fireplaces. But you don't need a hearth to create an attractive display shelf. Home furnishing catalogs sell factory-made versions of these shelves, but they're not nearly as nice as woodworkers can make them – despite their high prices. The techniques shown here will take you through the design and construction process, enabling you to create your own masterpiece from premilled stock and shop-made moldings.

Choose your size & style.

The design of a mantelpiece shelf is only limited by your creativity with molding profiles and the wall space you have available.

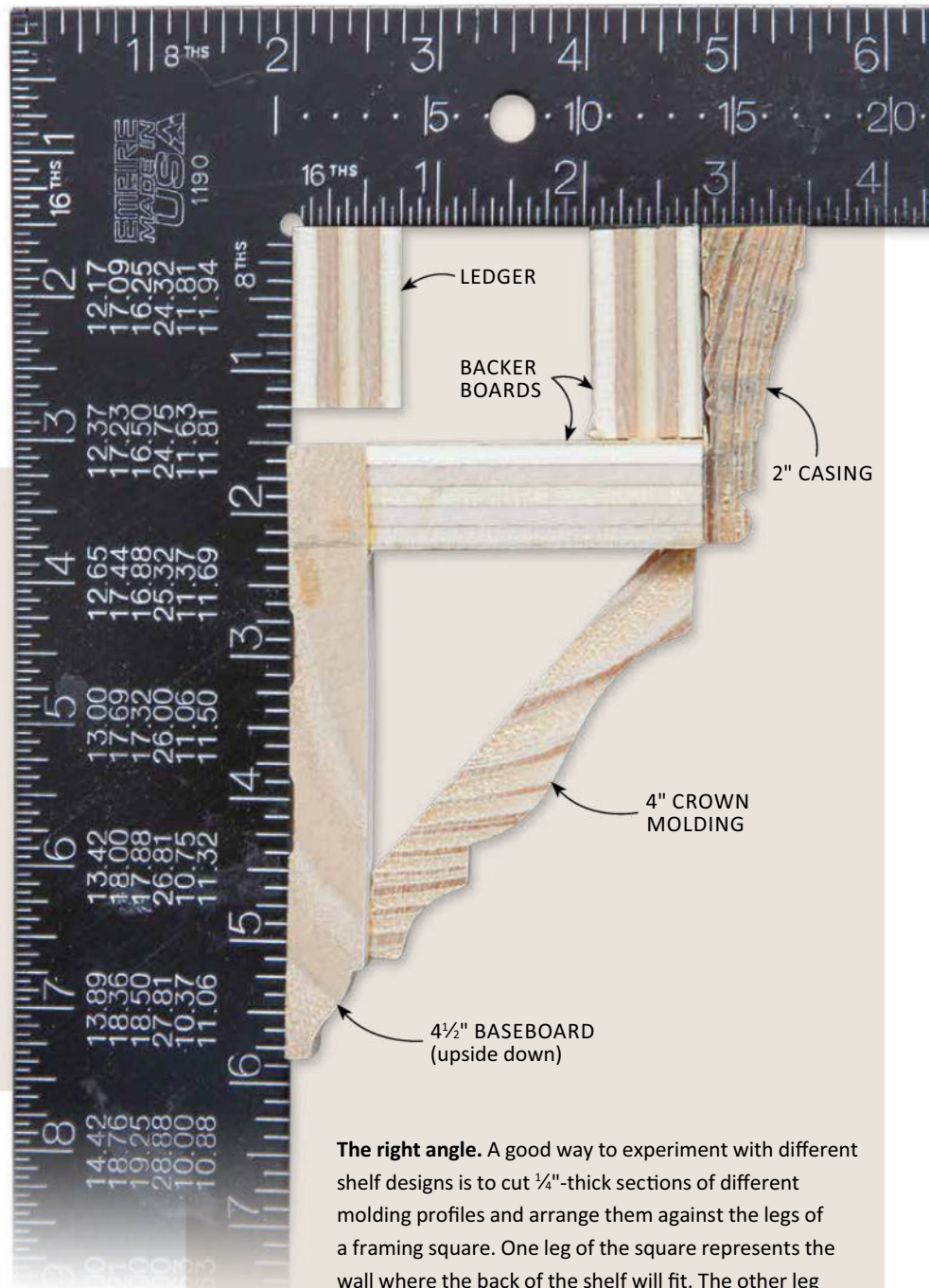
Start with more than you need. It's useful (and fun) to have a wide range of moldings on hand when building mantelpiece shelves. Make sure you have an ample supply of the profiles you intend to use, because creating mitered returns eats up a lot of material.



Shelves!

Designing your shelf: Concentrate on the cross section

Though the combination of profiles may change, mantelpiece shelves share common anatomical details. Your design is certain to include a ledger strip (for installing the shelf), backer boards, mitered molding, and a top.



The right angle. A good way to experiment with different shelf designs is to cut $\frac{1}{4}$ "-thick sections of different molding profiles and arrange them against the legs of a framing square. One leg of the square represents the wall where the back of the shelf will fit. The other leg represents the top of the shelf. Backer boards play an important supporting role. The ledger strip is required for installing your shelf: Screw it to the wall, fit the shelf over the ledger, then secure it with two trim-head screws driven through the shelf top and into the ledger. (NOTE: The cross section design shown here was used to build the top shelf shown on the facing page.)

Cutting mitered returns:

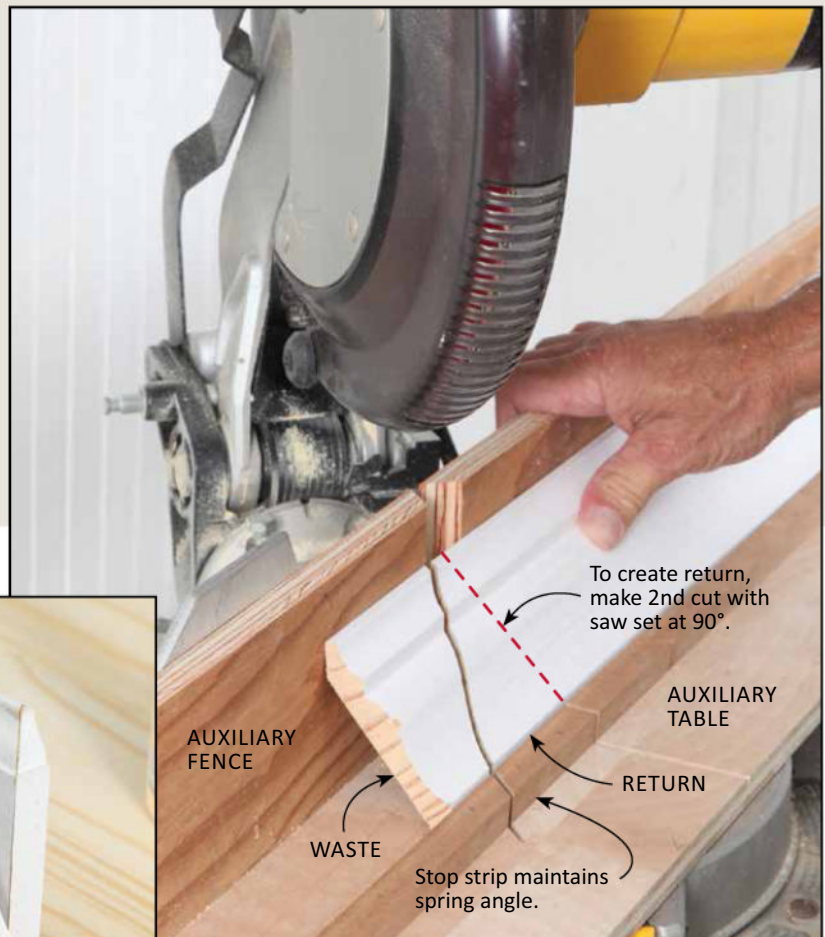
Position your molding upside down and backwards

Mitered returns give a mantelpiece shelf its distinctive look. To create them, you have to think like a trim carpenter who's installing crown molding in a room. Positioning your molding "upside-down-and-backwards" in the miter saw provides the proper orientation for cutting

the outside miters used to make mantelpiece shelves. The miter saw's vertical fence represents the wall. The table surface represents the ceiling or (for mantelpiece shelves) the shelf top or horizontal contact surface. It's smart to attach an auxiliary fence and table surface

to the miter saw for this work. To cut crown molding, also attach a stop strip to the auxiliary table to keep the molding positioned at the right spring angle for cutting. The cuts made in the stop strip facilitate easy and exact registration with layout marks made on your molding.

Customized for crown molding. Attach an auxiliary fence and table to your miter saw for accurate cuts in crown molding. The saw's vertical fence represents the wall, so the molding is cut upside down. The "spring angle" for crown molding is correct when the narrow flats along the edges of the profile sit flat against the fence and table. By attaching a stop strip to the auxiliary table, you can maintain the correct spring angle when cutting mitered returns.



Careful handling required. Always add the mitered return after installing the longer molding piece. To cut a mitered return, make the miter cut first, then the square cut. To avoid damaging the return, you can lay it flat on the saw table to make the square cut.

Assembling a shelf:

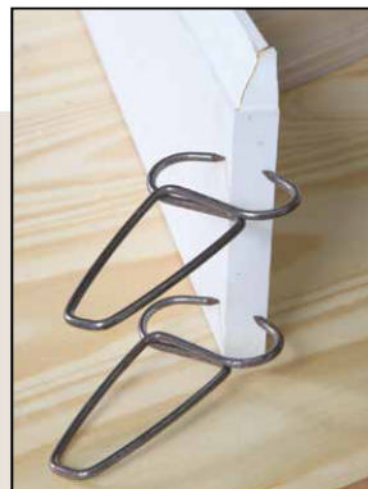
You'll need glue, air nailers, and clamps

The basic sequence for assembling a mantelpiece shelf is always the same: Complete the ornate underside of the project first, then attach the top. Instant CA glue can be used, but my

preference is Titebond II. It's easy to spread with a finger and clean up with a damp rag. With either adhesive, it's important to seal the end grain of all miters with an initial

coating of glue before making a second application that actually does the bonding work.

Pin & pinch. The pin nailer is especially helpful when attaching delicate mitered returns. Spring-type miter clamps are also good to have on hand. Their sharp tips pull mating parts tight till the glue sets. Both fastening aids leave marks that are nearly invisible.



Build off the backer. Backer pieces provide a gluing and nailing substrate, while also keeping each molding course straight. It's best to complete one course of molding at a time, always attaching the largest and longest molding piece first.

Special features to add

Make up some bullnose molding. This rounded detail makes an attractive edge on the shelf top.

A bullnose router bit sized for $\frac{3}{4}$ "-thick stock will enable you to create this edge treatment on the router table.



Add a plate groove. To display plates on your shelf, rout a $\frac{1}{4}$ "-wide groove between 1" and $1\frac{1}{2}$ " from the back edge of the shelf top.



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The fast way to make perfect tenons and tongues on the tablesaw

By Paul Anthony

Joinery is probably the most exacting aspect of woodworking. It's where thousandths of an inch matter. No kidding. If a tenon, for example, is even .004" (the thickness of a dollar bill) thinner than its mating mortise, the joint's strength has been compromised, no matter how well glue appears to hold it together. Because cutting joints can be fussy and time-consuming, it makes sense to take advantage of any efficiencies where you can.

This is where twin-blade joinery comes in. By stacking two identical blades together, you can reduce the time it takes to cut tenons, tongues, and other joints with parallel faces. At the same time, you're ensuring accuracy. For example, a common way to

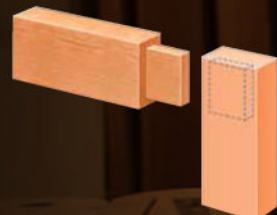
cut tenons is to saw one cheek, then flip the stock around on your tenon jig to saw the opposite cheek. The problem with this is that any inconsistency in your stock thickness translates into inconsistency in your tenon thickness. As you'll see, twin-blade joinery solves this problem, eliminating the need to fine-tune the tenon thickness for final fitting. The technique is just as effective at cutting accurate tongues on panel edges for the same reason. Although a different principle applies, twin-blade joinery is also the perfect approach to cutting double spline slots.

All the technique requires is two identical saw blades and some shop-made spacers. The small expense pays off big time, as you'll find once you try the method.

Joinery Options

All four of these joints can be made quickly and precisely with twin-blade joinery.

Standard Tenon



Tongue



Shallow Shoulder Tenon



Double Spline





What it takes



Blades, spacers, and shims. The key to twin-blade joinery is a pair of matched blades. Full-sized blades provide maximum depth of cut, but the outer blades from a dado head will also work. What's important is that the blades include some raker teeth—which are squared across, rather than beveled—to create a flat-bottomed cut. Spacers of $\frac{1}{8}$ "-thick aluminum create the gross blade offset, with shims of various thickness added to fine-tune the cut width. You can use commercial dado set shims, or make your own from aluminum cans, manila folder paper, and flat board from notepads. Mark or code your shims for easier setup.



Tenon jig and ZCI. To cut tenons, you'll need a tenon jig. A commercial model will work, but I prefer a shop-made version that rides the rip fence. You can outfit a jig with hold-downs if you like, although this can slow down production. Whatever jig you use, outfit it with a replaceable backer to eliminate exit tearout. It's important to outfit your tablesaw with a ZCI (zero-clearance insert) to prevent work from slipping downward into the throat plate opening, especially if you're not using hold-downs on your jig. (For more on ZCI's, see issue #53.)

Make the spacers



You can make spacers from aluminum, brass, hardboard, or any other non-compressible material of a consistent thickness. For minimum material investment and greatest set-up flexibility for common tenon sizes, make six $\frac{1}{8}$ "-thick spacers. They don't have to be perfectly concentric or of a precise diameter. (I make 3"-diameter spacers using $\frac{1}{8}$ "-thick aluminum plate.) Begin by using dividers to scribe out the perimeters, and then drill a $\frac{1}{4}$ "-diameter hole at the center of each.

Saw shy. After laying out the spacers and drilling $\frac{1}{4}$ "-diameter center holes, bandsaw each disc to shape, staying just a bit outside your layout lines. (No, aluminum won't hurt your bandsaw blade.)



Smooth the perimeter. To clean up the edges for safe handling, first mount each spacer on a $\frac{1}{4}$ "-diameter bolt, securing it with a nut. Then chuck the setup in a drill press, and sand the edges with coarse-grit sandpaper.



Enlarge the arbor hole. Clamp each spacer to a backer board at the edge of your drill press table, and widen the center hole to $\frac{21}{32}$ ". Sand or file away any remaining burrs afterward.

Determine the winning combination



Gauge the tooth offset. Hold an automotive feeler gauge against the blade body and front face of a tooth to gauge the tooth offset. This offset represents half the amount of shims you'll need to add to your spacers to get you close to the bulls-eye.



Keep a record. For future reference, keep a chart of the various spacer/shim combinations that work with your dedicated saw blade set. I keep my chart with my hollow chisel mortise set.

The thickness of a tenon or tongue is usually a specific increment ($\frac{1}{4}$ ", $\frac{5}{16}$ ", $\frac{3}{8}$ ", $\frac{1}{2}$ ", etc.), based on the width of the chisel or diameter of the router bit that cut the mortise, dado, or groove. It takes some initial fussing to arrive at the correct combination of spacers and shims for any given thickness, but you only have to do it once, as long as you record it for future reference. You can do this totally by trial-and-error, or you can take a measured approach, as I'll show you here, regarding the setup required for making a tenon.

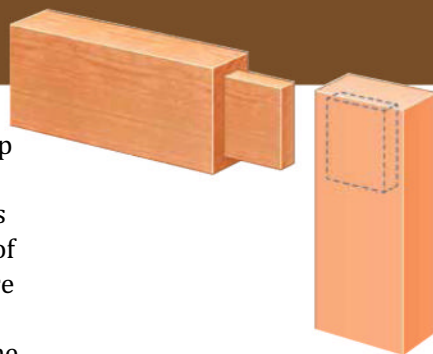


Set up, and test the cut. To set up for a test cut, mount your inner blade, followed up with spacers that total no more than your desired joint thickness. (Two $\frac{1}{8}$ " spacers for the $\frac{1}{4}$ " tenon desired here.) Then add enough shims to account for twice the tooth offset. Add the outer blade, a ZCI, and then make a test cut. Try the fit in a sample mortise; it should be very close. Remove or add shims, and recut until the test tenon fits perfectly, requiring just a bit of hand pressure to fully insert it in its mortise.

Download blank spacer/shim charts online
Go to woodcraftmagazine.com.

Cutting typical tenons

Typical tenons (with their relatively deep shoulders) involve a 2-step process: sawing the cheeks, then the shoulders. To ensure proper joint alignment during assembly, make sure to first accurately dress your workpieces to their final thickness, and mark the “show” face of every piece so you can orient it properly on the tenon jig. Once you’re set up, you can cut every tenon to precisely match its mortise width every time. Quickly follow up with the shoulder cuts, and you’re done.

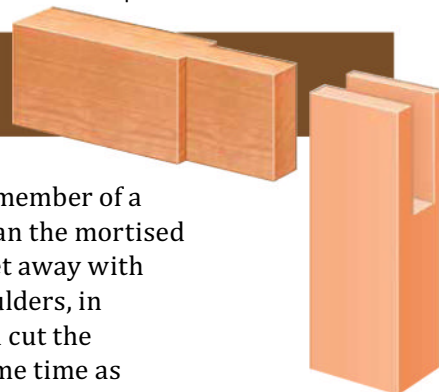


Tenon cheeks done fast. Having set up the proper blade/spacer/shim configuration, place the workpiece “show” face out on the jig, using a sacrificial backer to prevent tearout. Position the jig to locate the cut, and then feed the workpiece over the blades. For the greatest precision, remove the sawn workpiece before retracting the jig to set up the next cut.



Tenon shoulder cuts. To cut the shoulders, feed the work “on the flat” using a miter gauge. To prevent the freed waste from kicking back and possibly spoiling the cut, don’t use the rip fence as a stopblock. Instead, register the work against a raised stand-off block clamped to the fence.

Cutting shallow-shoulder tenons

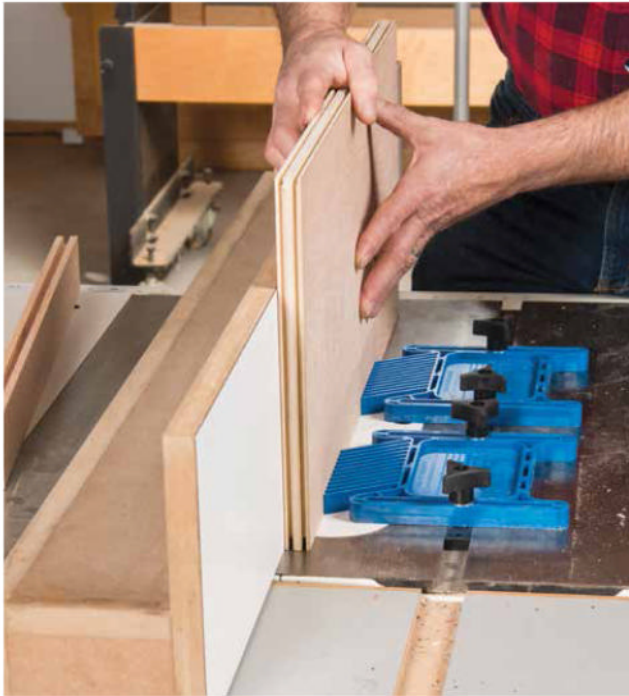


When the tenoned member of a frame is thinner than the mortised member, you can get away with minimal tenon shoulders, in which case, you can cut the shoulders at the same time as the cheeks, making for really fast work. To ensure square shoulders, make sure to use blades that include raker teeth.

Single-pass work. If tenon shoulders are designed to be narrower than the width of the blade teeth, the joint can be cut in one pass. To prevent scoring the face of your jig, use double-faced tape to attach a sacrificial panel to the jig.

Tools & Supplies:
See Buyer’s Guide
on Page 66.

Cutting tongues



A tongue that's true. For stability, feed a panel on edge against a tall fence. Featherboards pressing the work against the fence will ensure that the tongue remains parallel to the faces of the panel.

Frame-and-panel joinery often involves sawing the panel edges to create a tongue that fits into a groove in the edges of the frame. The blade/spacer/shim setup is exactly the same as for sawing a tenon. The only difference is how the workpiece is fed.



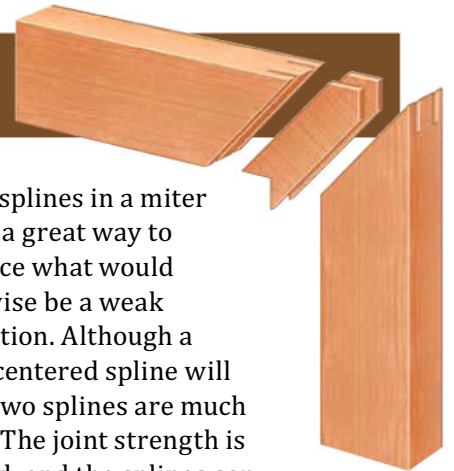
A safe chute for shoulder cuts. To prevent the freed waste from shooting out when sawing tongue shoulders, clamp a raised auxiliary fence to the rip fence for a pinch-free cut.

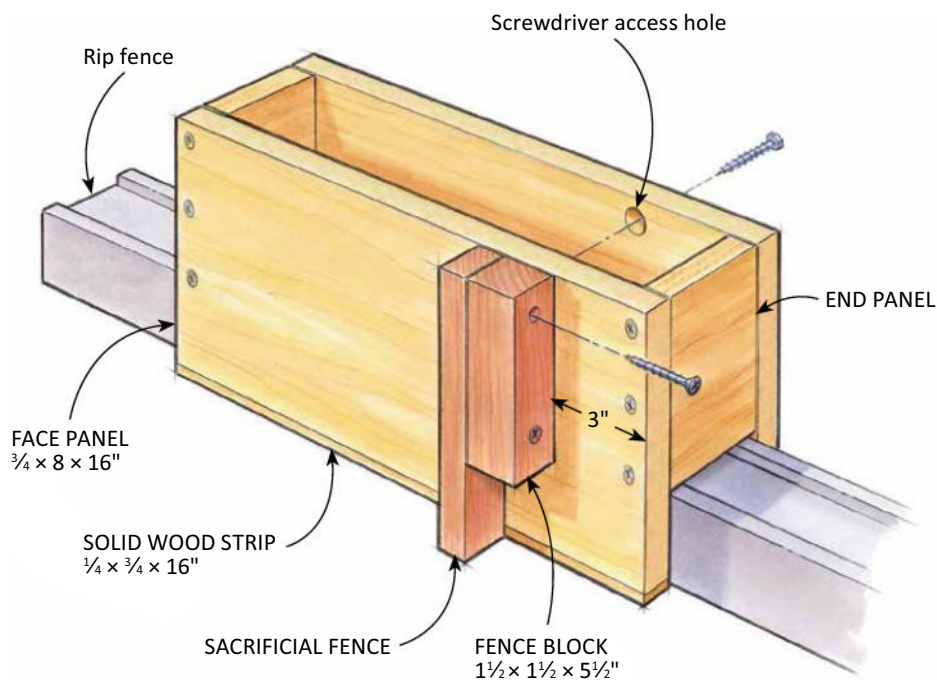
Better spline joinery



Gluing splines in a miter joint is a great way to reinforce what would otherwise be a weak connection. Although a single centered spline will work, two splines are much better. The joint strength is doubled, and the splines can be located closer to the faces of the stock, where they'll better resist separation due to wood movement.

Twice as strong. Twice as fast. Using a twin-blade setup to saw double spline slots halves the cutting time and ensures perfect slot alignment for trouble-free glue-ups.





Faces first. Saw the face panels from $\frac{3}{4}$ "-thick MDF or hardwood plywood. (The MDF used here happened to have a maple veneer.) Clamp the faces to your rip fence, and mark a piece of $\frac{3}{4}$ "-thick plywood to fit between them to make the end panels.

Tenoning Jig

This essential workhorse is easy to build, accurate, and very efficient to use

By Paul Anthony

Of all the jigs in a furniture maker's arsenal, a tenoning jig is one of the most useful. It allows you to use your tablesaw to cut tenon cheeks, open-end mortises, spline slots, and other cuts that require standing workpieces on end.

Various commercial models are available, most of which ride in the saw table slots. Unfortunately, I've found the ones that I've used to be expensive, heavy, and somewhat clunky to adjust. I much prefer this shop-made version, which is designed to straddle the ubiquitous Biesemeyer-style rip fence found on most modern tablesaws.

Unlike the angle-adjustable fence on commercial models, the fence on this jig is fixed at 90°, but that's fine for the vast majority of joints. In any case, you can outfit the opposite face of the jig with any additional fence configuration you like.

As shown in the drawing above, the jig design couldn't be much simpler. What's important is that the fence block is milled perfectly square, and that the face panels are dead-flat. When made properly, and fitted well to the rip fence, the jig produces terrifically accurate joinery. (Check out page 28 to see it in action.)



Drill clearance holes. Make one $\frac{1}{32}$ " oversize for fine adjustment. With the fence block clamped square to the panel, tap the screws to mark their centers, then bore the pilot holes on the drill press.



Test for fit. Saw the end panels to size, and clamp them between the face panels to make sure the jig fits snugly on the fence, but slides easily without binding. If it's too tight, shim it out by applying masking tape to the edges of the end panels. If it's too loose, trim the edges.



Face panel layout. With face panels cut to size and butted together along their top edges, I mark the location of a carefully milled fence block on one face panel. This enables me to lay out the clearance holes for attaching it to the panel, and corresponding screwdriver access holes in the opposite face panel. Note that I've glued $\frac{1}{4}$ "-thick solid wood edging along the bottom edge of each face block. This enables me to joint the assembled unit square later (if necessary) without harming my jointer knives.



Assembly. Drill pilot holes and clearance holes, and then screw the face panels to the end panels, carefully aligning the top edges of the parts to keep the unit square.



Ready to work. With the jig straddling your rip fence, make sure the face panel sits square to the saw table (above). If necessary, run the unit across your jointer to square the bottom edges to the faces. Then screw the fence block in place square to the saw table. (The oversize clearance hole will allow adjustment.) Finally, attach a sacrificial fence to the fence block (right).





Get Organized with an Entry Bench

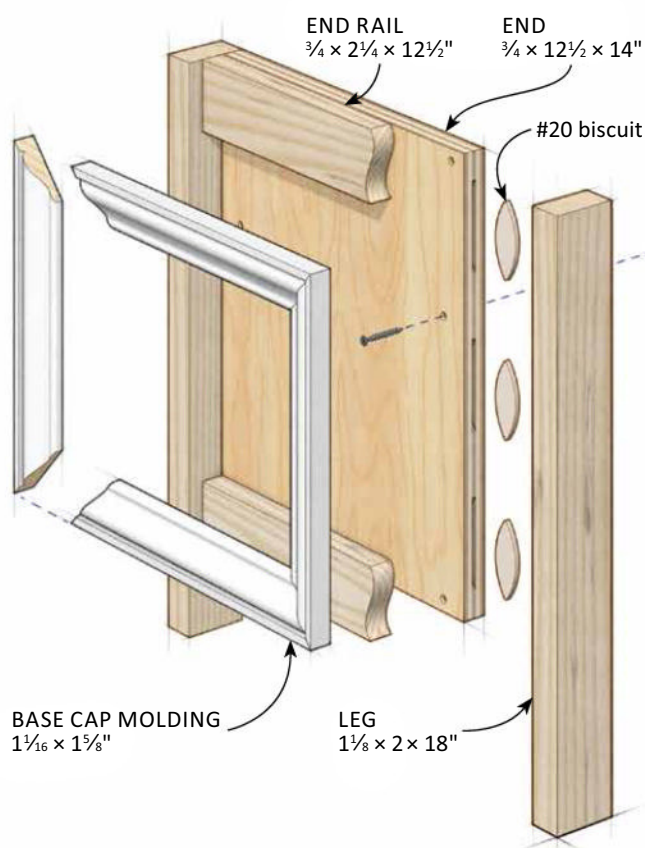
Comfort, beauty and utility, packed into a single piece of furniture

By Andy Rae

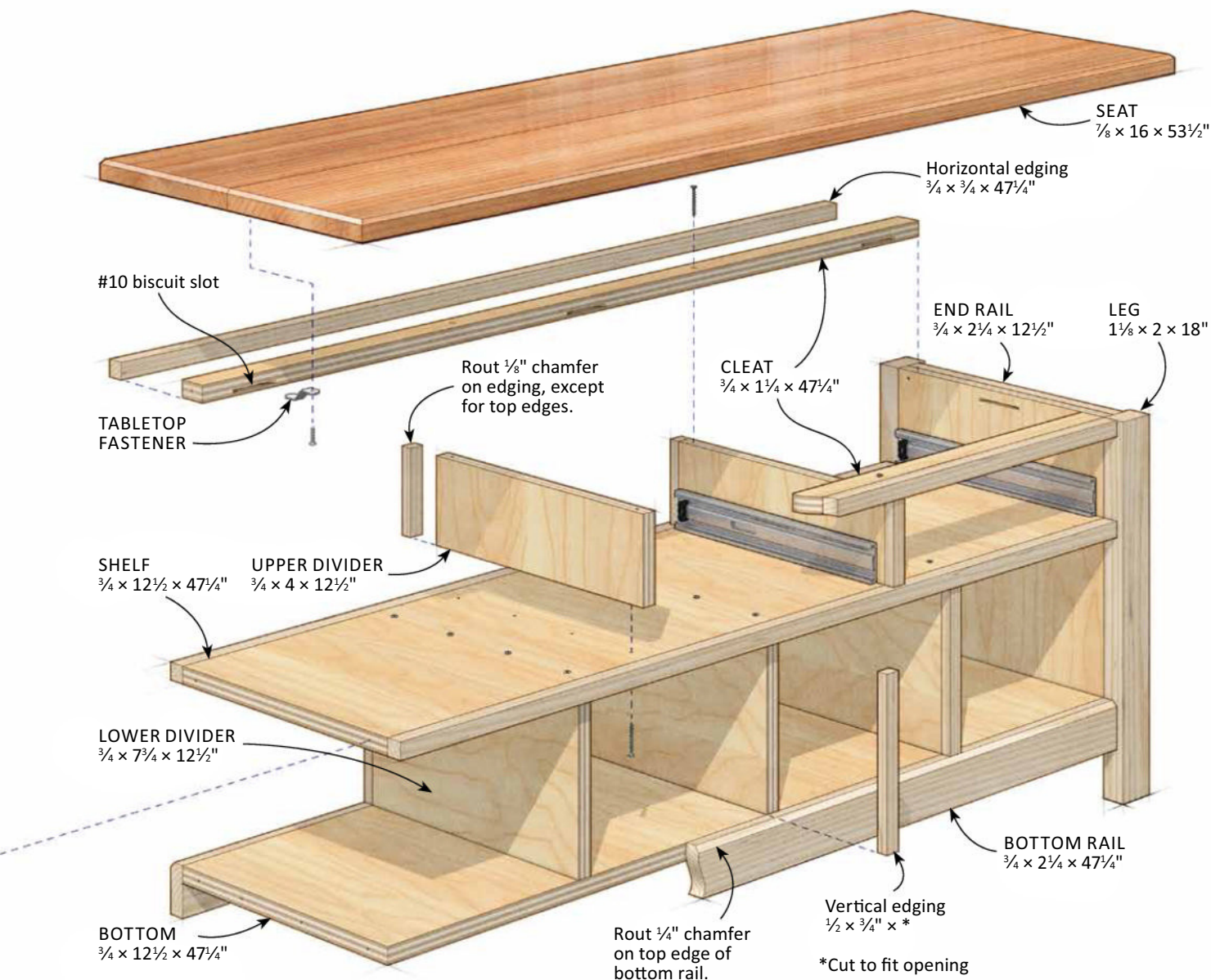
Doesn't everyone need an entry bench? This hard-working piece of furniture provides attractive storage space for boots, baseball mitts and plenty of other items, neatly organized beneath ample seating space. High-priced, factory-made versions are available, but a woodworker can achieve better quality for a lot less. My design offers four large cubbies and three cherry-front drawers that operate on touch-to-open slide hardware. You can build a bench just like mine for under \$100 in materials.

Tools & Supplies:

See Buyer's Guide on page 66.



A Plywood Case with Solid Wood Trim & Top



For drawer construction details, see drawing, p. 41.

Hardwood plywood is a good choice for the case and drawer boxes. It's strong, stable, and takes paint well. I covered the edges with maple trim. The seat and drawer fronts are solid black cherry, but just about any solid wood top will work with this design. Push-to-open drawers add convenience and eliminate bulky pulls.

Major construction steps

- Build the plywood case.
- Add legs and mitered molding to ends.
- Paint the completed base.
- Build and install drawers.
- Add top and drawer fronts.

Hardware order

- 3 pairs, 12" Accuride "touch-to-open" drawer slides
- 8 steel tabletop fasteners with 8-#8 $\times \frac{1}{2}$ "-long, roundhead installation screws

Build the plywood case from the bottom up

The biggest challenge in building the case is to make all seven openings the right size, as shown in the elevation view, opposite. I get these details right by dimensioning parts accurately and by carefully marking the locations for upper and lower dividers. Screws and glue provide more than adequate strength for the butt joints in this assembly. I use a brad nailer to pin parts in place with 1½" nails until screws can be driven. Remember to slot the ends and cleats for tabletop fasteners before assembly.



Skillsaw, then tablesaw. The case can be made from a half sheet of ¾" hardwood plywood. I clamp a straightedge across the panel to guide my circular saw, and take care to cut parts about ⅛" oversize. Then I cut them to finished size on my tablesaw.

Case construction sequence

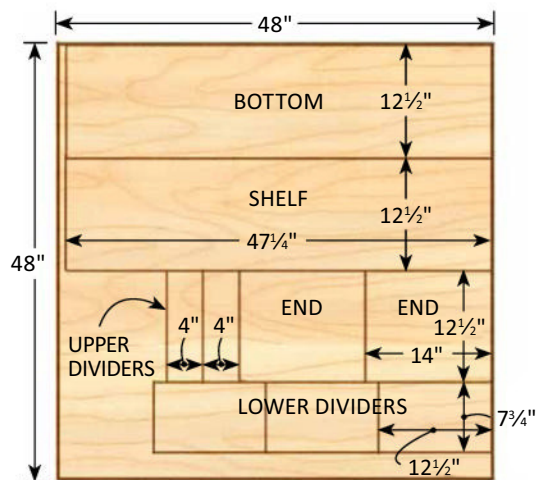
- Join the three lower dividers to the bottom.
- Join the two upper dividers to the shelf.
- Join the upper assembly to the lower assembly.
- Join the cleats to the upper dividers.
- Join the ends to the case assembly.



Tack, then screw. Take care to keep dividers inside layout lines and tack them in place with 2" brads. Then reinforce each joint with three 2" screws.



All case parts except for the two long cleats can be cut from a half-sheet of $\frac{3}{4}$ " hardwood plywood. I prefer to cut parts to rough size with my circular saw and a straightedge guide, then cut to final size on the tablesaw. The cutting diagram shown at right provides an efficient cutting layout.



Technical drawing of a wooden cabinet with dimensions:

- Top panel height: 4"
- Top panel width (left section): $15\frac{1}{4}"$
- Side panel height (middle section): $7\frac{3}{4}"$
- Side panel width (left section): $11\frac{1}{4}"$
- Bottom panel height: $\frac{3}{4}"$
- Bottom panel width (left section): $47\frac{1}{4}"$
- Bottom panel width (right section): $48\frac{3}{4}"$
- Overall height: 14"



Align, then attach. Maintain flush edges and accurate layout when joining shelf subassemblies.



Add cleats. Cap the case with a pair of long cleats that are screwed to ends and upper dividers. Use a biscuit joiner to cut #10 biscuit slots in ends and cleats, where metal tabletop fasteners will fit. Make one slot in each end, 2 slots in each cleat.

From case to bench in 3 steps

- Join legs to case with glue and biscuits.
- Attach trim to front edges of case.
- Install rails and mitered panel molding to case ends.

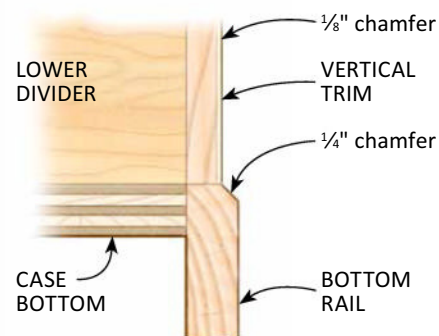


Add the legs. Position the case upside down on a flat surface, spread glue, add biscuits, and clamp two legs to each end.

Add legs and trim

With the case complete, it's time to attach legs and trim. The trim that covers the front edges of the case needs to be chamfered; you don't want sharp corners on these high-traffic cubbies. I mill trim to finished thickness and width, but leave it long so I can cut each piece to fit. Attach the horizontal edging with glue and 1½" brads. Then install the verticals between the horizontals. Secure the end rails to the case with 1¼" brads, then dress up the ends with mitered molding secured with pin nails.

Trim Detail



Chamfer the edging. Adjust bit height for a ⅛"-wide chamfer, clamp featherboards fore and aft of the bit, and use a pushstick and a steady feed rate to rout the chamfer.



Long pieces first. All edging should be cut to fit. After installing the bottom rail and horizontal edging with glue and finish nails, cut and install all the short vertical pieces.



Embellish the ends. Glue and nail the end rails to fit between the legs, then install mitered molding with glue and 1" pin nails.

Build and install the drawers

Box sides are rabbeted where they join the front, back and bottom pieces. I rely on the $\frac{1}{2}$ " plywood bottom to square and stiffen the box. It's important to size each drawer box based on the inside dimensions of the opening where it will fit. Accounting for the slide hardware, I subtract an inch from the width of the drawer opening to get the correct finished width of the drawer box. When all three boxes are together, I rout a $\frac{1}{8}$ " chamfer on outside edges, do any necessary sanding, then apply several coats of spray lacquer. This finishes the boxes off nicely before I install them.

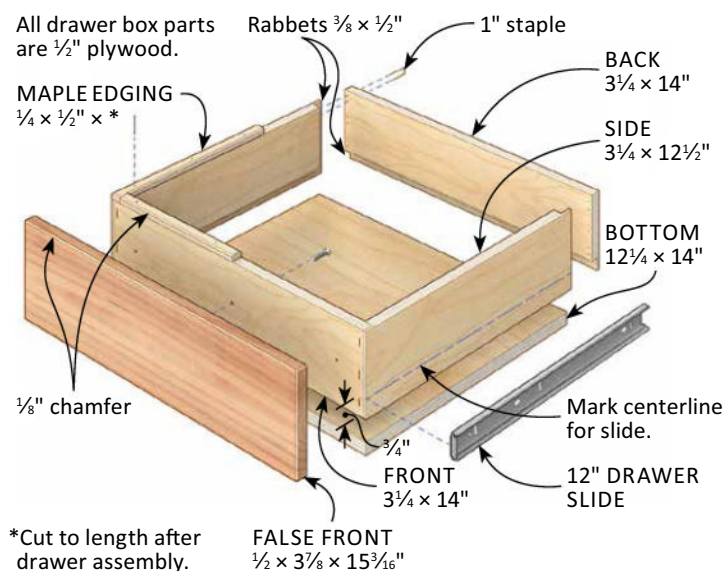


Speedy rabbet. Set dado width to match the thickness of your drawer box plywood, then raise the dado blade $\frac{3}{8}$ " high into a sacrificial fence secured to the rip fence. With this setup, you can guide box sides against the miter gauge to mill the short rabbets. Cut long rabbets by registering the work against the fence, as shown above.



Fasten from the front, not the side. With the drawer box upside down, shoot staples or brads through the front or back and into the sides for a strong connection. The fasteners will be hidden when you install the false front.

Drawer Construction



Install from above. Start with the slide housings that get screwed to the vertical dividers. Each housing can rest on the shelf and butt against a combination square set to a $\frac{1}{2}$ " depth. Once all slide housings are installed, lay out centerlines on drawer box sides for installing the mating slide pieces. Make sure the front edge of the slide is flush with the front of the drawer box. Install the drawer boxes, and check the slide action. A gentle push on the front should cause the drawer to pop open. Cut each false front $\frac{1}{8}$ " smaller than the opening where it will fit (in length and width). Use folded paper or business cards as spacers to wedge each false front in place before securing it to the drawer box with three countersunk screws, driven from inside the drawer.



Paint the base, then install the top

At this point, just about all the construction work is done. I detach the drawer false fronts and mark (on an unseen inside face) each front's location. Then I glue up a cherry top, taking care to get the best grain match on the boards I need to make up the full 16" width. After cutting the top to its finished size, I chamfer the edges as indicated in the drawing, and give the top and cherry drawer fronts four coats of wiping varnish. Make sure to apply the same number of coats on all sides of these parts so that they're sealed evenly to avoid warping. The base gets a coat of primer, followed by a coat of antique blue paint. When all the finish has dried, I clamp the base and cherry top upside-down on my workbench and attach the top with tabletop fasteners. After reinstalling the drawers and false fronts, my bench is ready to do its job.



Two-coat finish. Doing a thorough job of finish-sanding and priming the base sets the stage for a good finish coat.



Clips allow wood movement. As explained on p. 56, steel tabletop fasteners are designed to fit into slots and screw to the underside of a solid wood top. I clamp the assembly upside-down and install the clips with a right-angle driver attachment on my cordless drill.

Have it your way Consider different design options to personalize your bench. Without changing the dimensions of this bench, you can give it an entirely different look. The simplest options are to vary the paint color and select a different type of wood to use for the top and drawer fronts. In the version shown here, I used milk paint in an antique red tone and topped the bench with cypress. I kept the upper compartments open instead of filling them with drawers. For a more subtle change, use a different molding profile to embellish the ends of the bench.



Jig Maker's Toolkit

Stock up on this time-saving collection of important ingredients

By Joe Hurst-Wajszczuk



A good jig is one of the smartest investments a woodworker can make. When the right materials, fasteners, and hardware are used, a jig pays you back by making a difficult or monotonous procedure simpler, faster, more accurate, and safer. If you've experienced these rewards, you've probably also endured the frustration of trying to cobble together a jig when you don't have the right materials on

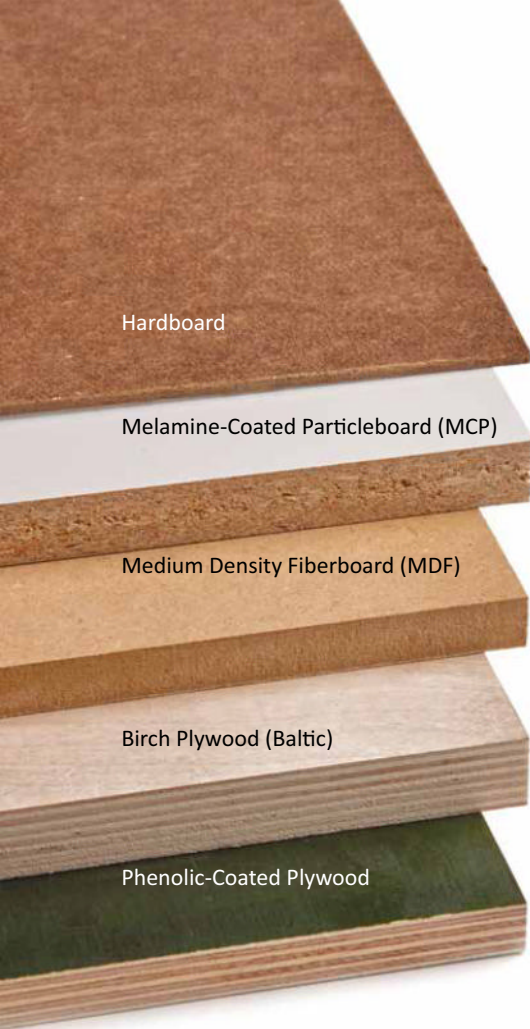
hand. After twenty-plus years of jig building, I've come up with the comprehensive collection of items described on the pages ahead. Whether you are knocking together a jig for a one-time operation, or making one that you plan to use for a long time, this kit will take the frustration out of jig creation. That's right: You can build it right the first time, instead of settling for compromises and workarounds.

Checklist:

- ☒ Plywood & MDF
- ☒ Glue
- ☒ Screws
- ☒ T-track
- ☒ Clamps
- ☒ Inserts & T-nuts
- ☒ Knobs

If there's a jig-making item that didn't make our list, but you can't do without, send an e-mail to editor@woodcraftmagazine.com. We'll share the best suggestions in a future issue.

Stock up on sheet goods



Hardboard

Melamine-Coated Particleboard (MCP)

Medium Density Fiberboard (MDF)

Birch Plywood (Baltic)

Phenolic-Coated Plywood

Sheet goods offer a combination of strength and stability that's difficult to match with solid wood. Most of these products are readily available at your local home store.

Hardboard. This mash-up of fibers is smooth, slick, precisely thickened, and inexpensive—ideal attributes for any jig-making material. Standard hardboard is fine for one-time jigs, but tempered hardboard is better suited for those that may see repeated use.

Particleboard. Melamine-coated particleboard is flat, slick, and glue-resistant. It's not as stiff or durable as plastic laminated MDF or plywood, but it will often do.

Medium-Density Fiberboard. I have a love/hate relationship with this stuff. It's my go-to sheet material for jigs because it's cheap, flat, and precisely thickened. It's also dense enough

for use as router templates. On the downside, it's heavy, tends to sag, and generates clouds of dust with sawing or routing.

Plywood. Hardwood plywood is stiffer and smoother than construction-grade sheets, making it the logical choice for jigs. Despite its attributes, I prefer MDF because of the price difference, and because plywood thicknesses are typically less than listed and can vary from sheet to sheet. (Higher-priced plywoods, such as Baltic Birch and Appleply, are stiffer and more stable. I buy these materials as needed for my "keeper" jigs.)

Phenolic Plywood. Skinning Baltic-birch plywood with a phenolic resin creates a super-stable panel that's slick and resistant to moisture, chemicals, and abrasion. I reserve this top-shelf sheet good for my ultimate jigs and fixtures.

When wood just won't work

Every good jig kit needs a small stockpile of plastics. Each of these items offers unique attributes, such as flexibility, durability, and visibility, that you can't get from wood.

Laminate. Plastic laminate can provide a slick, durable skin for hard-working jigs and fixtures. In the workshop, grey offers the best combination of reflection and contrast.

Acrylics and polycarbonates.

Clear baseplates and guards let you keep an eye on your work. Acrylic (e.g., Lucite, Optex) is more rigid, giving it an edge for router table baseplates, but it's not as strong as polycarbonate (e.g. Lexan, Tuffak). If there's a chance of a blade or bit encounter, use polycarbonate.

Phenolic. This plastic-and-paper composite is

easier to machine than clear plastics, but it's pricey. I reserve it for baseplates and tablesaw blade inserts.

Polyethylene. UHMW (ultra-high molecular weight) polyethylene is dense, tough, rigid, and slick. It's great for bases and guide strips that need to move. It's easy to machine, but doesn't work with adhesives.



Acrylic

Polycarbonate

Phenolic

Polyethylene

Plastic laminate

Stick to it

This selection of go-to glues offers a range of strengths and drying times. Just remember that making jigs is different than making furniture, so be judicious. There will be times when you'll want to reposition or remove a part without damaging the workpiece or ruining the jig.

Quick Stickers. Hot-melt glue and double-faced tape can make permanent bonds or offer temporary tacking. For the latter, don't use too much, and take care when separating the stuck parts. Contact adhesive is a true dual-purpose adhesive. For a temporary bond, mist the surface and immediately stick the item in place. For a permanent bond (sufficient to affix laminate) spray both surfaces, let dry, and then press the parts together.

Wood-to-Wood. Regular yellow glue is still the gold



Quick-stickers

Wood-to-wood

Universal

standard of jig joiners. This glue is inexpensive, easy to clean up, and strong. The only downside is the time it takes for the bond to reach full strength. When minutes matter, I use Nexabond, a fast-curing cyanoacrylate formulated for joining wood to wood.

Universal Adhesives. These two belong in your kit because

they bond almost anything to anything. Epoxy is my choice for joining wood to metal. As when permanently affixing a bolt into a plywood base, for example. For sticking parts to plastics, I prefer E6000, a flexible one-part craft adhesive. To ensure that the glue is good to go, I prefer small single-application tubes.

Pull the trigger for faster fastening

There will be times when you can't come up with a convenient means of clamping two pieces together, or simply do not want to sit around watching glue dry. This pair of problem solvers can help, and may even change the way you approach jig making.

With a little guidance from the drilling jig, pocket hole screws can be used to secure a glue joint without the hassle of additional clamps, or without glue for a solid, reversible joint. The jig and bit take care of the clearance hole and counterbore while the self-drilling screw tackles the pilot and pulls the parts together.

A 23-gauge pin nailer offers an even faster, and less visible

fastening option. The tiny pins may not have as much long-term holding power as screws, but they can hold parts together while an adhesive cures. The pins' tendency to pull through can be used to your advantage. For some operations, a few pins can tack parts together more conveniently than double-sided tape. When you're done, simply pry the parts apart. The holes left by the headless fasteners disappear under a first coat of finish.



23-gauge pins

Pocket screws



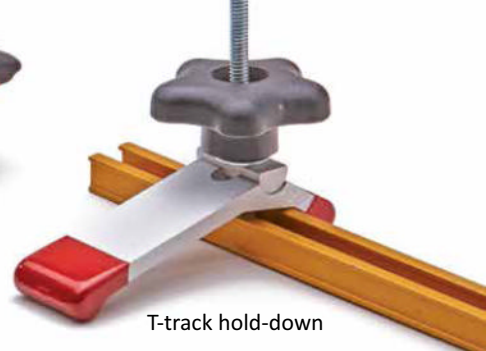
Standard toggle



Vertical handle toggle



Auto-adjust toggle



T-track hold-down

Quick-action clamps. Fast, but can slip.



C-clamps. Cheap and strong.



F-style clamps. Power plus wide grip.

Hold it!

Clamps are cheap insurance, not only for your work, but for you. These accessories have the mechanical advantage to grip workpieces more reliably than you could accomplish with hand pressure, and the ability go where fingers should fear to tread.

Toggles. Start with a basic assortment like what's shown above, and buy more as needed for specific jigs. (To ensure even clamping pressure on ends of longer workpieces you'll want to buy a pair of each.) The first three toggles are usually screwed directly to a jig's face or base. The T-track hold-down is more maneuverable, but it requires an additional means of engagement—either a T-track, or series of through holes—to

set the bolt. Remember that you can employ the same clamps on several different jigs, so don't be put off by the cost. Remove a few screws, or twist off a knob, and you can relocate the clamp from one jig to another.

Clamps. My jig-kit clamps are smaller and shorter than most in my clamping arsenal. The object is to fix the workpiece without making the jig top-heavy, or interfering with a blade or bit. Strength is a consideration, but you only need enough pressure to keep parts from shifting. For one-handed convenience, I often reach for pistol grips, but rely on C-clamps or F-style clamps when I need more security. (An advantage to threaded clamps is that they can be cinched securely enough to serve as handles.)

Counterbore can extend the reach of short screws.



Flatheads



Decking

Drywall

Round washer heads



PowerHeads



Screws you will use

Since most jigs are made from sheet goods, a basic assortment of screws should meet most of your needs.

Drywall. These screws work fine with plywood, but may snap when working with MDF. Also, fully-threaded shafts can prevent boards from pulling together. Predrilling and clamping parts together when driving helps, or you can opt for a different fastener.

Decking. The self-drilling tip and underhead nibs reduce

the need for predrilling and countersinking, while the smooth shanks helps draw parts together without a clearance hole.

Round washer heads. In addition to a self-drilling tip and smooth shank, the flat-bottomed head prevents this fastener from pulling through the top and overdriving.

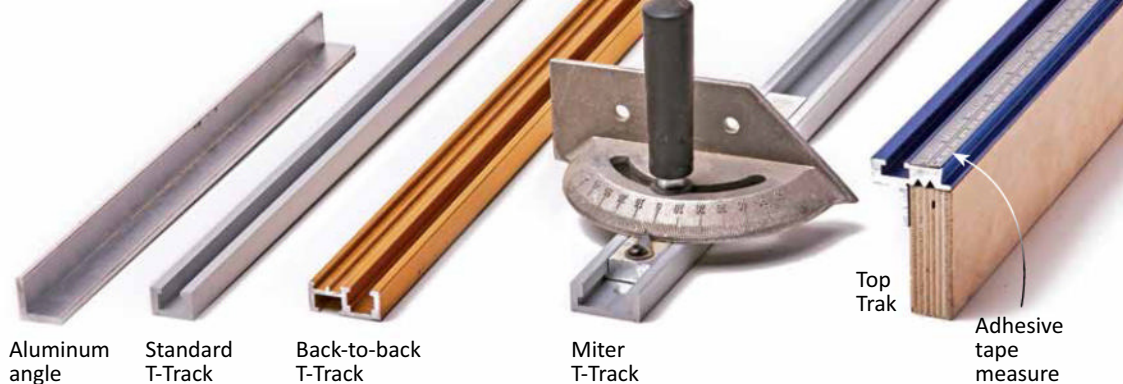
PowerHeads. Discovering that these cabinet-hanging screws sit flush like flat heads and resist pull-through like washer heads, I now keep a few on hand.

Track stars

Aluminum extrusions are one of the most useful and versatile components for jigs and fixtures. While most metalworking requires special equipment, aluminum can be sawn and drilled much like wood. The metal's strength permits a variety of useful profiles in thicknesses that would be almost impossible to match with other materials.

Angle. OK, it's not a track, but this home center staple has found its way into a bunch of jigs. This extrusion's basic profile is the key to its versatility. I've used angle for edging, fences, and tracks.

Standard. My second favorite



profile, standard T-tracks provide a channel in which T-shaped and standard head $\frac{1}{4}$ " bolts can slide freely and be locked in place. To install, rout or dado a $\frac{3}{4}$ "-wide slot, then glue or screw them in place.

Back-to-back track. The double-slotted profile provides additional sliding and setting options. I prefer INCRA's T-track because the built-in scale-slot (a shallow groove along the top of one of the tracks) offers a means of setting pieces according

to specific measurements.

Miter slot. For jigs destined for regular use, this $\frac{3}{4}$ "-wide slot extrusion keeps bars from wearing out the walls of a dado or groove.

Top trak. This T-slot profile, made by KREG, can be added to the edge of a board for incorporating T-nut stops or other accessories to the fence of your drill press, crosscut sled, or miter saw station. This profile also has a slot for a self-adhesive scale (sold separately).

Threads for success

Glue, pins, clamps, and screws keep parts fixed, but most jigs have one or more elements that need to shift about and then lock into position, or require some special means of securing the workpiece. For this you'll need special hardware. To create your own construction set, you can make several hundred trips to the hardware store, or buy a ready-made kit, like the one shown at right. Unlike my make-shift collection, the threads on the knobs, handles, nuts, bolts, and inserts match ($\frac{1}{4}$ "-20 tpi), enabling the parts to be used in any combination. Buying the set is also cheaper than buying the parts a la carte.

The set contains the parts needed to complete a jig kit. The T-nuts and threaded

inserts serve as reversible and adjustable means of securing two parts together. Once installed, they offer a threaded anchoring point for bolts or threaded knobs. The T-bolts and oval nuts fit into the T-track, enabling you to devise your own sliding fences and stops.

Tip

To top off your jig kit, buy a few extra sets of baseplate screws to fit your routers.



Double-Duty Dollhouse

A not-so-big home for dolls or books, with a secret storage spot

By Tom Whalley
and Marlen Kemmet

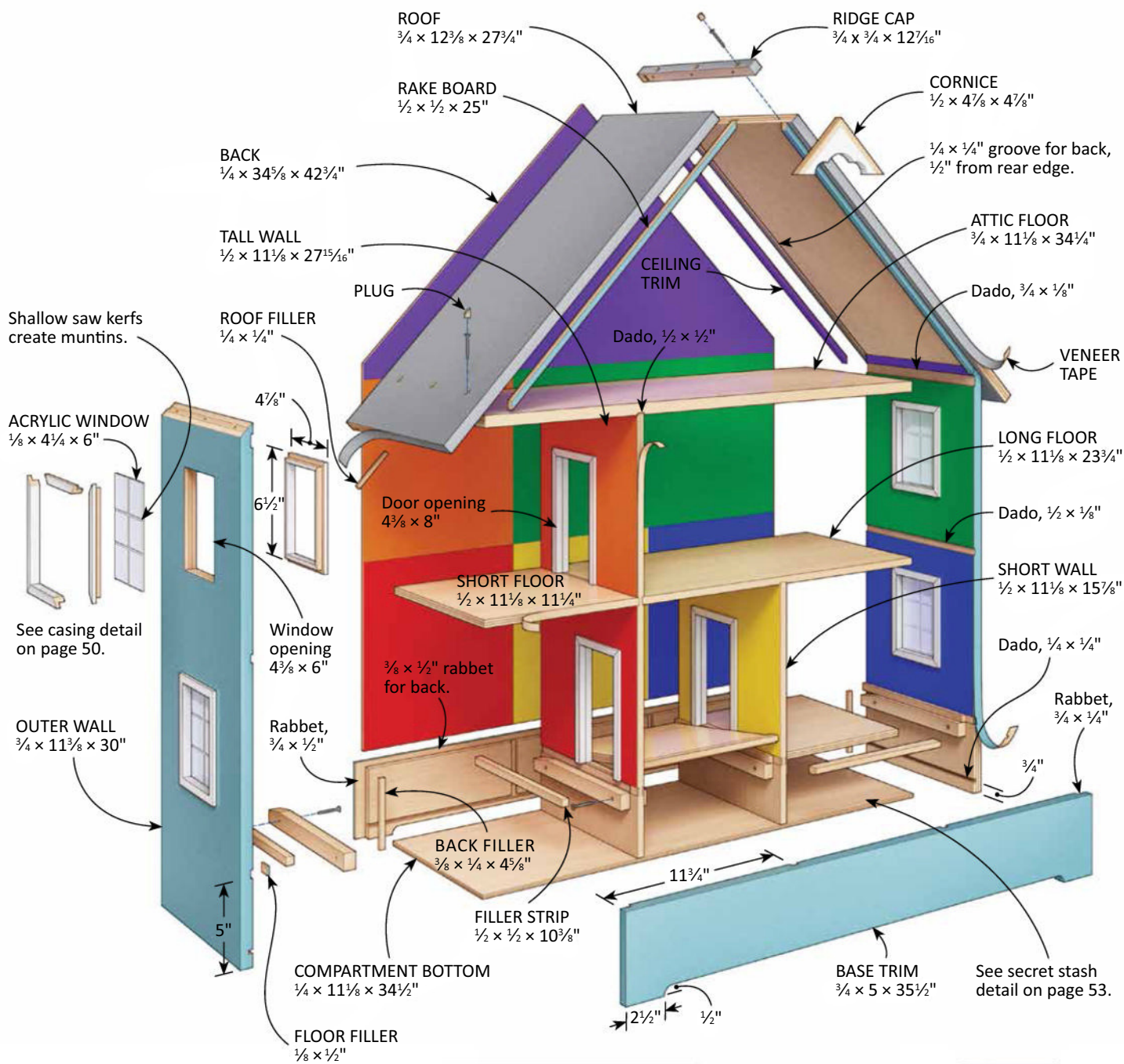


The problem with kids isn't just that they grow up so quickly, it's also that they quickly outgrow the gifts you build for them. Here's a dual-purpose project designed to pass the test of time. In "play" mode, you have a fully functional dollhouse with rooms sized to hold commonly available lightweight boxes. But this multi-colored mansion can easily serve as a bookcase when its dollhouse days are over.

Like any good dollhouse, this one has enough architectural detail to inspire fun play time: brightly colored rooms, windows, doors, and multiple levels. Construction materials are pretty basic: plywood, iron-on edging, solid wood trim and a few pieces of clear acrylic.

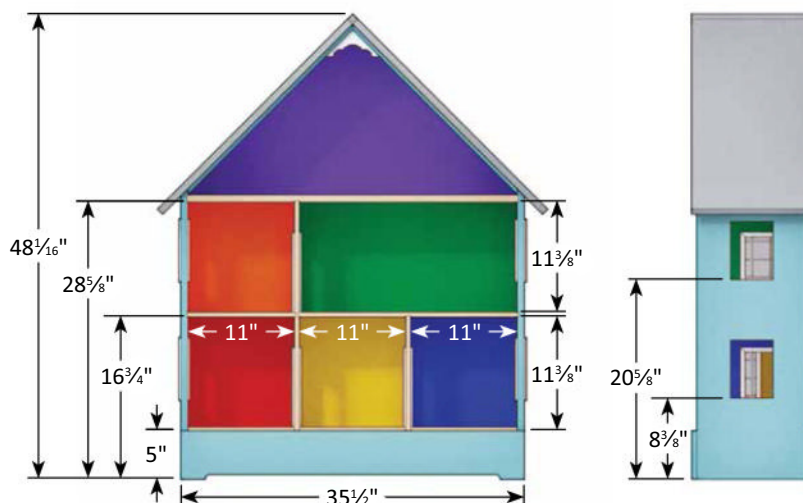


Flip-up floor panels. Pressing the back edge lifts the front, revealing secret storage in the base.



Online Extra

For complete SketchUp drawings, including the jigs used to paint the walls, go to woodcraftmagazine.com and select the "Project Plans" tab.





Eliminate alignment errors. After applying veneer tape to the front edges of the walls and attic floor, cut the dados using a miter gauge outfitted with an auxiliary fence and a stop.



Smooth the sill. Trim covers the rough-sawn edges around the windows and doors, but the bottom edge of each doorway remains exposed. To sand the bottoms flush with the dados, set a pair of scrapwood guides into the floor dados as shown.

House raising: walls, floors,

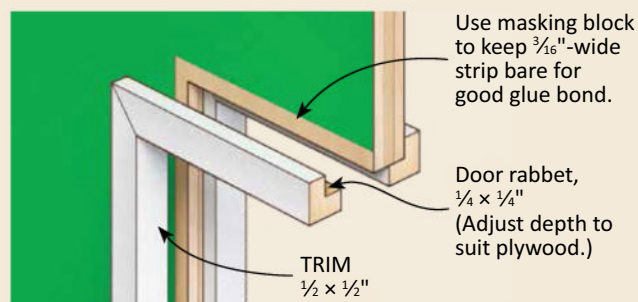
Though the joinery and materials in this project mark it as a bookcase, architectural details make the construction process a little unusual. Follow these construction steps:

- 1** Cut the base, walls, floors, and compartment bottom to finished sizes. Leave the tilt-up bottom floor panels (see page 53) for the very end.
- 2** Apply the iron-on veneer to the front edges of the walls and floors, as shown in the drawing.
- 3** Cut the dados where the walls and floors join. Test-fit the wall and floor



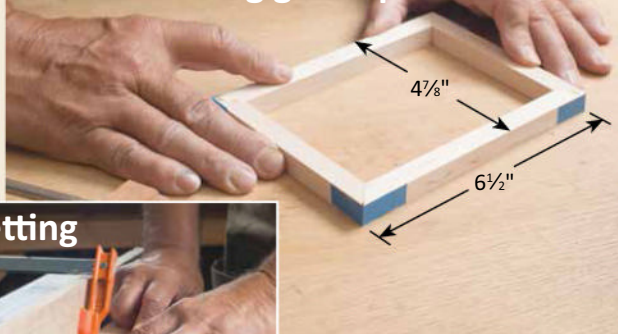
Mask, then spray. Finishing the rooms is easier now than after assembly, but you'll need to mask off the rabbets, grooves, and dados to ensure a solid glue bond. Custom-made masking blocks keep paint off a $\frac{3}{16}$ " strip around windows and doors.

Prefab window & door casings



To start, mill about 40' of $\frac{1}{2} \times \frac{1}{2}$ " trim stock. As you tape and glue the mitered window trim pieces together, make certain that the joints are tight and the assembly flat. After the glue has cured, sand each door and window frame smooth, and then paint the three outer faces. Rabbet the inside (bare) edges of the window and door frames. Adjust the depth of the window casing rabbets so that the acrylic fits between the inner and outer frames. To make a pair of door casings, saw a double-length door casing assembly in half, using a miter box and model saw.

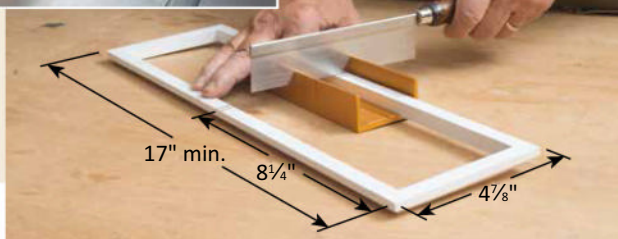
Window casing glue-up



Rabbetting



Cutting 2 doors



windows & doors, plus paint & trim

joints for snug, square assembly.

4 Cut the window and door openings. Sand the bottom edges of all door openings flush with the floor dados (see photo on facing page).

5 Cut and assemble the mitered casings for all the windows and doors. Rabbet the casings to fit the sawn openings.

6 Prefinish the walls and casings with spray enamel, masking the edges of the openings as shown at left. Top off the pieces with a coat of clear lacquer.

7 Install the door and window casings on interior wall openings using glue.

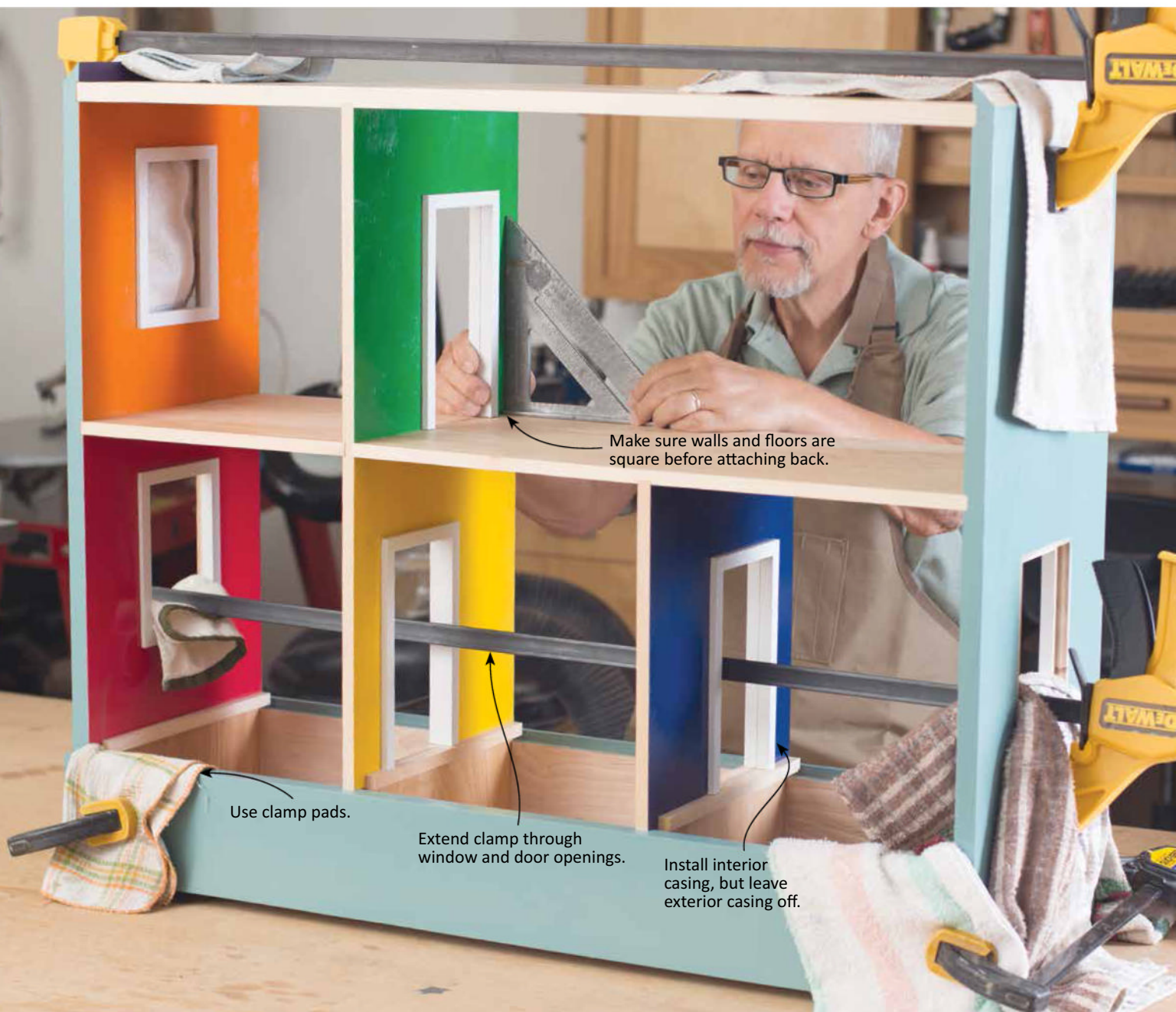
8 Assemble the case (see photo, below).

9 Paint and install the back of the case.

10 Assemble and then raise the roof (see page 52). Paint, then install the trim.

11 Cut, score, and install the acrylic windows. Then, attach the exterior window casings.

12 Install the tapered cleats for tilt-up floor panels. Carefully measure and fit the tilting floor panels on the first floor.





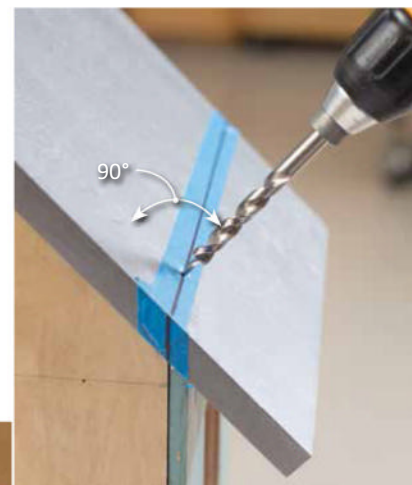
Tack the back. After cutting the back to fit, and painting the front to match your rooms, attach it to the case using glue and pin nails. Mark the locations of the floors so that your pins don't miss their target.



Square peak. I temporarily set a piece of $\frac{1}{4}$ " plywood in the roof panel grooves and used a shop-made right-angle brace to make sure the roof panels were aligned and perfectly square before joining them to the ridge cap.

Final framing: adding the back & roof

Made from $\frac{1}{4}$ " plywood, the back stiffens the case assembly when glued and nailed to walls and floors. After installing it, cut the roof panels to finished size and groove their rear edges to fit over the back's top edges. Join the roof panels together by screwing and gluing them to the ridge cap. Then install the back, screwing into outer walls, as shown below. When adding the decorative cornice and rake board trim, feel free to develop your own design and color scheme.



Block-guided drill bit. To secure the roof to the outer walls, I needed to drill angled pilot holes through the roof and into the outer walls. Using a $\frac{3}{8}$ " pocket-hole drill bit I started the holes perpendicular to the surface, then used an angled guide block to finish the hole. After installing the screws, plug the holes, trim them flush, and sand smooth.

Window glazing

The last few steps qualify as “punch-list items” in carpentry parlance—small details that make a difference—so take your time.

To create kid-safe windows I used $\frac{1}{8}$ "-thick acrylic. After cutting the acrylic to fit, I cut shallow grooves to simulate muntins, using a blade that cuts a flat-bottom kerf. Fit the acrylic in the window opening, and then install the exterior window casing as shown.

Tip

To prevent scratching the acrylic, leave the protective wrap in place until you have finished cutting the muntin lines.



Muntin maker. Using a pushblock for support, cut $\frac{1}{64}$ "-deep kerfs (just enough to score the surface) in the acrylic panels to simulate muntins.

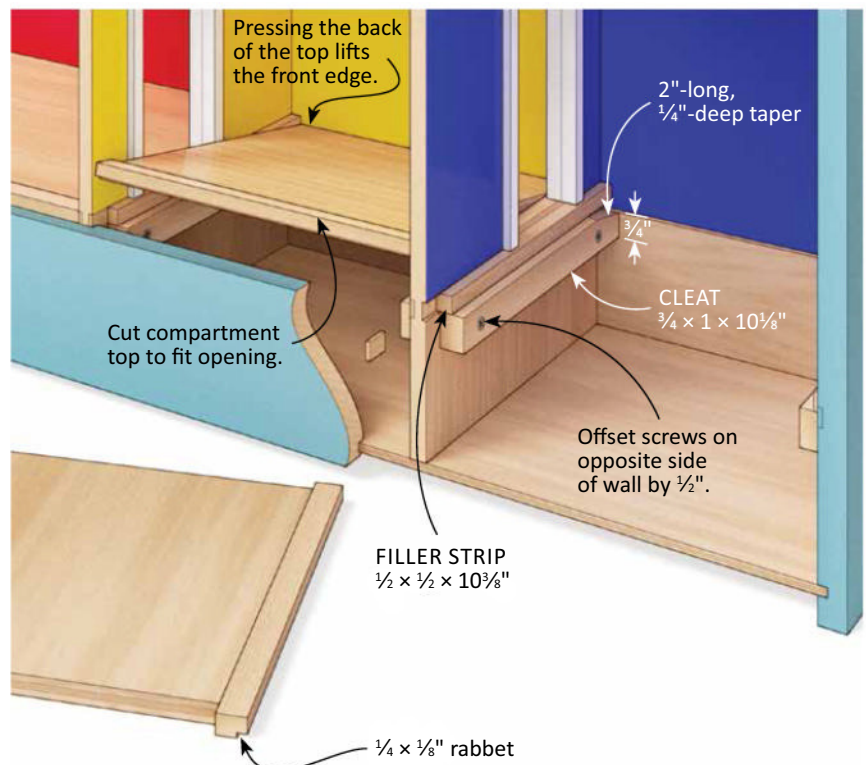


Press-fit windows. Insert the acrylic windows with the grooves facing inward, and glue the outer window trim assemblies in place on the outside walls.

Secret stash: fitting the flip-up floors

In order for the compartments to be a secret, the floor panels must fit perfectly. Measure the floor openings and then subtract just $\frac{1}{16}$ " from the dimensions to size each floor panel's depth and width. Allow for solid wood trim on front edges, with $\frac{1}{4} \times \frac{1}{8}$ " rabbets to fit over the top edge of the base.

Take a moment to fill in any remaining gaps. I plugged the dadoes in the underside of the roof and on either edge of the compartments with filler strips and then dabbed on a bit of finish to match the surrounding wood.



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Attaching Tabletops

Three solid fasteners that allow for wood movement

By Joe Hurst-Wajszczuk

Show me a woodworker who has glued or screwed a solid wood tabletop to its base, and I'll show you a person who has learned a painful lesson in wood movement. Mother Nature doesn't strike right away, but in time an overly-secured top

is doomed to shrink and crack during the dry season, or expand and bow (or damage the base) during the humid months.

The solution is simple: tabletop fasteners. These tiny clips and blocks offer a solid means of attachment and allow

for some seasonal give and take. Here's a brief overview of three commonly used options, utilizing inexpensive hardware or scrapwood, plus some selection and installation advice to help you choose the right solution for your next project.

Joinery Class



Drill before assembly. Bore the recess $\frac{3}{16}$ " in from the rail's inside edge and a hair deeper than the fastener.



Perfect pivoter. Drive the screw so that the clip can pivot slightly, and then check that its head sits flush with the rail.

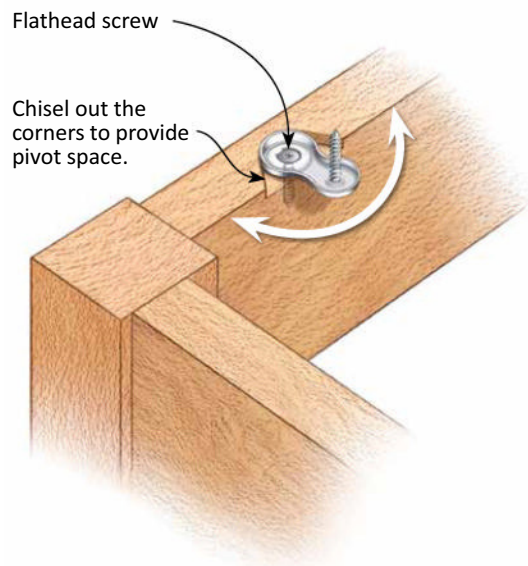


Figure-8 fasteners

Figure-8 or "desktop" fasteners are screwed to both the apron and the tabletop, and pivot to accommodate wood movement. These fasteners are inconspicuous and easy to install. Because they don't allow for much wood movement, they're best suited to tabletops under 18" wide. To maximize movement, widen the recesses as shown above.

Also, slightly angle the fasteners installed on rails running parallel with the top's grain.

Installation is quickly accomplished with a drill press and Forstner bit, followed by a touch of chisel-work. Just remember to drill the recesses before attaching the legs.

Z-clip fasteners

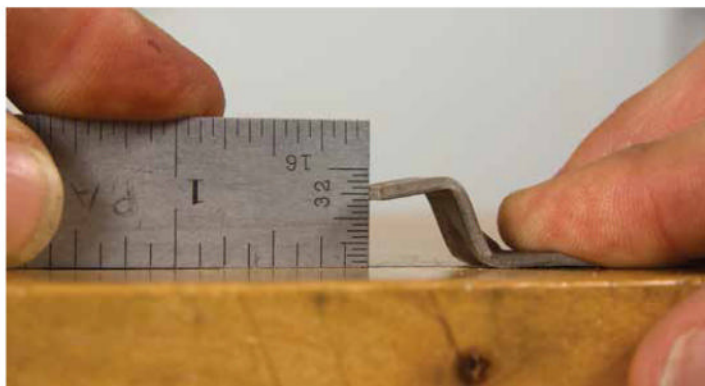
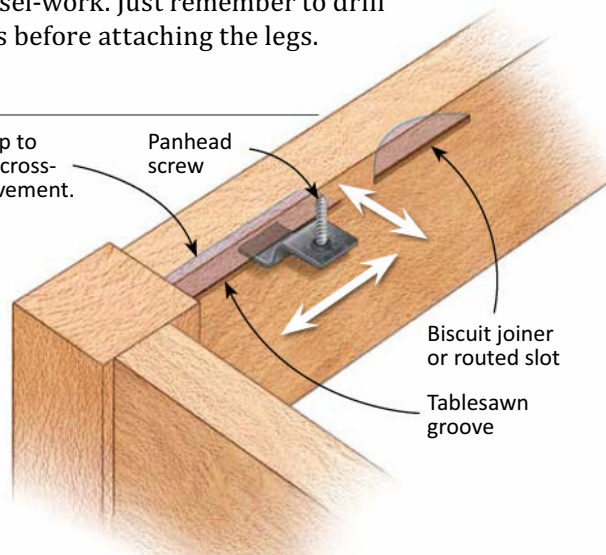
With one end screwed to the tabletop, and the other sitting freely in a groove or slot cut on the inside face of the rail, Z-clips allow more movement than figure-8's. They also offer more installation options. The rails can be slotted at the tablesaw before assembly, or after, using either a biscuit joiner or a router.

When attaching clips, be mindful of wood movement direction. Set the clips that will experience side-to-side movement fully in their slots. For the clips dealing with in-and-out movement, leave a gap during wet weather, or set them tight during drier months.

Adjust gap to allow for cross-grain movement.

Panhead screw

Biscuit joiner or routed slot
Tablesawn groove



Put the squeeze on. To determine the location of the slot or groove, measure the height of the clip's tip and add $\frac{1}{32}$ ".



Simple slotter. For post-assembly clip slots, clamp a board to the rail's outer face, and rout the inner face with a $\frac{1}{8} \times \frac{3}{8}$ "-deep slot cutting bit.



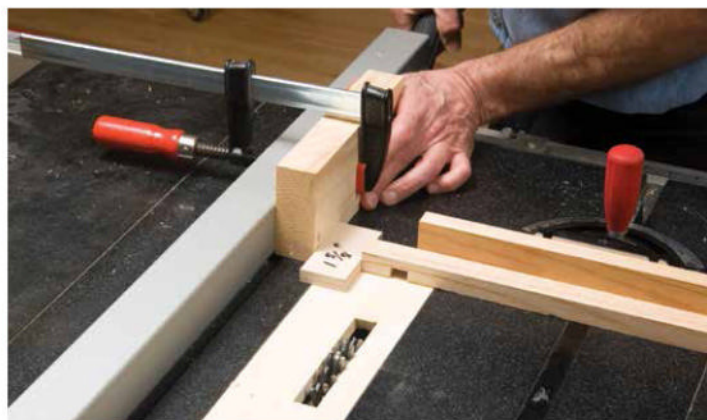
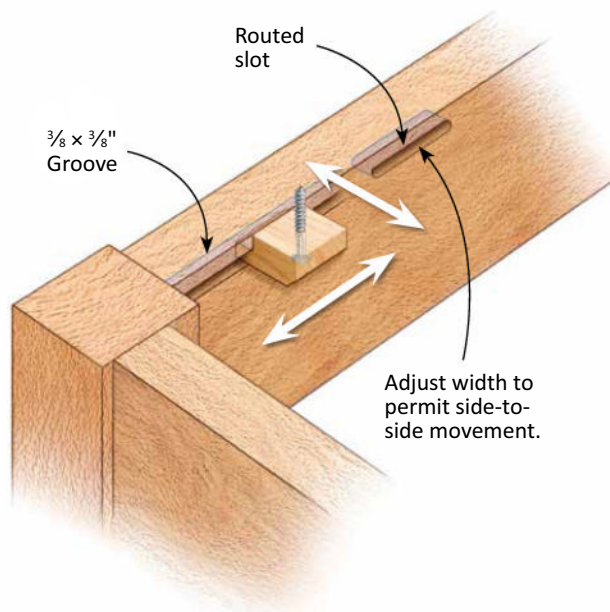
Shop-made wood buttons

Wooden buttons are installed in dadoes or slots, much like Z-clips, but are stronger and infinitely more attractive. They take a little time to make, but you can mill a batch from scrap in less time than it takes to run to the store.

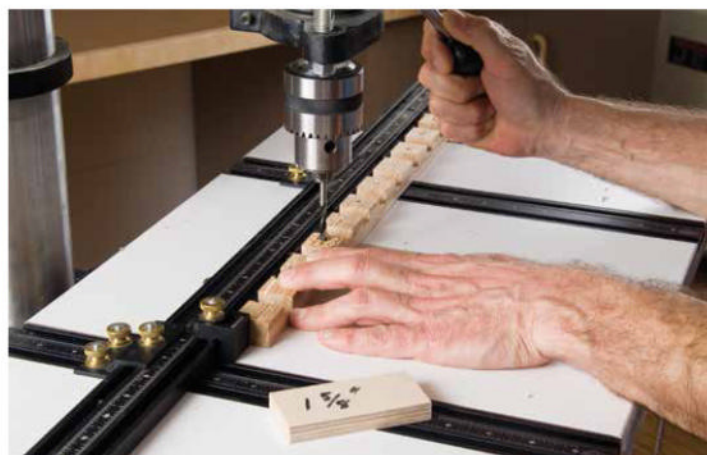
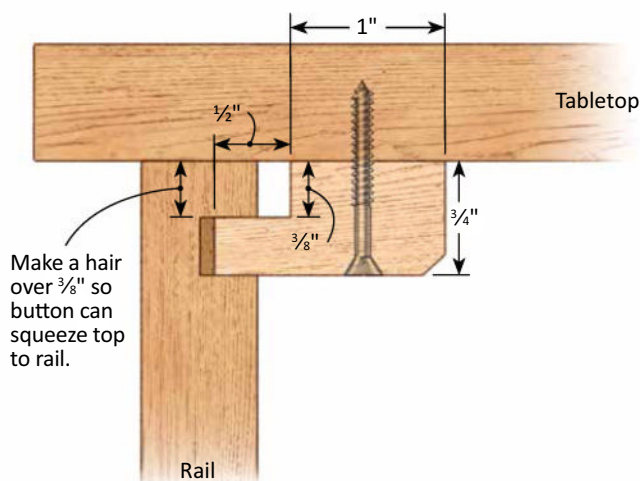
To make the buttons shown below, start with a strip of hardwood $\frac{3}{4} \times 1 \times 24$ " long. Set up a dado head for a $\frac{5}{8}$ "-wide cut, and outfit your miter gauge with an auxiliary fence that reaches the blade. Clamp a thick stopblock to your tablesaw's fence, a few inches in front of the blade.

Saw a $\frac{3}{8}$ "-deep dado 1" in from each end of the strip, then use a $1\frac{5}{8}$ " spacer to reposition the fence and cut the next set. Repeat the set-up process until you've finished the strip.

I use the same spacer for drilling the screw clearance holes, and then saw the buttons from the strip by eye. Chamfer the sharp outer edges, and finish up with a light sanding.



Dado a strip. Cut a dado in each end of the strip and then use a $1\frac{5}{8}$ " spacer to reset the fence and stopblock for the next cut.



Bore the buttons. Use the spacer/stop trick when drilling the screw clearance hole in the center of each button-to-be.



Free at last. Align the blade with the button's rear edge and make the cut. Stop the blade before removing the button.

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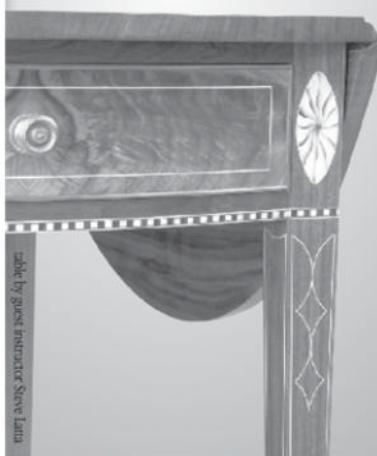


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Peg Racks

Bet you can't build just one

By Chad McClung

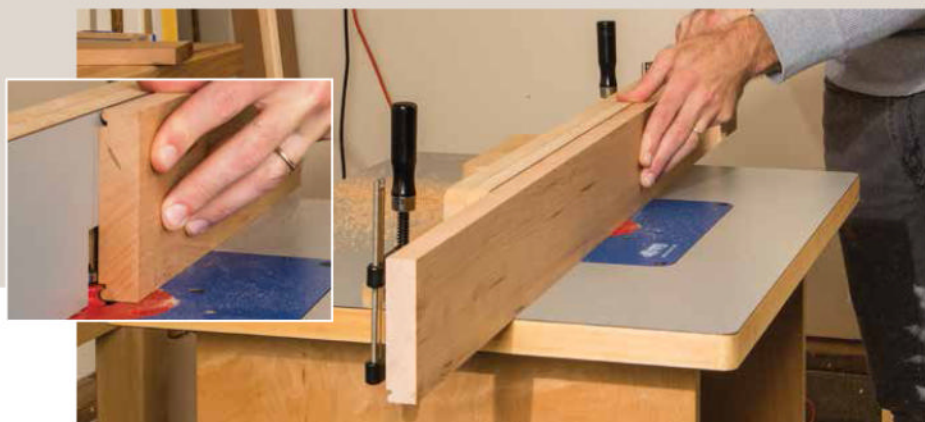
Peg racks have huge convenience and de-cluttering value—there's no better place to stow hats, coats, sweaters, purses, backpacks, and other gear. Outfitted with metal hooks or (as shown here) Shaker pegs, this simple organizer can team up with an entry bench (see page 36) or be used on its own in a bedroom, hallway, closet or any place you find empty wall space.

Apart from their utility, peg racks make

sense because they're inexpensive and easily customizable. Size the backer board to fit your wall space, detail the edges on the router table, then mount your chosen pegs or hooks. Although a peg rack can be installed by driving screws through the face of the backer board, it looks nicer to keep mounting screws hidden. You can do this by routing keyhole slots in the back of the board, as shown here.

Begin with the backer board

Dress your lumber square and flat, and trim to final size. Choose your profile and rout the edges. Mark the centers, then drill the holes for the peg tenons.



Be edgy. After cutting the backer board to width and length, bead the long edges on the router table. (Cove and round-over bits also create pleasing edge profiles.)



Get spaced out. Large Shaker pegs should be placed 4-6" apart.

Invisible installation

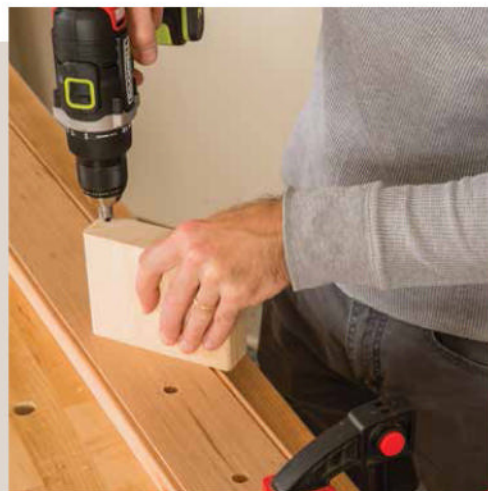
Routing keyhole slots on the back of the completed peg rack will enable you to hang the rack on a pair of hidden installation screws. To do this, you'll need a keyhole router bit, a guide bushing slightly larger than the bit's large diameter, and a shop-made jig (shown below) to align and guide the router. Start your installation by marking on the wall a level line to which the top edge of the peg rack will align. Use a stud finder to locate two studs on your installation line, and transfer the stud locations to the back of your backer board. A jig for plunge-routing the keyhole slots is easy to make from $\frac{1}{2}$ " plywood. Test your jig and technique on scrap stock before you set up and rout the peg board.



Simple ingredients. To make a peg rack, all you need are wooden pegs, a backer board, and a drill bit that matches the size of peg tenons. For pegs and bits, see page 66.



Circle and slot. Select a router bushing with an inside diameter that accommodates your keyhole bit (inset photo). The routing jig consists of a plywood platform with a rectangular slot that controls the movement of the circular router bushing. Screw a right-angled fence to the platform to ensure accurate positioning of the slot. With the jig clamped to the backer board and the bushing seated in the slot, plunge down to make the larger hole, then rout the narrower slot by moving the router till the bushing hits the opposite end of the slot. Slide the router back carefully before raising the bit out of its hole.



Then go straight. No drill press? A short, square-cut 2x4 with one rabbeted corner can serve as a guide and depth stop for straight cutting. After boring all peg holes, final-sand the board and apply finish. Wait to glue pegs in their holes till after routing keyhole slots (right).



Trapped heads. A #8 flathead screw will be a good match for a typical keyhole slot. Choose installation screws long enough to extend at least $1\frac{1}{2}$ " into studs.

Shaving with both hands: How to choose & use spokeshaves

If you like working with a good hand plane, you'll love working with a spokeshave. Both tools excel at removing mill marks, smoothing rough or uneven surfaces, and chamfering edges. Although the spokeshave earned its name by helping wheelwrights create smooth, uniform parts, I've come to rely on spokeshaves for all kinds of shaving and shaping work.

Thanks to the small sole that surrounds a spokeshave's blade, this tool can be used in tight quarters or on curved surfaces that would foil even the smallest block plane. But unlike a block plane, a spokeshave can't be used with one hand. Despite other differences,

all spokeshaves come with a pair of handles. Using both hands enables you to control the pressure and direction of your shaving action.

Straight or curved?

The first spokeshave to buy is a straight-bladed version. You can use a straight-blade spokeshave to smooth concave surfaces as long as the radius isn't too small (see photos below). Spokeshaves with convex or concave blades are really best for specialized work – like hollowing wooden seats (convex) or shaping curved legs (concave).

My Pinnacle spokeshave has become my favorite, mainly because of its quality



construction and the twin thumbscrews that make it easy to fine-tune the blade's position. Models without thumbscrews tend to be less expensive, but I find them trickier to adjust. A straight blade for a spokeshave is sharpened just like the blade for a hand plane.

Pay attention to grain direction

Before I put my spokeshave to work on a project, I usually test the blade adjustment on some scrap stock and fine-tune as necessary. Make sure to clamp your work securely,



Push downhill. When smoothing a curve like this, always work from both sides so you can shave in a downhill direction to avoid tearout.

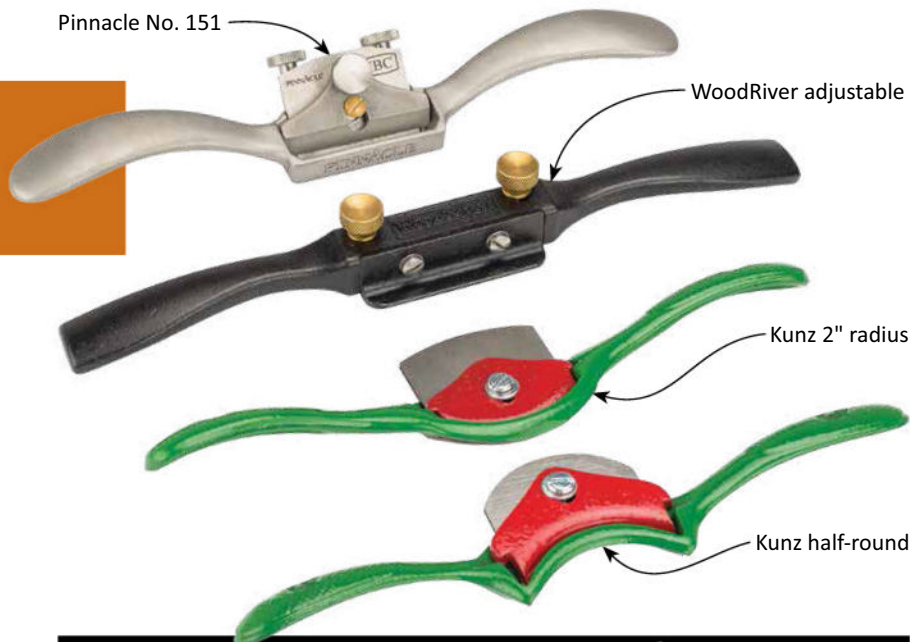


Chamfering champ. Along curves or straight edges, the spokeshave offers excellent control for chamfering, rounding and shaping.

Choose your weapon. Straight-blade spokeshaves like the Pinnacle and WoodRiver offer the most versatility. Curved versions are good to have for hollowing or rounding work.

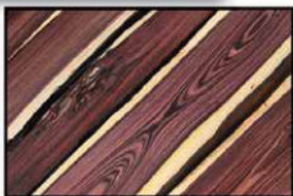
because you'll be applying pressure with both hands. You can pull the tool toward you to take a shaving, or push on the handles; choose the approach that feels most comfortable to you. But above all, pay attention to grain direction to avoid splitting and tearout. When shaving a concave surface, always work in a downhill direction, as shown in the photos. In other situations, make sure that you're not shaving into rising grain.

Pinnacle No. 151



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By Joe Hurst-Wajszczuk

Claro burl

Black walnut (*Juglans nigra*), which tops many lists of favorite furniture woods, also has a surprisingly multi-faceted role as a nation-builder. As early generations of American furnituremakers were discovering the splendor of this dark domestic wood, pioneers and colonists were harvesting the tree's nuts for food and employing the easy-splitting, decay resistant walnut logs for split-rail fences and log-and-timber-framed homes. Because of the wood's balanced attributes of strength, stability, and shock resistance, the U.S. military from the Revolution up to the end of

the 20th Century relied on black walnut for gunstocks.

Walnut trees may not play as important a role in our daily lives today, but the lumber continues to be a workshop favorite.

Where the wood comes from

Walnut trees can be found across the U.S. and in areas of southernmost Canada, but most of the commercial wood comes from the Central U.S. You'll find the finest trees in Iowa, Minnesota, and Wisconsin along the Mississippi River Valley.

Claro walnut is one of black walnut's closest and prettiest cousins. Typically identified as *Juglans hindsii*, there's some confusion as to the exact species. Hailing from California and Southern Oregon, it's sometimes referred to as California walnut. It exhibits a pronounced color and figure, particularly near the base of a trunk that had European walnut grafted to it for increased nut production. Old orchard trees often reveal great beauty within when harvested.

Butternut (*Juglans cinera*) is on the other side of the color and price spectrum. Sometimes referred to as "white" or "poor man's" walnut, this species

is lighter and less expensive than its darker cousins, but it can be stained to match them, making it useful as a secondary wood. Butternut contains fewer extractives and works as easily as pine. While its softness is advantageous for carving, this makes the wood less suitable for furniture parts that need to withstand wear and tear, such as legs and tabletops.

How to select the best stock

Although walnut trees initially spring up quickly, they are slow to mature. The light colored sapwood surrounding the brown heartwood represents 10 to 20 years of growth. To control waste, most commercial dealers use steam in the kiln-drying process to encourage the compounds within the heartwood to migrate and darken the cream-colored sapwood. This process evens out the color, but it also robs the heartwood of its richer colors (see photos, at right).

While many woodworkers might be willing to drive some distance to obtain air-dried stock, regulations intended to contain the spread of the Thousand Cankers Disease

Black Walnut Quick Take

Density	Moderate
Hardness	Moderate
Stability	Excellent
Rot and insect resistance	Heartwood: Excellent
Texture	Fine
Toxicity	Moderate
Uses	Furniture, casework, gunstocks, carvings, turnings, musical instruments

Canker-tastrophe

Black walnut is under attack by the Thousand Cankers Disease (TCD), a fungal malady carried by the walnut twig beetle that lives under the tree's bark. The fungus creates black cankers that restrict the flow of nutrients and kill affected trees within three years. Unfortunately, other than premature leaf yellowing, TCD doesn't reveal itself on the trunk until it's too late.

TCD is rampant in the western states, but cases have also been confirmed in Tennessee, Virginia, and Pennsylvania. To control the spread of this blight, experts advise against transporting walnut logs or boards with intact bark. (Many states restrict the sale of air-dried lumber and live-edged boards across state lines.) Kiln-dried stock poses little threat of carrying the fungus-ridden beetle.

For more information about the disease and prevention tips, go to www.thousandcankers.com.

(see box, above) restrict transportation of air-dried walnut across state lines. So, if you're hunting for deeper purples and browns and cream-colored sapwood, search out a supplier using a dehumidifier kiln; its lower-temperature process reduces the moisture and arrests the fungus without affecting the color of the wood.

Working walnut in the shop

Walnut's beauty is more than skin deep. Falling midway between ring-porous woods like oak, and diffuse-porous woods like maple, walnut is considered "semi-ring-porous." This gradual cellular transition between early and latewood makes the wood less prone to chattering and tearout and friendly to work with both power machinery and hand tools. Thanks to its moderate hardness, walnut is easy to sand, and it can be polished to a high luster.

Despite its many attributes, you must be mindful of walnut's natural defenses. Mature trees contain the chemical compound juglone and other extracts that

can irritate the eyes and skin, so use common sense. Wear a dust mask or respirator, don goggles when machining, and wash exposed skin afterward. (Juglone can wilt or kill plants and harm horses and dogs, so take care when disposing of shavings and sawdust.)

Finishing walnut

To see what walnut will look like under a clear finish, wipe the wood with mineral spirits or alcohol. If you're working with air-dried stock, your project may not require much help; a few coats of oil or film-based finish should do the trick. To add extra warmth to kiln-dried stock, try pretreating with orange shellac or aniline dye before the topcoat. Walnut's semi-diffuse pore structure means that it does not need grain fillers.

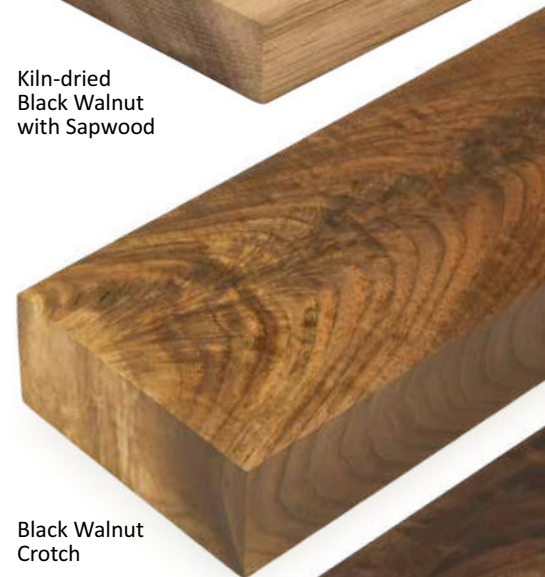
To conceal sapwood, try blending in the lighter sections with a dye stain. (The color of heartwood doesn't change over time.) Staining or shellacking the entire piece can provide additional camouflage, and can help even out the tones of contrasting boards.



Air-dried
Black Walnut
with Sapwood



Kiln-dried
Black Walnut
with Sapwood



Black Walnut
Crotch



Claro Walnut



Butternut

Buyer's Guide

Hot New Tools (p. 14)

1. Bosch JS1220 Cordless Jigsaw, www.amazon.com, **\$119.00**
2. Arbortech Contour Random Orbit Sander #160726, **\$104.99**
3. Arbortech Turbo Shaft #161431, **\$119.99**
4. Arbortech Mini Turbo Kit #160733, **\$159.99**
5. Bosch AG40-85P 4½" Angle Grinder #863659, **\$79.99**
6. Veritas Detail Flush-Cutting Saw #161271, **\$24.99**
7. Norton ProSand Multi-Air Sanding Discs, 5"-dia. 60 to 320-grit discs available in 3- and 10-disc packs. Go to www.woodcraft.com for pricing info.

Mantelpiece Shelves (p. 24)

1. Grex 23-gauge Model P650 2" headless Pin Nailer #838673, **\$269.99**
2. CADEX 1⅜" 23-gauge headless pinner & brad nailer, www.amazon.com, **\$149.95**
3. Miter Spring Clamps (set of 4), #846103, www.japanwoodworker.com, **\$14.00**
4. Bull Nose Router Bit: Freud 82-114, #830676, **\$46.47**

Twin-blade Joinery (p. 28)

1. Freud LU84R011 50-Tooth Combination Saw Blade #127241, **\$73.47**
2. Veritas Dado Shims #05J13.01, www.leevalley.com, **\$13.50**
3. .125" Aluminum Bare Sheet 1100 H14 (12 × 12") www.onlinemetals.com, **\$13.61**
4. 17/64" Jobber's Drill Bit (118° point) #8870A28, www.mcmaster.com, **\$2.57**
5. 21/32" Jobber's Drill Bit (118° point) #8870A56, www.mcmaster.com, **\$23.28**

Entry Bench (p. 36)

1. Whiteside Chamfer Router Bit ¾" shank, 45° angle #149227, **\$27.99**
2. Whiteside 2292 45° Chamfer Bit #149227, **\$27.99**
3. Table Top Fasteners, 8-piece #159301, **\$2.99**
4. Accuride 12" Touch Release Drawer Slides (3 pairs req.) #161631, **\$19.99/pair**
5. Rockwell Right angle Driver Bit Accessory #415715, **\$25.99**

Jig Maker's Toolkit (p. 43)

1. DeWalt Rapid Heat Ceramic Glue Gun, www.amazon.com, **\$26.99**
2. Double-Sided Tape, 2" × 36 yards #15D26, **\$47.50**
3. DAP Weldwood Spray, 16 oz. #146046, **\$10.99**
4. Nexabond 2500M Wood Glue, 1 oz. #159187, **\$7.99**
5. Titebond, 16 oz. #08L21, **\$4.99**
6. E-6000 Adhesive, 1 oz. #159626, **\$7.99**
7. System Three 5-Minute Epoxy, pint #124269, **\$39.99**
8. KREG R3 Jig Kit #147643, **\$39.99**
9. GREX P635 23-Gauge Headless Pinner #836278, **\$189.99**
10. Low Silhouette Toggle, 6 × 1¾" #143938, **\$14.19**
11. Vertical Handle Toggle, 2⅝ × 3⅝" #144312, **\$12.59**
12. Armor Auto-Adjust Toggle, High Horizontal #160648, **\$25.99**
13. Woodpeckers Deluxe Hold Down Clamp #142603, **\$10.99**
14. Jorgensen 4½" Micro Bar Clamp #153259, **\$5.99**
15. C-Clamp, 3", www.amazon.com, **\$7.12**
16. HCS 82° Single-Flute Countersink, ½" #06J50.20, www.leevalley.com, **\$26.50**
17. FastCap PowerHead Wood Screws, #10 × 1¼", 50-piece #147462, **\$4.50**

18. FastCap PowerHead Wood Screws,

- #10 × 2½", 50-piece #147484, **\$5.50**
19. WoodRiver Aluminum T-Track, standard, 24" #159894, **\$9.99**
 20. INCRA T-Track Plus (back-to-back), 24" #142581, **\$13.99**
 21. WoodRiver Standard Miter Track, 32" #159900, **\$14.99**
 22. KREG Top Trak, 4' #145827, **\$18.99**
 23. WoodRiver ¾"-20 Jig Hardware Kit, 150 piece #152866, **\$84.99**

Double-Duty Dollhouse (p. 48)

1. ClosetMaid 58711 Cubeicals Fabric Drawer, www.amazon.com, **\$8.17**

Joinery Class: Attaching Tabletops (p. 55)

1. Desk Top (Figure 8) Fasteners, 10-piece #159303, **\$4.49**
2. Table Top (Z-clip) Fasteners, 8-piece #159301, **\$2.99**

Peg Racks (p. 60)

1. Whiteside 3052 Keyhole Router Bit #815828, **\$19.49**
2. Freud Traditional Beading Router Bit Freud 80-104 #828783, **\$38.47**
3. Pegs, Classic Shaker, (10) Maple/Birch #04E51, **\$4.19**

Tommy's Tips (p. 62)

1. Pinnacle No. 151 Spokeshave #152803, **\$104.99**
2. KUNZ Spokeshave, 2" Radius #01T11, **\$43.99**
3. KUNZ Spokeshave, Half Round #16B02, **\$43.50**
4. WoodRiver Adjustable Spokeshave #150740, **\$54.99**

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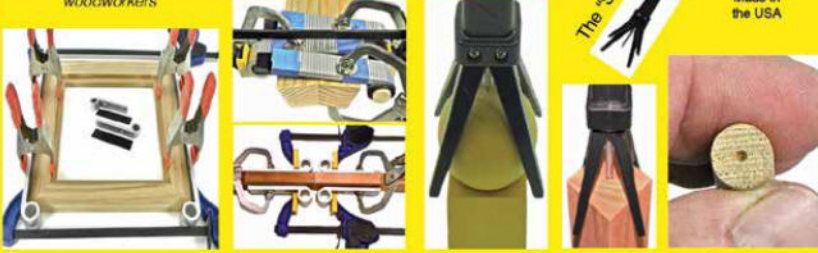



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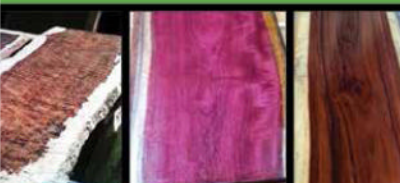
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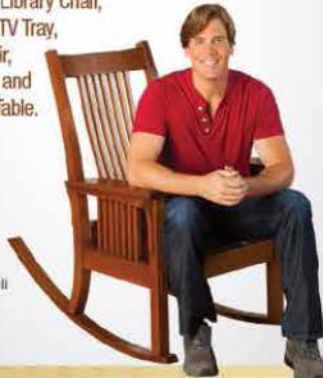


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