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WOOD®

SEPTEMBER 2002
ISSUE 143

Tips, Tools, Techniques, and Projects for the Home Woodworker

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all of the how-to and hardware you need

TOOL TEST

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- best buys, p. 90
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WOOD® magazine September 2002, Issue 143

This seal is your assurance that we build every project, verify every fact, and test every reviewed tool in our workshop to guarantee your success and complete satisfaction.

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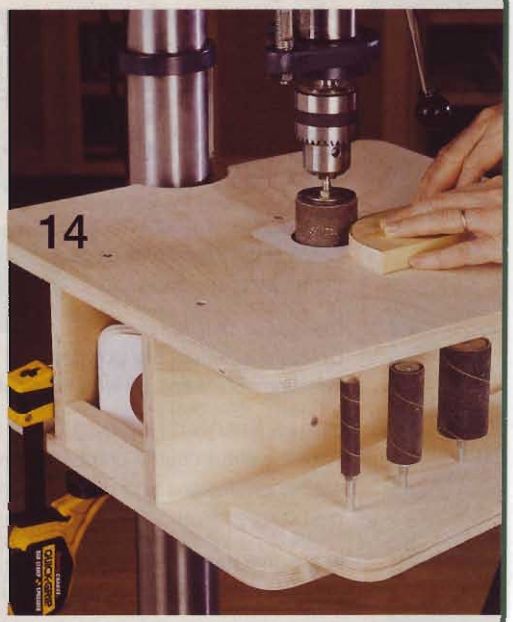
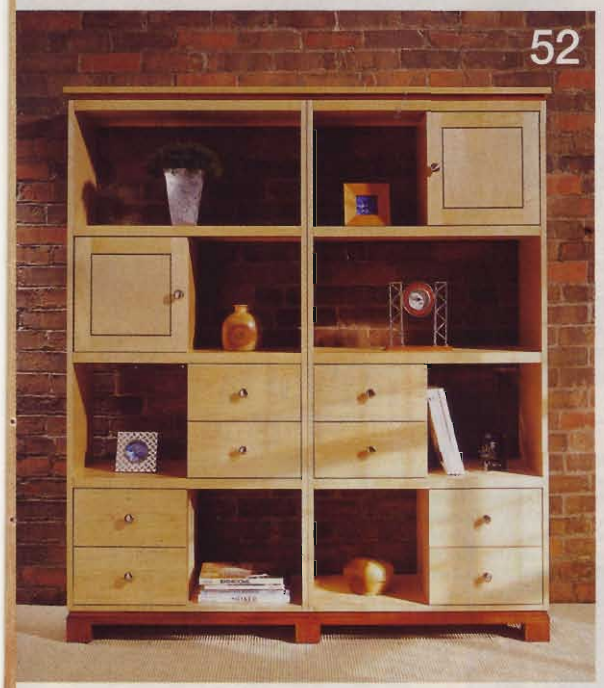
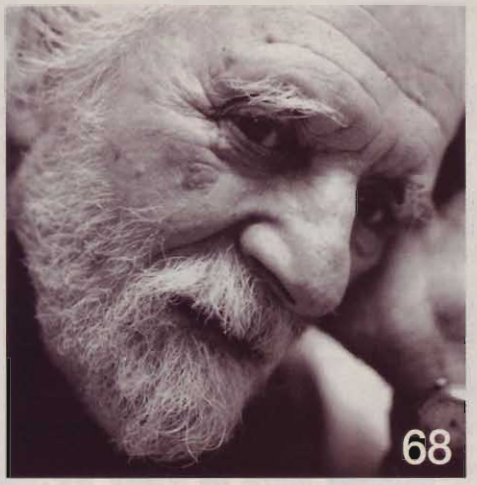
PROJECTS





TECHNIQUES

Cover Photograph: Baldwin Photography



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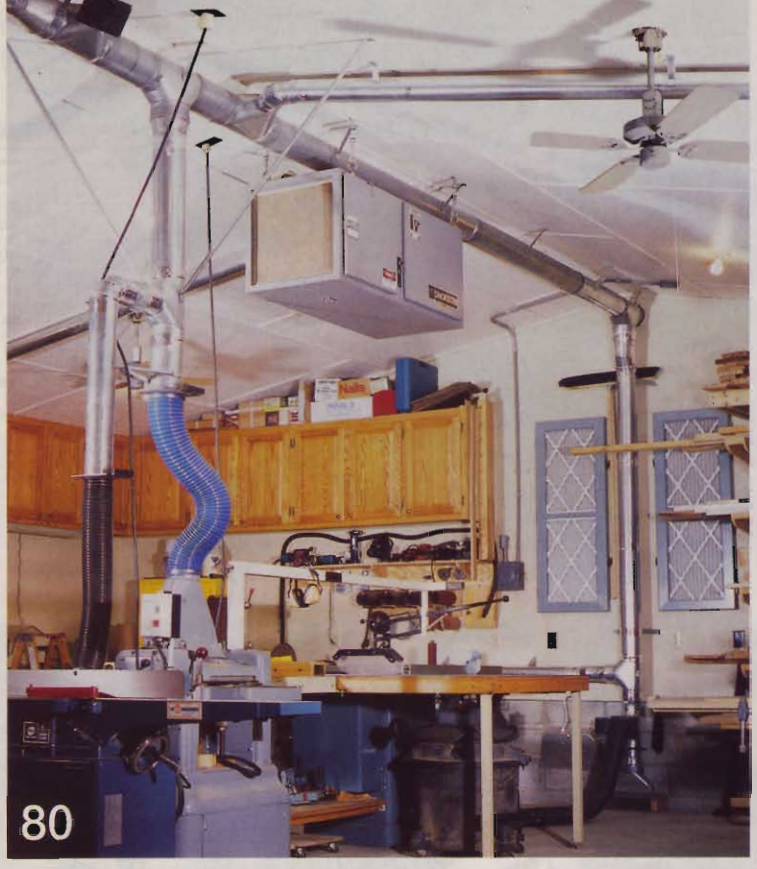

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editor's angle

Seeing double can be a good thing

Some projects go together perfectly the first time. Then there's the chaise lounge on *page 44*. We built it twice before we felt everything was just right.

We built one chaise lounge in mahogany (left) and one in cypress. Both look great.

As I mentioned in the last issue, our staff builds every project you find in *WOOD* magazine in our on-premise workshop. It's the only way to ensure that our instructions are complete and accurate.

In fact, we sometimes repeat the entire process of building a project, then reverifying the instructions, drawings, and the hundreds of dimensions that go with it. That's what happened with the chaise.

After it was completely designed and built, Projects Editor Owen Duvall still wasn't totally satisfied. He felt that the cross members that support the platform slats were too complex. They required perfectly spaced 1⅝"-wide dado cuts for holding the slats. Those dadoes would require a fancy jig and additional steps. And, Chuck Hedlund, our master craftsman, felt that the slats and cross-member supports did not have room to expand.

Clearly, the project required design modifications. First, the dadoes were removed, thus eliminating the jig and expansion problem in one fell swoop. Some platform parts originally required 2"-thick stock, and those were reduced to 1½" in thickness so you can make them from 2× stock or glued-up ¾" boards.

It was easy enough to make those changes to the drawings, but how could we be certain of how the finished chaise would look, assemble, and function without building another one? We couldn't, so we made version two. It turned out super.

There's nothing sacred about our wood selections. As shown *above*, we built one chaise from cypress, and the other from mahogany. We did this to show that the same project can look fantastic in more than one type of wood. You could also build it from other outdoor-hardy species, say redwood or cedar.

I mention this because readers occasionally ask why we build some projects from pricier woods, such as cherry or maple. For the most part, we choose widely available woods that best suit the project's look and function. You can substitute less-expensive woods, say birch in place of maple, or appropriately stained poplar in place of cherry. I've done it, saved a few bucks in the process, and encourage you to consider doing the same.

Enjoy your time in the shop,

Bill Krier

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ABC MPA

talking back

Our bulletin board for letters, comments, and timely updates

Readers put their spins on our spans

One of the most gratifying parts of working at *WOOD*® magazine is receiving photos of your completed projects. We're often impressed by how exactly a project matches the one we built. At other times, we're amazed with the ways you create a customized project based on our ideas and design.

Imagine, then, our delight when photos started coming in of our Well-Rounded Bridge (issue 133), shown at *right*. Some bridges are spitting images of the 9'-long project. Others, such as the ones shown *below*, are lengthened, widened, or altered completely to suit individual needs.

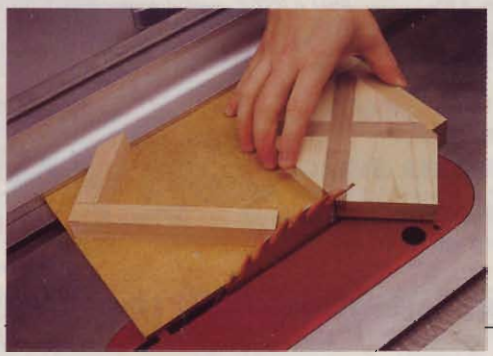
Great work, folks. Keep it up, and keep sending photos. We'll continue providing inspiration and adaptable projects.

—The WOOD staff

Paul Wiggins of Mount Vernon, Ohio, went to great lengths—16' to be exact—to customize the bridge that now allows access to a small island in his pond. He beefed up the beams, used wood spindles, and made the bridge wide enough to handle his riding mower.

Bill O'Connor of Horse Shoe, North Carolina, wanted a flat-topped bridge across his creek, so he built the 16' arched beams based on our design and attached them to concrete piers on each bank. Bill topped the deck with composite wood planks. Railings are yet to come.

Karl Reinecker of Castaic, California, bridged the gap between his yard and ridge-top deck by widening our original design. Then he carried the theme beyond the bridge, building a matching custom arbor that ties the spaces together and frames a spectacular view.

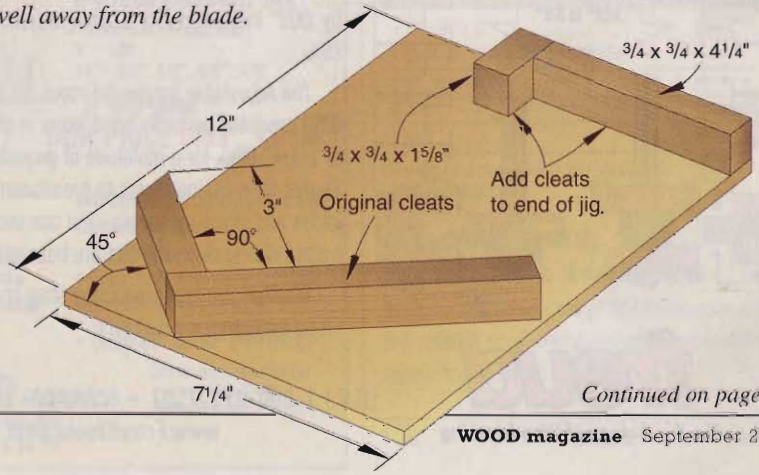


Keep safe while cutting coaster corners

Congratulations on a very nice project with the coasters (issue 139, shown at *left*). But photo C on page 46 concerns me. Where will the hand end up if a kickback happens?

—Luther Woodward, East Liverpool, Ohio

To make this cut safer, we modified the corner-cutting jig, as shown below. *By holding the coaster as in the photo,* lower left, *you can trim the final corner while your hands remain well away from the blade.*



Continued on page 11

Hunting the hedgerows for Osage orange

In issue 140 (Ask WOOD, page 20) you advised Dean St. Clair about Osage orange wood. Having grown up in the Ozarks area northwest of Springfield, Missouri, I had many instances of dulled axes due to metal lodged in the wood. This wood grows in hedgerows, usually along fence lines. When fencing gets stapled or nailed to the growing wood, it can become imbedded. I would hate to think of what a piece of metal in the wood might do to expensive planer knives or turning tools. Thanks for a great magazine.

—Ken Marshall, Council Bluffs, Iowa

Good point, Ken. We advise using a metal detector anytime readers harvest their own wood.

Guard against tablesaw kickback

Your article in issue 140 about guarding against kickback (page 12) is right on. But I would like to stress the importance of using safety glasses and zero-clearance inserts on the tablesaw.

Recently, I was ripping off a ¼×8" piece of oak that dropped into the throat opening (I was using the standard insert) and flipped up into my face. Though I guided it with a pushstick and stood off to the right of the blade, I still got hit just above my left eye. I now have a 1" scar over my eyebrow. The safety glasses may have saved my eye.

—Jim Evans, Hot Springs, Ark.

Write Us!

Do you have comments, criticisms, suggestions, or maybe even a compliment specifically relating to an article that appeared in *WOOD*® magazine? Please write to:

Talking Back
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or e-mail us at **talkingback@mdp.com.**

Due to the volume of letters and e-mails we receive, we can respond to and publish only those of the greatest interest to our readers.

Project updates

Please note the following dimensional changes to projects that appeared in recent *WOOD*® magazine issues:

•Hideaway Home Office computer center (issue 140, p. 52)

The position of the flap stay, shown in Drawing 5a on page 58, should be 5¼" down from the underside of the carcase top (H).

•Desk Organizer (issue 140, p. 60)

The two dividers (C), shown in the materials list, should be ½×8¾×5".

•Retro TV Desk Clock (issue 140, p. 78)

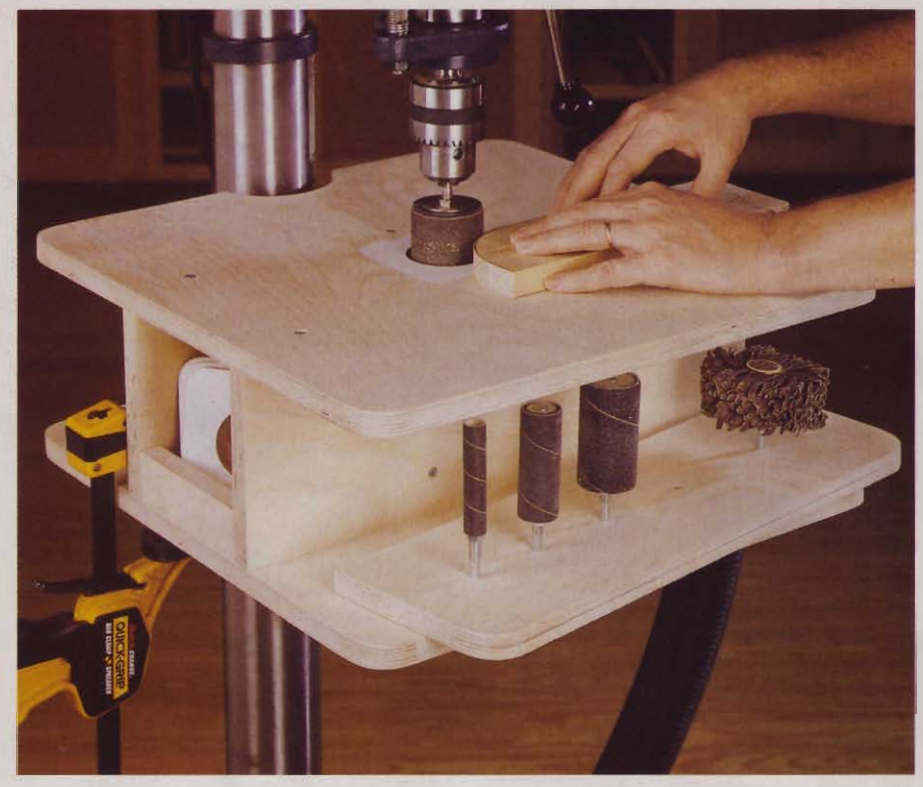
The hole in the body (A) that receives the clock insert should be 2⅜" diameter by ¾" deep.

Get article information online

Do you have a question on a project? You'll find a complete listing of all known updates to past *WOOD* magazine projects on our Web site at **www.woodmagazine.com**. Just click on *WOOD* magazine on the left side of the screen, then on Editorial Extras in the drop-down menu. You'll find a list, by issue number, of every update we're aware of to a measurement or parts supplier from issue 1 through today.

drill-press drum-sanding table

A convenient station for cleaning up contours

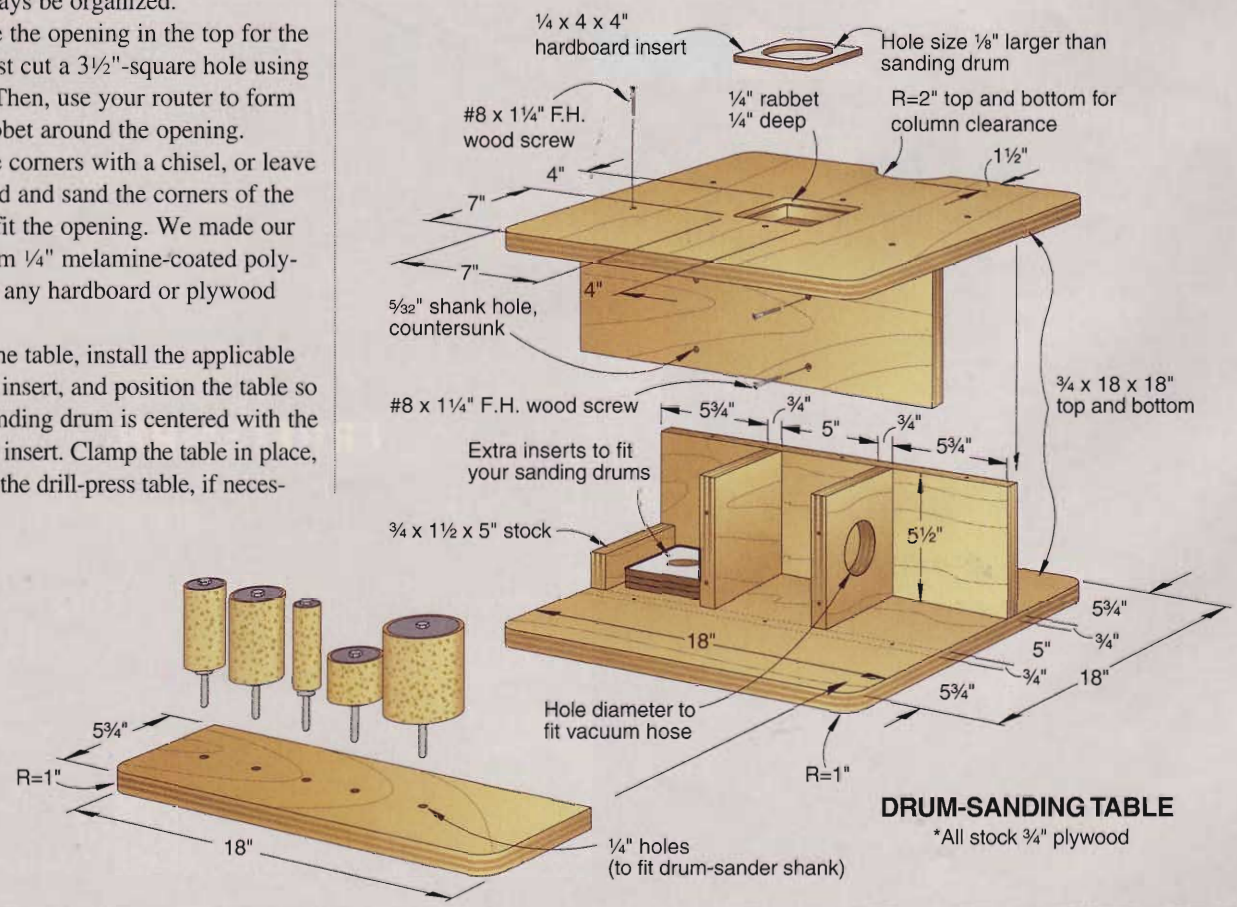


This handy table helps you in three important ways. First, it has a dust-collection port for capturing fine dust before it becomes airborne. The table also accepts inserts that you size to tightly fit your sanding drums. That provides workpiece support and improves dust-collection efficiency. And, with storage areas for sanding drums and inserts, you'll always be organized.

To make the opening in the top for the inserts, first cut a 3½"-square hole using a jigsaw. Then, use your router to form the ¼" rabbet around the opening. Square the corners with a chisel, or leave them round and sand the corners of the inserts to fit the opening. We made our inserts from ¼" melamine-coated polyboard, but any hardboard or plywood will do.

To use the table, install the applicable hardboard insert, and position the table so that the sanding drum is centered with the hole in the insert. Clamp the table in place, and adjust the drill-press table, if necessary, to square the sanding surface with the drill-press spindle. Attach the hose from your vacuum, and you're set to go.

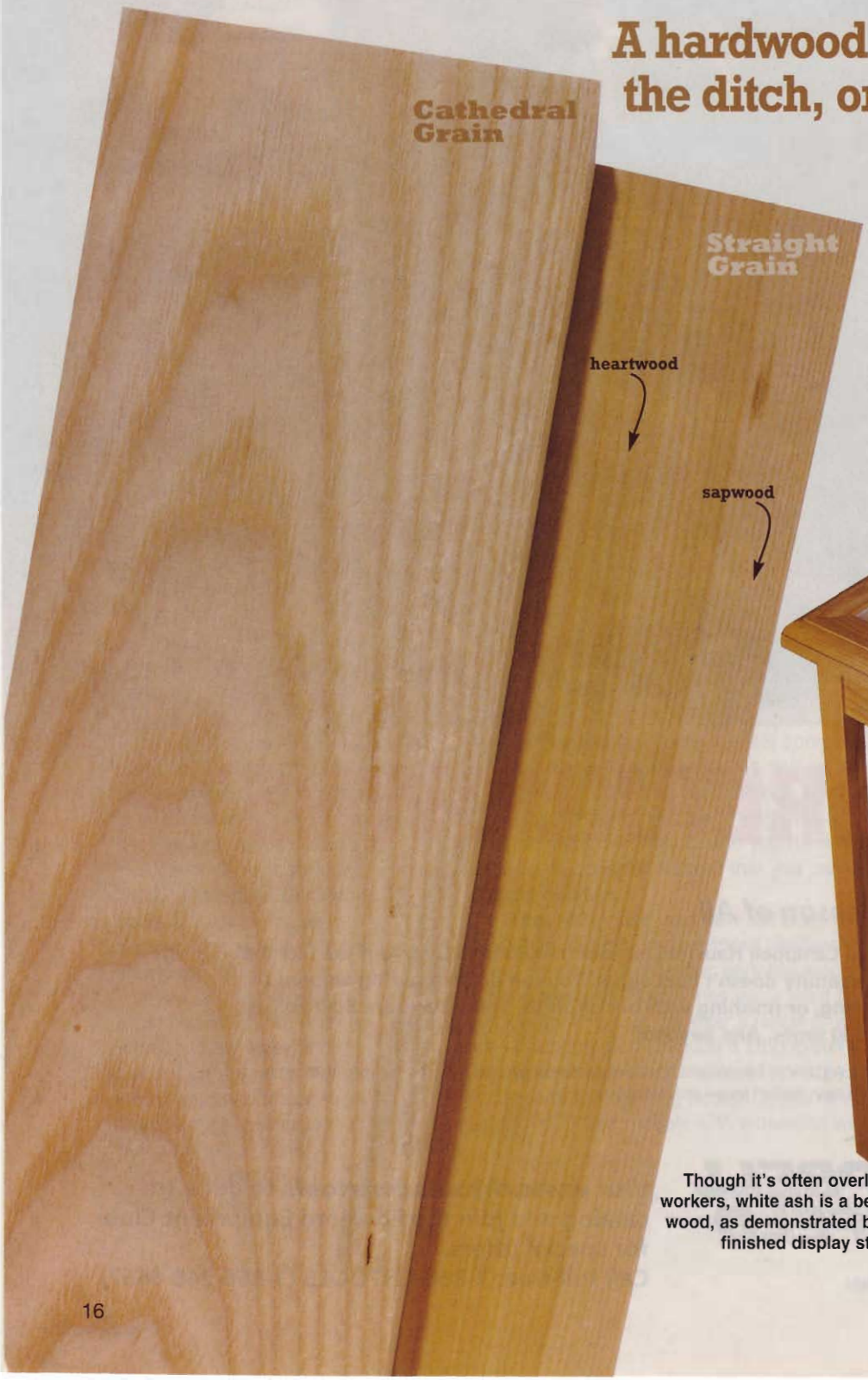
Written by **Owen Duvall**
Illustration: **Roxanne LeMoine; Lorna Johnson**
Photograph: **Baldwin Photography**



DRUM-SANDING TABLE
*All stock ¾" plywood

white ash

A hardwood for the diamond, the ditch, or the dining room



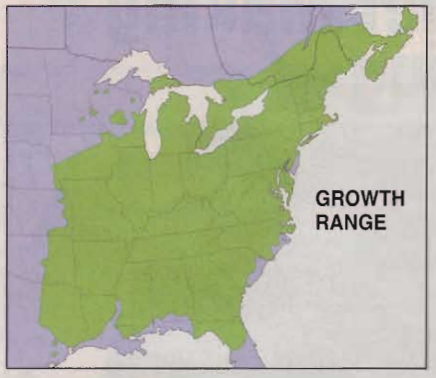
Even if you never picked up a woodworking tool, chances are you'd still know the appearance, heft, and texture of white ash. That's because this tough, light-colored hardwood has long been the material of choice for baseball bats and tool handles.

Beyond those utilitarian uses, white ash is great for woodworking thanks to its availability, workability, resilience, and reasonable price. You can create beautiful furniture pieces using ash, such as the display stand, *below*.

Continued on page 18

Though it's often overlooked by woodworkers, white ash is a beautiful furniture wood, as demonstrated by this naturally-finished display stand (issue 135).

Whether clear-finished or stained, white ash produces beautiful projects. By experimenting with stain colors, you can create a look that matches other hardwoods, especially red oak.



By any other name

White ash (*Fraxinus americana*) grows over a wide range of the eastern United States, as far west as Nebraska, and into southern Canada, as shown on the map, *above*. The tree grows to 80' heights with a trunk 2–3' in diameter. In the rich Ohio River Valley, trees can reach 100–120' tall with diameters of 6'.

There are four other common varieties of ash in the Fraxinus family: green ash (*Fraxinus pennsylvanica*), blue ash (*Fraxinus quadrangulata*), pumpkin ash (*Fraxinus profunda*), and black ash (*Fraxinus nigra*). Black ash has very dark wood. The others feature grain and color so similar to white ash that they are often grouped and sold together as "ash."

True white ash, though, provides the largest volume of commercial lumber. The wood is consistent, with uniform hardness, heavy weight, and great resistance to twist, warp, and dimensional change. Unlike many hardwoods, woodworkers most prize the creamy-white sapwood over the darker heartwood and, therefore, often prefer younger, faster-growing trees over old-growth timber.

Often, the whitest, straightest-grained logs are reserved for veneer, yet plentiful supplies remain of great-looking boards. You may have to sort through a lot of lumber to match the color of ash hardwood with veneer or plywood.

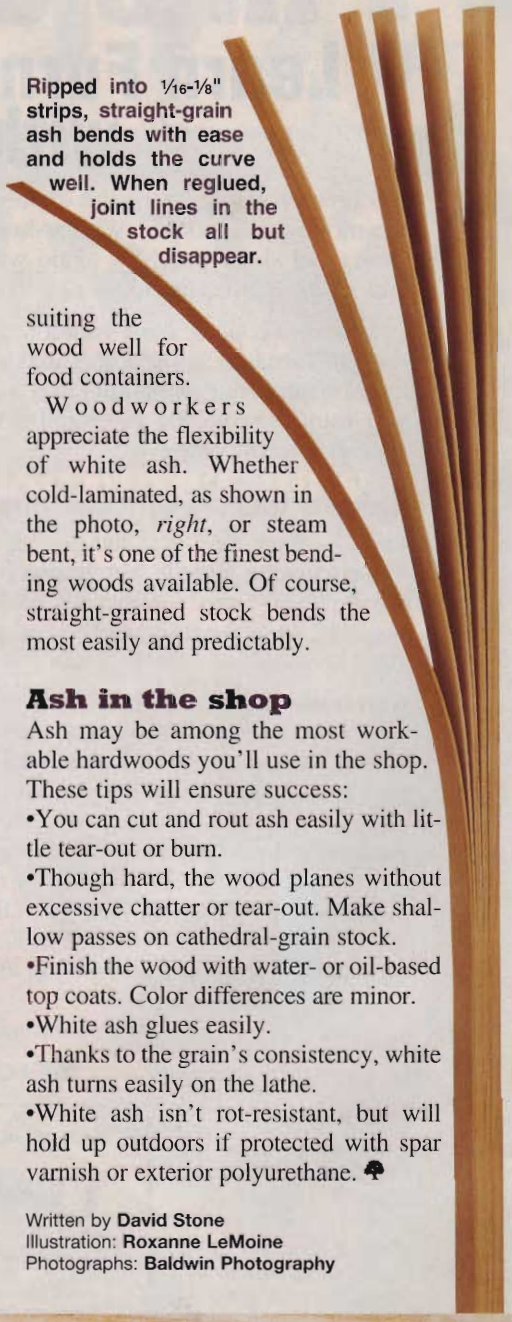
The wood does have a pronounced grain pattern, with darker-colored latewood that is visible in both straight- and cathedral-grained boards, shown in the photo on the *previous page*. The appearance resembles red oak, but with a lighter hue. As shown in the photo, *above*, properly stained ash imitates red oak nicely, often at lower cost.

White ash does occasionally show zigzag or crosshatch patterns, visible in the photo, *below*. These insect tracks aren't voids, they're refilled with wood cells as the tree grows. The condition is common enough that it's not considered a defect in lumber, but is viewed as a defect in veneer-grade logs. The tracks are often darker than surrounding wood.

Common uses for ash

Seeing duty as bats and tool handles, white ash obviously can withstand abuse. Chairmakers favor the wood for that reason. White ash imparts no taste, suiting the wood well for food containers.

These zigzag tracks are remnants of tunnels made by the cambium miner, a larvae that feeds on the new-growth layer (cambium) under the bark. After the larvae leave, new growth fills the voids.



Ripped into 1/16-1/8" strips, straight-grain ash bends with ease and holds the curve well. When reglued, joint lines in the stock all but disappear.

Woodworkers appreciate the flexibility of white ash. Whether cold-laminated, as shown in the photo, *right*, or steam bent, it's one of the finest bending woods available. Of course, straight-grained stock bends the most easily and predictably.

Ash in the shop

Ash may be among the most workable hardwoods you'll use in the shop. These tips will ensure success:

- You can cut and rout ash easily with little tear-out or burn.
- Though hard, the wood planes without excessive chatter or tear-out. Make shallow passes on cathedral-grain stock.
- Finish the wood with water- or oil-based top coats. Color differences are minor.
- White ash glues easily.
- Thanks to the grain's consistency, white ash turns easily on the lathe.
- White ash isn't rot-resistant, but will hold up outdoors if protected with spar varnish or exterior polyurethane.

Written by **David Stone**
Illustration: **Roxanne LeMoine**
Photographs: **Baldwin Photography**

White Ash at a Glance

Price: Though predominantly an eastern wood, white ash is available throughout the country, and at reasonable prices. To get a range, we surveyed lumber dealers from around the country for their prices on Firsts-and-Seconds (FAS), 4/4 boards, surfaced on two sides (S2S). Costs were surprisingly consistent, averaging about $2.80 per board foot.

Pros: White ash is known for its resilience, making it perfect for implement handles and baseball bats. It also bends well, either in cold lamination or with steam. Ash takes finishes well without blotching. The neutral color allows a range of stain colors, and helps make ash an excellent substitute for red oak.

Cons: There is a pronounced color difference between early and latewood, especially in old-growth trees. Boards often contain prevalent cathedral grain. Ash is not rot resistant. Dealers may group several species of ash together because the differences in grain, color, and texture are usually negligible.

TLC for antique tools

A lifelong collector shares his secrets.

A wire brush attachment on a motorized rotary tool makes it easy to remove light rust from small surfaces and get into tight spaces, such as the ones on this plane frog.

Old tools require special care to assure that they stay around for years to come. For some pointers on how to preserve them without compromising their aesthetic or monetary value, we turned to Jim Price, Ph.D., an antique/vintage tool specialist.

Old tools are made of either wood, metal, or a combination of both. To preserve them, it's important to remove rust to prevent further oxidation of the metals, and to clean the wood and prevent it from drying out and cracking.

Before you clean a tool, however, Jim recommends that you first research its rarity and value. Some tools are so rare that it's better to store them "as is" in a secure display cabinet or sell them to a collector. To determine the rarity of tools, turn to the Internet. Check out "The Electronic Neanderthal" at www-2.cs.cmu.edu/~alf/en/en.html. Now, with those rare tools set aside, follow these tips from Jim to preserve the remainder of your old tools.

Start with parts

- Separate wood and metal parts as much as possible.
- Loosen stubborn fasteners by soaking them for several days in a penetrating fluid, such as WD-40. You can safely immerse an all-metal tool in kerosene or diesel fuel for a couple of weeks to free up frozen parts. Another way to release a nut is to apply heat to it with the tip of a soldering iron. Doing this causes the nut to expand.

Cleaning metal parts

- Soak metal parts in a degreaser, such as Castrol's Super Clean (call 800/462-0835 or go to www.castrolusa.com for the retailer nearest you), to remove oily grime.
- Remove heavy rust from parts with a scraper. Jim makes his own by grinding the end of an old file to a steep bevel and honing the edge to remove any burr that could scratch the metal. (He does not recommend using naval jelly-type rust dissolver for cleaning old tools.)
- Dislodge remaining light rust with a small wire brush rotating in your drill press at 600 to 800 rpm (a slow speed pre-

Continued on page 22

To clean wood and bring back its beauty of yesteryear, gently rub it with 0000 steel wool and the thinned wood cleaner.

vents bright spots on the metal). For hard-to-reach areas or small surfaces, use a small wire brush in a motorized rotary tool, as shown in the opening photo on *page 20*.

- Clean brass parts with a fine metal polish and a cloth. Jim relies on Mothers Mag and Aluminum Polish (call 714/891-3364 or go to www.mothers.com for a retailer near you). If you want to remove the green patina common on brass, leave the polish on the brass for awhile before polishing.

Restoring wood parts

- Clean wood parts with a special beeswax mixture that you easily can make (see *below*). Apply the thinned cleaner mixture to the wood, and let it soak in for a few minutes. Then, rub away loosened dirt with paper towels. To remove even more soil and grime, rub the wood with the mixture and 0000 steel wool, as shown on *page 20, bottom*. Saturate really dry wood with the liquid, and let it soak in for several days.
- To protect the wood and give it a soft sheen, apply the wax paste mixture and let it dry for 24 hours. Then, buff it with a soft cloth. You also can apply the wax to metal parts to protect them.

Written by **Owen Duvall**
Photographs: **Baldwin Photography**

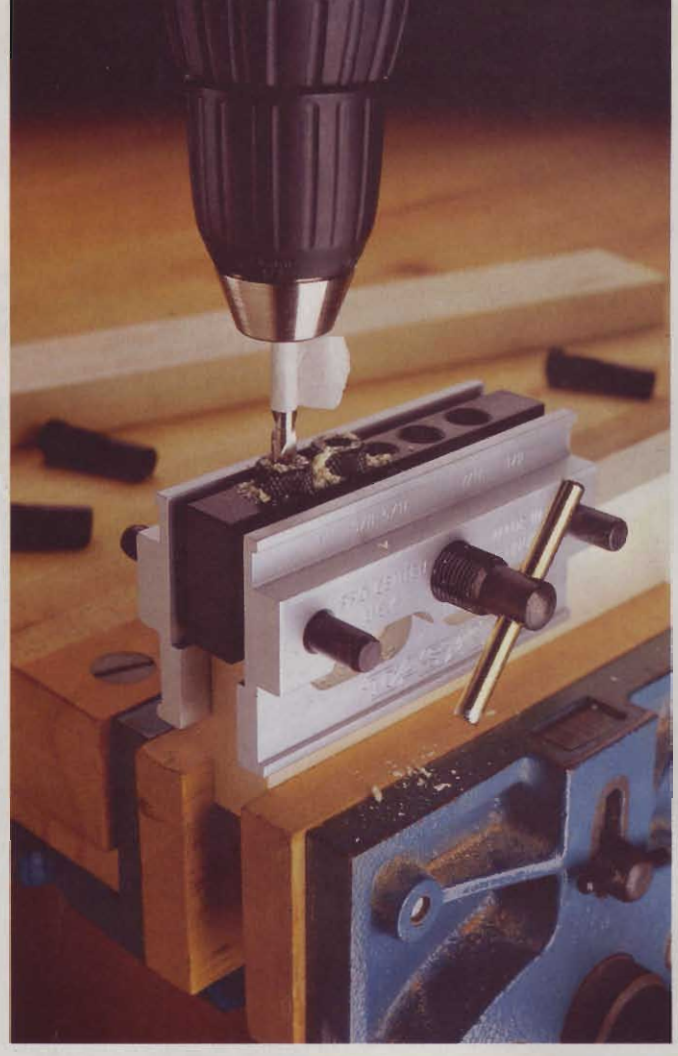
Jim's recipe for wood restoration

To make your own wood cleaner and wax mixtures, you only need three easy-to-find ingredients: turpentine, beeswax, and natural lemon oil. First, shave some beeswax into the turpentine, and stir to a paste consistency. Warming the turpentine a little by placing an open jar of it in a container of hot water speeds up the process. Divide this mixture in half. To one half, add a little lemon oil, making it the consistency of a good furniture wax for protecting wood. To the other half, add considerably more lemon oil, thinning it for cleaning.

If anyone knows what to do for old tools, it's Jim Price. Jim has collected, reconditioned, and used them for 40 years, and has owned as many as 25,000! But the number has dwindled somewhat in recent years as he has been giving tools to museums and selling others. Why selling? So he can buy more old tools, of course.

dependable dowel joints

With simple dowels and glue, you can bond wood on the cheap.

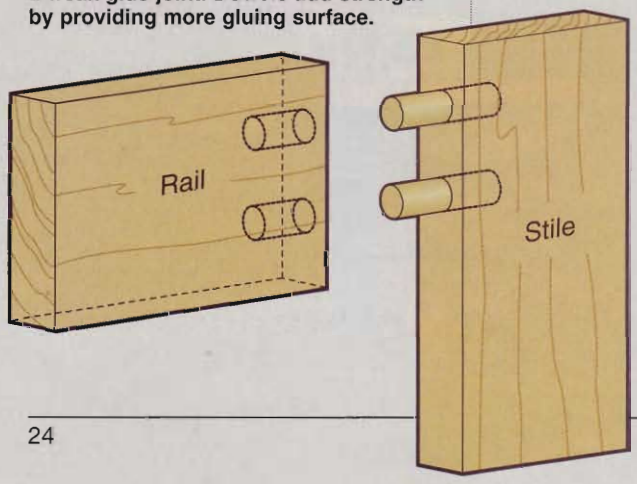


With this deluxe model, you can drill a pair of holes without moving the jig, and you also can change bushing sizes. It costs $52.99 from Woodcraft. Call 800/225-1153, and order item number 124315.

The woodworking world may be flooded with biscuits, but don't forget about dowels for quick, reliable joints. These workshop veterans can handle joints too small for a standard biscuit, as well as large tasks. Better still, they don't require a pricey, specialized power tool for installation. A portable drill and a doweling jig will do the trick.

Doweling jigs cover a wide price range, but they all clamp onto the workpiece to guide your drill bit. The least expensive models might have a plastic body, and require you to reset the jig for each new hole. The model pictured *above right* is part of the Task line of Telco Tools. It centers itself automatically on your stock, allows you to bore more than one hole without moving the jig, and adapts to different dowel sizes with screw-in bushings.You can find a couple of models to choose from at a hardware store or home center or in a mail-order catalog.

The typical dowel joint includes a pair of dowels centered in the stock's thickness. The rail's end grain would result in a weak glue joint. Dowels add strength by providing more gluing surface.



Use the right dowels

Dowels made specifically for joinery come with straight flutes or a spiral groove, as shown in **Photo A**, and both designs work well. The flutes and grooves allow air and excess glue to escape during assembly, resulting in a stronger bond. By contrast, standard, smooth, multipurpose dowels scrape all the glue to the bottom of the hole, and create air pressure that makes assembly more difficult.

For ¾" stock, use ¼" dowels centered in the workpiece, whether you're edge-gluing or making a rail-and-stile joint. In the latter case, the rail should be at least 1½" wide before you move up from one dowel

Continued on page 27

Dowels come in various lengths, diameters, and styles. The basic ¼×1½" style with straight flutes will serve most purposes well. Use larger-diameter dowels for stock that's over ¾" thick.

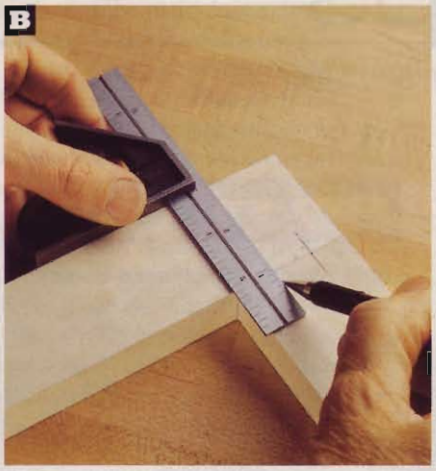
to a pair. When you use two, keep each dowel ⅜" to ½" away from the edge of the rail, as shown in **Photo B**. Stock that's 5" wide or more calls for at least three dowels for a rail-and-stile joint. For joining boards edge to edge, space your dowels 10–12" apart. Mark the correct depth on your drill bit, as shown in **Photo C**, to create holes that allow a ⅛" gap at each end of the installed dowel.

Line everything up

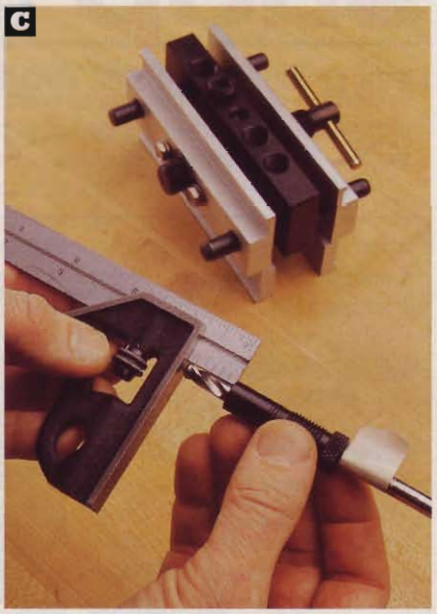
Carefully align your layout marks with the guide marks etched into the body of the jig. If you're off just slightly, the joint won't go together correctly. Keep the handle side of the jig on the face side of your workpieces, in case the centering function is slightly off.

During assembly, apply glue inside each dowel hole, spreading it with a toothpick or a ⅛" dowel. Also put glue on the mating surfaces of the joint. Tap the dowels into one half of the joint with a mallet, slide the other half in place, and clamp.

Photographs: **Baldwin Photography**
Illustration: **Roxanne LeMoine**



Make accurate layout lines so your dowels match perfectly. Mark both parts of the joint at once, using a fine pencil or a knife. Most doweling jigs require a mark for each hole, as shown here.

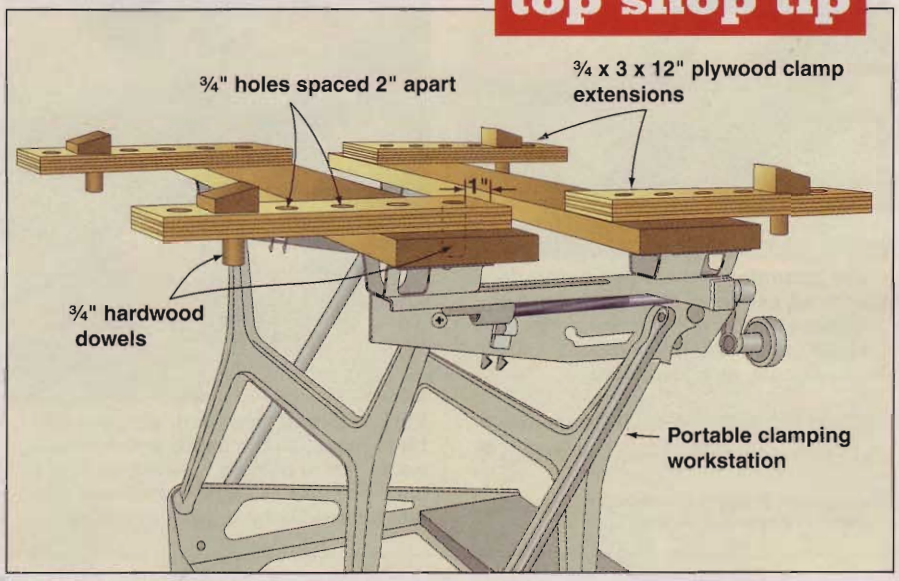


Put a masking tape "flag" on your drill bit to establish the depth of the dowel holes. We're using a bushing as a reference because the bushing's lower end sits flush with the bottom of the jig.

shop tips

Helping you work faster, smarter, and safer

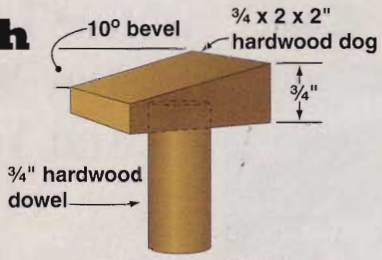
top shop tip



Extend your workstation's reach

While refinishing an old dresser recently, I removed the top to scrape off the paint. The problem was how to hold it during the scraping process. Clamping it to my workbench meant moving the clamps part way through the job, and my portable clamping workstation doesn't open wide enough for the dresser top.

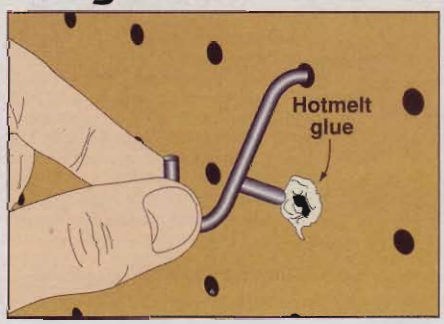
To give the workstation's jaws added capacity, I made a set of four clamp extensions, as shown *above*. I made my own dogs out of hardwood scraps and



¾" dowels, but you could modify the design to use your workstation's own plastic dogs. The extensions add 20" of clamping capacity to my Workmate, and have never let me down.

—Dennis Peterson, Lewiston, Idaho

Hang a hook with hotmelt glue



To keep peg hooks from pulling out, I squirt a shot of hotmelt glue into the perforated-hardboard holes and insert the hook before the glue sets. To move the hook later, soften the adhesive with a heat gun or blow dryer, and pull the hook out with a needle-nose pliers.

—John Kaner, Anchorage, Alaska, via WOOD ONLINE®

Continued on page 30

our winner

When we called Dennis Peterson to congratulate him on his tool-winning Top Shop Tip, at *left*, he was busy customizing the Tilt-Top Router Table from *WOOD®* magazine, issue 109. "I love the concept, but I'm going to make my tabletop wider," he said.

Dennis likes to come up with his own designs, too. In fact, he once took 25 years to craft a rolltop desk. "Actually, it started out as a flattop desk," Dennis told us, "but by the time I completed it, I decided I wanted a rolltop and had to figure out how to convert it."

A DeWalt 12" compound mitersaw (DW706) goes out to Dennis Peterson for sending in this issue's Top Shop Tip. Miter fine work, Dennis!

You can win a free tool, too!

Tell us how you've solved a workshop dilemma, and we'll send you $75 if we print your solution. And, if your tip is the Top Shop Tip, you'll also win a tool worth at least $250.

Send your best tips, along with photos or illustrations and your daytime telephone number, to: **Shop Tips, *WOOD®* Magazine, 1716 Locust St., GA-310, Des Moines, IA 50309-3023.** You can also e-mail tips to **shop-tips@woodmagazine.com**, or post them on our Top Shop Tip discussion group at **www.woodonline.com**.

Because we try to publish only original tips, please send your tips only to *WOOD* magazine. Sorry, but we can't return your materials.

Box-joint jig fits the bit

In my experience, straight router bits can vary as much as .005" from their stated diameter, which doesn't sound like much until you use that bit to make a box joint. However, if you make your box-joint jig to fit the bit, you'll never need to calibrate or compensate for an oversized or undersized bit. In fact, I've made three such jigs for various-sized joints, and each jig cut perfect joints on the first try.

Before routing the slot in the jig's base, assemble the fence, base, and guide bar, as shown in the drawing. In your table-mounted router, install the straight bit and set it to the correct cutting depth. Place the jig on your router table with the guide bar in the miter slot, and rout a slot into the jig.

Rip three short pieces of hardwood just a whisker wider than the slot you just routed. Two of these pieces are spacers used only when making the jig; the third is the indexing pin. Sand spacer #1 until it fits snugly into the slot. Sand a bit more off spacer #2 and the indexing pin so they slip easily in the slot.

To complete the assembly of the jig, dry-fit spacer #1 in the slot, butt spacer #2 alongside spacer #1, and glue the indexing pin to the jig's base while holding it tight against spacer #2. After the glue sets, drill and countersink the base for ¾" flathead wood screws to secure the indexing pin.

Remove and discard the spacers, and use the jig as you normally would. I added a couple of UHMW-tape strips to the bottom of the jig so it slides smoothly on the tabletop.

—*D.G. Payne, Aloha, Ore.*

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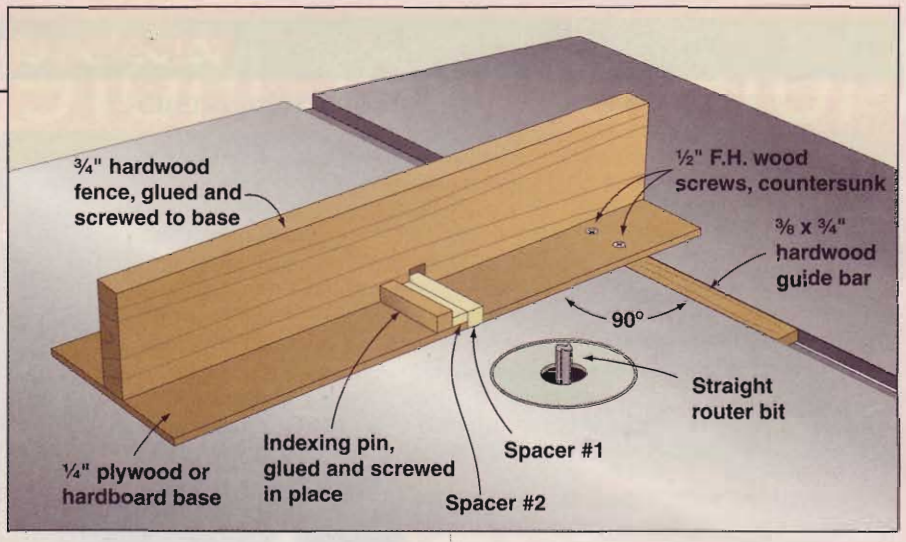


Radial-arm saw finger saver

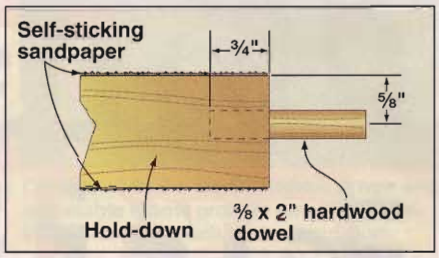
When using my radial-arm saw to cut a narrow workpiece, I used to worry about having my fingers too close to the blade. So I designed a hold-down, shown *below*, to keep my hands well clear.

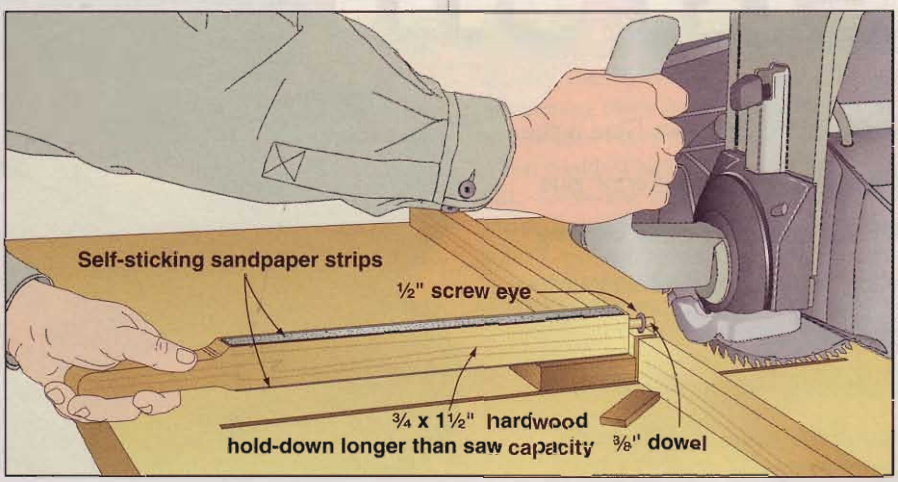
To build one, bore a ⅜" hole into one end of a length of ¾" hardwood, and glue in a short length of dowel. (Make the hole slightly off-center to accommodate different workpiece thicknesses.) On the opposite end, shape a handle. Add strips of self-sticking sandpaper to the faces of the hold-down for a better grip on the stock.

Finally, thread a screw eye into the top of the saw's fence just left of where the blade passes through. (On my saw, as with most, the fence friction-fits between the two table surfaces, so I also added a cleat under the table to prevent the fence from pulling out when pressing on the handle.)

When working with narrow stock, position the workpiece, insert the dowel end of the hold-down into the screw eye, and press down on the handle. The downward pressure keeps the workpiece from moving during the cut.

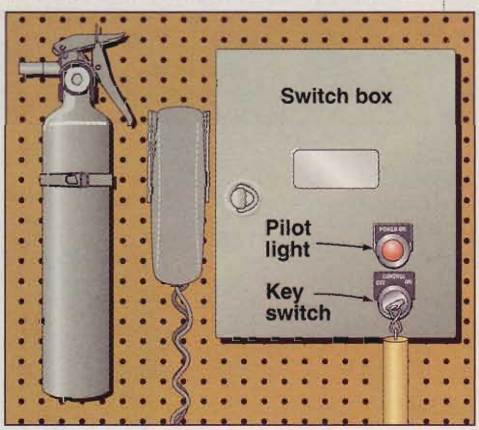
—Norm Hadeen, Aurora, Colo.





Peace of mind comes with a key

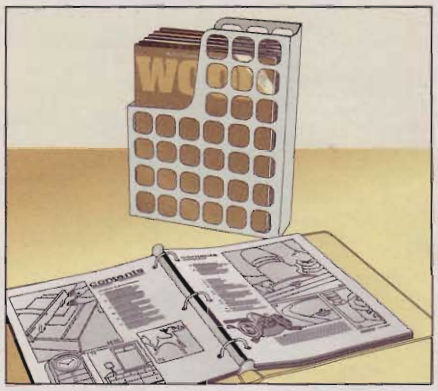
After hearing horror stories about children getting injured by power tools left plugged in but unattended, I decided to make sure it wouldn't happen on my watch. So, when I wired my shop, I installed a key-operated shutoff switch that kills power to all of the outlets simultaneously. A pilot light on the switch box tells me when the outlets are "hot."



For an added measure of safety, I wired it so that I can't turn off the lights in the shop until the key switch is turned off. Although the wiring isn't complicated, have a licensed electrician do the job (or at least have one draw up the wiring diagram for you).

—Ron Klavoon, West Seneca, N.Y.

Continued on page 34



Copies of TOC make a magazine index PDQ

If you're like me, you can recall seeing a specific project in a woodworking magazine, but can't remember the issue in which it appeared. The online index at WOOD ONLINE® is helpful, but I've indexed my magazines in a way that lets me put my fingers on the article without logging in.

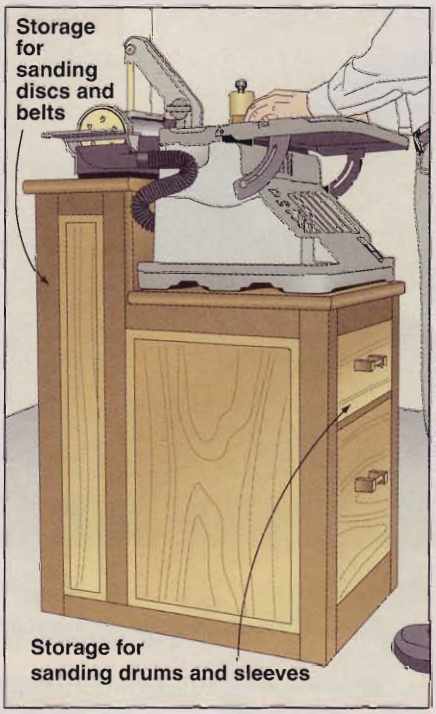
First of all, I keep my magazines in order by issue number. Then, each time I get my *WOOD®* magazine in the mail, I photocopy the Table of Contents, and put the copy in a three-ring binder, as shown at *left*. This way, I can scan the contents of every magazine to quickly locate the project, technique, or tool review I'm looking for.

—Jack Simpkins, Clinton, Iowa

Stepped-up sanding center

I've found that benchtop power tools aren't always at the best working height when mounted on a workbench. So I built a stepped stand, shown *below*, for my belt/disc and oscillating spindle sanders that puts the tables of both machines at the same comfortable working height. Drawers on both ends of the stand keep sanding discs, belts, and drums clean and close at hand.

—Todd Oster, Concord, Ga.



shop TIP

You'll find more great Shop Tips throughout every issue of *WOOD* magazine. Look for boxes like this one nestled among the project and technique articles.

beat the beetles

Holes on the outside of wood mean trouble on the inside.

Chances are, you don't spend much time crawling around on the floor checking for tiny piles of sawdust under your furniture. But if you happen to spot one, and the dust is as fine as talcum powder, you might have a problem.

Inspect the piece for holes about the size of a pinhead. Fine dust plus holes equals powder post beetles. That's a generic name for several types of little creatures, but they all do the same thing. Their larvae burrow into wood, leaving tiny holes. They eat the wood's cellulose while they're in there, then emerge as beetles through larger "flight holes." They'll rack up a lot of damage if you don't stop them. The best strategy is to kill the larvae, fill the holes with a matching putty—or leave them open if you like the distressed look— apply a finish, and monitor the furniture piece for further activity.

Launch your attack

Tom Ellis, an entomologist with the Michigan State University Extension Service, recommends a product called Bora-Care as the best way to get rid of active powder post beetle larvae. Bora-Care penetrates into the wood and kills insects with a form of boric acid.

A

Mix one part of Bora-Care with one part of water to go after powder post beetles. You can brush it on, as shown here, but that's most effective with stripped or unfinished wood.

Check at hardware stores and home improvement stores for Bora-Care, manufactured by the Nisus Corporation (800/264-0870, www.nisuscorp.com), or do an internet search for sources. You might spend $35 for a quart, but that should be enough to last you, your relatives, and your neighbors for a long time.

To use Bora-Care, mix it with water according to label directions, then brush it onto an unfinished or stripped piece of furniture, as in **Photo A**. If the piece is finished and you don't want to strip it, use a syringe to inject the Bora-Care into the flight holes, as in **Photo B** on *page 36*.

The toxic liquid will soak through the surrounding wood and poison any beetles munching nearby. It remains in the wood for some time, so it will kill larvae that hatch later, too.

Fumigation is another way to get rid of powder post beetles, but don't try to do it yourself. It's potentially hazardous to your health. Instead, take the furniture piece to

Continued on page 36

a pest control company, and have professionals handle the job.

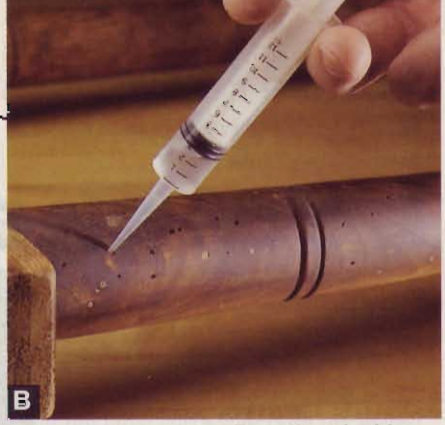
Watch for further activity by taping a piece of paper over the pinholes and flight holes you've treated, as in **Photo C.** If any beetles escape the Bora-Care treatment, you'll see holes in the paper where they chewed their way out.

Don't stop yet

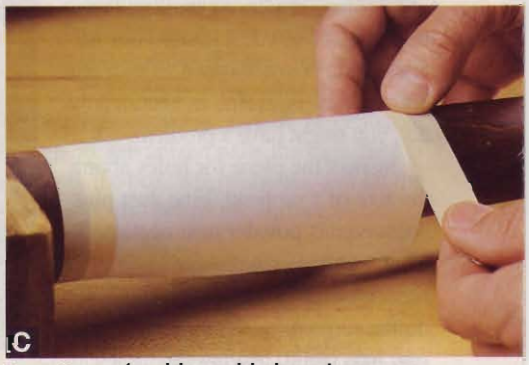
The area with holes isn't the only possible trouble spot. The female powder post beetle might lay several dozen eggs on a piece of furniture, placing them one at a time in small cracks on the surface of the wood. You can get rid of the eggs by cleaning the wood with soap and water.

Newly hatched larvae tunnel into the wood through cracks in old finishes. They can't punch through an intact finish. So it's worthwhile to refinish a damaged piece after treating it.

If you want to postpone the refinishing for some reason, keep the piece of furniture in a dry place. Powder post beetles like wood with at least 10 percent moisture content. Even better, enclose the item inside a big plastic bag or a sealed sheet of plastic, with mothballs inside.



The surest way to get Bora-Care inside finished wood is to inject it into the flight holes with a syringe. From there it can soak throughout the area.



Bora-Care should provide long-term protection, but here's how to make sure you killed all of the active beetles. Tape paper over the treated area, and see if any chew through.

Follow the light

We've talked about eggs and larvae, but watch for the adult, too. When the powder post beetle leaves your furniture, it's reddish-brown, about ⅛" long, and probably headed for a window or other lighted area.

If those telltale piles of sawdust showed up just recently, it's worth scouting around the windows with a spray can of insecticide. An aerosol "bug bomb" will kill the exposed powder post beetles in a closed room, too.

However, an aerosol canister won't get the ones that might still be inside your furniture. That's because it sprays out a cloud of droplets, not a gas.

Written by **Jim Pollock**
Photographs: **Wm. Hopkins; Marty Baldwin**
Furniture from **Country Caboose, West Des Moines, Iowa**

ask wood

Answers to your questions from letters, e-mails, and WOOD ONLINE®

How do you give pine an aged color?

Q I'm making a project with white pine, and I want it to have the color you see in antique pine pieces. How can I create this effect?

—*Woody, via* WOOD ONLINE

The darker pine sample received linseed oil, tinted super blonde shellac, and garnet shellac. On the lighter-colored sample, you see the effect of linseed oil and garnet shellac.

A Woody, we direct your attention to the samples shown *above right*. They exhibit the beautiful colors and blotch-free results that professional woodworker Steve Mickley of Cincinnati produces by using shellac on pine. However, there's more to his method than buying a can from the hardware store. It involves linseed oil, dye, and a couple of grades of shellac.

Here's his recipe for the lighter look: Apply a coat of boiled linseed oil, and allow it to cure, which could take several days; apply a coat of 2-pound-cut garnet shellac (mixed in the ratio of 2 pounds of shellac flakes per gallon of denatured alcohol); and finish with a clear topcoat.

To produce the darker "pumpkin pine" color, Steve follows these steps: Again, start with boiled linseed oil, and wait until it cures; apply a coat of 1-pound-cut super blonde shellac, tinted with burnt sienna dye that's soluble in alcohol; then apply a coat of 2-pound-cut garnet shellac; for a still darker color, add additional coats of garnet shellac; and finally, finish with a clear topcoat (water-base, in the samples you see here). Steve rarely uses traditional stains, preferring this method of adding dye to shellac. If you don't have a nearby source for dyes and the various grades of shellac, try Woodworker's Supply (800/645-9292), or log on to www.shellac.net or www.woodfinishingsupplies.com.

—WOOD® *magazine*

His router refuses to spit the bit

Q I have trouble removing bits from my Bosch 1613 EVS plunge router, and had the same problem with a Skil plunge router. Sometimes, I can tap the bit with a piece of wood and remove it, but other times, I have to remove the collet nut completely to get the bit out. What's causing the problem?

—*James Fields, Hendersonville, N.C.*

A Jim, sawdust residue inside the collet might be a factor, or it could be that the collet has been tightened so hard and so often that the thin metal inside has lost some of its flexibility. Remove the collet, blow out the dust, then use blade-and-bit cleaner, or a similar solvent, to soak any residue out of there. If that doesn't solve the problem, you can replace the collet at a reasonable cost. For example, Seven Corners Hardware (800/328-0457) carries a ¼" collet for your router for $15.95, and a ½" collet for $15.25, along with collets for other models and brands. To keep new collets in shape, avoid overtightening them, and always remove the bit after use.

—WOOD *magazine*

Continued on page 39

When batteries die, tools can live on

Q I have a number of cordless tools lying around useless because the batteries will no longer hold a charge. They take what seem to be special-sized batteries, and when I inquire at the service centers, I'm told, "You can't buy them. They would cost more than a new tool."

This doesn't seem right. The batteries are only a small component of the tool. Is there a place where batteries of this type can be purchased for less than the cost of the entire tool?

—Ed Huck, Franklinville, N.J.

A Ed, we talked to a sales manager at Interstate All-Battery Center (formerly Battery Patrol), and he said the answer is a qualified yes. The housings of many rechargable tools with built-in batteries and some detachable battery packs are screwed together and can be opened to replace worn-out cells. Even detachable battery packs whose housings are glued together can be sawn apart to replace the cells, then sealed back together. The cost varies from tool to tool. It will be cost-effective in some cases, but not in others.

Interstate All-Battery Centers are scattered across the United States and Canada. Check your local Yellow Pages or the dealer locator on their Web site at www.interstatebatteries.com, or call the RAD Fulfillment Center at 866/842-5368.

As for the standard detachable battery packs, you can find replacements for the most popular models at home centers. We took a look at cordless drill batteries and found several that cost nearly half the price of the matching drill. For example, a 14.4-volt Black and Decker Firestorm drill costs about $89, and a replacement battery goes for $40. So, if you wanted two new batteries, you'd probably be better off buying a new tool.

—WOOD® magazine

What's the right way to cure green wood?

Q I am getting ready to have a pecan tree cut down, and would like to keep several pieces about a foot long and 8" in diameter to use later for small boxes, etc. How can I keep the wood from splitting while drying?

—Fred Nehrings, Mexico Beach, Fla.

A Cut the wood at least 20" long so you can cut 4" of waste off each end. Rip it on a bandsaw to the likely thickness. Paint the ends of the wood with oil-based paint to even out the drying. Ends always dry faster, but the paint slows this process. Stack the small pile of wood on stickers ¾" to 1" thick in your garage or some other place where it will get some air flow and stay dry.

—Shane Farrell, WOOD ONLINE®

A Don't stack wood directly on a concrete floor in the garage, because it will pick up moisture. As for the waiting time, wood expert R. Bruce Hoadley points out that there's no rule of thumb that applies to every species of wood in every climate. He suggests marking the initial storage date on each piece of wood. Over the years, that will help you learn the approximate drying times in your area.

—WOOD magazine

Continued on page 41

Smooth cutting board gets rough—why?

Q I recently made several cutting boards using maple and cherry. After sanding them, I coated them with mineral oil. After the first use, one was washed and the wood came out as rough as if it hadn't been sanded. What should I have done?

—via WOOD ONLINE®

A Water raises the grain on wood. You should have wet the surface, let it dry, then resanded before you applied the mineral oil. This will not stop the grain from reacting to water in the future, but it will reduce the effect. Lightly resand your boards now and apply more mineral oil.

—*Howard Acheson, Larchmont, N.Y.*

A Sand the board smooth, then heat some mineral oil (the microwave is just dandy for this), and apply a liberal amount. Allow it to soak in for a while, then go over the surface with a scraper to remove any raised grain. A couple of applications like this a few days apart will give you a smooth, sealed board.

—*Jim Kull, McKinney, Texas*

Some hardboard carries a sticker on each piece that identifies it as standard or tempered. Or, you might find this sort of tag marking an entire stack.

Taking the temper of hardboard

Q In many of your plans and projects, you recommend "tempered" hardboard. How is this product different from standard hardboard?

—*Matt Thomas, Indianapolis*

A Matt, we usually choose tempered hardboard because it resists warping from moisture and its harder surface produces crisper edges when sawed or drilled. According to Dick Enlow, from the Georgia-Pacific corporation's wood laboratory, the first step in making hardboard is to "cook" wood in a pressurized steam vessel. Then the manufacturer mixes the softened wood pulp with resin, forms the mixture into mats, and cures these flat pieces in a hot press. The traditional tempering process involves treating the hardboard with oil and heating it for several hours in a kiln at 300 degrees F. Newer plants attain the same result by adding wax and more resin during the manufacturing process. When you're buying hardboard, look for the word "tempered" on a display label or product sticker, or ask the retailer to check the product specifications. You can't identify tempered hardboard by appearance alone.

—*WOOD® magazine*

Continued on page 42

Drilling holes without splintering

Q After cutting craft templates on my scrollsaw, I drill small holes in them so I can hang them with a piece of wire. The problem is that I get a lot of splintering around the holes I'm drilling. I use brad point bits and work with mostly pine and some basswood. Is it the bits, the wood, or me?

—dversluy@theinter.com

A If the splinters are on the entry side, I'd say the spurs of the brad-point bit need sharpening. If they're on the exit side, you should use a backer board and maybe sharpen the spurs.

—Anthony Mazzeo, Clarksburg, N.J.

A You need to have the drill or drill press cranking at a pretty good clip to prevent tearout on the entry side. Speed it up, and you should only need a backer board.

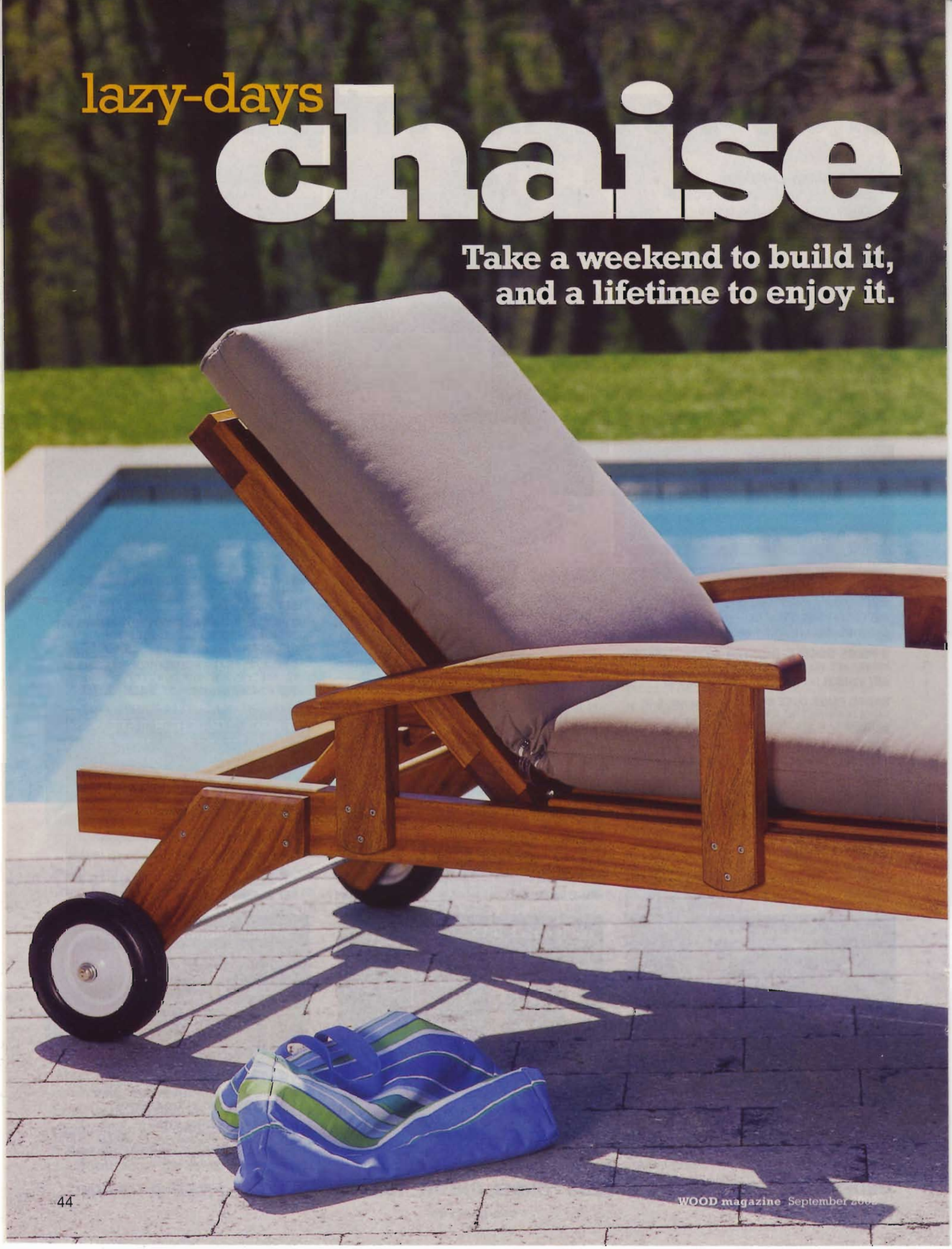
—Wayne Van Coughnett, New Milford, Conn.

Got a question?

If you're looking for an answer to a woodworking question, write to **Ask WOOD, 1716 Locust St., GA 310, Des Moines, IA 50309-3023** or send us an e-mail at **askwood@mdp.com**. For immediate feedback from your fellow woodworkers, post your question on one of our discussion groups at **www.woodonline.com**.

lazy-days chaise

Take a weekend to build it, and a lifetime to enjoy it.



Who says that a comfortable chair can't look as good as it feels? This chaise lounge delivers on both counts. You'll find that its adjustable back gives you five relaxing positions, making it ideal for reading a novel or simply soaking up the rays.

***Note**: To make the 1"- and 1½"-thick stock needed for some of the chaise's parts, we planed 5/4 and 8/4 boards to the required thickness. As an option, you can make the 1½"-thick stock by laminating two 4/4 boards and planing them to thickness. Also, save yourself some work by finish-sanding each part after cutting and before assembly.*

Finally, we used a standard 23×75×4" lounge cushion. (See the Buying Guide at the end of this article for our source.)

Start with the frame

1 From 1½"-thick stock, rip and crosscut the frame inner rails (A), wide cross member (B), and cross members (C) to the sizes listed in the Materials List.

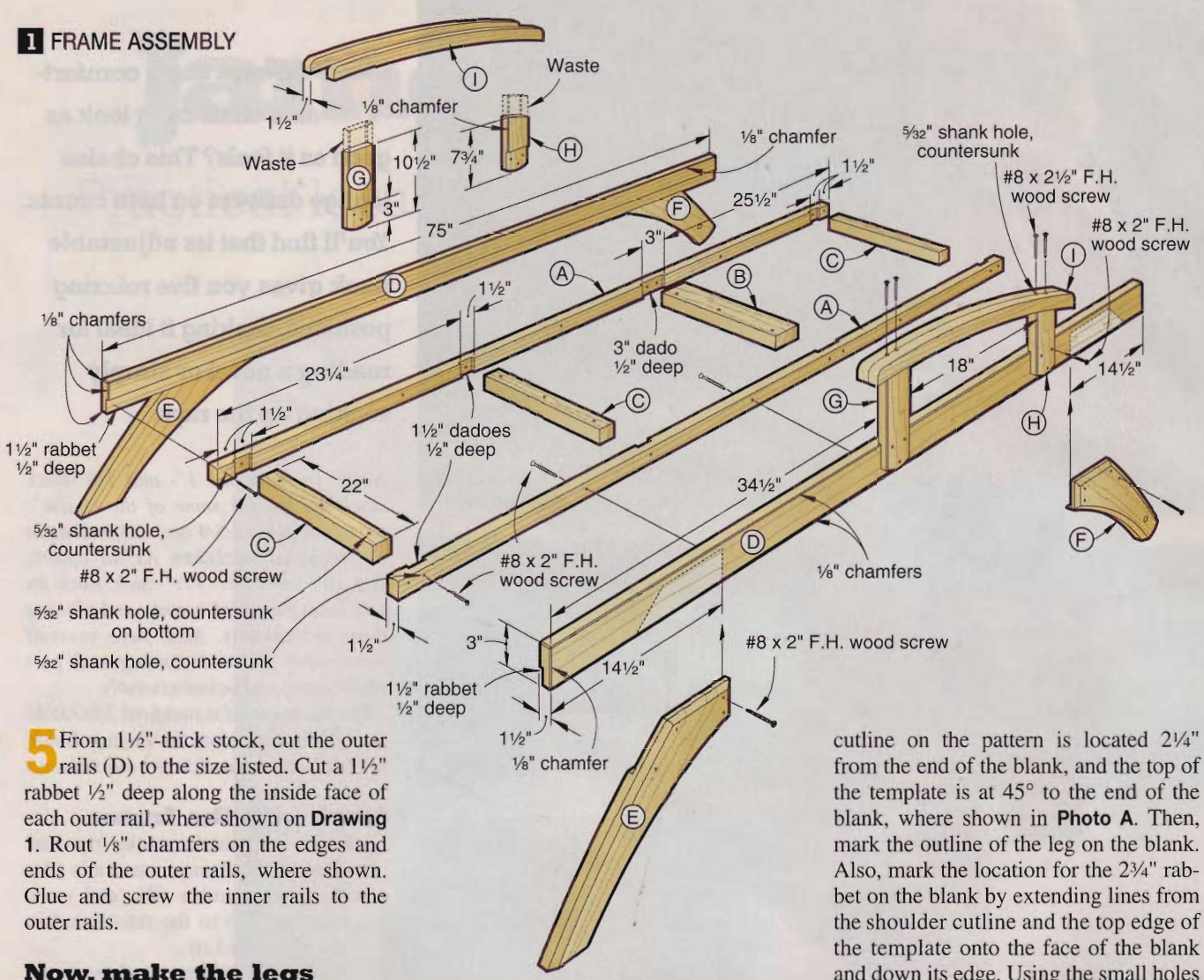
2 Cut the ½"-deep dadoes on the inside face of the inner rails (A), where dimensioned on **Drawing 1**.

3 On the outside of the inner rails (A), drill the countersunk shank holes for attaching the cross members (B, C). On the inside of the rails, drill the countersunk shank holes for attaching the outer rails (D). Also, on the bottom of the wide cross member (B) and two cross members (C), drill the countersunk shank holes for attaching the seat platform (**Drawing 2**) to the frame.

4 Dry-assemble the inner rails and cross members, and check for correct fit and for square. Then, glue and clamp the assembly, drive the screws, and recheck for square.

***Note**: If you plan to use your chaise lounge outdoors, assemble it using an exterior-type glue and stainless steel, brass, or deck screws.*

1 FRAME ASSEMBLY



5 From 1½"-thick stock, cut the outer rails (D) to the size listed. Cut a 1½" rabbet ½" deep along the inside face of each outer rail, where shown on **Drawing 1**. Rout ⅛" chamfers on the edges and ends of the outer rails, where shown. Glue and screw the inner rails to the outer rails.

Now, make the legs

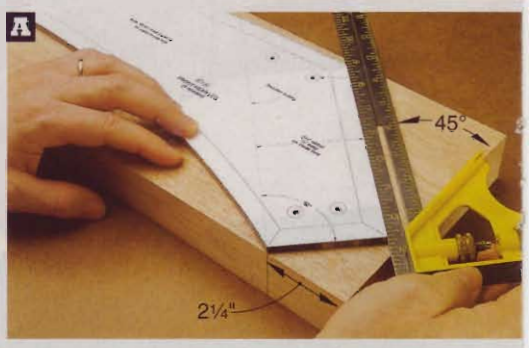
1 From 1½"-thick stock, cut two 7×22" blanks for the front legs (E) and two 7×19" blanks for the rear legs (F).

2 Cut from ¼" hardboard a 7×22" blank for the front leg template and a 7×19" blank for the rear leg template. Make two copies of the full-size leg pattern from the *WOOD PATTERNS®* insert. Using scissors, trim the end of one pattern, which will be for the rear legs, by cutting just outside the line for the 2½" radius. Adhere a pattern to each hardboard blank using spray adhesive. Bandsaw the templates to shape; then sand the edges smooth.

3 Drill a small hole (ours was ⅛"), sized to accept an awl or a nail for marking purposes, through the front and rear leg templates at the locations for the four mounting screws, where shown on the patterns. Drill another hole at the center of the ½" hole for the wheel axle in the rear leg template.

4 Place the front leg template on one of the 22"-long blanks. Position the template so that the bottom of the shoulder cutline on the pattern is located 2¼" from the end of the blank, and the top of the template is at 45° to the end of the blank, where shown in **Photo A**. Then, mark the outline of the leg on the blank. Also, mark the location for the 2¾" rabbet on the blank by extending lines from the shoulder cutline and the top edge of the template onto the face of the blank and down its edge. Using the small holes in the template as guides, mark the locations for the mounting screws on the leg blank with an awl or a nail.

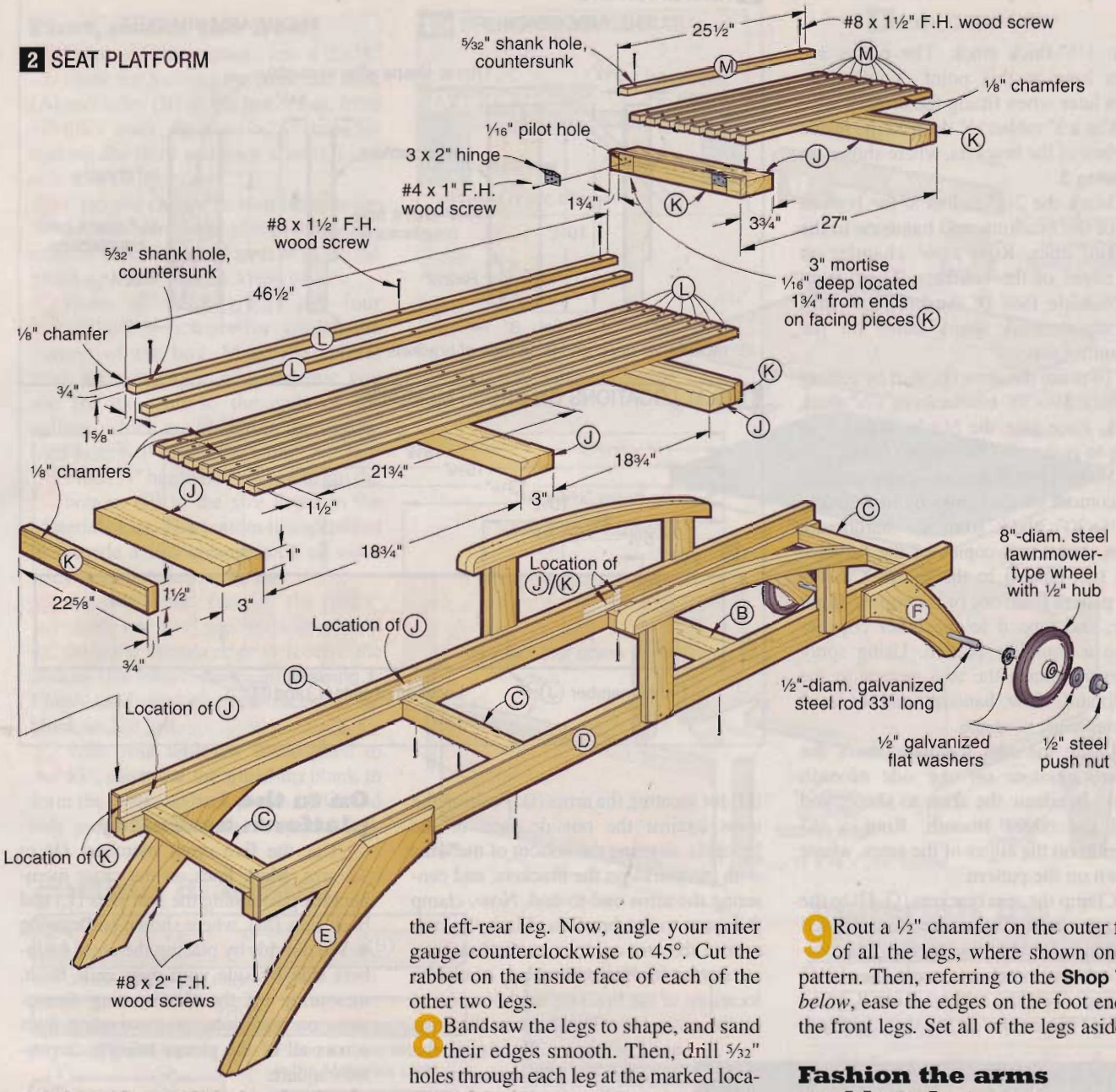
5 Following the same process, mark the other front leg blank. Then, mark the two rear leg blanks using the rear leg



Align the front- and rear-leg template on a leg blank by using a combination square to position the top of the template at 45°.

Why is it called a "chaise lounge"?

Well, that's what English-speaking people call it. Actually, French-speaking people call it a "chaise longue" (pronounced "shezz lohng" with a long *G*), which literally means "long chair." The word "longue" presumably changed to "lounge" in the English translation due to the chair's resemblance to a couch or lounge. No matter which way you say it, it's still a comfortable chair with a long seat.



template. Also, mark the location for the wheel axle hole.

6 Because the right and left legs of each pair of legs (E, F) are mirror images, you need to mark the inside face on the leg blanks to ensure that you cut the rabbet on the correct side of each blank. To do this, refer to **Drawing 1** for the orientation of the front and rear legs; then mark the inside face on the blanks.

7 Adjust a ¾" dado blade in your tablesaw to ½" high. Also, attach an auxiliary extension to your miter gauge. Angle your miter gauge clockwise to 45°, and lock it. Then, cut the rabbet on the inside face of the right-front leg and the left-rear leg. Now, angle your miter gauge counterclockwise to 45°. Cut the rabbet on the inside face of each of the other two legs.

8 Bandsaw the legs to shape, and sand their edges smooth. Then, drill 5/32" holes through each leg at the marked locations for the mounting screws, and countersink the holes on the outside face. Now, drill a ½" hole for the wheel axle through each rear leg at the marked location.

9 Rout a ½" chamfer on the outer face of all the legs, where shown on the pattern. Then, referring to the **Shop Tip**, *below*, ease the edges on the foot end of the front legs. Set all of the legs aside.

Fashion the arms and brackets

1 To make the tall arm brackets (G) and short arm brackets (H), cut two pieces 3×12" and two pieces 3×10"

SHOP TIP

Give damage-prone edges a break

Lightly sand a small chamfer on all sharp edges on parts that see movement and abrasion during use, such as the foot end of the front legs in this project. That will protect them from splintering and tear-out.

from 1½"-thick stock. The pieces are extra long at this point. You'll trim them later when fitting the arms.

2 Cut a 3" rabbet ½" deep on the inside face of the brackets, where shown on **Drawing 3**.

3 Mark the 2½" radius at the bottom of the brackets, and bandsaw to the marked lines. Rout a ⅛" chamfer on the edges of the brackets. Then, from the outside face of the brackets, drill the countersunk shank holes for the mounting screws.

4 To make the arms (I), start by cutting four 3¼×30" blanks from 1½"-thick stock. Face-glue the blanks together in pairs to make two 3×3¼×30" blanks.

5 Make a template for marking the arm contour on the blanks by first cutting a 3¼×30" blank from ¼" hardboard. Then, make two copies of the full-size arm half-pattern in the insert. Cut the arm pattern from one of the copies, flip it over, and tape it to the other copy to make a complete pattern. Using spray adhesive, attach the arm pattern to the hardboard. Now, bandsaw and sand the arm template to shape.

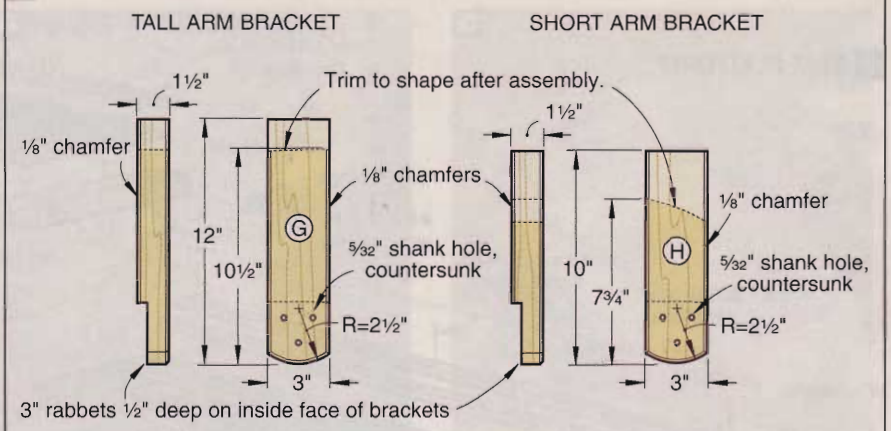
6 Using the arm template, mark the arm contour on one side of each blank. Bandsaw the arms to shape, and sand the edges smooth. Rout a ⅛" chamfer on the edges of the arms, where shown on the pattern.

7 Clamp the arm brackets (G, H) to the outer rails (D), where dimensioned on **Drawing 1**. Measuring from the bottom of the brackets, mark the 10½" dimension on the tall brackets (G) and the 7¾" dimension on the short brackets (H) for locating the arms (I). Position the arms against the outside face of the brackets, aligning the bottom of the arms with the marks on the brackets, and centering the arms end-to-end. Now, clamp the arms to the brackets. Mark the bottom of the arm contour on the brackets, as shown in **Photo B**. Also, mark the locations of the brackets on the arms and on the outer rails (D). Remove the arms and brackets. Bandsaw the ends of the brackets to the marked lines, and sand smooth.

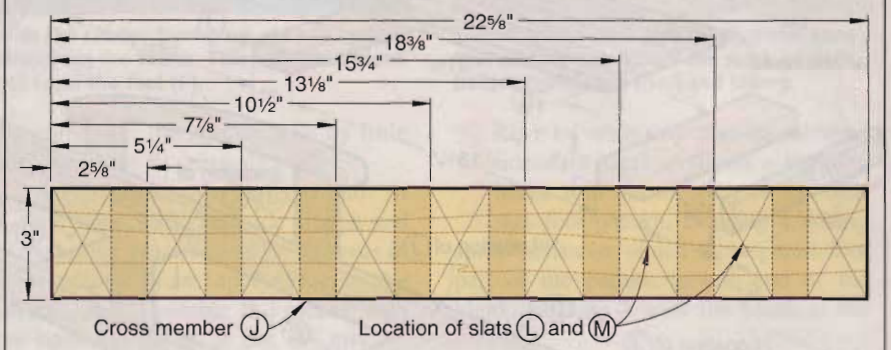
8 Reattach the brackets to the outer rails at the marked locations, and temporarily secure them with screws (no glue yet).

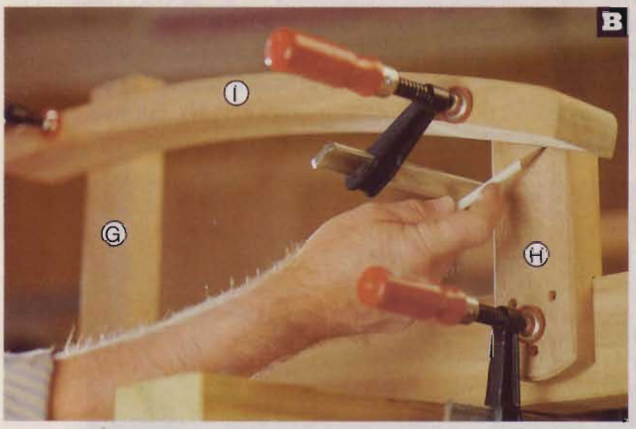
9 Reposition the arms on top of the brackets, and center them side-to-side. Drill the countersunk shank holes through the arms for the mounting screws; then, drive in the screws. Now, remove the screws from the brackets only, and set the bracket/arm assemblies (G/H/I) aside.

3 ARM BRACKETS



4 SLAT LOCATIONS ON CROSS MEMBERS





With the arms (I) clamped in position to the arm brackets (G, H), mark the bottom contour of the arms on the brackets.

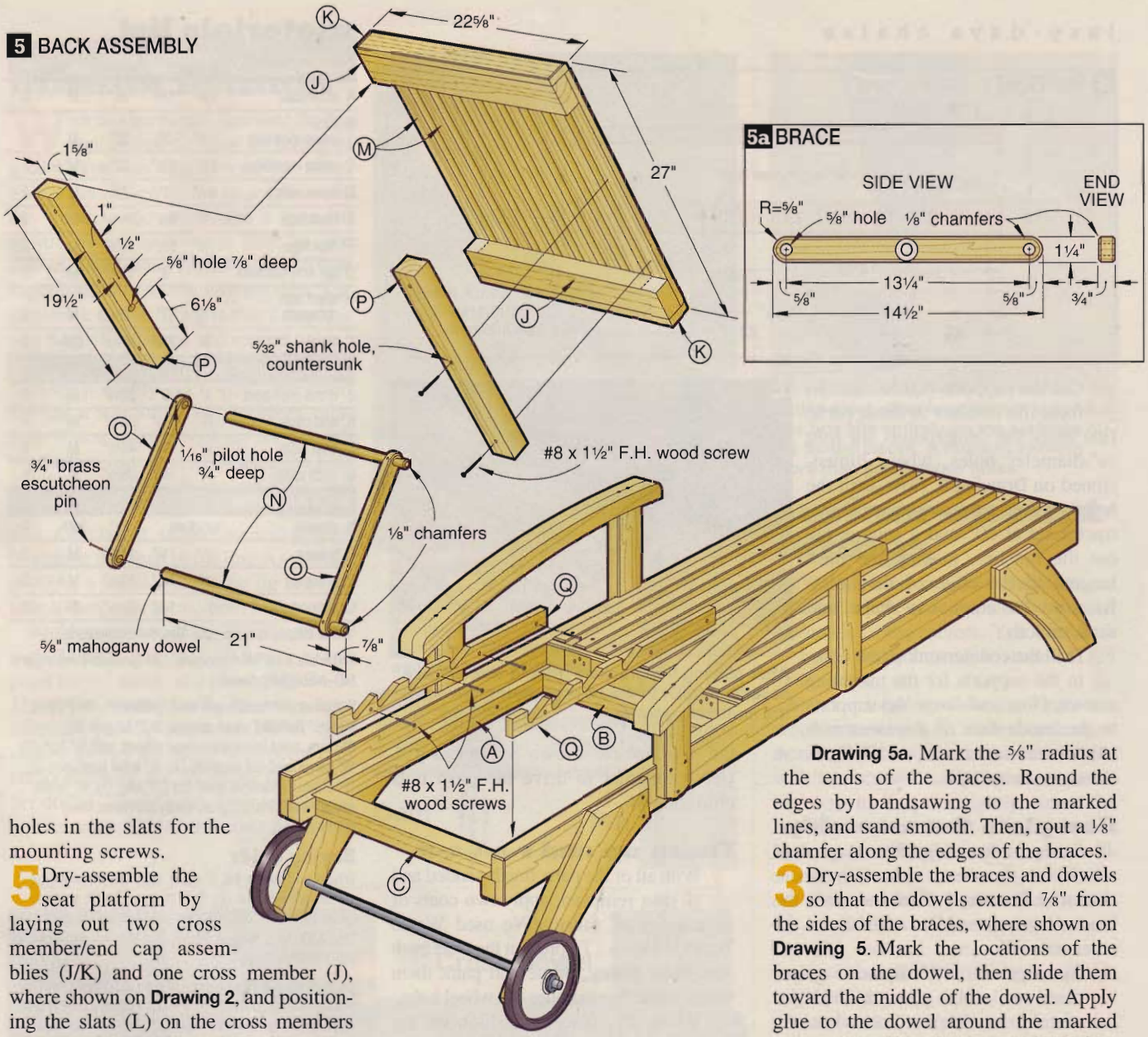
On to the platform assembly

1 Cut the five cross members (J) to size. Mark lines on the cross members for positioning the seat slats (L) and back slats (M), where shown on **Drawing 4**. We did this by placing the cross members side by side with their ends flush, measuring off the slat locating dimensions on one piece, and extending lines across all of the pieces using a carpenter's square.

2 Cut the four end caps (K) to size. On two of the end caps, rout a ⅛" chamfer around the edges of one face, where shown on **Drawing 2**. These pieces will become the foot end of the seat platform and the head end of the back platform. On the remaining two end caps, cut the 3" hinge mortises 1/16" deep, where dimensioned.

3 Glue and clamp the end caps (K) to four of the five cross members (J), with their bottom edges flush.

4 Cut the seat slats (L) and back slats (M) to size. Rout a ⅛" chamfer around the top edges of each slat. Then, drill the countersunk shank



holes in the slats for the mounting screws.

5 Dry-assemble the seat platform by laying out two cross member/end cap assemblies (J/K) and one cross member (J), where shown on **Drawing 2**, and positioning the slats (L) on the cross members where marked. Make sure that the assembly J/K at the foot end has a chamfered end cap (K), and the assembly J/K at the opposite end has an end cap with hinge mortises facing out. Also, check that the ends of the slats are flush against the end caps and that the middle cross member is centered in the platform. Check the assembly for square. Then, glue and screw the slats to the cross members.

6 Using the same process, assemble the back platform with the other two cross member/end cap assemblies and the back slats (M).

7 Position the seat platform on the frame assembly, centered between the outer rails (D). Ensure that the face of end cap (K) rests flush with the rail ends. Secure the platform with mounting screws driven through the cross members (B, C) and into cross members (J).

8 Using the hinges as a template, drill 1⁄16" pilot holes at the mortised hinge locations. Screw the hinges to the back platform. Now, screw the remaining hinge leaves to the seat platform, employing an extra pair of hands to hold the back platform in position.

Make the back assembly

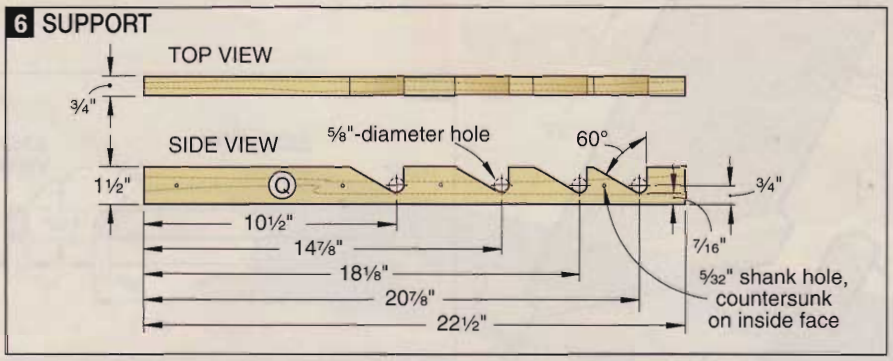
1 From ⅝"-diameter mahogany dowel, cut the dowels (N) to size. Sand ⅛" chamfers on their ends.

2 Cut the braces (O) to size. Drill ⅝" holes through the braces to receive the dowels, where dimensioned on **Drawing 5a.** Mark the ⅝" radius at the ends of the braces. Round the edges by bandsawing to the marked lines, and sand smooth. Then, rout a ⅛" chamfer along the edges of the braces.

3 Dry-assemble the braces and dowels so that the dowels extend ⅞" from the sides of the braces, where shown on **Drawing 5.** Mark the locations of the braces on the dowel, then slide them toward the middle of the dowel. Apply glue to the dowel around the marked areas; then slide the braces back into position, securing them with ¾" brass escutcheon pins driven into pilot holes, where shown.

4 Cut the brackets (P) to size so they fit between the cross members (J) in the back platform. Then, drill a ⅝" hole ⅞" deep in each bracket, where shown, to receive the ends of one of the dowels (N). Check the fit of the dowel ends in the bracket holes, making sure that the dowel rotates freely. If not, sand the ends of the dowel. Now, drill the countersunk shank holes in the brackets for the mounting screws.

5 Fit the ends of one of the dowels into the holes in the brackets, and install the assembled parts in the back platform, where shown on **Drawing 5** and **Photo C.**



6 Cut the supports (Q) to size. To form the notches in these parts, first mark the centerpoints for four ⅝"-diameter holes, where dimensioned on **Drawing 6**. Now, drill the holes. Using a bevel gauge or protractor set at 60° and a square, lay out the notches, making the lines tangent to the edge of the holes. Bandsaw the notches to shape, and sand smooth.

7 Drill the countersunk shank holes in the supports for the mounting screws. Glue and screw the supports to the inside face of the inner rails (A) between cross members (B, C), where shown on **Drawing 5**.

After placing the brackets (P) and dowel/brace assembly (N/O) in the back platform, drive in the mounting screws

Complete the assembly

1 Screw the front legs (E) and rear legs (F) to the outer rails (D), where shown on **Drawing 1**. Glue and screw the bracket/arm assemblies (G/H/I) to the outer rails (D).

2 Cut a piece of ½"-diameter galvanized steel rod to a length of 33" for the wheel axle. (We used a hacksaw to cut the rod.) Insert the rod through the ½" holes in the rear legs. Then, install the washers, wheels, and push nuts on the axle, where shown on **Drawing 2**. Use a hammer to drive the push nuts onto the rod.

Finish up and r-e-l-a-x

1 With all of the parts finish-sanded and all dust removed, apply two coats of an exterior oil finish. (We used Watco Teak Oil Finish.) To prevent the steel push nuts from rusting, prime and paint them with a color that matches the wheel hubs.

2 When dry, place a cushion on the lounge. Then, sit down, adjust the back position to your liking, and take a well-deserved rest.

materials list

Frame Assembly	FINISHED SIZE T	W	L	Matl.	Qty.
A inner rails	1½"	1½"	75"	M	2
B wide cross member	1½"	3"	22"	M	1
C cross members	1½"	1½"	22"	M	3
D outer rails	1½"	3"	75"	M	2
E* front legs	1½"	6½"	21 1/16"	M	2
F* rear legs	1½"	6½"	17⅞"	M	2
G* tall arm brackets	1½"	3"	10½"	M	2
H* short arm brackets	1½"	3"	7¾"	M	2
I* arms	3"	2⅞"	28 7/16"	LM	2
Platform Assembly					
J cross members	1"	3"	22⅝"	M	5
K end caps	¾"	1½"	22⅝"	M	4
L seat slats	¾"	1⅝"	46½"	M	9
M back slats	¾"	1⅝"	25½"	M	9
Back Assembly					
N dowels	⅝"-diam.		21"	MD	2
O braces	¾"	1¼"	14½"	M	2
P brackets	1"	1⅝"	19½"	M	2
Q supports	¾"	1½"	22½"	M	2

*Parts initially cut oversize. See the instructions.

Materials Key: M–mahogany, LM–laminated mahogany, MD–mahogany dowel.

Supplies: ¼" hardboard; #4x1", #8x1½", #8x2", and #8x2½" flathead wood screws; 3x2" hinges (2); 8"-diam. steel lawnmower-type wheels with ½" hub (2); ½" galvanized flat washers (4); ½" steel push nuts (2); ½"-diam. galvanized steel rod 33" long (1); ¾" brass escutcheon pins (2); glue; spray adhesive; clear outdoor finish.

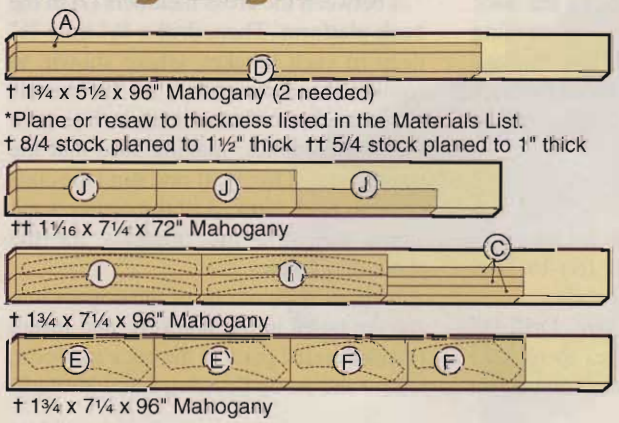
Buying Guide

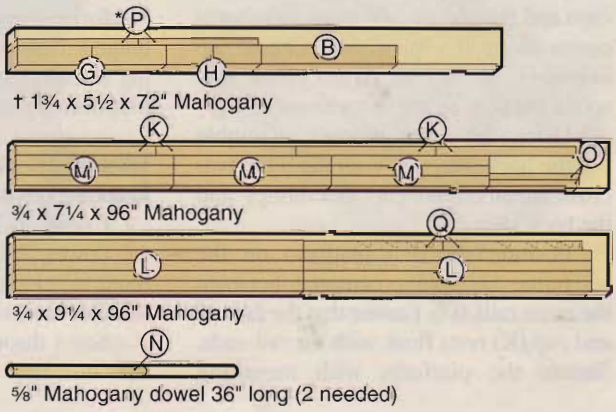
Wheel and hinge kit. 8"-diam. steel lawnmower-type wheels with ½" hub (2), 3x2" hinges (2) with screws. Order kit WDCL, $29.99 ppd. from Miller's Hardware Inc., 1300 M.L. King Jr. Pkwy, Des Moines, IA 50314, or call 515/283-1724.

Cushion. Style 306 chaise cushion, 23x75x4", approximately $80.00 (depending on fabric options), manufactured by Carter Grandle, Sarasota, FL. For the retail store nearest you, call 941/751-1000, or go to www.cartergrandle.com for a complete list of stores.

Written by **Owen Duvall**
Project design: **Kent Welsh**
Illustrations: **Mike Mittermeier, Lorna Johnson**
Photographs: **Baldwin Photography**

cutting diagram





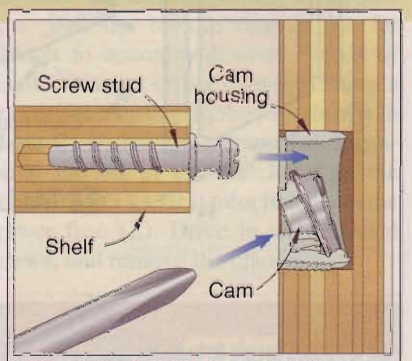
Create a customized design from these **modular** components.

a knockout knockdown CABINET system

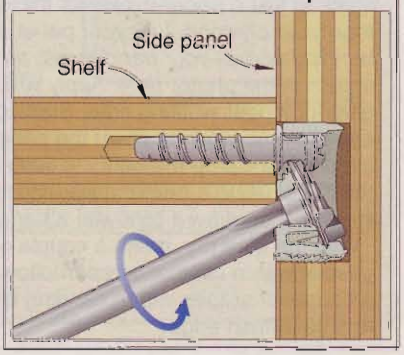
4 more ways to assemble the components

As shown in the examples, *left*, you can build a bookshelf or display shelf, sideboard, buffet cabinet, chest of drawers, or any combination of these elements—tall or short, wide or narrow. Because the shelf unit looks the same from both sides, and the door and drawer boxes have finished backs, as shown *above*, this project can be positioned away from a wall, acting as a room divider.

Designed to match the futon sofa (issue 139) and the TV stand (issue 141), this sleek, versatile cabinet system lends itself to any number of furniture pieces that easily assemble and disassemble. We'll show you how to build the components, detailed in the photo, *left*; you decide what your needs are, and build to suit. The key to the system lies in the cam-lock knockdown hardware, shown *right*, that lets you alter your furniture as your needs change or grow. If you don't foresee the need for the knockdown feature, you can join the parts by conventional methods, such as screws or biscuits. For information on other types of knockdown hardware, see the article on *page 62*.



This project owes its versatility to special knockdown hardware. Simply insert the screw stud into the cam housing's socket. Turn the cam clockwise to lock the stud in place.

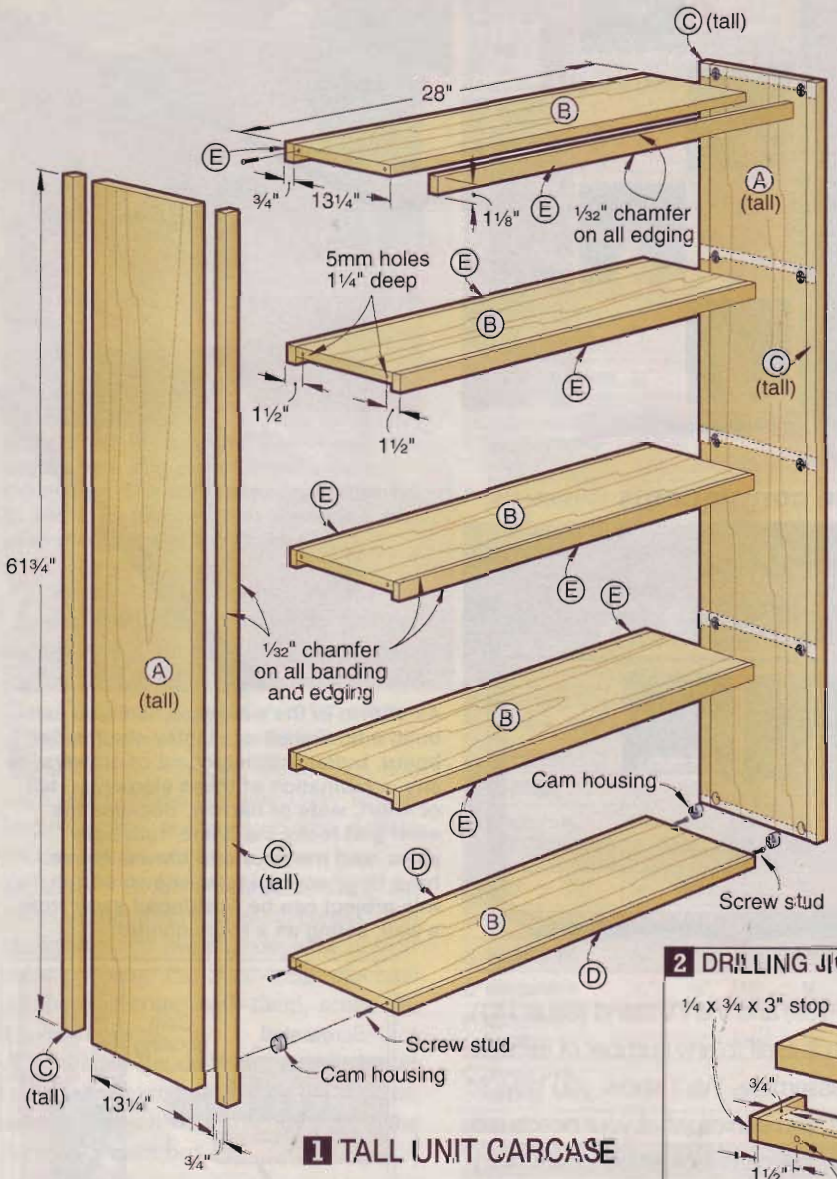


For the items needed to build this project, see the **Cutting Diagrams** and **Materials List** on *pages 58-60*.

BY THE NUMBERS—PLANNING YOUR PROJECT

The Materials List and Cutting Diagrams show parts for a pair of long and short sides, a single and double base and top, one door box (add the drawer shelf to make a drawer box), one door, and two drawers. To develop a cutting list for the configuration you want to build, draw your design on paper, then count the number of each component you'll need.

For example, the unit in the large photo, *opposite*, consists of two pairs of tall sides, 10 shelves (two of which are bottom shelves), one double base, one double top, six boxes with four drawer shelves, two doors, and four pairs of drawers. The chest of drawers, lower left corner *above*, is made up of one pair of short sides, three shelves (one of which is a bottom shelf), a single base, single top, four boxes with four drawer shelves, and four pairs of drawers.



1 TALL UNIT CARCASE

First, build the carcase

1 From ¾" plywood, cut the sides (A) and shelves (B) to the sizes shown on the Materials List. You'll need five shelves for a tall unit, and three for a short unit.

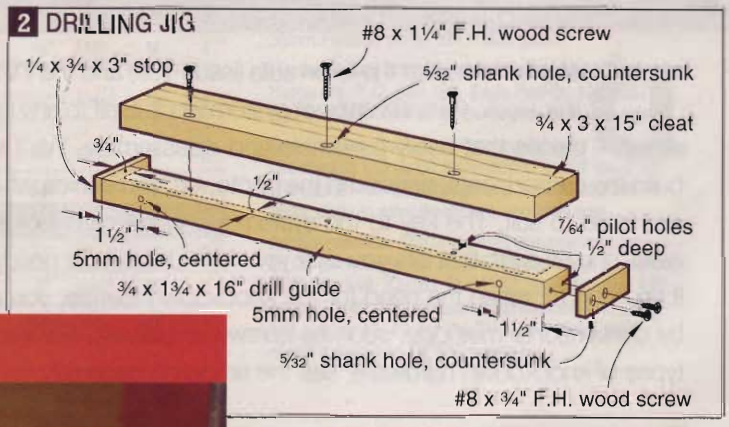
2 Rip the side banding (C), bottom banding (D), and the shelf edging (E) to width, and cut them about ½" longer than their mating plywood panels. Glue and clamp the banding to the sides and bottom shelf. Glue and clamp the edging to the remaining shelves, where shown on **Drawing 1**. See the shop tip "Reduce banding sanding," *below left*, for a time-saving method for applying the banding.

3 With the glue dry, sand the banding flush with the faces of the sides and the bottom shelf. Sand the edging flush with the shelves' top faces. Trim the banding and edging ends flush with their respective panels' ends.

4 Mark the bottom end of each side (A/C). Lay out the locations of the 25mm holes for the knockdown fitting cam housings on the sides (A/C), where dimensioned on **Drawing 3**. Measure the locations for the top pair of 25mm holes from the top end. Measure all the other vertical locations from the bottom end, as indicated on the drawing. See the shop tip "Fast, foolproof marking," *opposite*, for a good marking method.

5 Chuck a 25mm Forstner bit in your drill press, set the fence 1½" from the bit's center, and adjust the depth stop to drill ½" deep. Drill the cam-housing holes at their marked locations.

6 To drill the pilot holes in the ends of the shelves for the knockdown fitting screw studs, build the jig shown in **Drawing 2**. When drilling the 5mm guide holes in the drill guide, use your drill press and a fence fitted with a stopblock

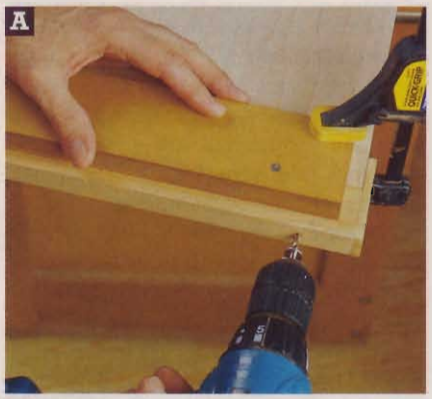


SHOP TIP

Reduce banding sanding

To reduce sanding time when applying banding, carefully plane your banding stock to just a paper-thickness thicker than your plywood. Lay your panel and banding across your bar clamps, as shown in the photo, *right*. Apply white glue for longer working time. Starting at one end and working down the panel's length, first clamp the banding flush with the panel using a pair of quick-action clamps, then draw it tight with a bar clamp.

With the glue dry, make a couple of passes with a cabinet scraper followed by a couple of swipes with a sanding block to create flush edges.



With its right stop against the shelf's right edge, clamp the drilling jig in place, and drill the first hole. Unclamp, shift the jig so its left stop is against the shelf's left edge, and drill the second hole.

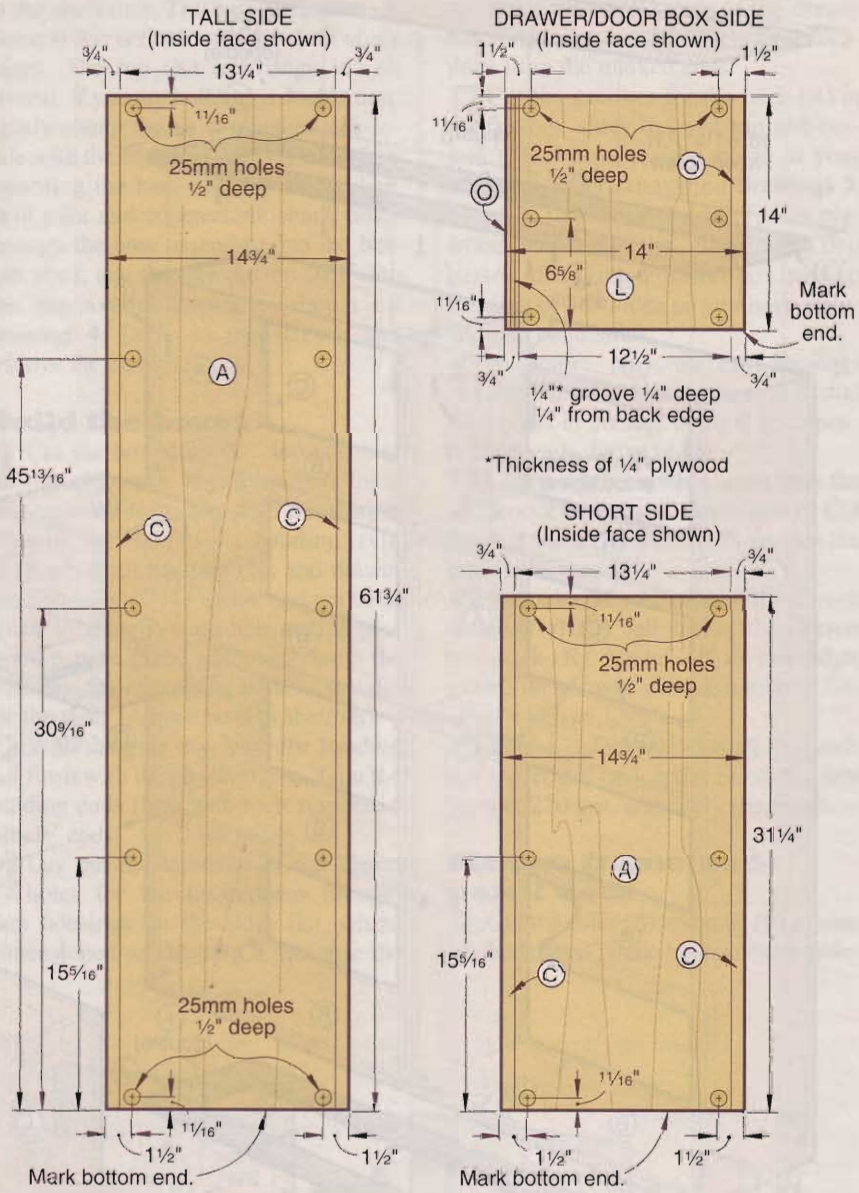
for maximum accuracy. Clamp the jig to the shelves with their top faces up. Chuck a 5mm bit in your drill so it protrudes 3" from the chuck. Slip a #10 flat washer over the bit, and drill the stud pilot holes, as shown in **Photo A**. The chuck acts as a depth stop, and the washer protects the jig from the chuck's jaws.

7 Rout a 1/32" chamfer on all the banding and edging, where shown on **Drawing 1**. Finish-sand the sides and shelves to 220 grit. Apply two coats of satin polyurethane, sanding lightly with 220-grit sandpaper between coats.

8 Press the cam housings into their holes so they are flush with the surface. Engage the end of your combination square in the housings' slots to rotate them into alignment. Orient the stud holes to the sides' top, except for the bottom pairs. These stud holes are oriented toward the bottom.

9 Drive in the studs with a screwdriver until the stud's flange seats on the shelf's end.

3 SIDES



SHOP TIP

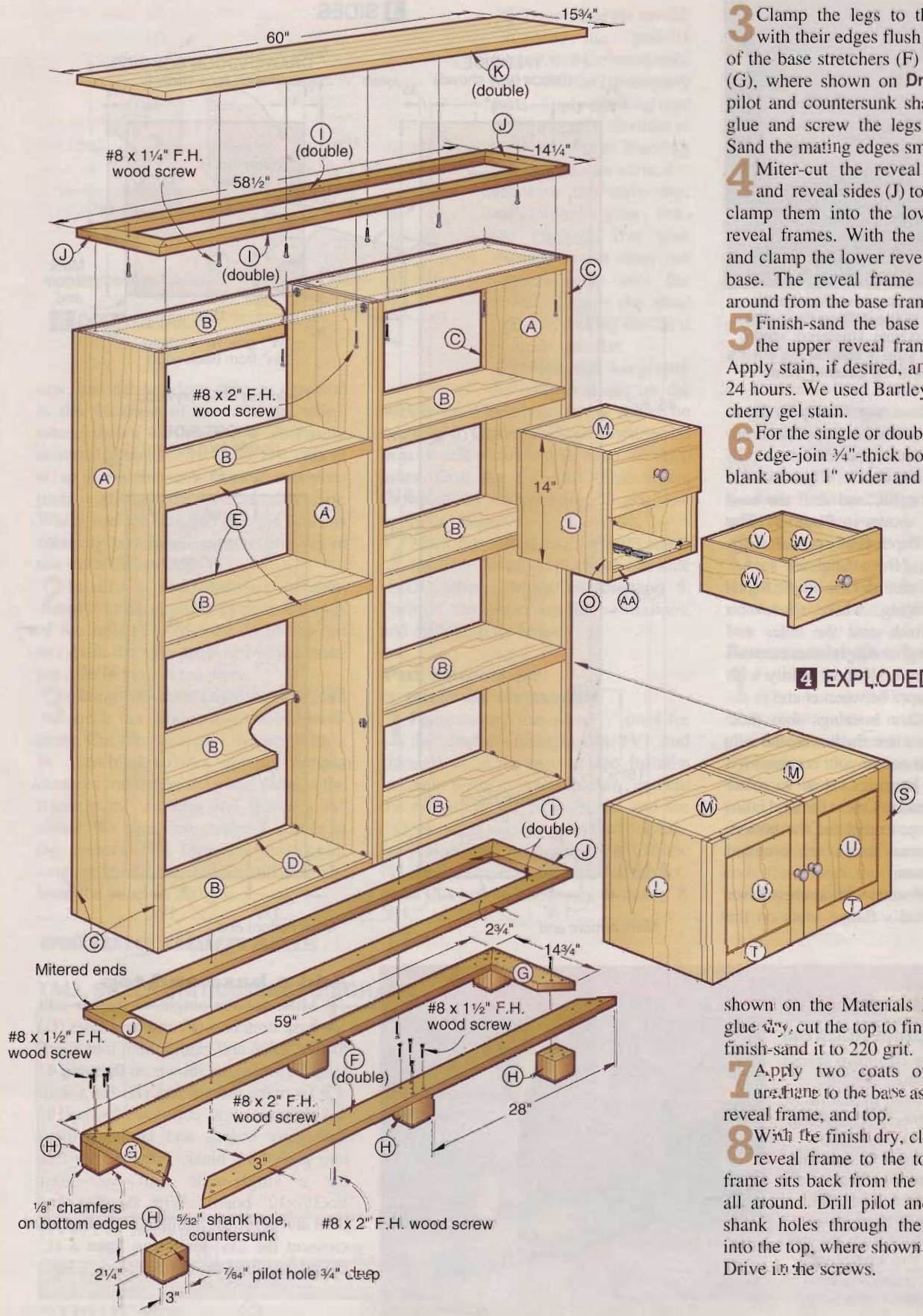
Fast, foolproof marking

To speed the repetitive layout of the cam-housing holes, mark the desired measurements on a piece of masking tape applied to your tape measure blade. The masking tape does not interfere with the operation of your tape measure. As long as you always measure from the bottom edge of the workpiece, you won't accidentally mismark the location of a hole.

Add a base and top

1 Miter-cut the single or double unit base stretchers (F) and base sides (G) to size. Glue and clamp them into a rectangular frame, as shown on **Drawing 4**.

2 To make the six feet (H) for a double-wide unit, cut four 3/4×3 1/8×18" mahogany boards and laminate them into a 3"-thick blank. For the four feet for a single-wide unit, use four 3/4×3 1/8×12" boards. With the glue dry, joint and plane the blanks to 3" wide, then crosscut the 2 1/4"-long legs. Rout a 1/8" chamfer around the bottom of each leg.



4 EXPLODED VIEW

3 Clamp the legs to the base frame with their edges flush with the edges of the base stretchers (F) and base sides (G), where shown on **Drawing 4**. Drill pilot and countersunk shank holes, and glue and screw the legs to the frame. Sand the mating edges smooth.

4 Miter-cut the reveal stretchers (I) and reveal sides (J) to size. Glue and clamp them into the lower and upper reveal frames. With the glue dry, glue and clamp the lower reveal frame to the base. The reveal frame sits in ¼" all around from the base frame's edge.

5 Finish-sand the base assembly and the upper reveal frame to 220 grit. Apply stain, if desired, and let it dry for 24 hours. We used Bartley Pennsylvania cherry gel stain.

6 For the single or double unit top (K), edge-join ¾"-thick boards to make a blank about 1" wider and 1" longer than shown on the Materials List. With the glue dry, cut the top to finished size, and finish-sand it to 220 grit.

7 Apply two coats of satin polyurethane to the base assembly, upper reveal frame, and top.

8 With the finish dry, clamp the upper reveal frame to the top. The reveal frame sits back from the top's edge ¾" all around. Drill pilot and countersunk shank holes through the reveal frame into the top, where shown on **Drawing 4**. Drive in the screws.

Insert the shelf studs in the cam-housing sockets. Turn the cams with a Phillips screwdriver to lock the shelves in place.

Assemble the shelf unit

1 Lay one side (A/C) on the floor with the cam housings up. Insert the shelves (B/E) and bottom shelf (B/D), as shown in **Photo B**.

2 Position the other side on the upturned shelves, engaging the shelf studs in the cam-housing sockets. Turn the cams to lock in the shelves.

3 Clamp the base assembly (F/G/H/I/J) and top assembly (I/J/K) to the shelf unit. The base stretcher/side frame (F/G) is flush with the shelf unit's edges. The top (K) overhangs ½" all around. If you are building a double unit, tightly clamp the units together side-to-side with the ends and edges flush before mounting the base and top assemblies. Drill pilot and countersunk shank holes through the base assembly into the bottom shelf, and through the top shelf into the top assembly, where shown on **Drawing 4**. Drive in the screws, and remove the clamps.

Build the boxes

1 Cut the box sides (L); top and bottom (M); and, if you are building a drawer box, the drawer shelf (N) to size.

2 Rip the box side banding (O), top/bottom banding (P), and drawer shelf banding (Q) to width, and cut them about ½" longer than their mating plywood panels. Plane, glue, and clamp the bandings to their mating parts as you did for the sides (A) and bottom shelf (B).

3 With the glue dry, sand the banding flush with the panels' faces. Trim the banding ends flush with their respective panels' ends.

4 Lay out the locations of the 25mm holes for the knockdown fittings' cam housings on the sides (L), where dimensioned on **Drawing 3**. Because the cam-housing holes for the drawer shelf in the drawer box are slightly below center, mark the bottom ends of the drawer box sides, and measure these hole locations from the marked ends.

5 Cut the grooves for the back (R) in the box sides (L) and top and bottom (M) with a regular blade in your tablesaw, where shown on **Drawings 3, 5**, and **7**. To make a good fit for the plywood back, cut the grooves in two passes. If making a drawer box, pair up the drawer box sides so you have right- and left-hand sides.

6 As before, press the cam housings into the sides. Use the jig to drill stud pilot holes in the top, bottom, and drawer shelf ends. Drive in the studs.

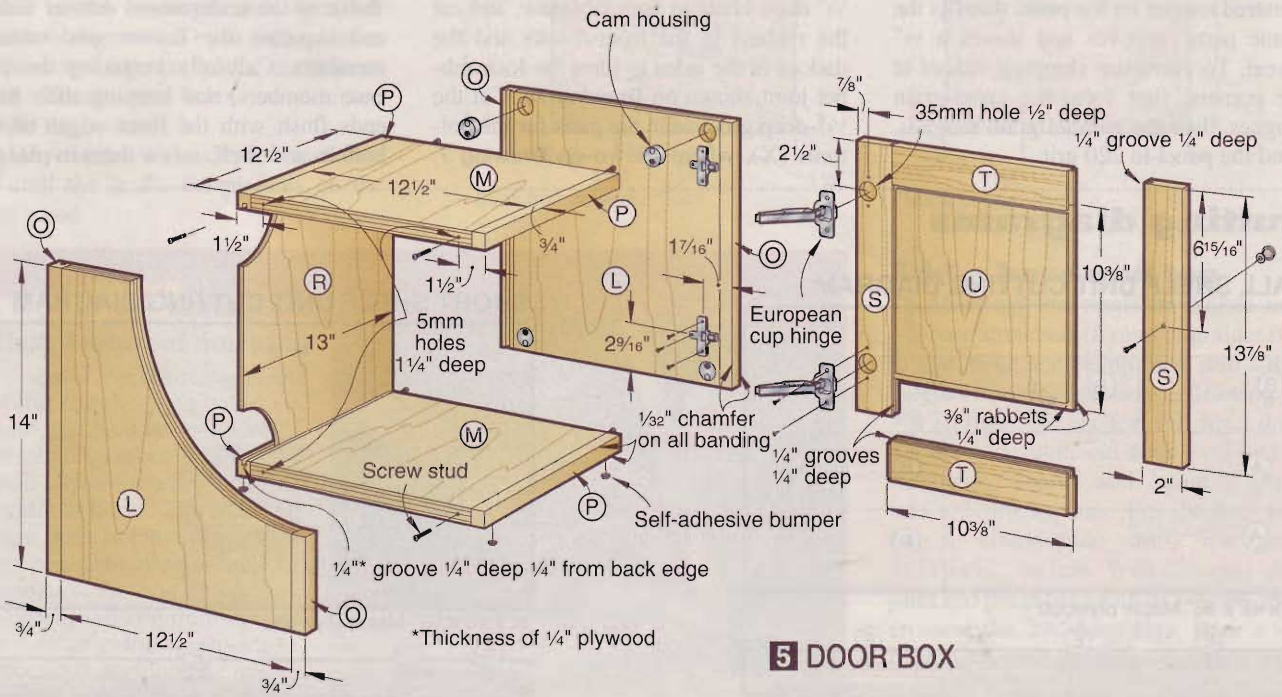
7 Clamp a box together, and check the groove-to-groove dimensions. Cut the box back (R) to size. Note that the grain runs vertically.

8 To make the rear edge of the drawer shelf (N/Q) fall inside the drawer box back (R), rip ½" off its rear edge, giving the drawer shelf assembly a finished width of 13½".

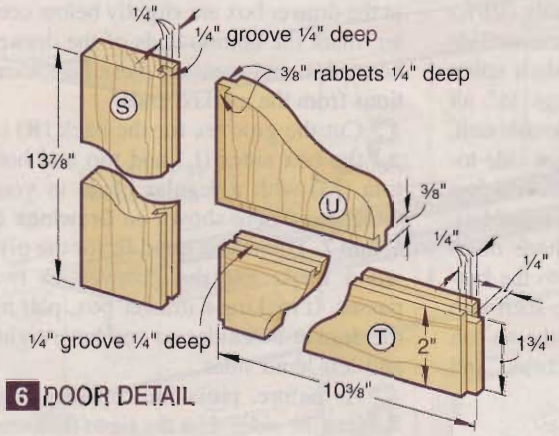
9 Rout a 1/32" chamfer on all the banding edges and ends. Sand the box parts to 220 grit, and apply the finish.

Make a frame-and-panel door

1 Cut the stiles (S) and rails (T) to size. Install a ¼" dado blade in your table-



5 DOOR BOX



6 DOOR DETAIL

saw, and cut ¼"-deep grooves centered in the thickness of the rails and stiles, where shown on **Drawing 6**. To ensure centered grooves, first make test cuts in scrap that is the same thickness as your parts, adjusting the fence as necessary. When you are satisfied that the fence is correctly positioned, cut the grooves in the stiles (S) and rails (T).

2 Install a ¼" dado blade in your tablesaw, and form the tenons on the ends of the rails (T). Test the fit of the rail tenons in the stile grooves by first making cuts in your scrap piece.

3 Clamp your door frame together, and check the groove-to-groove dimensions. Cut the panel (U) to size. With a ⅜" dado blade in your tablesaw, form a centered tongue on the panel that fits the frame parts' grooves and leaves a ⅛" reveal. To eliminate chipping veneer at the corners, first form the cross-grain tongues, then the parallel-grain tongues. Sand the panel to 220 grit.

4 To enhance the reveal, stain the panel's tongue with the same stain used on the mahogany parts. Apply masking tape to the tongue's shoulder to keep stain from bleeding onto the panel's surface.

5 With the stain dry, squeeze glue into the grooves. Use glue sparingly so it does not squeeze out into the reveal. Clamp the door together, making certain it is square and flat.

6 Mark the hinge-cup hole locations on the back of the door's stile, where shown on **Drawing 5**. Chuck a 35mm Forstner bit in your drill press, and drill the ½"-deep holes. Drill the ⅜16" knob hole where shown. Sand the door to 220 grit, and apply the finish.

7 Mark horizontal and vertical centerlines for the hinge plates on one side (L/O), where shown on **Drawing 5**. Position the plates on the centerlines, and drill the pilot holes.

Put together a pair of drawers

1 Plane enough lumber to ½" thick for the drawer fronts/backs (V) and sides (W). Cut the parts to size. Install a ¼" dado blade in your tablesaw, and cut the rabbets in the fronts/backs and the dadoes in the sides to form the lock-rabbet joint shown on **Drawing 7a**. Cut the ¼"-deep grooves in the parts for the bottoms (X), where shown on **Drawing 7**. Use a regular blade in your tablesaw, making two passes to match the thickness of the ¼" plywood.

2 Drill the four 5⁄16" holes in the fronts (V) for mounting the drawer faces (Z), where shown. The faces are fastened to the drawers with washer-head screws. The oversize holes allow you to adjust the faces' positions during final assembly. Sand all the drawer parts to 220 grit.

3 Dry-assemble the drawer parts to check their fit, and measure for the bottoms (X). Cut the bottoms to size. Apply glue to the lock rabbets and grooves, and clamp the drawers together.

4 Resaw a ¾×2½×12" board in half and plane it to ¼" thick for the drawer slide cleats (Y). Glue and clamp the cleats to the drawer bottoms, centered where shown on **Drawing 7**.

5 Cut the drawer faces (Z) to size. Drill centered 3⁄16" holes for the knobs. Sand the faces to 220 grit. Apply finish to all the drawer parts.

6 Resaw and plane a ⅜×¾×8" blank for the glides (AA). Cut them to length, and drill centered countersunk shank holes. Set the glides aside.

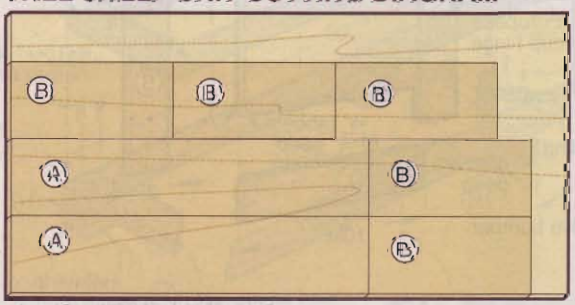
Assemble the boxes

1 Position the glides (AA) on the drawer box bottom (M/P) and drawer shelf (N/Q), where shown on **Drawing 7**. Drill pilot holes, and screw the glides in place.

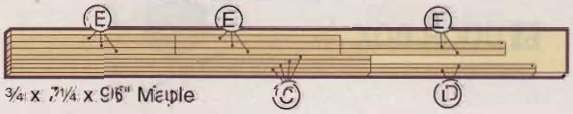
2 Remove the optional rear bracket from the undermount drawer slides, and separate the drawer and carcase members. Carefully centering the carcase members, and keeping their front ends flush with the front edges of the bottom and shelf, screw them in place.

cutting diagrams

TALL SHELF UNIT CUTTING DIAGRAM

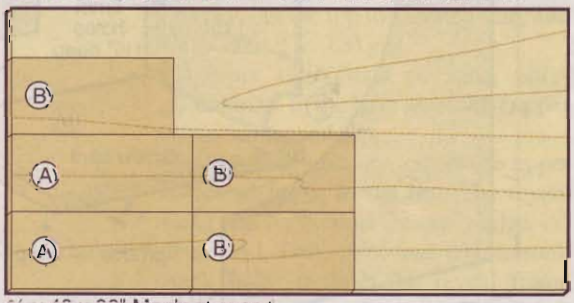


¾ x 48 x 96" Maple plywood

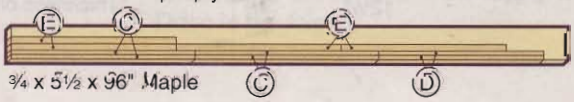


¾ x 7¼ x 96" Maple

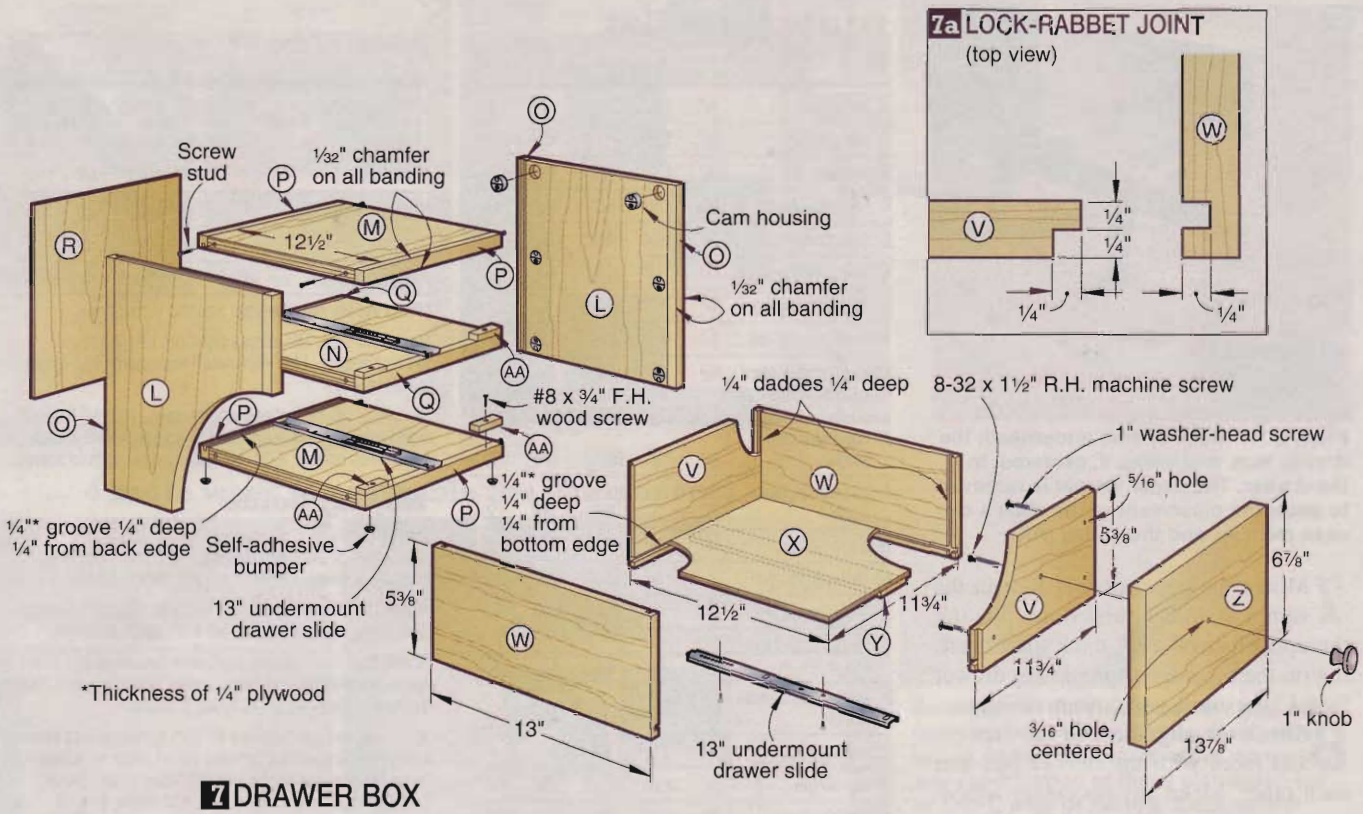
SHORT SHELF UNIT CUTTING DIAGRAM



¾ x 48 x 96" Maple plywood



¾ x 5½ x 96" Maple



7 DRAWER BOX

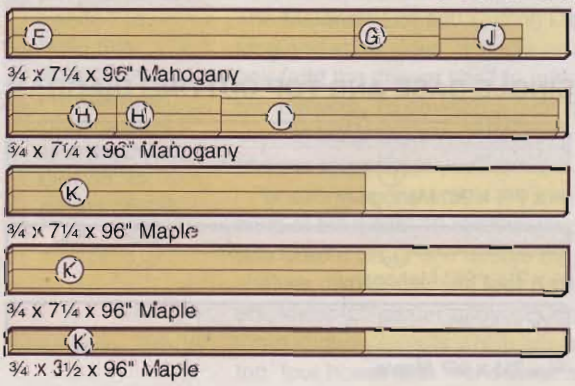
3 Insert the top, bottom, and drawer shelf studs in the cam housings of one side of the door and drawer boxes. Lock them in place. Slide the backs into the grooves. Mate the other sides with the protruding studs, and lock the cams.

4 Screw the hinge plates to the door box. Press the hinges into the cup holes, and using the holes in the cup flanges as guides, drill the pilot holes. Drive in the screws. Install the knob, and snap the hinges onto the plates. Turn the adjustment screws to center the door on the box.

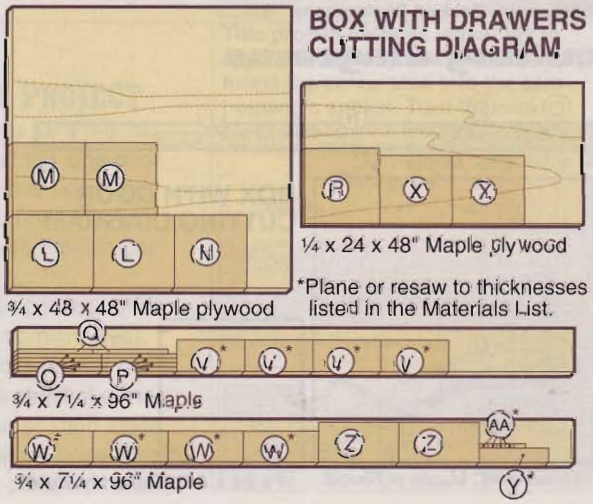
5 Turn the drawers upside down. Carefully centering the slides' drawer members, and keeping their front ends flush with the drawers' front edges, screw them in place. Slide the drawers into the box, and check to see if they are square in their openings. If not, the slides' slotted holes provide adjustment.

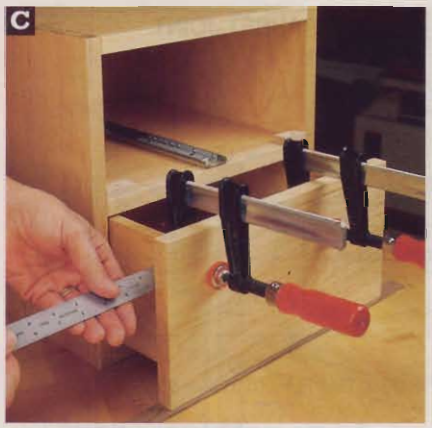
6 To mount the lower drawer face (Z), place the drawer box on a flat surface. Pull the bottom drawer out far enough to accommodate the heads of small C-clamps or bar clamps. Clamp a drawer face to the drawer, as shown in **Photo C**. Remove the drawer and, centering the bit in the 5/16" holes in the drawer front (V), drill pilot holes into the drawer face (Z). Drive in washer-head screws, and remove the clamps.

DOUBLE BASE AND TOP CUTTING DIAGRAM



BOX WITH DRAWERS CUTTING DIAGRAM





Place a 1/16"-thick spacer underneath the drawer face, and clamp it, centered, to the drawer. The upper drawer is removed to show the placement of the slide's carcase member and the glides (AA).

7 Mount the upper drawer face in the same manner, this time placing the upper face on a 1/8"-thick spacer resting on the top edge of the lower drawer face. Clamp, drill, and drive in the screws.

8 Check the alignment of the drawers and faces with the drawer box and each other. Make any necessary adjustments to the positions of the drawer slides and drawer faces. When you are satisfied with the alignment, using the holes in the drawer faces as guides, drill the knob screw holes through the drawer fronts. Using the 1½"-long machine screws that come with them, screw the knobs in place.

9 To keep the door and drawer boxes from slipping around on the shelves, adhere four self-adhesive bumpers to the bottom of each box.

Written by **Jan Svec** with **Charles I. Hedlund**
Project design: **Kevin Boyle**
Illustrations: **Roxanne LeMoine; Lorna Johnson; Tim Cahill**
Photographs: **Baldwin Photography**

materials list

Carcase	FINISHED SIZE T	W	L	Matl.	Qty.
A sides–tall	¾"	13¼"	61¾"	MP	2
A sides–short	¾"	13¼"	31¼"	MP	2
B shelves–tall	¾"	13¼"	28"	MP	5
B shelves–short	¾"	13¼"	28"	MP	3
C* side banding–tall	¾"	¾"	61¾"	M	4
C* side banding–short	¾"	¾"	31¼"	M	4
D* bottom banding	¾"	¾"	28"	M	2
E* shelf edging–tall	¾"	1⅛"	28"	M	8
E* shelf edging–short	¾"	1⅛"	28"	M	4
Base and top					
F base stretchers–single	¾"	3"	29½"	MY	2
F base stretchers–double	¾"	3"	59"	MY	2
G base sides	¾"	3"	14¾"	MY	2
H* feet–single unit	3"	3"	2¼"	LMY	4
H* feet–double unit	3"	3"	2¼"	LMY	6
I reveal stretchers–single	¾"	2¾"	29"	MY	2
I reveal stretchers–double	¾"	2¾"	58½"	MY	2
J reveal sides	¾"	2¾"	14¼"	MY	2
K* top–single	¾"	15¾"	30½"	EM	1
K* top–double	¾"	15¾"	60"	EM	1
Boxes					
L sides	¾"	12½"	14"	MP	2
M top/bottom	¾"	12½"	12½"	MP	2
N drawer shelf	¾"	12½"	12½"	MP	1
O* side banding	¾"	¾"	14"	M	4
P* top/bottom banding	¾"	¾"	12½"	M	4
Q* drawer shelf banding	¾"	¾"	12½"	M	2
R back	¼"	13"	13"	MP	1
Door					
S stiles	¾"	2"	13⅞"	M	2
T rails	¾"	2"	10⅜"	M	2
U panel	¾"	10⅜"	10⅜"	MP	1

Drawers	FINISHED SIZE T	W	L	Matl.	Qty.
V fronts/backs	½"	5⅜"	11¾"	M	4
W sides	½"	5⅜"	13"	M	4
X bottoms	¼"	11¾"	12½"	MP	2
Y* slide cleats	¼"	2½"	12"	M	2
Z faces	¾"	6⅞"	13⅞"	M	2
AA*glides	⅜"	¾"	1½"	M	4

*Parts initially cut oversize. See the instructions.

Materials Key: MP–maple plywood, M–maple, MY–mahogany, LMY–laminated mahogany, EM–edge-joined maple.

Supplies: #8x¾" flathead wood screws, #8x1¼" flathead wood screws, #8x1½" flathead wood screws; #8x2" flathead wood screws; 8-32x1½" roundhead machine screws.

Buying Guide

Hardware.

•Each pair of *tall* sides (A) requires 20 cam housings and screw studs. Order kit no. KIT09021, $9.40.

•Each pair of *short* sides (A) requires 12 cam housings and screw studs. Order kit no. KIT09022, $5.64.

•Each door box requires eight cam housings and screw studs, two hinges and hinge plates, one knob, and four bumpers. Order kit no. KIT09023, $9.94.

•Each drawer box requires 12 cam housings and screw studs, two undermount drawer slides, eight 1" washer-head screws, two knobs with 1½"-long knob screws, and four bumpers. Order kit no. KIT09024, $14.16.

Note: The cam housings are available in almond (ALM), brown (BRN), and white (WH). We used almond. When ordering, specify the color that best matches your plywood.

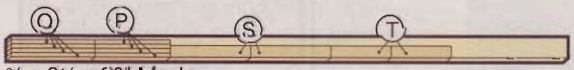
Drill bits. 5mm drill bit no. H001.41.168, $4.29; 25mm carbide-tipped Forstner bit no. CMT317.250.11, $19.95; 35mm Forstner bit no. MP31628, $9.88.

Hardware and drill bits available from Woodworker's Hardware, P.O. Box 180, Sauk Rapids, MN 56379. Call 800/383-0130 or go to www.woodhardware.com.

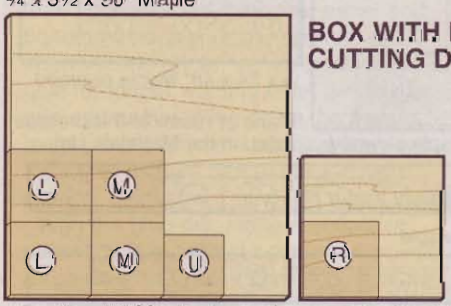
Back issues. Back issues are available for $6.95 each. Order issue 139 (futon sofa/sleeper) and/or issue 141 (TV stand). Call Schlabaugh and Sons at 800/346-9663, or go to www.woodstore.woodmall.com.

Article reprints. Article reprints are available for $5.00 each. Write to: *WOOD* Article Reprint Service, P.O. Box 349, Kalona, IA 52247. Specify issue 139, pages 36–42, for the futon sofa/sleeper, and issue 141, pages 46–49, for the TV stand. Make your check payable to *WOOD* magazine.

cutting diagrams



¾ x 3½ x 96" Maple

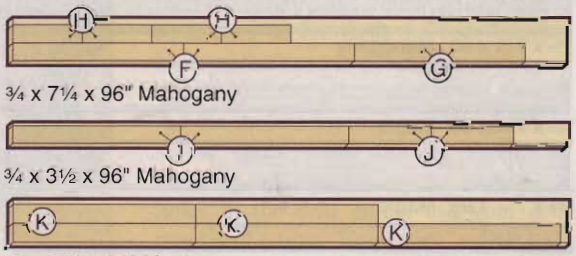


BOX WITH DOOR CUTTING DIAGRAM

¾ x 48 x 48" Maple plywood

¼ x 24 x 24" Maple plywood

SINGLE BASE AND TOP CUTTING DIAGRAM



¾ x 7¼ x 96" Mahogany

¾ x 3½ x 96" Mahogany

¾ x 7¼ x 96" Maple

choosing and using knockdown hardware

It's a lot easier to move big furniture one part at a time, thanks to these little fasteners.

Woodworkers usually try to build furniture so that it will never come apart. Sometimes, though, it makes sense to build a piece with an eye to disassembly and reassembly. Maybe it's destined to move from apartment to apartment, or maybe you know there's a winding flight of stairs in its future.

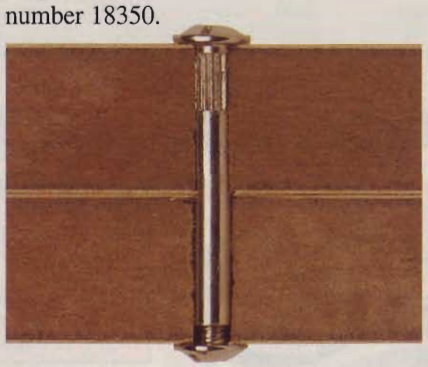
Whatever the reason, you can reach your goal with knockdown hardware. Manufacturers use a staggering array of designs, but you'll find what you need in the smaller selections contained in woodworking catalogs. A sample of those choices can be seen *above*.

Some knockdown fasteners require nothing more than a single drilled hole. Others won't work right without a sequence of precisely placed holes. Those call for jigs, whether purchased or shopmade, and probably aren't worth the extra time and expense unless you're building a large installation or several identical pieces. In most cases, a catalog that carries these fasteners also carries the specific metric drill bits necessary for installation. Here's what you can expect from five types of conventional knockdown fasteners.

Panel connectors

Use these to join adjacent cabinets, such as the components of an entertainment center. They're designed to join two ¾"-thick pieces. Preparation is quite simple; clamp the cabinets together, and drill a 5mm hole through both cabinet sides, taking care to keep the bit perpendicular to the surface. The size of the hole isn't super-critical, so if you don't have metric bits, use a 7/32" bit. Install the connector, thread the parts together, and tighten it with either a straight-slot or Phillips screwdriver.

A package of eight connectors costs $2.61 from the Rockler professional catalog. Call 800/233-9359 and order item number 18350.

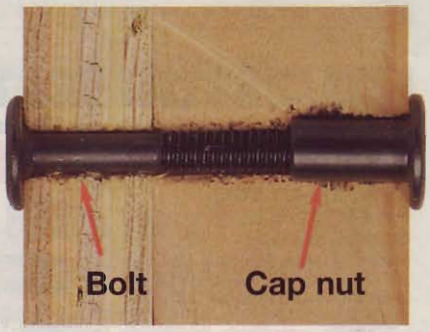


Knockdown fasteners don't get any simpler than this. To join side-by-side panels, drill a hole, insert a panel connector, and tighten with a screwdriver.

Connector bolts

These are a heavier version of the panel connectors, suitable for holding separate boxes together. Again, just clamp the components together, and drill through both sides. You'll need a ¼" hole for the bolt, plus an 1 1/32" hole ⅝" deep to accept the cap nut. Tighten this fastener with a 4mm allen wrench on the bolt and a 5mm allen wrench on the nut.

A package of 10 connector bolts 1⅛" long, good for joining two pieces of ¾" stock, costs $3.99 from Woodcraft. (Other lengths also are available.) Call 800/225-1153. The corresponding cap nuts also cost $3.99. Order item number 06M40 for the package of bolts and item number 06M50 for the nuts.



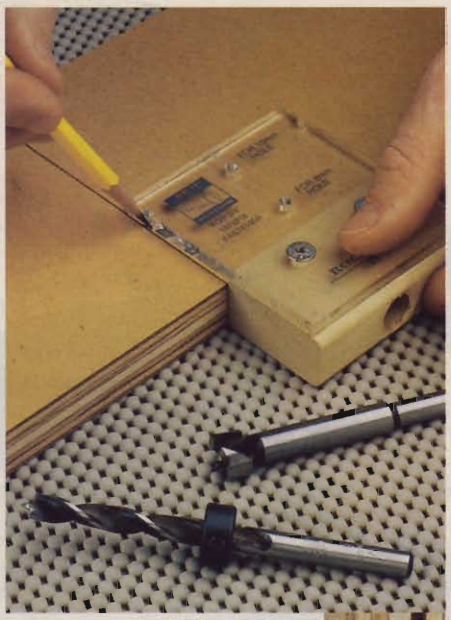
Similar to a panel connector, this design places more surface area against the sheet goods. Tighten it with allen wrenches on the bolt and the nut.

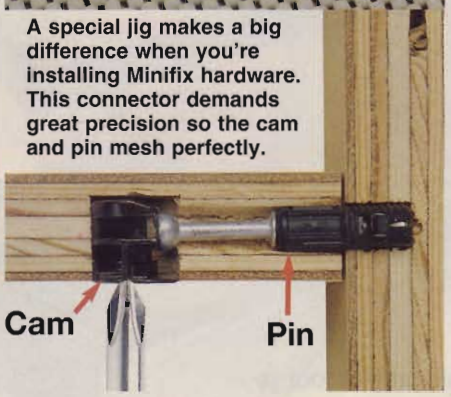
Minifix fittings

With this hardware, you hide the pin and tighten the joint by means of a cam. You can find several variations on the pin design. Some pins screw into the wood; some screw into a threaded plastic insert; and some, like the one shown, insert into a drilled hole, and then expand slightly as you turn the cam. The drawback to this fitting is that it requires two perfectly aligned and spaced holes.

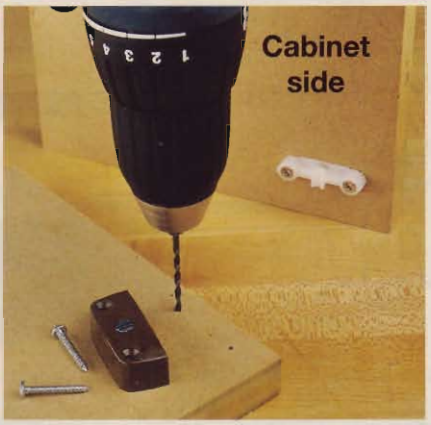
Because of the precision required, the Minifix probably isn't worth the effort for just a few joints, but becomes valuable if you plan to tool up for a small production run. You must align the hole for the housing with the pin hole, and locate it at a precise distance from the end of the board, so the cam will properly engage the head of the pin. As you see at *right*, a wood and plastic jig is available to help you locate both holes.

Rockler item number 22161 contains eight Minifix fittings (both housings and pins) for ¾" stock, at a price of $3.74. A 15mm Forstner bit for the housings, item number 21249, costs $6.79. If you choose to buy the 8mm brad-point drill bit for the pins, it's $3.81 for item number 46763. The Minifix Jig It template is item number 92114, and costs $19.79.





A special jig makes a big difference when you're installing Minifix hardware. This connector demands great precision so the cam and pin mesh perfectly.



Unlike most other knockdown fasteners, this one sits entirely on the surfaces of the joined pieces. It requires nothing more than small screw holes.

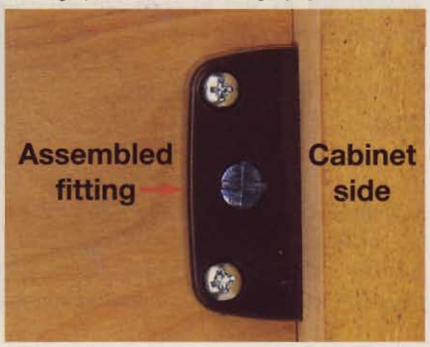
Surface-mount fittings

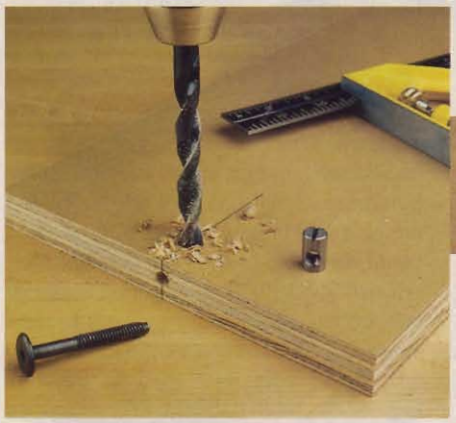
This style offers easy installation, but the whole unit remains visible on the inside of the cabinet. You can use it to make 90° joints with stock of any thickness.

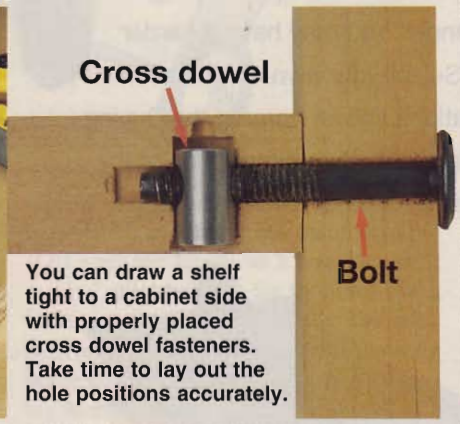
Select a location where the connector won't interfere with doors or hinges. Attach the white plate to the cabinet side with two screws, as shown *above*, making sure to keep it slightly above the adjacent surface. Then slide the brown housing over the plate and attach it with screws that run perpendicular to the first set of screws. Now you're ready to turn the center slot with a screwdriver, moving the internal cam. As this cam engages the plate, it draws the pieces together for a snug fit.

Woodworker's Hardware carries surface-mount fittings in brown and white. Call 800/383-0130 to order. The internal plate, item number B040.2020, costs 24 cents; it's 43 cents for each brown housing (B040.2010BRN) or white housing (B040.2010WH). You'll receive mounting screws with the fittings.

Photographs: **Baldwin Photography**







You can draw a shelf tight to a cabinet side with properly placed cross dowel fasteners. Take time to lay out the hole positions accurately.

Cross dowels

Use these threaded steel dowels in conjunction with connector bolts, and you have a piece of hardware that holds two pieces at 90°, such as a shelf to a cabinet side, or a railing to a leg. Like the Minifix, this fastener requires precise hole alignment. Another factor to consider is that the bolt head remains exposed on the outside of the cabinet.

To hold a shelf, drill a ¼" hole through the cabinet side and into the end of the shelf. Then drill a 10mm, or ⅜", hole from the bottom of the shelf, perpendicular to and centered on the first hole. Make this hole ⅝" deep. Insert the bolt and the dowel, thread them together, and tighten with a 4mm allen wrench.

Cross dowels come in packages of 10, at a price of $2.99, from Woodcraft. Order item number 06K70.

keepsake box with contemporary flair

Bird's-eye maple with bubinga

Contrasting woods and tapered legs make it a real eye-grabber.

Don't let the refined appearance of this project fool you. It's not difficult to make. We'll show you how to shape the tapered legs using patterns and a sander. You may have a harder time choosing which woods to use. Select your own combination of species, or try one of the combinations shown *here*. In the Buying Guide on the *opposite page*, you'll find a handy source for all of the necessary stock milled to the required thicknesses.

Lacewood with cocobolo

Ash with cherry

First, make the box

1 From ½"-thick stock, cut a 2×28" blank for forming the front and back (A) and sides (B) of the box. Also, from ½"-thick stock, rip two ¼×28" strips for making the front and back trim (C) and side trim (D).

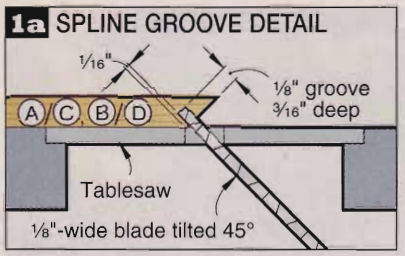
2 Glue and clamp the trim strips to the edges of the 2×28" blank. When dry, remove the clamps and sand or plane the glued-up blank to a thickness of ⅜".

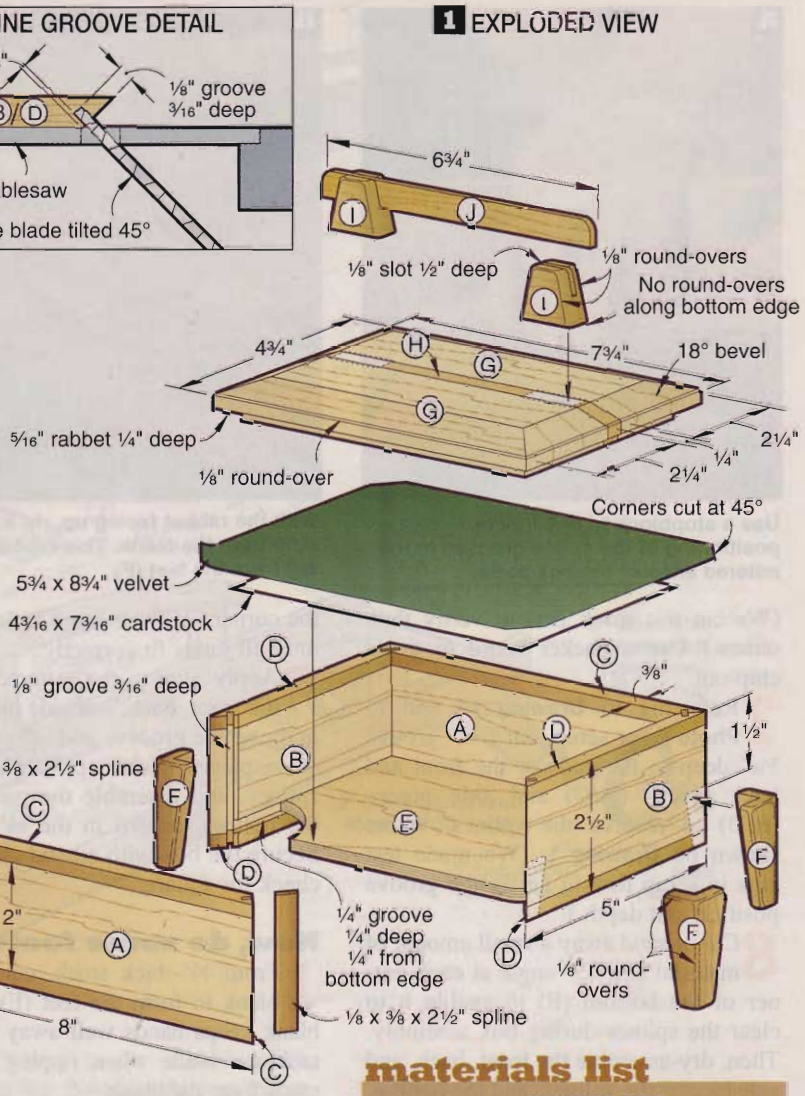
3 From ⅛"-thick stock, cut four ⅛×⅜×2½" splines for joining the corners of the box. Make the splines from the same type of wood that you use for the trim so the ends of the splines, which are visible in the assembled box, will match the trim.

4 From ¼" hardwood plywood, cut the bottom (E) to the size listed in the Materials List. The bottom is undersized to provide a 1/32" clearance on all sides when it is installed in the box.

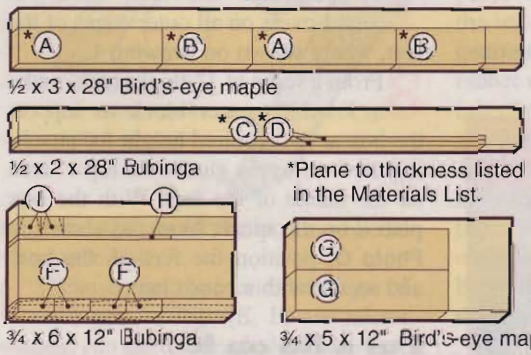
5 On the inside face of the 2×28" blank, cut a ¼" groove ¼" deep and ¼" from the bottom edge to receive the bottom (E), where shown on **Drawing 1**. Finish-sand the grooved face of the blank to 220 grit.

6 With your tablesaw blade tilted to 45°, miter-cut the glued-up blank to form the front and back pieces (A/C) and side pieces (B/D) to the lengths listed.





cutting diagram



materials list

Part	FINISHED SIZE T	W	L	Matl.	Qty.
A* front and back	⅜"	2"	8"	BM	2
B* sides	⅜"	2"	5"	BM	2
C* front and back trim	⅜"	¼"	8"	B	4
D* side trim	⅜"	¼"	5"	B	4
E bottom	¼"	4 1/16"	7 1/16"	HP	1
F* feet	¾"	¾"	2"	B	4
G* lid sides	¾"	2¼"	7¾"	BM	2
H* lid center	¾"	¼"	7¾"	B	1
I* handle braces	¾"	1"	1¼"	B	2
J handle	⅛"	½"	6¾"	B	1

*Parts initially cut oversize. See the instructions.

Materials Key: BM–bird's-eye maple, B–bubinga, HP–hardwood plywood.

Supplies: Spray adhesive, velvet, cardstock.

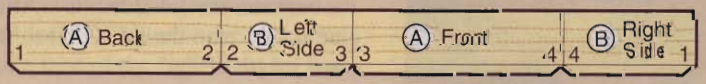
Buying Guide

Hardwood kit. Enough stock for one box, kit no. W1431, $25.95 ppd. Enough stock for five boxes, kit no. W1435, $99.95 ppd. Specify wood combination for kit (bird's-eye maple/bubinga, lacewood/cocobolo, or ash/cherry). Some blanks in kit are preglued and machined to simplify project. Order from Heritage Building Specialties, 205 N. Cascade St., Fergus Falls, MN 56537, or call 800/524-4184.

SHOP TIP

Cut parts in sequence for continuous grain flow

To have continuous grain flow at the corners of a box, miter-cut the pieces in sequence from the blank (e.g., cut the back first followed by left side, front, and right side). Identify the parts with numbers, where shown, to make it easy to match up the corners during assembly.



Use a stopblock to ensure consistent positioning of the spline grooves in the mitered ends of the box parts.

With the rabbet facing up, rip a ¾"-wide strip from the blank. This rabbeted blank will form the feet (F).

With the box on a 1" spacer, make sure that all four feet touch the work surface before tightening the band clamp.

(We cut test stock first to verify tight miters.) Use a backer board to avoid chip-out.

7 Referring to **Drawing 1a** and to **Photo A** for setup, cut a ⅛" groove 3/16" deep in the ends of the front and back pieces (A/C) and side pieces (B/D) to receive the splines, where shown on **Drawing 1**. (We made test cuts in scrap first to verify the groove position and depth.)

8 Cut or sand away a small amount of material at a 45° angle at each corner of the bottom (E) to enable it to clear the splines during box assembly. Then, dry-assemble the front, back, and side pieces; the splines; and the bottom, and check that all joints fit together without gaps. Remove material from the corners of the bottom little by little until all joints fit correctly.

9 Apply glue to the mitered ends of the front, back, and side pieces, and in the spline grooves and ¼" grooves in these pieces. Now, apply glue to the splines, and assemble the pieces with the bottom located in the ¼" groove. Secure the box with a band clamp, and check for square.

Now, do some footwork

1 From ¾"-thick stock, cut a 4×12" blank to form the feet (F). A wide blank keeps hands well away from the tablesaw blade when ripping the foot stock from the blank.

2 Cut a ½" rabbet ½" deep along one edge of the blank.

3 Rip a ¾"-wide strip from the rabbeted side of the blank, as shown in **Photo B**.

4 Make four photocopies of the full-size foot pattern, **Drawing 2**. Using spray adhesive, attach the tapered foot part of the pattern to one end of the blank, bending it over the blank at the fold line.

5 Taper the sides of the foot by sanding to the pattern lines. (See the **Shop Tip,** *below left.*) Then, crosscut the 2"-long foot from the blank.

6 Using the remaining patterns and following the same process, form the other three feet from the blank.

7 To complete the feet, sand ⅛" round-overs on all outer edges of the feet, where shown on **Drawing 1**.

8 From a scrap of 1"-thick stock, make a 3¾×10" spacer block to support the box at the required height for attaching the feet. Apply glue to the top 1" area on the inside of the feet. With the box placed on the spacer block, as shown in **Photo C**, position the feet on the box, and secure with a band clamp.

Put a lid on it

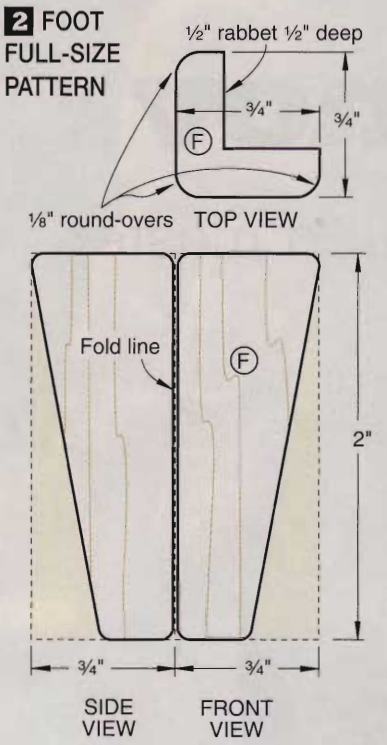
1 From ¾"-thick stock, cut two 2¼×8½" pieces for the lid sides (G). As shown on the **Cutting Diagram**, cut these from a 5"-wide piece to maintain grain flow on the lid. Also, from ¾"-thick stock, cut a ¼×8½" strip for the lid center (H).

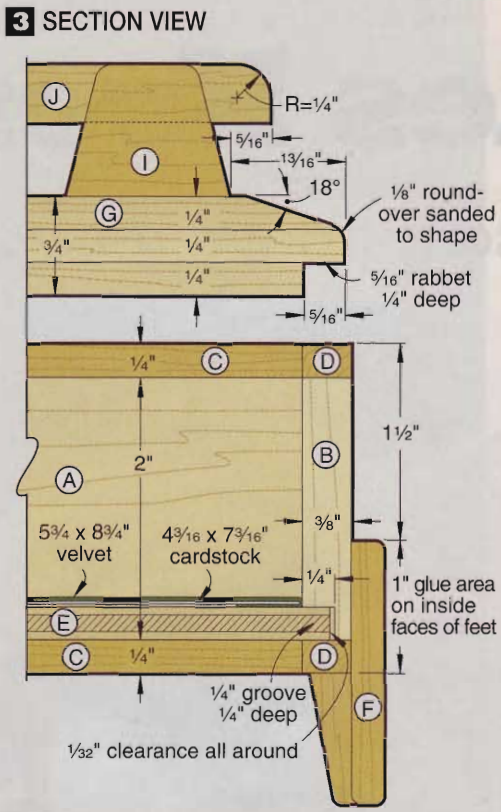
2 Glue and clamp the lid center (H) between the lid sides (G). After the glue is dry, trim the lid (G/H) to its finished length of 7¾".

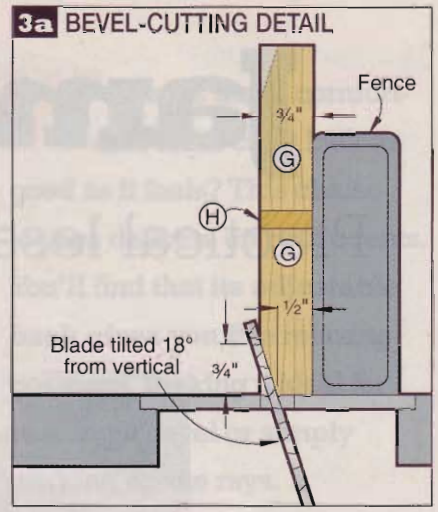
SHOP TIP

Forming tapers on small parts safely

You don't have to risk getting your fingers too close to the moving blade of your tablesaw or bandsaw to form tapers on small parts, like the feet (F). A safe way to do this is to sand the tapers, and to use a 12"-long blank that will keep your fingers out of harm's way. First, mount a belt sander in your vise, with the belt up. Then, form the tapers on the end of the blank by sanding to the lines of the attached pattern, as shown at *right.*







3 To cut the 18° bevel on the lid, where shown on **Drawing 3**, tilt your saw blade to 18° from vertical, and position your fence ½" away from the base of the blade, where shown on **Drawing 3a**. Cut the bevel on the ends of the lid first; then, cut the sides. Cutting in this sequence minimizes chip-out.

4 Using your tablesaw or a rabbeting bit in your table-mounted router, cut a 5/16" rabbet ¼" deep around the perimeter of the lid (G/H) on the bottom side, where shown on **Drawing 3**. To avoid chip-out, make several passes around the lid, raising the blade or bit a little at a time with each pass.

5 Sand the ⅛" round-over on the top outer edges of the lid (G/H), where shown on **Drawing 3**. Finish-sand the entire lid to 220 grit.

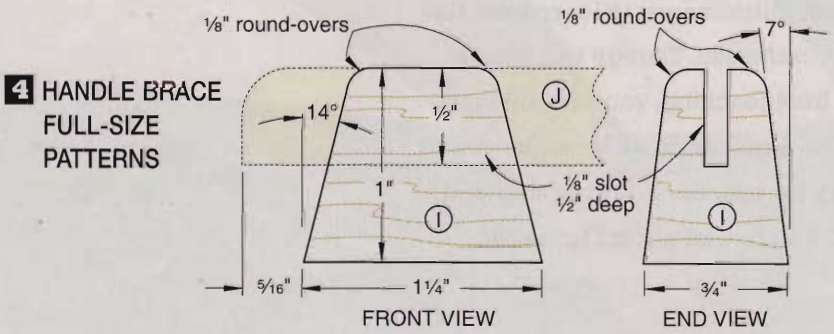
6 To make the handle braces (I), first cut a 1×12" blank from ¾"-thick stock.

7 Install a ⅛"-wide blade in your tablesaw and set it to ½" high. Adjust your fence to center the blade on the ¾" thickness of the blank. Now, cut a groove along the length of the blank to accept the handle (J), where shown on the end view of the full-size handle brace pattern, **Drawing 4**. Then, crosscut the blank to make two 1¼"-long pieces.

8 Make two photocopies of the full-size handle brace pattern. Attach the front view part of the pattern to the handle brace pieces using spray adhesive. Sand to the pattern lines to form the 14° sides and ⅛" round-overs. Remove the patterns. Then, attach the end-view pattern to the braces, and sand to the pattern lines to form the ⅛" round-overs on the outer top edges and the 7° bevel on the sides.

9 From ⅛"-thick stock, cut the handle (J) to the size listed. Referring to **Drawing 3**, form the ¼" radius at each end of the handle by sanding.

10 Glue the handle in the slots of the handle braces (I) so that the ends of the handle extend 5/16" from the bottom of the braces, where shown on **Drawing 3**. Now, glue and clamp handle assembly I/J to the lid, where shown on **Drawings 1** and **3**.



Finish and line the box

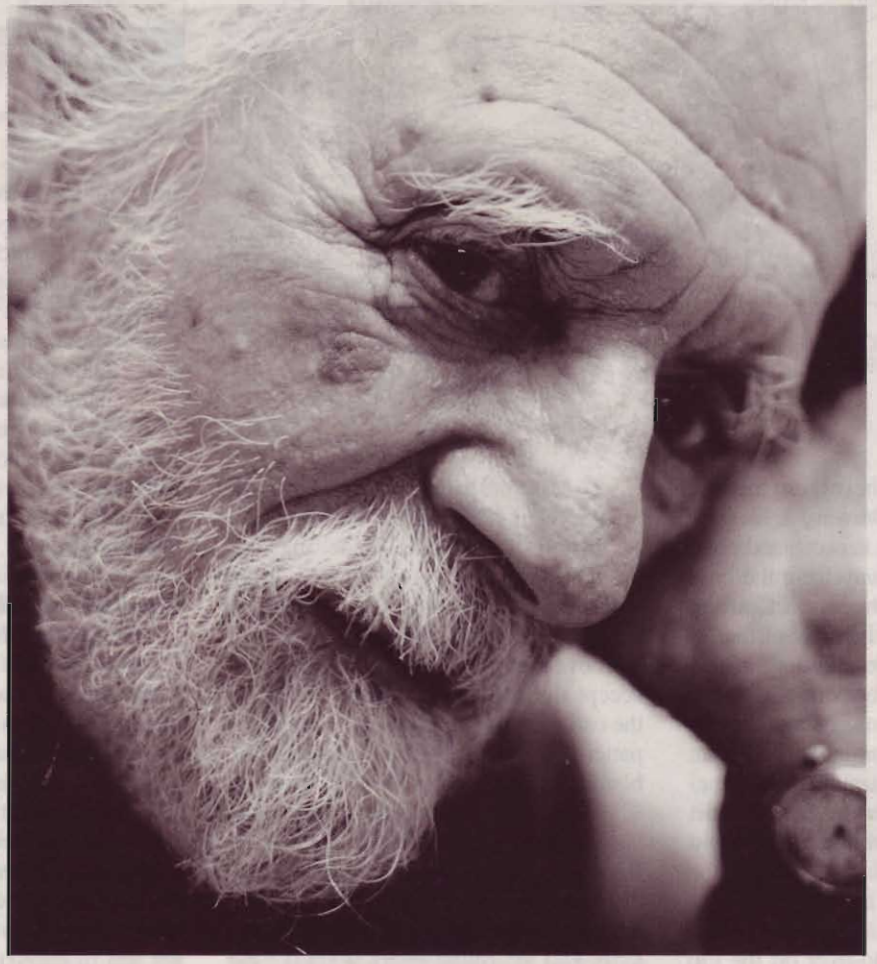
1 Finish-sand the box, lid braces, and handle with 220-grit sandpaper. Remove all dust with a tack cloth. Apply three coats of a clear finish of your choice, sanding to 400-grit between coats. (We used aerosol lacquer.)

2 Finally, cut a piece of cardstock to 4³/16×7³/16", and cut a piece of velvet to 5¾×8¾". Referring to **Drawing 1**, cut the corners of the velvet at 45°. Apply spray adhesive to the bottom of the velvet and to the top of the cardstock. Join the two glued surfaces together, centering the cardstock on the velvet. Fold the outer edges of the velvet onto the bottom of the cardstock. Now, apply spray adhesive to the bottom of the cardstock. Place the cardstock/velvet in the box, and press in place against the bottom.

Written by **Owen Duvall** with **Thomas Frazier**
Project design: **Dave Morrison**
Illustrations: **Roxanne LeMoine; Lorna Johnson**
Photographs: **Baldwin Photography**

James Krenov

Practical lessons from a renowned master



Woodworkers from all over the world have made pilgrimages to learn from this master craftsman. Though he recently retired from teaching, you can still learn from his experience as he walks you through his process for designing and building one-of-a-kind furniture.

On the short list of the world's leading masters of the craft, most woodworkers put James Krenov's name near the top. His work is in museums worldwide. He's received dozens of honors over the years, and has written several books that have profoundly influenced both professional and hobbyist woodworkers. To learn more about the man, see "A legend in his time" on *page 71*.

Krenov, though, is more devoted to teaching than pursuing glory. Until his retirement this year, he led the Fine Woodworking Program at California's College of the Redwoods, shown *below*.

Here, he shares his down-to-earth techniques for designing and building your own furniture. (To learn what the future holds for Krenov and the school, see "What comes next?" on *page 72*.)

Put Krenov's wisdom to work in your shop

"It's fine to use somebody else's plans when you're learning techniques but it's only natural to want to do your own work, too," Krenov says. "Even when you're just beginning, you don't need to limit yourself to other people's ideas. You can make what you want to make on the level where you happen to be. And you can use the experience to learn and move up a level or two."

No hurries, no worries

"Don't be in a hurry," Krenov always told his students. And they listened—during a nine-month course working eight hours or more a day and five, sometimes six, days a week, students in the program might end the year with one or two finished pieces.

Krenov's next advice: "Decide what you want to build and why." Purpose almost always guides design. What you want this piece to do and where you want it to do it will determine its shape and size. It also will help determine how long it might take to complete.

"If you're making a jewelry box on a stand for a particular person, think about that person, how tall she is, what she likes," Krenov says. "If you're making a table, think about the people who'll sit at it. How many are there? Are they large people? Small? What do they like?"

Sometimes, furniture's purpose is to display a particularly nice bit of grain in a prized board, but Krenov advises against ignoring function altogether.

"I think anybody who works with wood for any length of time will eventually want to do something that's primarily aesthetic, that shows off either the wood itself or your design. But you should always remember somebody has to live with this thing so it should be serviceable as well as pretty."

Krenov presides over his classroom at the College of the Redwoods' Fine Woodworking Program. Students of any age can choose from an intensive nine-month course during the school year, or take several seminars and workshops offered during the summer.

Krenov sketches a project, and then makes a rough ruler from scrap paper to get a sense of scale. "No need to be too careful or precise with drawings. Let yourself go. Just doodle," he says.

Put pencil to paper

Once the piece has shape in your mind, put it on paper. Start with a pencil sketch and don't worry about being pretty.

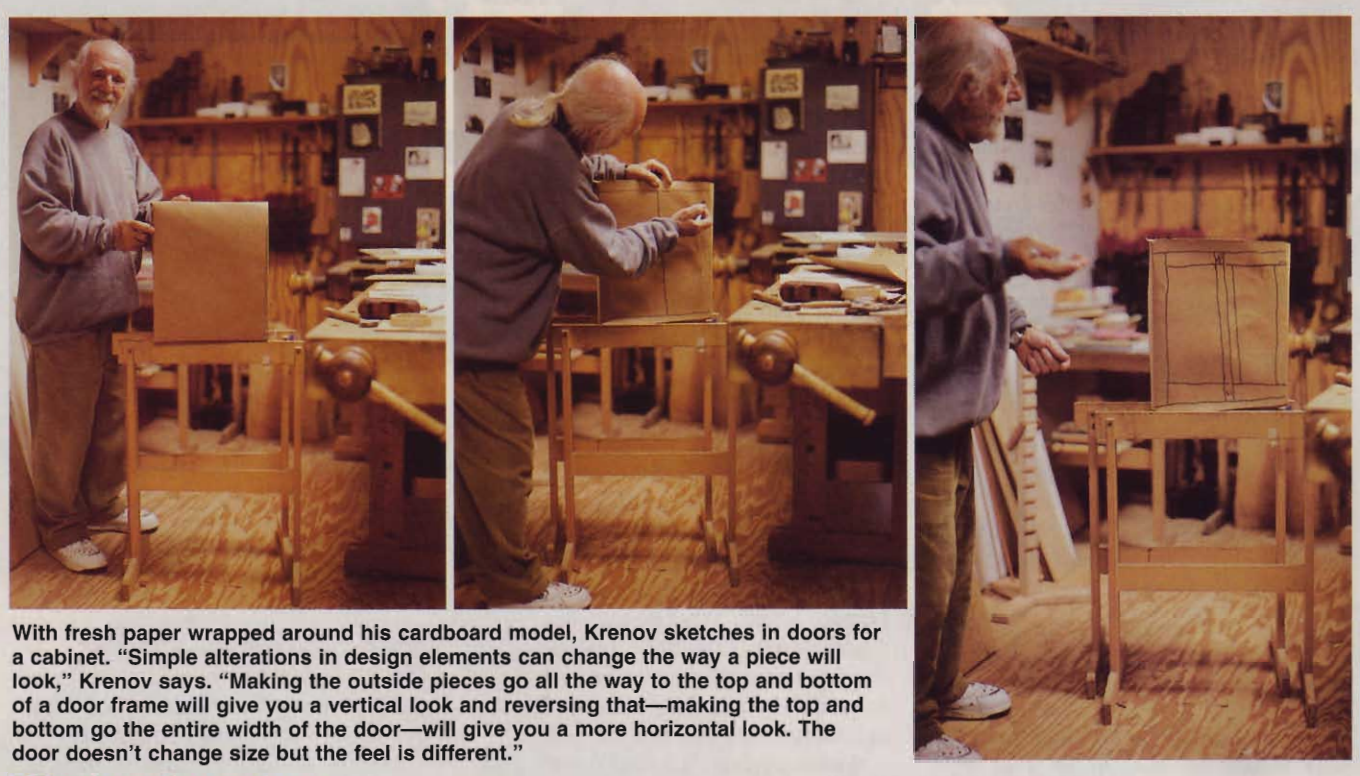
"And please, don't be careful about it," Krenov says. "Train your eye. Look around for shapes and curves and lines that please you. Play around a little bit and have fun. That's why we're drawn to this sort of thing, it's supposed to be fun."

Krenov rarely takes time to convert his rough sketches into scaled drawings, "but if it makes you more comfortable to use a straightedge and get all the dimensions right, have at it," Krenov says.

Once you have a shape and design you like, check the scale. You can use rulers or protractors, but "you don't need anything fancy," he says, while sketching ideas for a small display stand, as shown in the photo, *above*.

"Start with the focal part of what you're making," he says. "If I know I want the top part to be 24" high, I'll use the drawing to make my own ruler. Let's say two marks equals 24" for the top part." Krenov lays his scrap paper against the sketch and draws hash marks for the top of his cabinet, then follows the pattern down the length of the drawing, creating a crude ruler, with marks roughly representing 12" increments.

"Now we apply that scale to the stand and see how high we've made it. If it's way out of proportion—too high or too low—now is the time to make big adjustments. Little refinements can come later."



With fresh paper wrapped around his cardboard model, Krenov sketches in doors for a cabinet. "Simple alterations in design elements can change the way a piece will look," Krenov says. "Making the outside pieces go all the way to the top and bottom of a door frame will give you a vertical look and reversing that—making the top and bottom go the entire width of the door—will give you a more horizontal look. The door doesn't change size but the feel is different."

Moving from two dimensions to three

The heart of Krenov's process starts now, with the building of a full-size cardboard or paper model. The basic process is shown in the photos, *above*.

The cardboard model can be a simple box that happens to be the right size or a complex cutting and taping job that simulates wood thicknesses as well as height and width. Often, the simpler approach is adequate, and you needn't worry about making the cardboard pieces the accurate thickness, unless the thickness of a particular part affects overall dimensions.

"Most people, when they get to this point and actually see the volume of what they've drawn, say 'Gee, that's a lot bigger than I thought it was going to be,'" Krenov says.

If you're going to rethink your design—change the size, drawer configuration, rearrange shelves, curve the legs a little more—now is the time to do it.

Try your ideas in wood

Next comes building a full-dimension wood mock-up. This can be a complete project, or maybe just a corner or the framework for drawers, as seen in the photo, *right*. If you've built something similar to your piece before, and you feel confident about the joinery techniques, you might skip or modify this step. But if this is the first project of its kind to take shape in your hands, or if you're considering using new techniques, Krenov recommends a dry run.

"Whatever you're not sure of, you should try in practice wood first before you use the good stuff," he says. Poplar is a good choice—less expensive than other hardwoods but similar in workability.

This is the time to experiment. Try different joinery methods. Krenov pretty much sticks to the old school and uses dowels for most joints. "But like Bobby Dylan says 'The times they are a changin,'" Krenov says.

"If you want to try biscuits or something else entirely, try it. The way I do things is just one way, not necessarily the right way or even the best way. Experiment, look for refinements."

Although Krenov and his students rely highly on hand tools, he acknowledges there are other ways to do things.

"We certainly use power tools. Gadgets are fine, and we're not against easing the pain," he says. "But when your hands and eyes will do just as good a job, I prefer to do it that way. There are people who prefer to make dovetails with a router. They're certainly strong and they fit, but they don't have the feeling that a human hand made them. They don't make music. We're trying to make music."

In many ways, the mock-up becomes your teacher, allowing you to make rookie mistakes as well as insightful discoveries before you start the finished piece. The mock-up's value shows when it comes to gluing up a one-of-a-kind creation. If you're assembling a complex project it can be difficult to know where to start. The mock-up will teach you.

To practice your joinery, make full-size mock-ups, such as these hand-cut dovetail samples, the kind Krenov says "make music."

Krenov strives to help students develop their "reading" ability with visual aids such as these examples of multiple cuts following the grain on cabriole legs. Krenov emphasizes that with a little planning, no matter what the grain does in a furniture part, each cut can be laid out to make the best use of grain in harmony with design.

The mock-up also allows you to experiment with character-enhancing details. Certain hand-carved elements—drawer and door pulls, spring-loaded door catches and shelf brackets—have come to be known as "Krenovian" touches and can give a piece of furniture a personal flavor.

Now for the real deal

When practice is over and it's time to build the real thing, Krenov advises starting with the trickiest part.

"If you're trying to show off some nice grain in panel doors, start with those panels and then build the doors," he advises. "If something happens along the way—the panels don't hold up or need to be made smaller—you can adjust the cabinet's carcase to fit the doors. But if you start with the cabinet first, there's no room for adjustment."

Choice of wood is a matter of individual taste. Krenov is regarded as one of the best at choosing. His ability to read grain and incorporate it in furniture, as shown in the photo, *above*, has earned him much of his reputation, but he encourages new ideas and experimentation.

"There really is no right or wrong," Krenov says, "but there are degrees. There is better and worse. There are complementary woods—woods with color and grain that work well together. Mahogany and pear for instance. Maple and ... well, there are a lot of things that go well with maple ... like walnut, sometimes cherry, some of the exotic South American woods.

"You have to judge each piece [of wood] individually and keep your eyes and your mind open to the possibilities."

A legend in his time

James Krenov often is credited as the spark that ignited a renewed interest in handmade furniture in the last quarter of the 20th century. The first of his four books, titled "A Cabinetmaker's Notebook," published in 1975, generally is considered the most influential.

As they do in any discipline, masters become known for their particular strengths. Krenov is known for his keen sensitivity of design and artistry with hand tools.

"He's just phenomenal," says Taimi Barty, a Harvard engineering graduate who studied under Krenov. "He has an amazing eye and he's got a talent for getting other people to develop their eye."

Born in 1920 in Siberia, the only child of aristocratic Russian parents, Krenov was raised in Shanghai, then remote villages of Alaska and finally in Seattle.

He remembers as a young boy playing for hours by himself making intricate toys from wooden matchsticks. "Some of the Alaskan children would watch for a while, this thing whatever it was taking shape, and then they'd come over and we'd do it together," he says.

After a stint as a boat builder, Krenov studied in Sweden with Carl Malmsten, "Godfather" of Swedish design.

From Sweden, Krenov went to Boston and then New York as a college lecturer in design and woodwork. He taught for a while at the Rochester Institute of Technology. During a lecture series in the 1970s, he visited former students in Northern California and first encountered the Mendocino coast. He moved West with his wife Britta, and struck a deal with the community college which, in 1980, built a shop to his specifications in the little coastal town of Fort Bragg. The Fine Woodworking Program and Krenov have been going strong ever since.

This eight-drawer showcase is built from Kwila and broadleaf maple, with wrought-iron hardware. It's elegant lines and complementary woods demonstrate Krenov's talents as a designer and builder.

Finishing touches

When it comes to finishing, Krenov stays with tradition. Standard practice is to use a combination of oil; shellac (which Krenov calls "polish," as in French polish); and wax, usually in that order.

"Once again, experimenting, a willingness to try new things is good," Krenov says. "I was brought up on polish and it's still what I usually rely on, but depending on what kind of abuse your piece of

Finding the right use for the right piece of lumber is one of Krenov's fortes. A 2001 graduate put it this way: "He's got the most incredible eye for what will look right. You can look at something for days, weeks even, wondering why it's not quite right. He'll look at it for a minute or two, say 'Try this' and it works perfectly."

furniture is going to be subjected to, you might want to look at some of the other possibilities, like urethanes."

Finishing often starts with a coat of oil, but not always. "Something like Danish teak oil can really bring out the grain in some woods and offer good protection, but you have to be careful," Krenov adds. "If you put oil on pear wood, it looks like the garage floor. You should always experiment [with some scrap stock leftover from your project]."

Next comes the "polishing," a hand-rubbing process commonly called French polishing in which a cloth soaked in shellac and denatured alcohol is balled up into a second cloth which is rubbed on the wood's surface.

Finally, for protection and luster, Krenov often applies wax as a last step. Sometimes he uses a commercial brand. At other times he mixes up a wax of his own concoction.

Parting words

Over the past couple of decades, teaching has become as important to Krenov as the craft itself. He seems more passionate about connecting with people and sharing ideas than finding a really special piece of spalted maple.

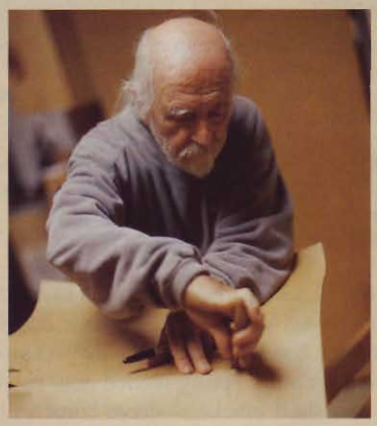
"This is not an oddity what we're doing here," Krenov says waving an arm across the landscape of his shop where 20 students are busy building hand planes. "People are doing this all over the world and I think the appreciation for this sort of work is growing.

"I would hope with magazine stories like this you can show people they can achieve great things. People tend to isolate me and they say 'Oh sure, he can do that.' But really anybody can achieve at a higher level than they thought they could before they tried. The thing is, you have to try."

For more information on the Fine Woodworking Program, contact:

College of the Redwoods
Fine Woodworking Program
440 Alger Street
Fort Bragg, CA 95437
707/964-7056
www.crfinefurniture.com
e-mail: woodshop@mcn.org

Written By **George Lauer**
Photographs: **Bill Holt**



What comes next?

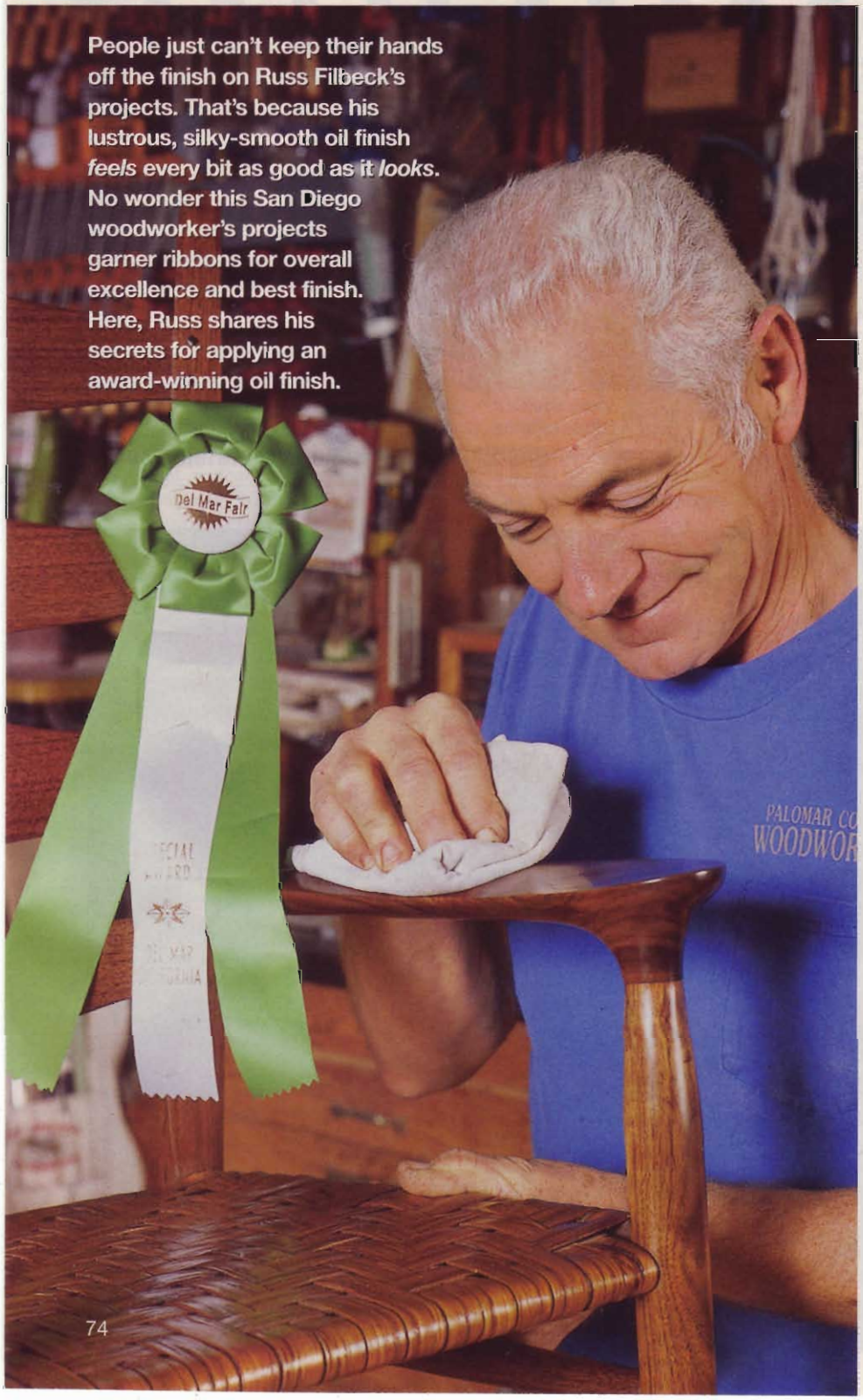
For the first time in more than 20 years, James Krenov is working in his own shop, and not at the school he helped make famous. For everyone involved, Krenov's retirement brings changes.

The College of the Redwoods Fine Woodworking Program will carry on—in fact, applications for summer and fall classes are more plentiful than ever. "We can't replace Jim. I think we all know that," said Michael Burns, who founded the school with Krenov and continues teaching there. "But we intend to carry on the traditions and style we've developed here, trying to keep the same spirit that Jim brought to this place."

Krenov, 82, plans more time on the beach with his wife, Britta, more time on the tennis court, puttering in his new home workshop, and "maybe a little writing if the spirit moves."

Russ Filbeck's award-winning oil finish

5 easy steps does it



People just can't keep their hands off the finish on Russ Filbeck's projects. That's because his lustrous, silky-smooth oil finish *feels* every bit as good as it *looks*. No wonder this San Diego woodworker's projects garner ribbons for overall excellence and best finish. Here, Russ shares his secrets for applying an award-winning oil finish.

We first got to know Russ back when his Appalachian ladderback youth rocking chair earned *WOOD®* magazine's Excellence in Workmanship Award at the 2001 Design in Wood Show at the Del Mar Fair near San Diego. (For more on this prestigious event, and the chair, see issue 139, page 25.)

After one look at his winning entry, we asked Russ if he would share his finishing procedure with our readers. He was more than glad to help. Of course, the sharing of knowledge comes natural to Russ, who retired from his job working aboard nuclear submarines in 1985. He operated a furniture restoration business after his Navy days, and became a woodworking instructor in 1989. Today, he teaches courses on beginning finishing, advanced finishing, and various aspects of woodworking, such as making rocking chairs, at Palomar College in San Marcos, California.

Here's what you'll need

- Liberon Finishing Oil
- Wet/dry silicon-carbide abrasive paper in 220, 320, and 400 grits
- Hard paste wax with carnuba wax (Russ prefers Liberon Black Bison Clear Fine Paste Wax)
- Wax applicator (Russ prefers old shoulder pads)
- Clean, white, cotton rags

See the Buying Guide at the end of this article for a source of Liberon products.

Wet-sanding is your first step to success

1 Prepare your project by sanding all surfaces to 220 grit or hand-scraping them. Place a drop cloth under your project. Saturate the wood surface with oil. Russ uses a small squirt bottle to dispense the oil in a controlled way.

Tear a sheet of 220 wet/dry abasive into ¼-, ⅛-, or 1/16-sheet pieces. Use the ¼-sheet pieces for large projects, such as tables, and the 1/16-sheets for small projects or tight areas. Fold those pieces to a size that feels comfortable in your hand. Use the abrasive to create an oil/wood slurry, as shown *above*. Sand with the grain until the oil is absorbed and the wood pores fill with the paste-like slurry.

Allow the slurry to thicken. Russ prefers Liberon Finishing Oil because it contains some alcohol to help it dry in about 20 minutes. Other oils, such as Minwax Antique Oil Finish, work fine, but may take 45–60 minutes to dry. Thoroughly wipe off all excess slurry with a rag, using a pointed stick with cloth wrapped around it to get slurry out of tight spots.

Do large projects in manageable sections. You can stop anywhere, wipe off the excess slurry, and start up again in an adjoining area with no lap marks.

Note: *For enclosed containers such as jewelry boxes or hope chests, apply the finish described here to the outside of the container only. "Oil finishes leave a musty, long-lasting smell on the inside of boxes, so I use shellac on the inside," Russ recommends. "Any fast-drying finish, such as lacquer, works well, too."*

2 Inspect the piece once an hour for six hours or as long as necessary to wipe off any "bleed-back," the term for oil that seeps back out of the wood pores as it dries. See photo *below*. Then, allow the first coat to cure for 48 hours.

Note: *You do need to be careful when disposing of the oil-soaked rags and abrasives. Immediately after use, place them in a water-filled or airtight metal container. Or, spread them out flat on concrete until dry. Never ball them up and toss them into the trash—the heat from the drying could cause spontaneous combustion.*

3 Repeat Steps 1 and 2 using 320-grit wet/dry abrasive. Allow this second coat to cure for 24 hours.

4 Repeat Steps 1 and 2 using 400-grit wet/dry abrasive. Allow 2–7 days of final curing time.

5 Apply two or more thin coats of a hard paste wax and buff to bring out the sheen of the oil finish. At this stage, Russ says most people tend to put wax on too thick. For thin coats he applies the wax with his wife's old shoulder pads, as shown *above*, and buffs after only five minutes instead of the 20 minutes cited on some product labels. Old white, cotton T-shirts work great for buffing.

How to maintain your beautiful finish

Russ suggests you replenish the finish with wax, not more oil. Do this no more than once a year, and make sure to wipe all dust off the surfaces before applying and buffing the wax.

Buying Guide

Liberon Finishing Oil. $23.35 for one liter; Liberon Black Bison Clear Fine Paste Wax, $15.95 for 14 ounces, plus shipping, from Wood Finish Supply, P.O. Box 86, Mendocino, CA 95460. To order call 800/245-5611, visit www.woodfinishsupply.com, or call 707/962-9480 for technical advice.

Written by **Bill Krier** with **Russ Filbeck**
Photographs: **Archie Breeden; Baldwin Photography**

FIRST-CLASS mailbox planter

Create real curbside appeal with a mailbox post and planter destined to be the envy of the neighborhood. Accented with flowers and standing 65" tall, this stylish design will show off your green thumb as well as your craftsmanship.

Start with the post assembly parts

Note: We used waterproof polyurethane glue for all glue-ups in this project. See the ***Shop Tip,*** opposite page, *for guidelines on its use. Also, where the project calls for medium-density overlay (MDO) plywood, use the type that has an amber face on both sides for best durability.*

1 From a 4×4 nominal (3½×3½" actual) cedar post, cut post (A) and crossarm (B) to the lengths listed in the Materials List.

2 Cut the 3½" dadoes in the post and crossarm for the half-lap joint, where dimensioned on **Drawings 1a** and **1b**. Also, cut the 1½" dadoes and 1½" rabbets around the post.

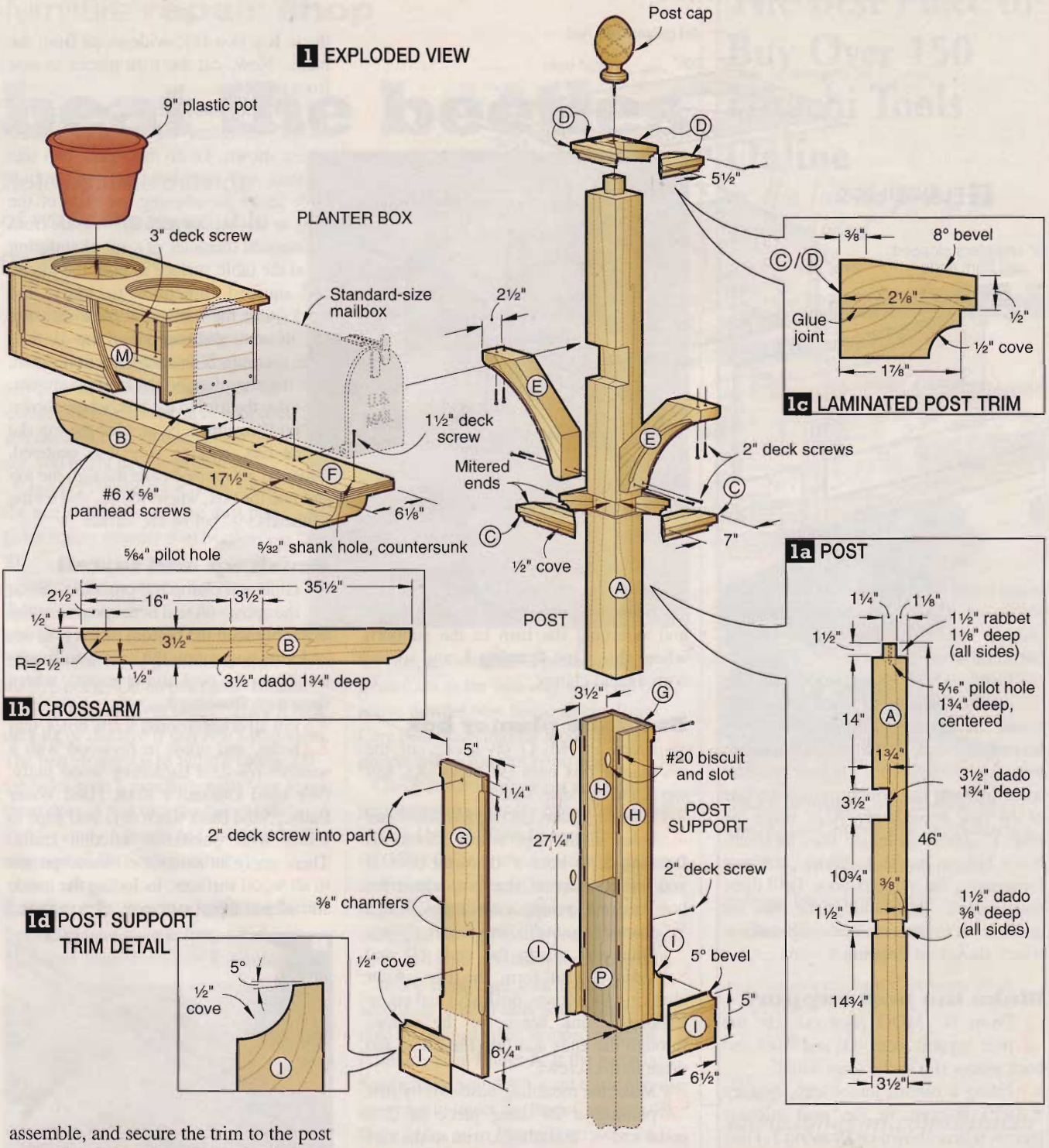
3 Drill the pilot hole centered in the top of the post for the post cap, where shown.

4 Mark the 2½" radius on the crossarm at both ends, where dimensioned on **Drawing 1b**. Bandsaw the contoured surface, and sand smooth.

5 To make the post bottom trim (C) and top trim (D), start by ripping two 52"-long strips from ¾" cedar. Make one strip 1⅞" wide and the other 2⅛" wide. Rout a ½" cove on the 1⅞"-wide strip, where shown on **Drawing 1c**. Glue (use waterproof polyurethane type) the top of the 1⅞"-wide strip to the bottom of the 2⅛"-wide strip, making their back edges flush. Clamp the strips together. After the glue dries, bevel-rip the blank to form the 8° bevel, where shown.

6 Miter-cut the bottom trim pieces (C) and top trim pieces (D) from the glued-up blank to fit the post. Glue,

Place the post on support blocks to make it easy to install the trim. Lightly spray the nonglued surfaces with water to accelerate curing of the glue.



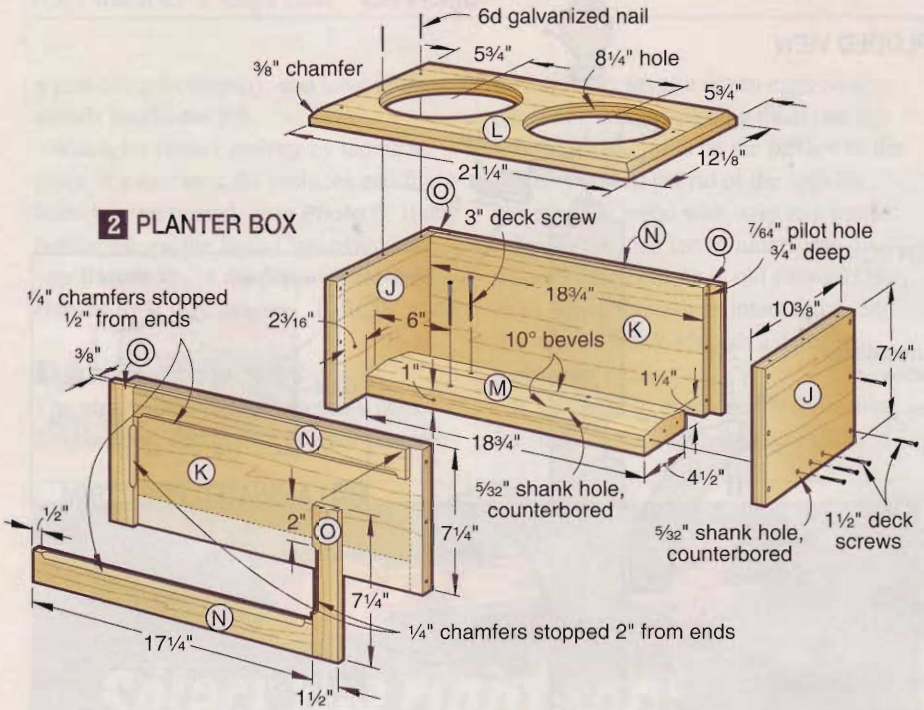
assemble, and secure the trim to the post with a band clamp, as shown in **Photo A.**

7 Make the crossarm brackets (E) by first planing or ripping a piece of 4×4 cedar 30" long to 2½" thick. Crosscut this piece to make two 3½×14" blanks. Make two photocopies of the full-size arm bracket pattern from the *WOOD PATTERNS®* insert. Adhere a pattern to each blank with spray adhesive. Then, cut the brackets to shape by bandsawing to the pattern lines, and drill the counter-

SHOP TIP

Working with waterproof polyurethane glue

Waterproof polyurethane glue cures when exposed to moisture in the air and in the wood. For best results, apply the glue to only one of the two surfaces to be joined. Then, spray a light mist of water on the nonglued surface, and join the parts together. Because the glue can cause skin and eye irritation, wear gloves and use eye protection.



bored holes for mounting screws, where shown on the pattern. Also, rout a ¼" chamfer on the curved edges of the brackets, where shown.

8 From ¾" MDO plywood, cut the mailbox base (F) to size. The base fits inside the bottom of the mailbox. The bottom of our standard-size mailbox measured ¾×6⅛×18½". If your mailbox has a different size bottom, adjust the size of the base accordingly. Also, make the base 1" shorter in length than the mailbox's bottom length to allow clearance for opening the mailbox door. Drill three countersunk shank holes in the base for attaching it to the crossarm with screws, where shown on **Drawing 1**.

Make the post support

1 From ¾" MDO plywood, cut the post support sides (G) and front and back pieces (H) to the sizes listed.

2 Using a biscuit joiner, cut slots for #20 biscuits in the post support pieces, where shown on **Drawing 1**. Glue and assemble the post support with biscuits. Clamp and check for square. Then, rout a ⅜" chamfer on the edges of the sides, where shown.

3 From ¾"-thick cedar, cut a 5×28" blank for the trim (I). Rout a ½" cove on the top edge, where shown on **Drawing 1**. Then, bevel-rip the blank to cut the 5° bevel along the top edge, where shown on **Drawing 1d**, with the bevel sloping toward the cove.

4 Miter-cut the trim pieces from the blank to fit the post support. Glue and assemble the trim to the support, where shown on **Drawing 1**, and secure with a band clamp.

Build the planter box

1 From ¾" MDO plywood, cut the planter box ends (J), sides (K), and top (L) to the sizes listed.

2 Using a jigsaw, cut two 8¼"-diameter holes in the top, where shown on **Drawing 2**, to hold 9"-diameter pots. If you use a different size pot, adjust the hole size and spacing accordingly. Rout a ⅜" chamfer around the top, where shown.

3 Glue and clamp the ends (J) and sides (K) to form the box. After checking for square, drill pilot and counterbored shank holes for the screws through the ends and into the sides, and drive in the screws.

4 Make the mounting base (M) by first planing a 24"-long piece of 2×6 cedar to 1¼" thick; then, trim to the size listed. Bevel-rip the 10° bevels on the base. Drill four ⅝2" shank holes with counterbores in the base for the mounting screws.

5 Glue the base in the box. Drill three counterbored shank holes in the box ends for the screws, and drive in the screws.

6 Make the planter box horizontal trim pieces (N) and vertical trim pieces (O) by first cutting a 3½×52" blank from ¾"-thick cedar. Plane the blank to ⅜" thick. Rip two 1½"-wide strips from the blank. Now, cut the trim pieces to size from the strips.

7 On your router table, rout stopped ¼" chamfers on the trim pieces, where shown. To do this, mark two sets of start and stop lines on your router table fence for aligning the ends of the trim, as shown in **Photo B**. Measure from the outside diameter of your chamfering bit at the table surface in both the infeed and outfeed directions to locate the marks. For the horizontal trim, measure ½" in each direction. For the vertical trim, measure 2" in each direction. Then, rout the chamfers on the trim, as shown.

8 Glue the trim to the box, where shown on **Drawing 2**. Now, glue the top (L) to the box, making sure it is centered. Drive 6d galvanized nails through the top and into the box, where shown, and set the nailheads 1/16" below the surface.

Finish up and install

1 Glue and clamp the crossarm (B) to the post (A). Then, position the assembly with the bottom of the post up, and glue and screw the crossarm brackets (E) to the post and crossarm, where shown on **Drawing 1**.

2 Fill all counterbored screw holes, nail holes, and voids in plywood with a weather-resistant hardening wood putty. (We used Durham's Rock Hard Water Putty.) Sand flush when dry. Seal gaps in joints with paintable silicone caulk. Then, apply an exterior oil-based primer to all wood surfaces, including the inside surfaces of the planter box.

Use the inner set of start/stop lines on your router fence when routing the stopped chamfers on the horizontal trim, and use the outer lines when routing the vertical trim.

3 Mount the planter box and mailbox base (F) to the crossarm with screws, where shown on **Drawing 1**. Leave a small gap (ours was ⅛") between the back edge of the mailbox base and the post to allow for the rear thickness of the mailbox. Thread the post cap on the post.

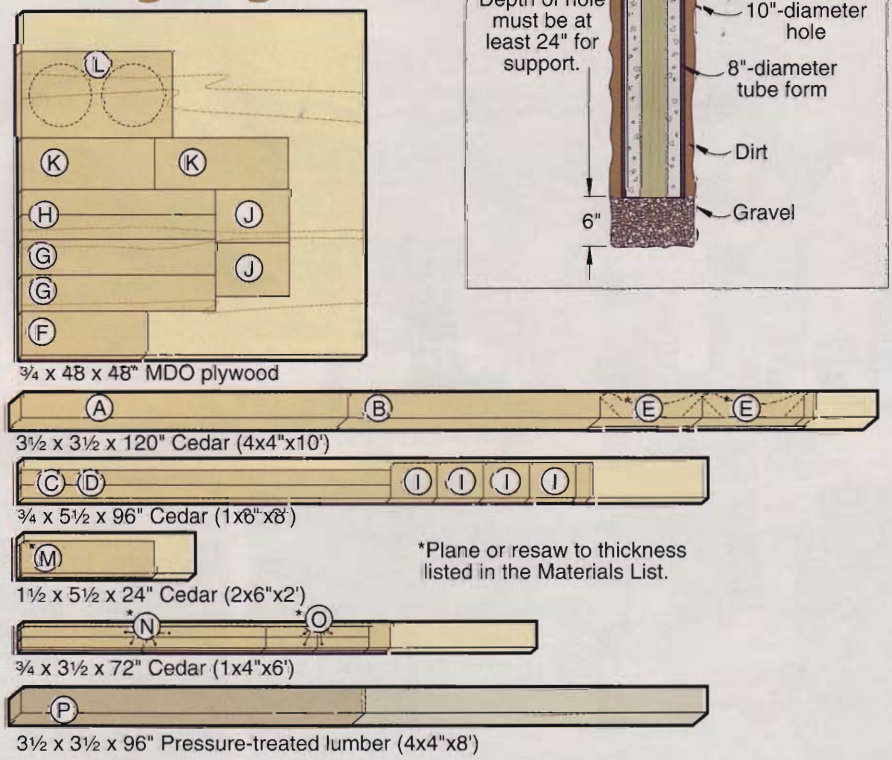
4 Paint all exposed wood surfaces with an exterior latex paint of your choice.

5 Refer to the sidebar "Before you dig..." for guidelines on locating and installing a mailbox. After determining a suitable location, install the 4x4 pressure-treated post (P) in the ground with concrete, as shown on **Drawing 3**. Trim the post, where shown.

6 Finally, slide the post support (G/H/I) over the post, stopping ½" above the ground, and drive two deck screws through the support into the post, where shown on **Drawing 1**. Insert the mailbox post (A) into the support until the bottom post trim (C) contacts the post support. Secure the post in the support with two deck screws, where shown. Apply paint to the screwheads. Attach your mailbox to the base. Place two pots in the planter box openings and, when weather permits, plant some colorful flowers in the pots.

Written by **Owen Duvall** with **Thomas Frazier**
Project design: **Kevin Boyle**
Illustrations: **Roxanne LeMoine; Lorna Johnson**
Photographs: **Baldwin Photography**

cutting diagram

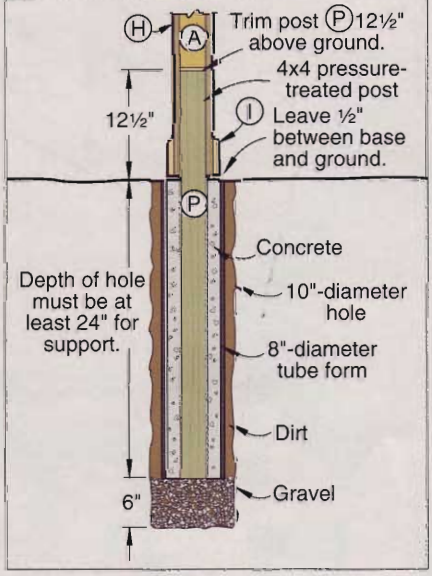


*Plane or resaw to thickness listed in the Materials List.

Before you dig...

Don't be too anxious to plant your new mailbox post. A quick call to your local postmaster could save you the aggravation of relocating the post (and possibly missing your mail delivery) if you put it in the wrong place. Requirements for locating a mailbox vary, depending on state and local regulations and road/curb conditions. Generally, the U.S. Postal Service requires that mailboxes be installed with their bottom 42–48" from the road surface and set back 6–8" from the front face of the curb. Our project positions the box height at approximately 44". If these specifications don't meet your local code, you can modify the length of the mailbox post or post support as appropriate. Also, if you need to dig a new hole or make your existing hole deeper for proper post support, make sure, for your safety, that there are no underground utilities in the area. Many utility companies list a toll-free number in the Yellow Pages for information on locating underground utilities. If you have difficulty finding a number, call the North American One Call Referral System at 888/258-0808 for a number to call in your state.

3 SUPPORT POST HOLE



materials list

Part	FINISHED SIZE T	W	L	Matl.	Qty.
POST ASSEMBLY					
A post	3½"	3½"	46"	C	1
B crossarm	3½"	3½"	35½"	C	1
C* bottom trim	1½"	2⅛"	7"	LC	4
D* top trim	1½"	2⅛"	5½"	LC	4
E* crossarm brackets	2½"	3½"	13¾"	C	2
F mailbox base	¾"	6⅛"	17½"	P	1
POST SUPPORT					
G sides	¾"	5"	27¼"	P	2
H front and back	¾"	3½"	27¼"	P	2
I* trim	¾"	5"	6½"	C	4
PLANTER BOX					
J ends	¾"	7¼"	10⅜"	P	2
K sides	¾"	7¼"	18¾"	P	2
L top	¾"	12⅛"	21¼"	P	1
M* mounting base	1¼"	4½"	18¾"	C	1
N* horizontal trim	⅜"	1½"	17¼"	C	4
O* vertical trim	⅜"	1½"	7¼"	C	4
SUPPORT POST					
P** post	3½"	3½"	48"	PT	1

*Parts initially cut oversize. See the instructions.

**Minimum post length is 36½". See text for installation requirements.

Materials Key: C–cedar; LC–laminated cedar; P–plywood, type MDO; PT–pressure-treated lumber.

Supplies: Waterproof polyurethane glue; spray adhesive; 1½", 2", and 3" deck screws; #6x⅝" panhead screws; #20 biscuits; 6d galvanized nails; weather-resistant hardening wood putty; post cap; standard-size mailbox; 9"-diameter pots (2); paintable silicone caulk; oil-based exterior primer; exterior latex paint; 8"-diameter tube form; concrete; gravel.

Guide to workshop dust control

Setting up a dust-collection system is easier than you think. Here's how one man made it work, and how you can, too.

Whether you have a tiny basement shop or a spacious "Garage Mahal" with plenty of room to work, you probably could benefit from a new or improved dust-collection system. Dust and chips from machining and sanding operations add clutter to your work area, and can damage your lungs, as well.

Unfortunately, setting up a system can seem perplexing, what with complicated terms, such as fan curve, static pressure, cubic feet per minute (cfm), and airflow velocity. Then there are those calculations required to determine the proper dust collector, duct sizes, and system layout.

But don't give in to frustration and the dust. We'll simplify it all for you. To do that, we worked with a dust-collection expert: Jeff Hill, an engineer with Oneida Air Systems, a leading maker of dust-collection equipment. Jeff and I traveled to WOOD® *magazine reader John McCausland's shop in Jamestown, Pa.*

There we analyzed John's dust-collection system to see how well it performed and where we could make improvements. See "Performance—by the numbers" on the next page *to learn how we tested the system. We learned a lot from this shop visit, and so will you.*

Following that, we'll distill all the technical mumbo-jumbo into a few basic rules of thumb that you can use to size your ducts and collector and lay out a customized system with only a minimum of calculations. We'll show options in ductwork and fittings to help you get started.

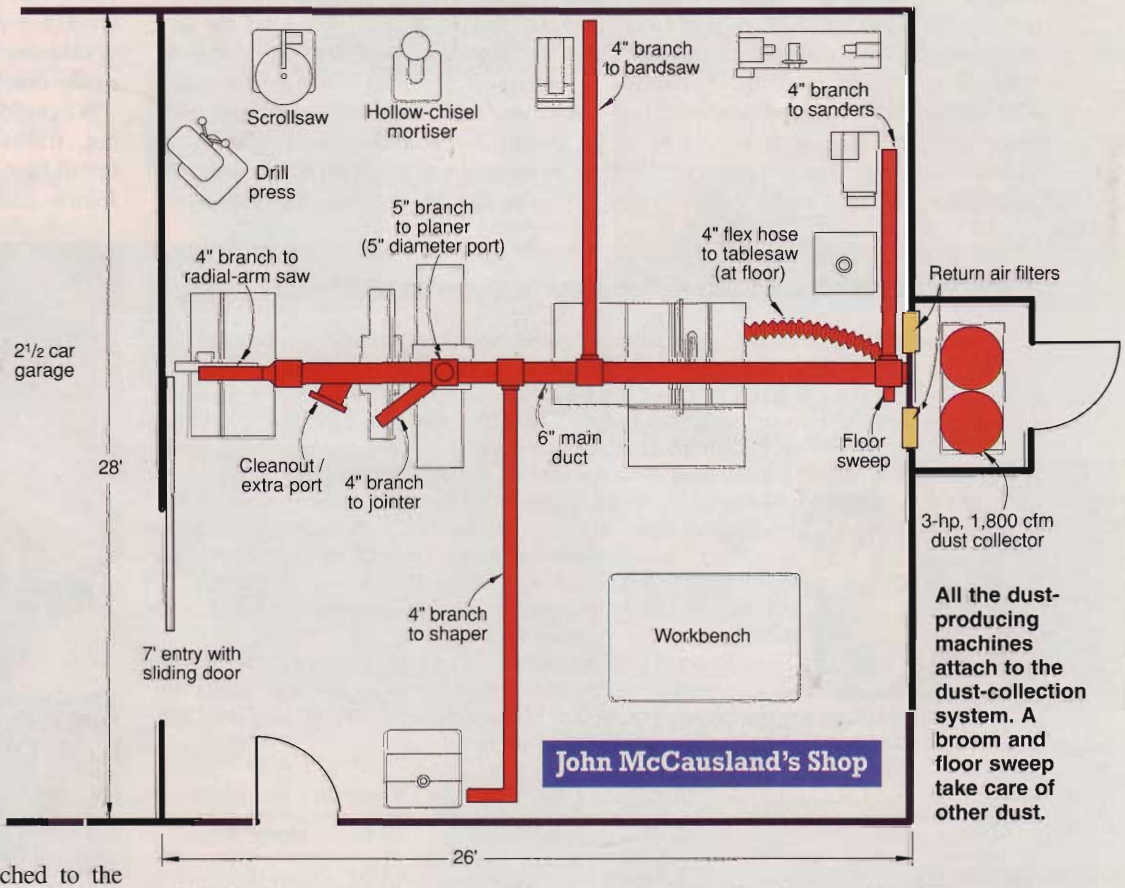
John (middle), Jeff (right), and I discuss the results of various tests, plotted in software on Jeff's laptop computer.

Dave Stone
Features Editor

One man's system: a case study

John McCausland taught woodworking, metalworking, and drafting for 30 years. So he knew a thing or two about what he needed when he designed and built his new shop in 1998. The 26×28' space, shown in the photo, *left*, and in the floor plan, *right*, provides John a place to pursue his hobby when not working as a ranger at a nearby state park.

John built his system using off-the-shelf components, and was happy with its performance. We knew the system worked, but we wanted hard data to see its strengths and weaknesses. We asked: "How can it be even better?"



All the dust-producing machines attach to the dust-collection system. A broom and floor sweep take care of other dust.

Let's start with the collector

A 3-hp dust collector with four bags powers John's system. To save space and reduce noise, John installed the collector in a shed attached to the shop, shown in the photo at the *top* of the *next page*. He ran the main duct through a hole in the wall, just below the peak of the vaulted ceiling.

Placing the dust collector outside the shop brings another benefit. The machine's stock bags filter only particles 20 microns and larger. But it's the fine particles 20 microns and smaller that are most hazardous to breathe. To capture them before the air returns to the shop, John cut holes in the wall that separates

A shed houses the dust collector outside the shop. The large bags on the left are oversize, 1-micron units; at right, the collector's stock 20-micron bags.

To reduce the number of long duct runs, a 5" section does double duty, serving the 15" planer and a 4" branch to the jointer.

Compared to the tee (installed), a wye and adjustable elbow provide smoother transition from a branch to the main duct.

the shed from the shop, and added frames that hold four high-efficiency furnace filters.

Our expert says: *The dust collector does the job, but isn't performing to its full potential. With stock filter bags, it musters only 736 cfm. The collector is rated at 1,800 cfm, which it probably can't achieve, but it's still short of the mark. The motor generates only about 60 percent of its maximum amperage (14 amps at 220 volts) due to ductwork inefficiencies.*

Jeff agreed that mounting the collector outside the shop saves space and reduces noise. But, he adds, "Why filter the air twice? Replacing the 20-micron bags with 1-micron bags would eliminate the small dust, and make the filters unnecessary."

John also could install a cyclone system in place of the current collector. A cyclone captures the big chips and most of the fine dust in an easy-to-empty tub. Therefore, the filter bags don't clog as quickly, and John will only face the mess of cleaning them every few months or so, rather than every few weeks.

We couldn't install a cyclone that day, but, following Jeff's advice, we did install four 1-micron bags ($45 each) on John's collector. As the chart *below*

Performance—by the numbers.

To get an idea of how well John's dust-collection system worked, we started by drilling a small hole in the main duct, just beyond where it comes through the wall. That allowed Jeff Hill to insert the pitot tubes for two different gauges: one that measured airflow in cubic feet per minute (cfm), and one to check static pressure (sp), as shown in the photo at *right*. Using an ammeter, we also measured the motor's amperage draw, *left*. See the results in the table *below*.

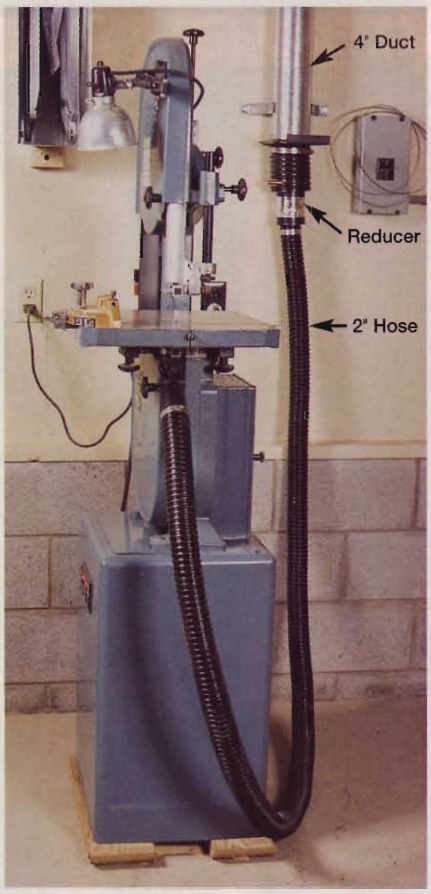
We took readings under three conditions: First, with all the blast gates open to check the system's maximum achievable flow. Next, we closed off all gates except the radial-arm saw to determine maximum flow farthest from the collector. Finally, we tested with just the bandsaw's gate open to determine flow at the most-restrictive port.

The first sets of numbers show performance with the collector's stock 20-micron filter bags. Performance was adequate everywhere but at the bandsaw. The second set reflects the impressive improvements made by installing 1-micron polyester felt bags.

		20-Micron Filter Bags		1-Micron Filter Bags	
Gates open	Port dia.	CFM	Motor Amps	CFM	Motor Amps
All	various	745	8.5	1,054	10.5
Radial-arm saw	4"	484	7.4	736	9.0
Bandsaw	2"	235	6.2	323	7.5

Jeff Hill inserts a pitot tube into the main duct to measure airflow. Opening various gates allows whole-system readings from one location.

Sharing duties reduces duct length. Here, one 5" branch serves the tablesaw, floor sweep, and a 4" pipe to two sanders. Blast gates direct airflow to just the ports in use.



A 2" hose restricts bandsaw duct pickup. Options for improvement include a 4" hose with a reducer or making a 4" port.

shows, airflow increased by more than 300 cfm due to the bags' greater airflow capability. That means the motor can pull more air and produce more of its potential power, as demonstrated by the increased amp draw.

Duct dos and don'ts

Because the price was right, John used HVAC (furnace-style) pipes to create the ducts in his dust-collection system. All the pieces consist of 26- and 28-gauge galvanized steel.

Our expert says: *Snap-lock HVAC pipe works fine, and is economical. But Jeff prefers 24-and 26-gauge galvanized steel for any ducts larger than 4" because it's strong enough to resist being sucked flat by a powerful collector. Never use lightweight 30-gauge or dryer-vent pipe. Even a modest collector can do them in.*

Where ducts intersect and turn, John used short-radius elbows and tee fittings designed for HVAC use. These increase resistance in the system, preventing it from moving all the air it could.

Our expert says: *These fittings really hinder the performance of John's system. Fittings designed for dust collection would get the most from his collector, or possibly allow using a smaller one.*

For best airflow, elbows should bend at a gentle radius—at least 1½-times (1.5×) the diameter of the pipe. The radius of HVAC elbows usually equals pipe diameter (1×). Where pipes join, wye fittings, seen in the photo, opposite page, upper right, *allow air and chips to flow through the transition with little turbulence.*

Duct sizing in John's system is straightforward, starting with the 6"-diameter main line. A 5" branch, shown in the photo *above*, serves the floor sweep, and has two additional 4" branches that serve the tablesaw and spindle- and belt/disc-sanders. At another point on the main, a 5" branch feeds in from the planer (with a 4" off-shoot to the jointer). All other branch lines are 4" diameter.

Machine hook-ups

John connected all of his machines to the ductwork using flexible hoses. Even machines he doesn't move around, such as the thickness planer and jointer, connect this way to simplify hookups and prevent machine vibration from rattling the ductwork. In most cases, the flexible hoses are less than 3' long.

John's bandsaw represents one exception to this rule. It's connected to the 4" branch line with approximately 8' of 2"-diameter flexible hose, as shown in the photo, *above*. This small hose fits the bandsaw's stock, under-table port.

Our expert says: *The long, small-diameter hose greatly reduces the cfm of airflow at the bandsaw, yielding marginal dust-pickup. Always run the largest appropriate hose as far as possible, then reduce it to a smaller port size only at the end. Better yet, modify the machine, if you can, to accept a larger port.*

Final analysis

John's system serves him well, removing chips *effectively*, even if lacking in *efficiency*. There's room for improvement, as we pointed out. But this case proves that, if you understand the basics, you can control workshop dust. Now, let's check out some rules for setting up a dust-collection system in your shop.

Ductwork and fittings selector

Type	General information
Spiral/industrial metal  Flexible Metal Duct · Spiral Duct · 45° Wye · Long-Radius 90° Elbow	• Designed specifically for dust collection, and therefore the most efficient. • Available only through specialty suppliers, such as industrial supply catalogs and online retailers. See the sources at the end of the article. • Costlier than HVAC-style: Ductwork: $1.80+ per foot; wye fitting: $15+ each; elbow fitting: $10+ each (prices given are for 4" ductwork). *Note: Prices for heavy-gauge industrial tees and wyes can run much higher.* • Used in professional shops and ruggedly built. • Fittings are designed to maximize airflow and material movement in system. • The spiral style is very rigid and has a smooth seam to minimize resistance. • May be available in a wider range of diameters. • Fittings generally work with metal, pvc, or plastic pipe. • Flexible metal duct can make gentle bends around obstructions.
HVAC-style metal  Snap-Lock Duct · Adjustable Elbow · Flared Tee	• Designed to move air only, not solid materials, such as dust and chips, so less efficient overall than the industrial components above. • Readily available at any home center in 24- or 26-gauge steel. • Priced economically: Ductwork: $1.50+ per foot; tee fitting: $6+ each; elbow fitting: $2+ each (prices given are for 4" ductwork). • Easy to assemble and install using screws or rivets. • No wye fittings available, just tee-style. Choose flared tees over straight tees. • No long-radius elbows available, short-radius only. • Fittings generally work with metal, pvc, or plastic pipe.
Polyvinyl chloride (pvc)  Radiused Wye · Radiused Tee · 90° Elbow · Schedule-35 Pipe	• Designed to move liquids, but capable of carrying air, dust, and chips. • Readily available in any home center or hardware store. • Economical in 4" sizes: Ductwork: $.35+ per foot; wye fitting: $2.25+ each; elbow fitting: $1.25+ each (prices given are for 4" pipe). *Note: Use "schedule-35" type (drain, waste, vent), not "Schedule-40."* • Diameters larger than 4" may be difficult to find and costlier. • Easy to cut, assemble, and install using special adhesive, screws, or rivets. • We recommend grounding to prevent static buildup in system. • Long-radius elbows and wye fittings are available, but only fit pvc pipe. • PVC is quieter than metal.
Plastic  Clear Duct · Flexible Hose with Wire · 45° Wye · 90° Elbow · 90° Tee · Flexible Hose	• Designed for dust collection at lower cost less than industrial metal. • Only available through ductwork suppliers and woodworking retailers. • Flexible hose available in black or clear. • Plain flexible hose is economical, type with spiral wire costs more: Black hose, no wire: $1.60+ per foot; black or clear w/wire: $3.60+ per foot (4"). • Flexible plastic hoses join rigid ducts to machines and fit around obstacles. • Flexible hose is well-suited to temporary use and for runs that get disconnected when not in use (such as an across-the-floor run to a tablesaw). • Spiral-wire hose provides crush-resistance and simplifies system grounding. • Static pressure loss of flexible hose is approximately 3 times higher than rigid pipe, so it is not well suited for building an entire system. • Clear plastic rigid ductwork allows views of blockages in ducts. Usually smaller in diameter, this style requires pvc "sleeves" to connect with fittings.
Blast gates  Plastic Gate · Aluminum Gate · "Half" Gate	• Absolutely necessary for controlling airflow in any dust-collection system serving multiple machines. • Available through ductwork and woodworking retailers in plastic or cast aluminum styles. • Moderately priced: Plastic gate: $5+ each; aluminum: $7+ each; aluminum half-gate: $15+ each (4"). • Blast gates allow you to close off airflow at individual machines or branches to maintain optimum airflow to the machines being used. • Half gate can be inserted at any point in duct by cutting a narrow slit. • Blast gates generally fit inside-diameter of any pipe or hose above, though they may require gaskets to achieve a tight seal in non-matching applications.

System Setup: What you need to know

To design your own system, you'll have to consider many factors, such as what machines you'll connect, where to place them, what size dust collector to buy, and what type and size duct system you'll need. Thankfully, you can build a great system following a few rules of thumb:

Note: *The following rules may yield a system with more power than you actually need, but too much power is better than too little. Plus, an oversized system can handle future expansion.*

Step 1. Find airflow needs: Start the process by determining how much air your tools need. Find the airflow requirements of each machine you'll connect to the system, and the corresponding duct size necessary using **Chart 1**, *below*.

Step 2. Lay out the ducts: Now lay out your duct system on paper, keeping the following in mind:

- Position the air-hungry machines closest to the collector.
- The largest duct diameter required from **Chart 1** determines the minimum size of your system's main duct. (The collector you choose in step three will influence this as well.)
- Whenever possible, build branches that serve more than one machine.
- Make duct runs as short as possible, minimizing the number of bends.

Plan the shortest, straightest runs you can because every bend and foot of duct adds air resistance, known as static pressure loss, shown in **Chart 2**, *below right*.

After you've laid out a tentative duct system, determine the static pressure loss for each branch using the chart. Be sure to include the equivalent footage for 45° wyes and 90° elbows. For each branch you also need to include whatever amount of the main duct exists between that branch and the collector.

Note: *Each foot of flexible hose equals 3' of rigid duct, so include these runs in the total. Also, port designs vary, so it's tough to calculate their static-pressure loss. To be safe, add 1.5" for each port on the branch.*

As an example let's say you have a 6" straight main duct. At 14' from the collector, a 45° wye branches into a 4" line to the tablesaw. That branch is 12' long with two 90° bends, and connects to the saw with 3' of flexible hose. Here's the static pressure loss for that branch:

14' (6" straight) × .045	= .63" sp loss
3' (one 4" 45° wye) × .07	= .21" sp loss
12' (4" straight) × .07	= .84" sp loss
12' (two 90° @ 6') × .07	= .84" sp loss
9' (3' of flex hose) × .07	= .63" sp loss
One tablesaw dust port	= 1.50" sp loss
Total sp loss for branch	= 4.65"

The branch with the greatest total static pressure loss is the one that determines what your dust collector will have to overcome. If you ever run your system with two blast gates open at the same time, add both totals to get your static pressure loss.

Step 3. Choose a dust collector: Now you can buy a collector. Each should be rated by horsepower, cfm, and a maximum static pressure. Eliminate any collector with fewer than 1.5 hp. Smaller, portable machines generally lack the power needed for a built-in system.

The cfm rating will be shown prominently, but the static pressure rating is more important. The number must be higher than the highest loss in your system, calculated in **Step 2**, to prevent chips and dust from settling in the ducts.

You'll also need to know the highest airflow value (determined in **Step 1**) to find the minimum cfm rating you should purchase. Don't be surprised if the dust collector that meets your static-pressure needs is rated at about double the cfm any of your machines requires. Manufacturers often rate cfm with no ducts attached, so their ratings are higher than you'll get in real-world use. (To learn more, see our dust collector review in issue 140.)

Your dust collector also needs to accommodate the largest diameter duct in your system. In fact, a good rule of thumb is to make your main duct the maximum size your dust collector can accept.

Chart 1: Airflow requirements for machines

Machine	Min. cfm required	Min. duct diameter
Bandsaw (12-16")	350	4"
Belt/disc sander	450	5"
Drill press	350-400	4"
Drum sander (12-24")	550-700	5"
Floor sweep	350-450	4-5"
Jointer (up to 8")	350-450	4-5"
Jointer (over 8")	450-550	5"
Radial-arm saw/mitersaw	450-600	5"
Router, table-mounted	200	3"
Scrollsaw	200	3"
Spindle sander	400	4"
Tablesaw (10")	350	4"
Thickness planer (10-15")	400	4"
Thickness planer (16-20")	600-800	5-6"

Chart 2: Figuring system static pressure loss

Duct diameter	45°	90°	SP loss per foot
3"	2.5'	5'	.10
4"	3'	6'	.07
5"	4.5'	9'	.055
6"	6'	12'	.045

Note: The 45° and 90° readings are based on long-radius industrial fittings. HVAC and PVC fittings will be less efficient, yielding more static pressure loss.

Options for ductwork and fittings

You've sized your collector and planned the duct layout, now you need to choose what ducts and fittings to use. You have a lot of options. See the "Ductwork and fittings selector" on the *opposite page*.

Even with the process simplified, setting up a dust-collection system takes planning. If you prefer to have someone else do the calculations described here, the companies *below* can help. Oneida Air Systems, for example, will design your system for $50, applicable toward the purchase of a cyclone or ductwork.

Once you've made all the decisions and bought your components, temporarily connect the ducts and fittings, and then check how well everything works. When the system performs to your satisfaction, screw, glue, or rivet the components together; seal the seams with tape or caulk; and start making sawdust. You won't have to clean it up.

Written by **David Stone**
Photographs: **Donna Chiarelli Studios; Baldwin Photography**
Illustration: **Roxanne LeMoine**

These companies provide information and products for setting up a dust-collection system in your shop:

Air Handling Systems, Inc.
Ductwork/hose, fittings, accessories, design assistance
800/367-3828; www.airhand.com

American Fabric Filter Co.
High-efficiency filter bags
800/367-3591; www.americanfabricfilter.com

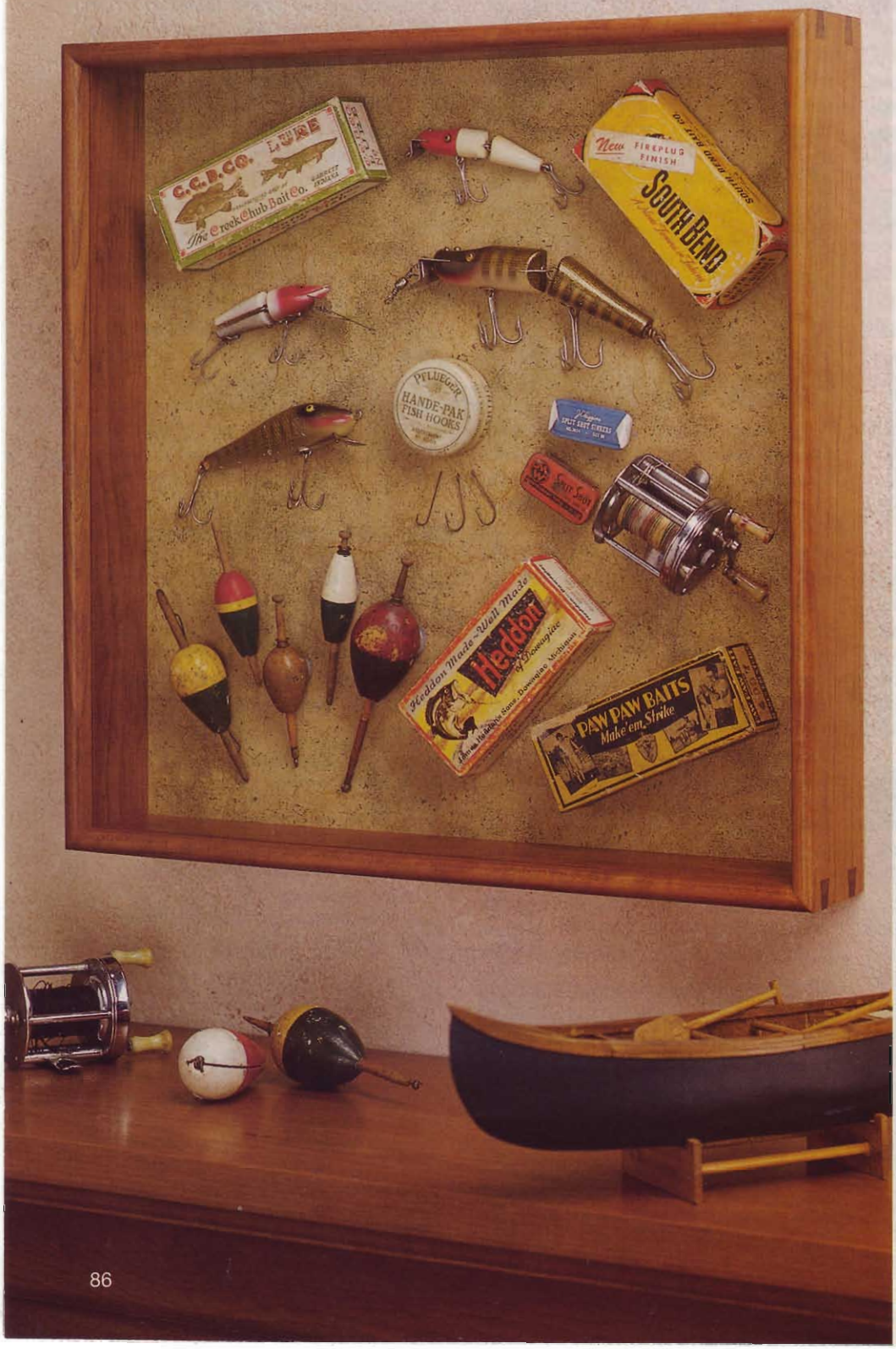
Grizzly Industrial, Inc.
Dust collectors, ductwork/hose, fittings, accessories, filter bags, design information 800/523-4777; www.grizzly.com

Oneida Air Systems, Inc.
Cyclone systems, ductwork/hose, fittings, accessories, filter bags, design assistance 800/732-4065; www.oneida-air.com

Penn State Industries, Inc.
Cyclone systems, dust collectors, ductwork/hose, fittings, accessories, filter bags, design information 800/377-7297; www.pennstateind.com

show-your-stuff shadow box

Small treasures get top billing behind glass with this versatile wall-hung showcase.



Nearly all of us have a small collection of one type or another. And those collections vary considerably. So we designed a display case that looks great, goes together quickly, and, most importantly, can be customized easily to fit any collection.

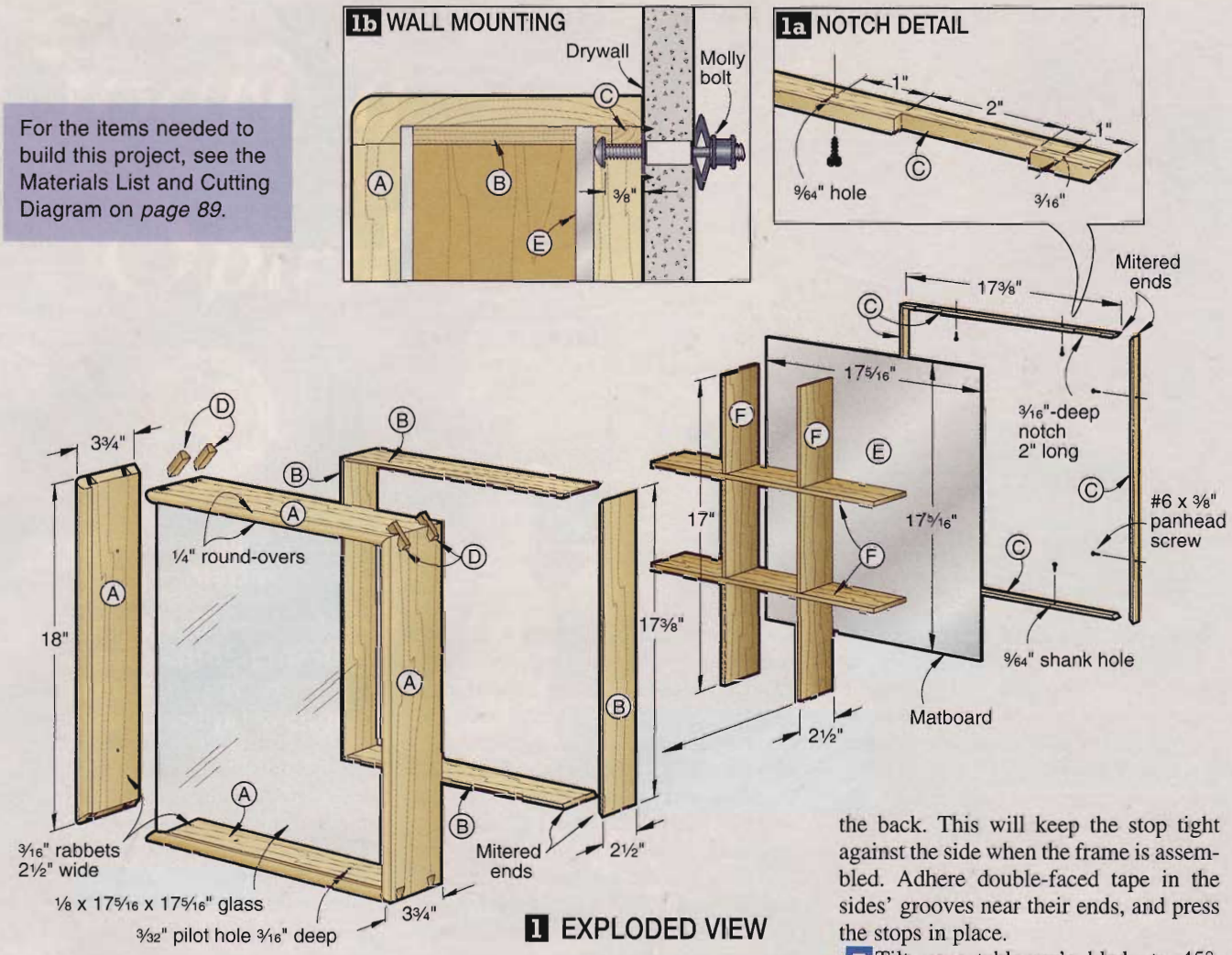
For lightweight collectibles that can be attached with adhesives or fine thread, build the case without dividers, as shown *at left*. For heavier items requiring a little more support, build dividers like those shown *below*. Later in this article you'll find tips for properly securing light and heavy objects.

Your collection dictates the case's depth

Before you build your case, measure the depth needed to display the items in your collection. Include the size of stands or fixtures you'll use to position the items. Our display case has a 2½" inside depth. If the objects you wish to display require more or less depth, simply vary the widths of the sides (A); glass stops (B); and, if you are using them, the dividers (F). The glass stops and dividers are the same width as your desired inside depth. Add 1¼" to the inside depth for the finished width of the sides. Depending on the width of the sides, you also may want to adjust the number and placement of the corners' dovetail keys.

Dividers add versatility to your showcase. See *page 89* for instructions for fitting your case with these easy-to-build dividers.

For the items needed to build this project, see the Materials List and Cutting Diagram on *page 89*.



1 EXPLODED VIEW

Start with the frame parts

1 Plane two ¾×4¾×40" boards to ½" thick for the sides (A). Cut side blanks ½" wider and 1" longer than the size shown on the Materials List. Install a ¼" round-over bit in your table-mounted router, and rout the sides' front edges, where shown on **Drawing 1**.

2 To form the 3/16"-deep rabbet in the sides (A), install a ¾" dado blade in your tablesaw, and plow out a groove, where shown in the three steps of **Drawing 2**. As indicated in **Step 3**, the sides are trimmed to final width after they are mitered.

3 Resaw a ¾×3½×40" board in half, and plane the two pieces to 3/16" thick to make blanks for the glass stops (B) and back stops (C). Cut the blanks to the same oversize length as the sides.

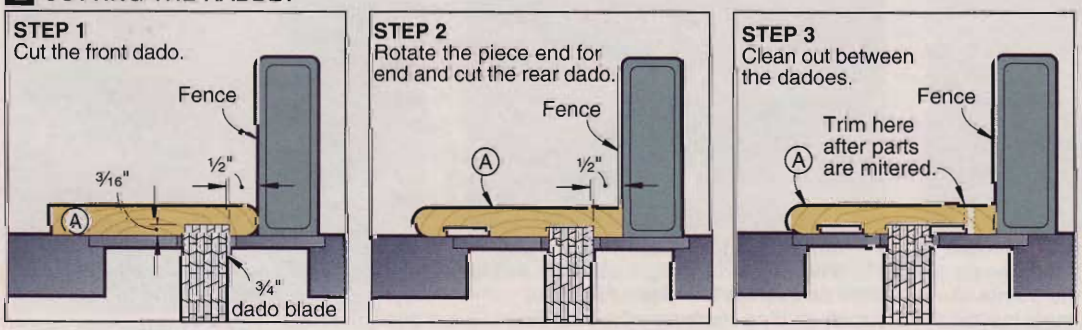
4 Pair up each side blank with a stop blank. Mark the plowed-out area of the side and the back of the stop so each pair can be reassembled in the same order. If there is any bow in the stop blanks, mark the outside of the bow as the back. This will keep the stop tight against the side when the frame is assembled. Adhere double-faced tape in the sides' grooves near their ends, and press the stops in place.

5 Tilt your tablesaw's blade to 45°. Attach a 24"-long auxiliary extension to your miter gauge, positioning it so the blade will cut through its end. With the taped-in stop blanks against the saw's top, miter one end of each side. Clamping a stopblock to the extension, miter-cut the parts to finished length.

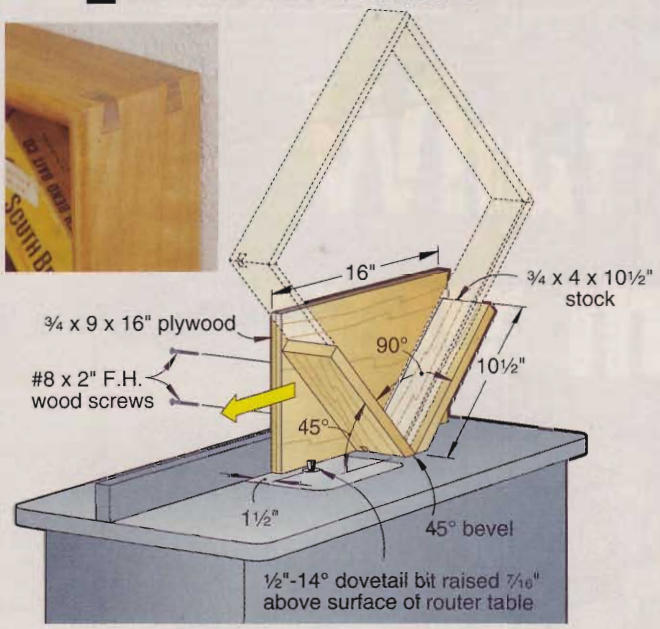
6 Remove the stop blanks, and cut the sides (A), glass stops (B) and back stops (C) to finished width. Trimming the excess width from the sides completes the rabbets, as indicated in **Step 3** of **Drawing 2**. Drill centered holes in the back stops for the panhead screws, where shown on **Drawing 1a**.

7 To hang the shadow box on a pair of nails or wall anchors, choose one side (A) as the top. With your dado blade, cut two 3/16"-deep notches 2" long in its mating back stop (C), where shown on **Drawing 1a**.

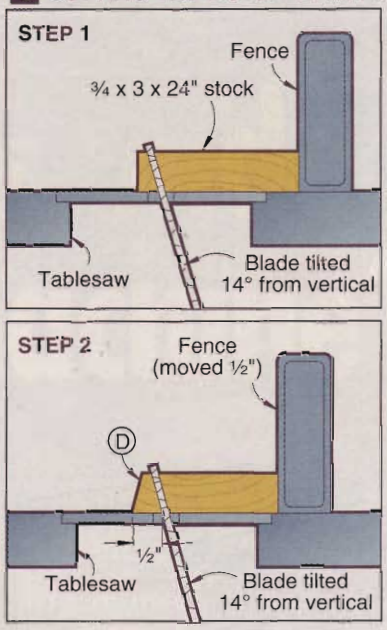
2 CUTTING THE RABBET



3 CUTTING THE DOVETAIL SLOTS



4 CUTTING THE DOVETAIL KEYS



Glue and spline the frame

1 Prepare the frame for gluing, as shown in **Photo A**. Turn the taped-together sides over, and spread glue on the miters. Form the frame, as shown in **Photo B**. Wipe away any glue squeeze-out with a damp cloth. Check for squareness by measuring the diagonals, and set the frame on a flat surface to dry.

2 Make the corner slotting jig shown in **Drawing 3**. Install a ½"-14° dovetail bit in your table-mounted router, and adjust it to cut 7/16" deep. Position the fence 1½" from the bit's center. Rout dovetail slots across the corners, as shown, then flip the frame so the opposite face is against the jig's back, and rout a second set of slots.

3 Cut a ¾x3x24" blank for the dovetail keys (D). Tilt your tablesaw's blade to 14° (the same angle as the dovetail bit), and bevel-rip the blank, as shown in **Step 1** of **Drawing 4**. Flip the blank end-for-end so its opposite face is against the saw's table. By careful measurement, position the fence to make the cut shown in **Step 2**. Make a cut about 2" into the blank's end, then carefully back the blank away from the blade. Test the key's fit, as shown in **Photo C**. Make any necessary adjustments, and repeat the test until you are satisfied with the fit. Rip a key strip the length of the remaining blank, and cut off eight 1"-long pieces for the keys (D).

4 Glue the dovetail keys (D) into the dovetail grooves. With the glue dry, trim them close to the sides' surface with a handsaw, then sand them flush.

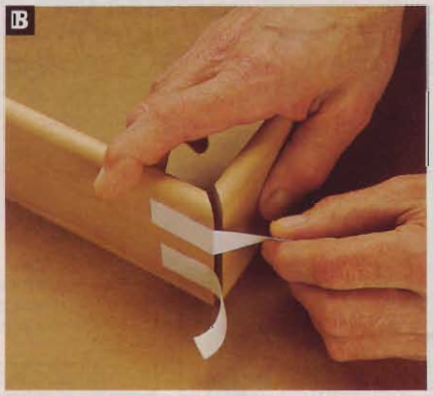
5 Have a piece of single-strength glass cut 1/16" smaller in length and width than the frame's rabbeted opening. Cut a piece of matboard for the back (E) the same size as the glass. Look for matboard at an art-supply store or a framing shop. Choose a color to complement the objects being displayed.

6 With the frame lying face down on your workbench, insert the glass, then slip the glass stops (B) in their marked places. Add the matboard back (E) and the back stops (C). Pressing the back stops snug against the back and using the holes in the stops as guides, mark the location of the pilot holes on the frame. Remove the back stops, back, glass stops, and glass. Drill the pilot holes in the frame.

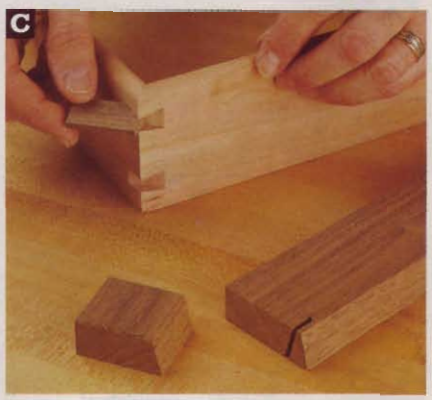
7 Sand the frame, glass stops, and back stops to 320 grit. Apply three coats of penetrating oil finish, following the directions on the can. Let the parts dry for a couple days after applying the last coat.

8 Attach the items you wish to display to the back. See "How to mount your collectibles," *opposite, top*, for tips on mounting your pieces. Reassemble the glass, glass stops, back, and back stops. Make sure the top of your display corresponds with the back stop that is notched for hanging. Secure the back stops with #6x⅜" panhead screws, as shown on **Drawing 1**. Drive nails or anchors into the wall, leaving ⅜" protruding, as shown on **Drawing 1b**. Hang the display so the fasteners' heads engage the slots in the top back stop.

Align the sides (A) with a straightedge, slipping the glass stop (B) underneath so the sides lay flat. With the points of the miters touching, apply masking tape.



Fold the taped-together sides, closing the miters, and forming the frame. Apply tape across the last pair of miters, tightly pulling them together.



Bandsaw the end off the key blank, freeing a test key. Check the key's fit in a slot. The key should slide in with just enough space for glue.

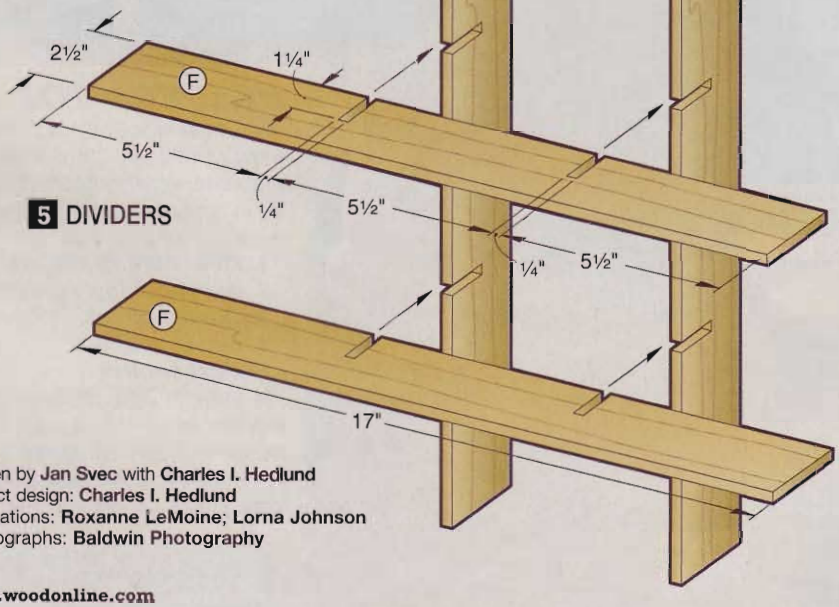
Make the optional dividers

Note: We divided our display case in thirds, both horizontally and vertically, giving us nine identical niches. You can divide your case any way you wish; the divisions can even be different sizes. Just vary the number and placement of the dividers, notching them together, as explained below.

1 Cut two ¾×2½×20" boards for the dividers (F). Resaw them in half, and plane the resulting four pieces to ¼" thick. Check the inside dimensions of your case, and trim the divider blanks to fit the opening.

2 To notch the dividers, install a ¼" dado blade in your tablesaw, and adjust it to cut 1¼" deep. (If your display case has a different depth than ours, adjust the dado blade to cut half the width of your dividers.) Attach a 3"-tall auxiliary extension to your miter gauge so it extends about 7" to the right of the blade. For accurate repeat cuts, clamp a stopblock to the extension, and cut the notches, where shown on **Drawing 5**. Because our dividers are partitioned in thirds, all the notches are cut using one stopblock position.

3 Sand the dividers to 320 grit. Apply finish to the dividers, as you did with the frame and stops. Let the finish dry for a couple of days. Assemble the dividers by interlocking their notches, as indicated on **Drawing 5**. Slide the divider unit into the display case after the glass stops are in place. See the sidebar *above, right*, for a tip on securing items to the dividers. Position the back, screw the back stops in place, and hang the display case as before.



5 DIVIDERS

How to mount your collectibles

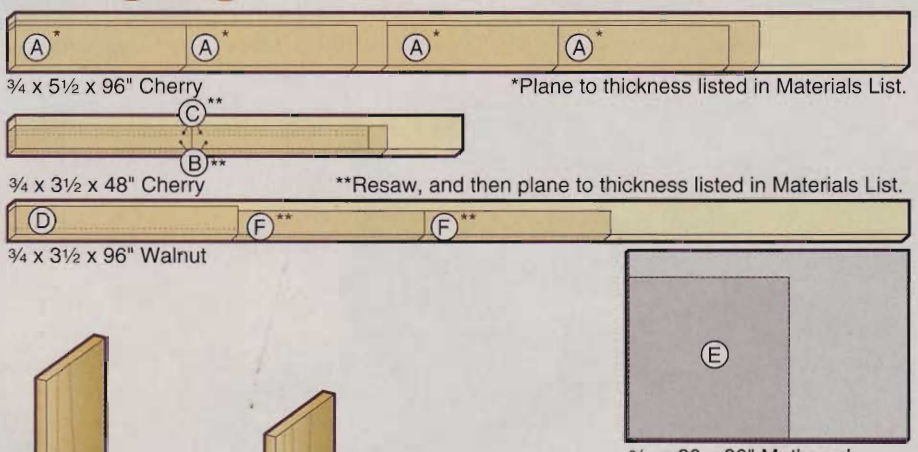
With your display case complete, you'll need a method for fastening the items to the matboard back, or if you are using dividers, securing the items to them.

Secure items to the matboard back with small dots of silicone adhesive, or tie them in place with thread, monofilament fishing line, or very fine copper wire. To tie your items, first poke holes through the matboard with a sewing needle. Loop the thread, line, or wire around the item, feed the ends through the holes, and tie the thread, line, or wire at the back.

Here's a sampling of stands for displaying everything from baseballs and dolls to spoons, plates, and teacups. See the Buying Guide for our source.

If you are using dividers, insert them in the frame and set it upright. To secure items that will stand on their own, roll small balls of Tacky Wax removable adhesive, and stick them to the bottoms of the items. Look for Tacky Wax at art or craft supply stores, or order it from the source in the Buying Guide, *below*. Position the items on the dividers, carefully pressing them in place. For some items, special stands are available, as shown *above*. Secure the stands to the dividers with Tacky Wax. Keeping the display case upright, add the back, screw in the back stops, and hang it on the wall.

cutting diagram



materials list

Part	FINISHED SIZE T	W	L	Matl.	Qty.
A* sides	½"	3¾"	18"	C	4
B* glass stops	3/16"	2½"	17⅜"	C	4
C* back stops	3/16"	½"	17⅜"	C	4
D* keys	7/16"	½"	⅞"	W	8
E back	3/16"	17 5/16"	17 5/16"	M	1
F* dividers	¼"	2½"	17"	W	4

*Parts initially cut oversize. See the instructions.

Materials Key: C–cherry, W–walnut, M–matboard.

Supplies: Single-strength glass, #6×⅜" panhead screws (8), nails or wall anchors. For the slotting jig: ¾×9×16" plywood, ¾×4×10½" solid stock (2), #8×2" flathead wood screws (4).

Bits and blades: ¼" round-over and ½"-14° dovetail router bits, and a stack dado-blade set.

Matboard: The matboard for the back (E) is available at art and craft supply stores and framing shops.

Buying Guide

Display stands. Stands for just about anything you wish to display are available from The Stand Man. To view the catalog, go to www.thestandman.com. To request a catalog or place an order, call 888/782-6312.

Written by **Jan Svec** with **Charles I. Hedlund**
Project design: **Charles I. Hedlund**
Illustrations: **Roxanne LeMoine; Lorna Johnson**
Photographs: **Baldwin Photography**

Hot-to-chop

10" compound mitersaws

Eleven shop-tested models vie for a spot in your shop.

READERS' TOP 5

We asked woodworkers on www.woodonline.com, our Web site, what qualities matter in a compound mitersaw. Here's what they told us:

1. ***Miter-cutting accuracy***
2. ***Bevel-cutting accuracy***
3. ***Quality of cut***
4. ***Fence quality***
5. ***Dust control***

We think that list is right on the money, and to it we'll add *power* and *handle comfort*. We'll take a close look at each area in this report.

From its humble beginning 40 years ago, the "power miter box" has evolved into a precision cutting machine suitable for most fine crosscutting tasks. Today, you'll find four styles of power mitersaws on the market: *Straight* mitersaws have a motor/blade head that rotates side-to-side to miter-cut stock laid flat or bevel-cut stock standing on edge; *compound* mitersaws also tilt one direction to miter and bevel simultaneously; *dual-bevel* mitersaws rotate and tilt both directions; and *sliding compound* mitersaws miter, bevel, and feature a sliding head that increases cutting capacity to about 12". For this article, we focused on 10" compound mitersaws because they strike the best balance between cost and capabilities for the home woodworker.

The key components in a compound mitersaw

• **Miter-cutting accuracy.** For maximum repeatability, miter detents (stops) should drop in solidly and accurately. All of the saws have detents at 0°, 22.5°, and 45°, left and right, to simplify setting the most common angles you're likely to use. If you plan to cut crown molding, several have a detent at 31.6° (which, combined with a 33.9° bevel angle, allows you to cut crown molding flat on the saw table). Nearly all of the saws go at least a couple of degrees past 45°, both left and right, for when you need a little more angle for a perfect fit.

Miter scales should be easy to read: Generally, we prefer a bezel-and-hairline-cursor arrangement over cast-in scales with pointers (see *top right* photos). A vernier scale—a secondary scale on the bezel with wider-spaced markings for partial degrees—makes it easy to precisely hit a fraction of a degree. Four saws (the Bosch 3924, Black & Decker BT1500, DeWalt DW703, and Pro-Tech 7208) sport this feature; Delta's miter scale itself is marked in ½" increments.

Once we adjusted them in the setup process, all of the saws' miter scales proved accurate. However, some detents were sloppier than others, making them less reliable.

• **Bevel-cutting accuracy.** All of the tested saws offer bevel stops at 0° and 45°, but the Bosch 3924 adds a crown-molding stop at 33.9°. (Others have the 33.9° bevel marked, but try eyeballing 1/10° when each full degree mark is less than 1/16" apart!) Most can go slightly above and below the 0°–45° range, but only the Ridgid MS1060 and Milwaukee 6494-6 allow you to do so without resetting the stops. Again, once adjusted at setup, all of the bevel scales proved accurate.

• **Quality of cut.** With identical blades installed, we saw little difference in cut quality from one saw to another. All of the saws come with carbide-tipped blades, but many are rough-cutting 24-tooth configurations. Others come with a smoother-cutting 40-tooth blade; Milwaukee supplies a high-quality 60-tooth blade.

Table inserts contribute to cut quality as well, and we like saws with a zero-clearance insert. Besides helping reduce tear-out, they also prevent small offcuts from dropping into the saw, which can inhibit turntable movement.

Finally, for the best possible cuts, such as when making picture frames, you'll need a stock hold-down to prevent the workpiece from shifting during the cut. Only about half the saws come with one of these devices; for the rest, it's an accessory.

• **Fence quality.** A compound mitersaw's fence must be tall enough to solidly support stock cut standing on edge, yet open enough to clear the tilting head when beveling. Some of these saws answer that paradoxical challenge with a fence that snugs up to the blade for 0° bevels, then flips or slides to the left for other bevel angles. We prefer these fences to the others that just leave that gap wide open all the time, reducing support for taller workpieces. Of course, you can add your own fence faces, and all saws but the Black & Decker come predrilled for the task.

• **Dust control.** Grabbing flying dust from a mitersaw blade is like trying to catch hailstones in a bucket: You can't make a bucket big enough to catch 'em all. Still, any dust collection is better than none at all. Although all of the saws come with dust-collection bags, some were more effective than others.

• **Handle comfort.** We like saws with a horizontal "D" handle because we find them more comfortable to use. Vertical Ds and straight-handled mitersaws put your wrist in an awkward and uncomfortable position with the blade at full height. You might not notice this making one cut, but after a few your wrist will make its opinion known.

Rating the miter scales

EXCELLENT: A hairline cursor, vernier scale, and high-contrast background place Black & Decker's miter scale among the best in the test.

GOOD: Despite a small gap between it and the cast-in scale, Ridgid's fine-line cursor reads easily and accurately.

FAIR: Pro-Tech offers a hairline cursor and vernier scale, but the dark background makes it difficult to read.

Testing for power and accuracy

Before we began our shop trials, we assembled all of the saws and installed identical 80-tooth, carbide-tipped crosscut blades (CMT #219). After adjusting the saws according to the process described in the "Maximize Your Mitersaw" article on *page 96*, we tested each machine's power by slicing slabs off the end of a pressure-treated 4×4 post. We then examined those cuts for signs of blade flutter and tear-out.

To check the accuracy and repeatability of the miter stops, we made 4- and 8-sided MDF frames using the saw's 45° and 22.5° stops. Next, we repeated this test using the saw's 45° bevel stop instead. Finally, we measured each tool's width-cutting capacity in ¾" material at 0° and 45° miter settings.

Now, let's look at each compound mitersaw

Black & Decker BT1500, $160, www.blackanddecker.com, 800/544-6986

High points

- Tall left fence slides aside for bevel cuts.
- Miter-detent release lever depresses easily.
- Twin bevel scales show cutting angle from either side of the saw.
- Vernier miter scale is a plus (although it goes only to ½°, while others go to ¼°).

Low points

- Miter-locking knob requires 1½ turns to free the turntable (others required ¼–1 turn).
- Motor didn't sound as smooth as more-expensive saws, and still emitted a "hot" smell after more than a month of use.

More points

- A nicely featured saw for the money, but we wonder how it will hold up under continous use.

Craftsman 24315, $200, www.sears.com/craftsman, or visit your local Sears store

High points

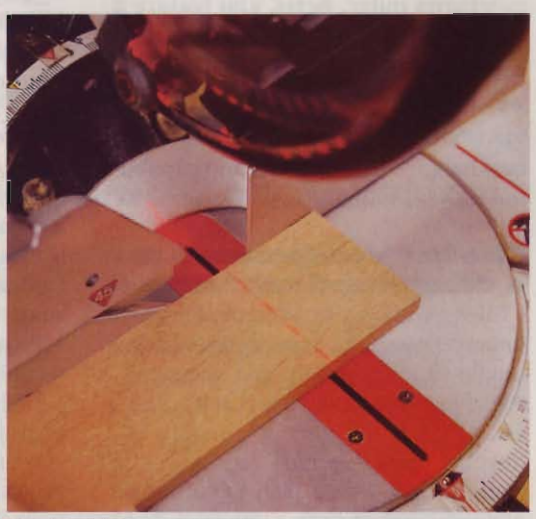
- Laser cutting guide (shown at *right*) proved handy and surprisingly accurate.
- Miter and twin bevel scales (similar to the Black & Decker BT1500) read easily.
- Markings on sliding left fence tell you where to set it for various bevel angles.

Low points

- Motor isn't as powerful as more expensive mitersaws.

More points

- As we went to press, the 24315 we tested was replaced by the model 21250. According to a Craftsman official, it's the same machine, but sports a sharper laser line with longer battery life, and an extruded aluminum table extension with an adjustable stopblock. The 21250 should be in stores by the time you read this.



Craftsman's arbor-washer-mounted laser creates a dashed line that overlays your cutline.

Delta 36-225, $190, www.deltamachinery.com, 800/438-2486

High points

- Powerful motor is surprisingly quiet.
- Crisp miter detents snap into place.
- ½° increments on miter scale are more intuitive than vernier scales.
- Scales read easily, especially the bevel scale with its clear line of sight and clean, wide markings.
- Dust collection ranks best in the test.
- Free-sliding table extensions double as carrying handles.

Low points

- No zero-clearance insert included.
- A sliding or flipping left fence would make this saw compete with higher-priced saws.

More points

- We named this saw one of the best values in the test.

DeWalt DW703, $230, www.dewalt.com, 800/433-9258

High points

- Starts fast and powerfully, yet brakes quickly.
- Bezel-and-cursor vernier scale goes to ¼°.
- Turntable frees with just ¼ turn of the locking knob, then glides smoothly.
- This is the only tested saw that breaks the 6"-width barrier in ¾"-thick stock. (See chart, *opposite*.)
- Sliding left fence is the tallest in the test.

Low points

- At 103 decibels, it's loud (others ranged from 92 to 102dB).
- Gap between the pointer and bevel scale forced us down to table level to get a good reading.

More points

- Well-built and smooth-operating, this saw earned one of our top recommendations.

Hitachi C10FCB, $185, www.hitachi.com/powertools, 800/706-7337

High points

- No manual detent release: Simply rotate turntable to the next detent.
- It's the only tested saw with a 35.3° miter stop for 45° crown molding.
- Hinged left fence flips in for stock support.
- No tools required to access arbor nut, making for easiest blade changes.

Low points

- Soft miter detents can't be trusted and make it difficult to get within a couple of degrees of a detent without "falling" into it.
- Must look around head pivot to read bevel scale.
- Vertical-D handle is uncomfortable to use.

More points

- A powerful saw with some nice features, but we can't overlook the soft miter detents.

Makita LS1040, $250, www.makitatools.com, 800/462-5482

High points

- It's the lightest saw in the test by far. (At 24.2 lbs., it's 6 lbs. less than next-lightest Ryobi, and 14½ lbs. less than heavyweight Pro-Tech.)
- Ribbed support rod inside dust-collection bag provides wide berth for incoming dust.
- Motor is one of the quietest tested.
- Turntable glides smoothly and left fence flips out.

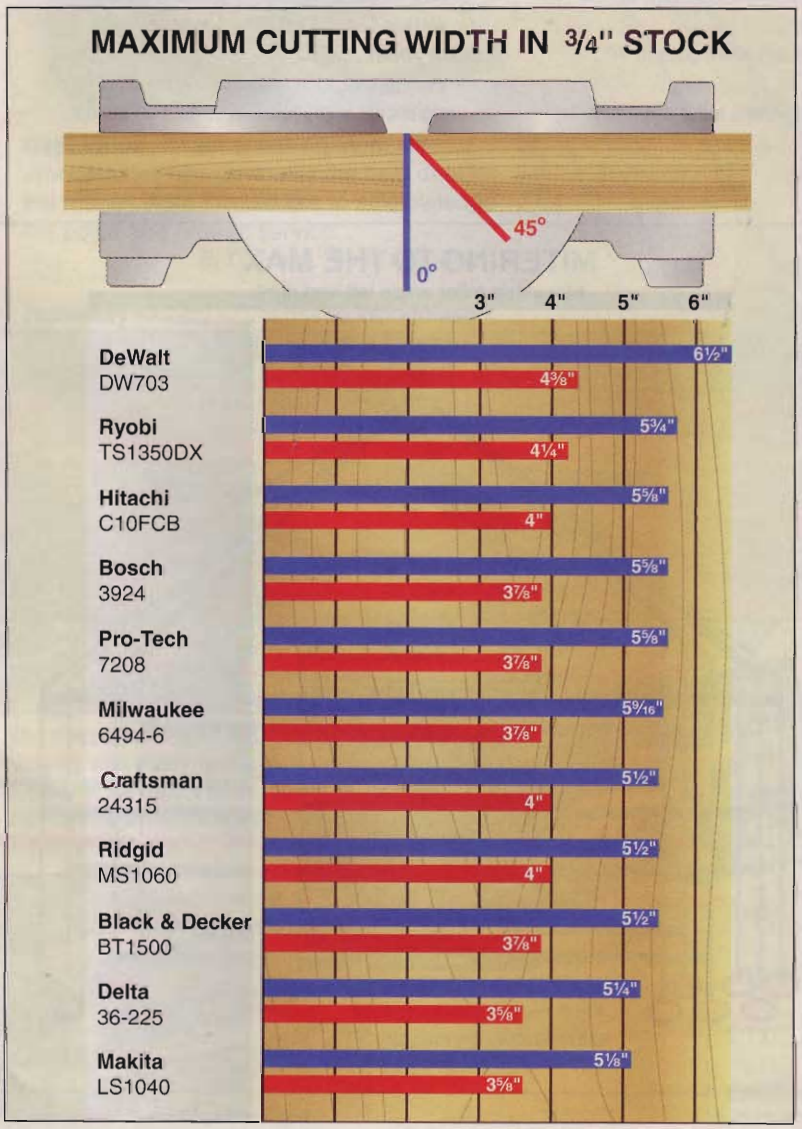
Low points

- Bevel scale unreadable from normal operating position because of its location, orientation, and tiny increment markings (see photo *below*).
- Vertical-D handle is uncomfortable to use.

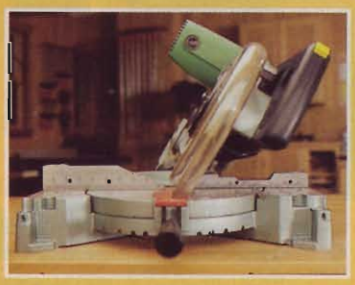
More points

- We found this to be a middle-of-the-pack mitersaw for a premium price.

Makita's bevel-scale cursor hides behind the knuckle and 45° stop. Reading the scale becomes harder yet as you tilt the head to bevel.



Dual-bevel mitersaws: The kings of crown



Two of the manufacturers in our test also make dual-bevel 10" compound saws. Delta's 36-085 and Hitachi's C10FCD make cutting crown molding intuitive because you cut the workpiece flat but in the same orientation as it will be installed. Finish carpenters use it enough to justify the extra $50–$55 cost.

For the home woodworker, though, work support can be a problem in a couple of ways. First, the fences on these saws must be wide open around the blade (see photo *above*) to allow for the wide bevel range, so they run 1–3" lower than on a single-bevel mitersaw. And, to properly use the dual-bevel function, a 10' length of crown molding requires more than 20' of clearance—at least 10' on both sides of the saw.

Milwaukee 6494-6, $325, www.mil-electric-tool.com, 800/414-6527

High points

- Premium 60-tooth blade comes standard.
- Miter detents lock solidly, and detent-override system allows uninhibited turntable rotation.
- The miter range is the widest in test. (See chart *below*.)
- Its long left fence detaches and flips (*right* photo).
- Spring-loaded bevel stops don't require resetting to go beyond 0° and 45°.

Low points

- Spring pressure works against you when "bumping" the bevel angle just a little more.
- Straight handle is uncomfortable for lengthy use.
- At 103 dB, it's loud.

More points

- If you can afford this $325 saw, you'll love it. It's the best performer in the test.

For solid support of 0° bevel cuts, Milwaukee's left fence can be oriented as shown *above*, or flipped for bevel cuts.

Pro-Tech 7208, $165, www.protechpower.com, 800/888-6603

High points

- Dual-position fence mounts in forward location to maximize thickness capacity; at rear to maximize width.
- Bezel-and-cursor miter scale goes to ¼°.

Low points

- Poor color contrast makes miter scale difficult to read.
- Stiff-tilting head hindered our best efforts to "sneak up" on a specific bevel angle.
- Dust bag wouldn't stay open, rendering it useless.
- Vertical-D handle is uncomfortable to use.

More points

- Even at this price point, the 7208 needs significant improvements to be a contender.

Bosch 3924: Can cordless cut it?

When we started looking at saws for this test, we decided to include the Bosch 3924 24-volt cordless mitersaw, a full-featured 10" saw. The saw has a ¼° vernier miter scale, sliding left fence, and a stop at 33.9° bevel for cutting crown molding.

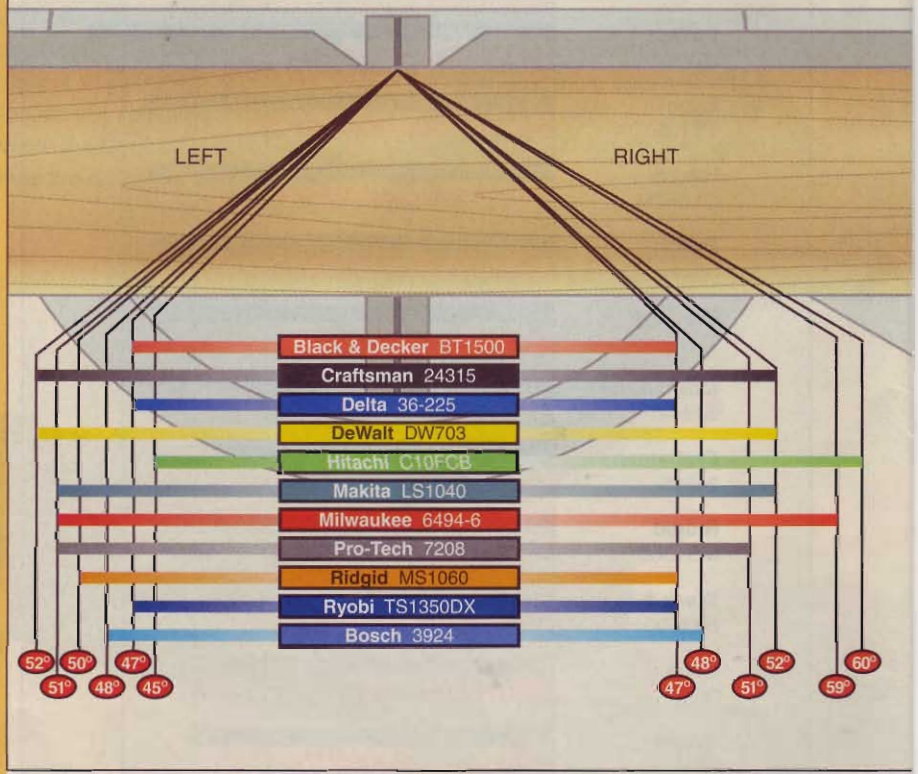
As you might expect, though, power and run time concerned us. Powerwise, the 3924 earned a "Fair" rating, regardless of whether we used a full-kerf 80-tooth blade or the supplied thin-kerf 40-tooth blade. Runtime depends on how you measure it: We cut pretty much continuously and drained the battery in less than eight minutes. In that time, we averaged 15–20 cuts through a pressure-treated 4×4 post.

Honestly, we don't see this mitersaw replacing the corded saw in your shop anytime soon. But for trim carpenters who must move from room to room, or deck-builders who may not always have easy access to AC power, we think it'll be a hit.

www.boschtools.com, 877/267-2499

MITERING TO THE MAX

Maximum miter angle left and right



Ridgid MS1060, $190, www.ridgidwoodworking.com, 800/474-3443

High points

- Bevel-stop pin opens up the saw's full -3° to 47° bevel range without resetting stops.
- Feels more powerful than some more-expensive mitersaws.
- Soft-grip miter-locking knob provides good purchase.

Low points

- Bevel scale forces eye to table level for accurate reading, and bevel-tilting action is stiff.
- Miter-locking knob crowds hand against benchtop.

More points

- We found this saw a mixed bag with some features well designed and others needing work.

Ryobi TS1350DX, $150, www.ryobitools.com, 800/525-2579

High points

- Widely spaced degree markings on the miter scale allow easy eyeballing of even fractional degrees.
- Good-sized bevel-lock knob is located left of knuckle for good access.

Low points

- Miter-lock knob requires a full turn before freeing turntable.
- Small gap between the bevel scale and cursor forces your eye to table level to ensure accuracy.

More points

- In spite of its modest construction, we were generally pleased with the performance of this saw.

Our picks from the pack

It's a tough choice between the DeWalt DW703 and the Milwaukee 6494-6 for top-tool honors. We lean toward the DW703, based on its big crosscut capacity, horizontal D-handle, and price. But for an extra $100, the 6494-6 includes a clean-cutting 60-tooth blade, a wider miter and bevel range, and lifetime warranty.

For best value, we also have two picks: the Craftsman 24315 and Delta 36-225. The Delta proved powerful and quiet in our tests but lacks a movable left fence. For about $10 more, you enjoy the benefits of Craftsman's sliding fence, laser cutting guide, and zero-clearance insert. But, you'll trade a little muscle for those features.

COVERING EVERY ANGLE OF 11 COMPOUND MITERSAWS

BRAND	MODEL	BLADE SPEED (RPM)	ZERO-CLEARANCE INSERT (YES, NO)	FENCE HEIGHT (INCHES) (LEFT, RIGHT)	MITER STOPS LEFT AND RIGHT, DEGREES (ALL HAVE STOPS AT 0°, 22.5°, and 45°)	BEVEL RANGE, DEGREES (LEFT, RIGHT) (1)	PERFORMANCE RATINGS (2)														ACCESSORIES (6)		CORD LENGTH	WARRANTY (7)	COUNTRY OF ASSEMBLY (8)	WEIGHT (POUNDS)	SELLING PRICE (9)
							TURNTABLE TRAVEL	MITER STOP RELIABILITY	MITER SCALE READABILITY	MITER LOCK	BEVEL LOCK	BEVEL SCALE READABILITY	FENCE	OBSERVED POWER	BLADE GUARD	HANDLE AND SWITCH	BLADE CHANGING EASE	DUST CONTROL (3)	BLADE QUALITY (4)	NOISE LEVEL (dB) (5)	STANDARD	OPTIONAL					
BLACK & DECKER	BT1500	5,500	Y	4¼, 2½	15, 30	47°, 2°	G	E	E	G	E	E	G	G	E	E	G	G	F	102	X		7'	2 yr.	T	30.0	$160
CRAFTSMAN	24315	5,000	Y	4⅛, 2½	30	47°, 0	G	E	E	G	E	E	E	G	E	G	G	G	G	101	H, L, S, X		7'	1yr.	T	34.0	200
DELTA	36-225	5,000	N	2½, 2½	15, 30	45, 0	G	E	E	E	G	E	G	E	E	E	G	G	G	95	H, X		8'6"	2 yr.	T	33.0	190
DeWALT	DW703	5,000	N	4¾, 3¼	10, 15, 31.6	48°, 3°	E	E	E	E	E	G	E	E	G	E	G	F	G	103		C, H, S, X	7'4"	1 yr.	T	33.0	230
HITACHI	C10FCB	4,900	Y	3½, 2⅝	15, 31.6, 35.3	45, 0	G	F	G	E	E	F	E	E	F	G	E	G	F	102	H, S, X		7'	1yr.	J	31.0	185
MAKITA	LS1040	4,600	N	4½, 3¼	30	45, 0	E	G	G	E	G	F	E	G	E	E	G	G	G	96		C, H, S, X	7'	1 yr.	U	24.2	250
MILWAUKEE	6494-6	4,800	Y	3½, 2⅜	15, 30	50, 3	E	E	E	E	E	G	E	E	E	G	G	F	E	103		H, S, X	7'	LIFE	U	37.5	325
PRO-TECH	7208	4,500	N	3½, 2½	15, 30	45, 0	G	E	F	F	G	G	G	G	G	E	F	P	F	100	H, S, X		6'10"	2 yr.	T	38.7	165
RIDGID	MS1060	4,600	Y	3, 2½	15, 31.6	47,2	G	E	G	G	G	G	G	E	E	G	G	F	G	101	S, X	H	9'6"	LIFE	U	34.0	190
RYOBI	TS1350DX	5,000	Y	3, 2½	15, 30	47°, 2°	G	E	E	G	E	G	G	G	E	E	G	F	F	100	H, S, X		7'6"	2 yr.	T	29.9	150
BOSCH	3924	3,600	Y	3½, 3½	15, 31.6	47°, 2°	G	E	G	F	E	G	G	F	G	G	G	F	G	92	H		N/A	1 yr.	T	30.0	460

NOTES:

For specifications on other types of tools, click on "Tool Comparisons" at www.woodmall.com.

1. (*) Requires resetting bevel stop to achieve this angle.
2. E Excellent, G Good, F Fair, P Poor
3. As equipped.
4. Rating for manufacturer-supplied blade.
5. Measured at operator's ear level while cutting 4x4.
6. (C) Crown-molding fence, (H) Stock hold-down, (L) Laser cutting guide, (S) Length stop, (X) Table extension(s)
7. (LIFE) Lifetime warranty against factory defects.
8. (J) Japan, (T) Taiwan, (U) United States
9. Prices current at time of article's production and do not include shipping, where applicable.

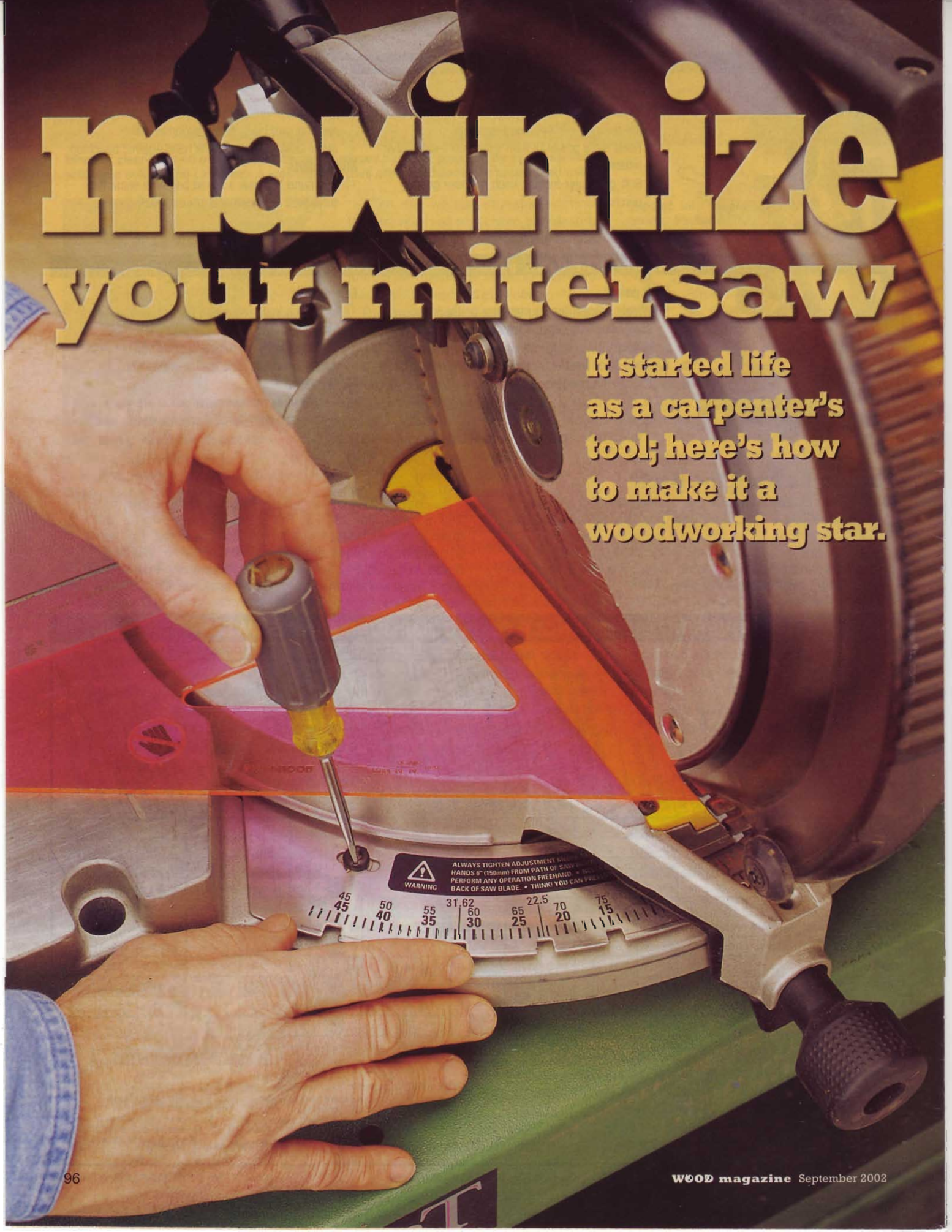
Written by **Dave Campbell** with **Rich Bright**

Photographs: **Baldwin Photography**

Charts: **Tim Cahill** and **Roxanne LeMoine**

maximize your mitersaw

It started life as a carpenter's tool; here's how to make it a woodworking star.



You can build wood projects for a long time without a power mitersaw, but once you have one, you find all sorts of ways to use it. It's handy for crosscutting long stock, making repeatable cuts, cutting flat miters, making compound cuts for angled sides, and more.

Like any tool, the mitersaw becomes more valuable and more fun to use if you set it up properly and learn how to use it to its full advantage. So try these keys for making your mitersaw do its very best.

Get squared up

Start by aligning your mitersaw accurately. Use a reliable square to see if the blade sits exactly 90° to the fence with its miter pointer set at "0." If the setting is off, check the owner's manual for the proper adjustment procedure. You'll either loosen the fence and square it to the blade, or loosen and adjust the gauge and turntable assembly, as shown in the large photo, *opposite*.

Now use your square to align the plate of the blade with the table. Make any adjustment by loosening the knob or lever that holds the saw head in place, tipping the head out of the way, and turning the stop bolt, as shown in **Photo A.** Set the bevel pointer to zero.

Also check the 45° setting. It can be difficult to fit a standard gauge in place for this step, so make a 45° cut on the end of a piece of scrap, using your newly calibrated miter scale. Hold this piece against the blade plate, as shown in **Photo B**, and adjust the bevel stop according to the instructions in your owner's manual.

Upgrade your blade

The blade that came with your mitersaw might not be the best one for your purposes. Make a few test cuts. If the results show excessive tear-out or rough saw marks, improve your saw's performance with a replacement blade. Look for a high-quality blade with 60 carbide teeth for most jobs, or choose 80 or even 96 teeth for the smoothest possible results. Match the tooth configuration to the task, as you would with a tablesaw blade.

If you have a sliding compound mitersaw, use zero- or negative-hook blades. They're safer than blades with more aggressive configurations because they don't "grab" the workpiece. Save your best blade, or blades, for fine woodworking. When it's time to cut 2×4s for a carpentry project, use a less-expensive blade with fewer teeth.

Different mitersaws have different methods of adjustment, but this is a common situation. The saw head rests on a bolt when set for vertical cuts. Turn the bolt to adjust the setting to exactly 90°.

Use the 45° angle setting to cut a template for the 45° bevel setting. It's easier to slide a piece of wood against the blade than to fit a combination square under the opposite side.

Along with the traditional ways of shopping for blades, you can find helpful information for each manufacturer's blades on the company's Web site. For one example, www.freudtools.com, the Freud site, takes you through a short series of options to find the right blade for any mitersaw application.

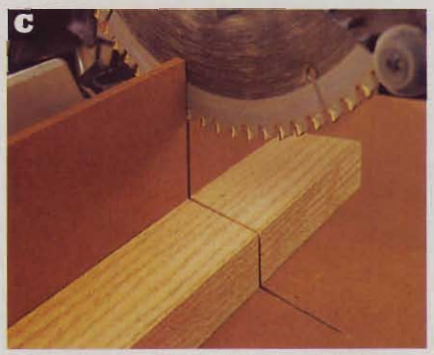
Cuts that look sharp

When you need precise results, use the hold-down that came with your mitersaw, or clamp the workpiece to the fence or table. No matter how firmly you hold it, an unclamped workpiece can shift imperceptibly as you make the cut.

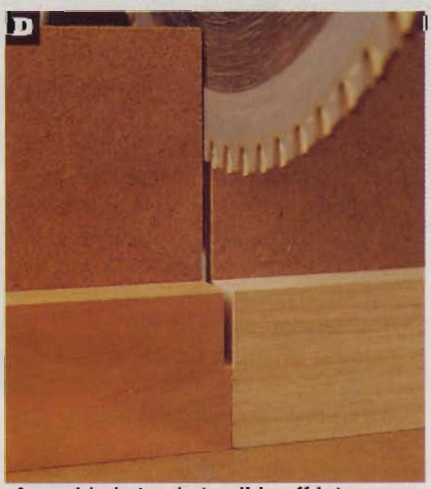
Decrease the chance of splintering on your workpiece with a zero-clearance auxiliary table and fence, as shown in **Photo C.** Cut two pieces of ¼" hardboard, one the size of your mitersaw fence, the other to match the table, and secure them in place with cloth-backed, double-faced tape.

Here's another tip for top results. When you need to "nibble" a blade's width of wood, or less, from the end of a workpiece, slide a scrap piece against it, and clamp them both firmly to the fence or table. This puts a solid mass of wood under the blade, as shown in **Photo D**, and your blade will cut straight, rather than seeking the path of least resistance

For the clearest look at your cut line, place the workpiece on the table with the keeper part on the left and the waste on the right. In our experience, more accurate cuts result when you lower the blade before turning on the saw, and match a left-leaning tooth to your line. Finally, resist the urge to race through each cut. For the cleanest possible cuts, wait until the saw gets up to speed before lowering the blade into the wood, and give it time to make the cut, too.



Even the best blade can create some tear-out on your workpiece. A zero-clearance arrangement such as this one keeps the splintering to a minimum.

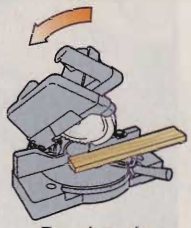


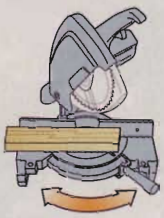
A sawblade tends to slide off into space when it's only partially on the workpiece, which causes inaccuracy as you trim the end of a board. A second board solves the problem.

cut tight miters with these tables

Miter and bevel settings for compound angles

Four sides, angle of side measured from vertical.





Angle of side	Bevel angle	Miter angle
5°	44.75°	5°
10°	44.25°	9.75°
15°	43.25°	14.5°
20°	41.75°	18.75°
25°	40°	23°
30°	37.75°	26.5°
35°	35.25°	29.75°
40°	32.5°	32.75°
45°	30°	35.25°
50°	27°	37.5°
55°	24°	39.25°
60°	21°	41°

A compound mitersaw gives you a great advantage in making angled sides, but first you have to find the right settings. Keep in mind that mitersaws have detent settings for the most common angles, making set-up quick and easy. In charts, *left and below*, we've compiled the information you need for a variety of situations. Use these settings with your stock lying flat on the table.

For a flat frame, refer to the chart *below* and simply set the miter angle of your saw by pivoting the head. For a box with angled sides, set your miter and bevel as shown in the chart to the *left*, and make a compound cut at each end of each piece.

Note: Bridge City Tool Works offers a complete listing of compound-angle settings in a $5 booklet called "Woodworker's Guide to Compound Miters." Call 800/253-3332 to order a copy.

Miter settings for frame corners

Number of sides	Miter angle
4	45°
5	36°
6	30°
8	22.5°

give your mitersaw a resting place

Now, where are you going to put your saw? Mitersaws are portable, but not as portable as, say, a cordless drill. A mitersaw is much more convenient to use if it has a permanent home. You can find plans for our "Mobile Mitersaw Center" in issue 119, or log on to www.wood store.woodmall.com/shoptoolac.html

If you don't have room for a permanent stand, you can store the saw away and place it on your workbench when you need to use it. Or, you might prefer to buy a portable stand. If so, consider the features at *right*.

- **Portability.** Some models sport big wheels that make it easy to move them outdoors and on stairs. Others have small wheels suitable only for rolling on a smooth, hard floor. Choose the style that will suit your needs. Also, if floor space is at a premium in your workshop, and you have a storage spot for your mitersaw, consider a stand that you can quickly fold up and stow in tight quarters.
- **Size.** Make sure your saw will fit on the stand's table and turn through its cutting range without interference. Also, check to see if it's big enough to hold other portable machines, such as your planer.
- **Stop system.** Sometimes you'll want to make several cuts at a given length. Miter stands offer a range of ways to set a stop for such tasks—but some don't include a stop system at all.
- **Workpiece support.** The most portable stands tend to use single-point supports to hold long boards. If you're willing to sacrifice some of that portability, you'll find models with extension wings that do a better job.

Photographs: **Baldwin Photography**
Illustrations: **Roxanne LeMoine**

shop-proven products

These woodworking wares passed our shop trials

Parallel-clamp universe expands

Since introducing the Bessey K-body clamp in 1988, American Clamping Company has virtually owned the parallel-clamp market. The jaws on these clamps stay parallel to maintain squareness and prevent bowing or "lifting" of an assembly during clamp-up. That feature, and the large jaw faces that distribute clamping pressure over a wide area, make these clamps a shop favorite despite their premium pricing.

Recently, two manufacturers stepped into the ring to take their best shots at the reigning champ of the parallel clamp. The challengers? Adjustable Clamp's Jorgensen Cabinet Master and Gross Stabil's PC².

The clamps feature several similarities: Clamping pressures spec out at 1,000

Jorgensen Cabinet Master

Performance	★★★★★
Price	$33 (24" clamp)
Value	★★★★★

Call Adjustable Clamp Company at 312/666-0640, or visit www.adjustableclamp.com.

Bessey K-Body

Performance	★★★★☆
Price	$35 (24" clamp)
Value	★★★★☆

Call American Clamping Company at 800/828-1004, or visit www.americanclamping.com.

Gross Stabil PC²

Performance	★★★★☆
Price	$40 (24" clamp)
Value	★★★☆☆

Call Gross Stabil at 800/671-0838, or visit www.grossstabil.com.

Continued on page 102

pounds or more; bar deflection, measured at various pressures, is virtually identical; and the jaws lock solidly and remain parallel when clamping. So, let's focus on the differences. Cabinet Master boasts the deepest jaws in the test—its 4" jaw measures ¼" and ⅝" longer from bar to jaw tip than the PC2 and Bessey, respectively. The newcomers also top the Bessey in jaw width, as shown at *top right*.

Sliding the movable jaw into position is easiest on the Cabinet Master, thanks to its smooth bar and forgiving lock/release mechanism. On the PC², I had difficulty finding the jaw's "sweet spot"—the exact handle position where the jaw slides freely, especially when dried glue accumulated on the bar's serrated edge. The Bessey suffers a little from glue buildup on the serrations, too, but the tight internal tolerances of the PC² made the bar downright impassable at times.

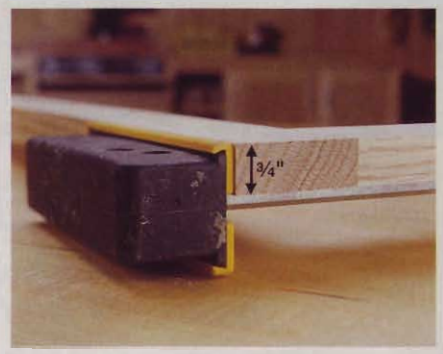
When it comes to capacity, sometimes you get more than you pay for. For instance, of the 24" clamps we tested, the Bessey opens to 25¾"; the Cabinet Master, to 25"; and the PC², to 24".

One unique feature of the Cabinet Master is the clamp stand/jaw stop at the end of the bar. (See photo *above*.) By holding the bar up off my benchtop, regardless of the jaw's location, I could line up a row of clamps, lay out my glued-up assembly on the bars, and slide the jaw without the clamp tipping or falling over.

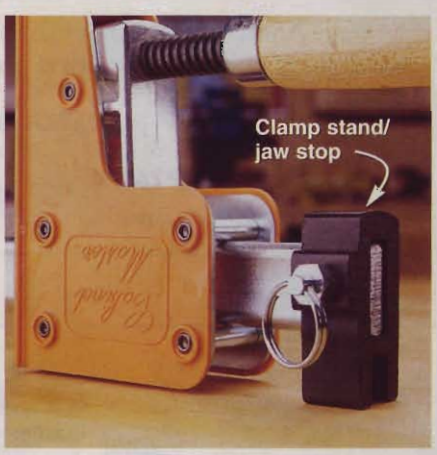
I was surprised to find the Cabinet Master clamps priced competitively with the Bessey, especially given the extra features of the Cabinet Master. The harder-to-find PC² clamps run about $5 per clamp more than the other models.

—Tested by Jeff Hall

Continued on page 106



Cabinet Master and PC² (shown) provide ¾" of jaw face on both sides of the bar, applying equal pressure across ¾"-thick glue-ups, such as face frames. Bessey has only ½" of jaw face available for that task.



Cabinet Master's clamp stand/jaw stop raises the bar so the jaw slides smoothly. The stop removes easily to convert the clamp to a spreader.

shop-proven products

Apply three coats of poly in one day

I love to put a tough polyurethane finish on projects that will see a lot of use. But I don't like the 4- to 6-hour wait between coats. Zar Ultra Fast Drying Polyurethane claims to dry well enough in 2 hours to sand and recoat.

To test this claim, I brushed a coat of Zar Ultra on an antique dresser that I had stripped and repaired. Two hours later I sanded and applied another coat without difficulty. Two hours after that, I brushed on a topcoat and let it dry overnight. The product levels out and dries as smooth as any poly I've tried.

If there's a performance trade-off for this fast-drying capability, I didn't see it. The open time—the time you can work it after applying it—seemed more like 15 minutes than the 30 minutes listed on the can. I consider that a plus because runs and sags can be brushed out after 5–10 minutes. Wait 20 minutes, though, and you'll wind up with brush marks.

Zar Ultra looks dark in the can, but it cured to a slightly lighter amber color than other oil-based polys. And, although it costs $1–$2 more per quart than Zar's regular poly, that's a small price to pay to cut my finish time in the shop to only a day.

—Tested by Bill Krier

Zar Ultra Fast Drying Polyurethane

Performance	★★★★★
Price	$8.50, quart
Value	★★★★★

To locate a dealer near you, call 800/272-3235, or visit www.ugl.com.

About our product testers

Bill Krier *is Editor-in-Chief of* WOOD® *magazine.* **Jeff Hall** *teaches woodworking and other technical skills to high-school students.*

what's ahead

A look at just some of the articles in our October issue (on sale September 3)

Projects for your home and shop

Bunk beds and dresser kick off children's set

Easy construction, great looks, and practical function describe the oak bunk beds and dresser in this complementary set. Look for a third matching piece—a child's desk—in the November issue.

A fitting flag case

Extreme miter angles won't stand in the way of you building this classic project, thanks to our simplified construction methods. You'll even learn how to properly fold a flag.

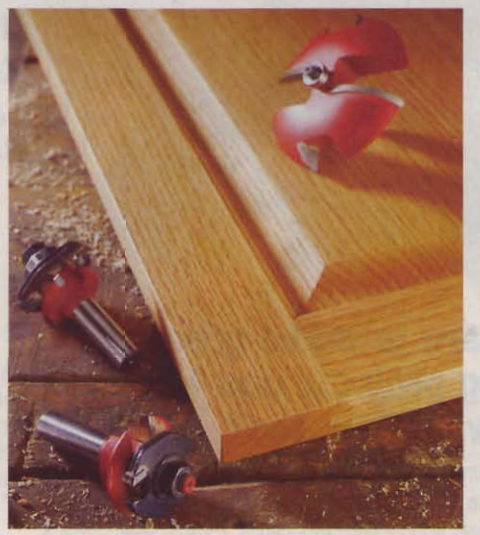
Versatile storage in a carousel

Here's an ingenious revolving shop organizer that we bet you can't resist building. It holds a ton of bits and accessories and makes them all instantly accessible.

Tools, Techniques, & Features

Buy a better bandsaw

Looking for a top-notch machine at a reasonable price? Or just wondering how your recently purchased model stacks up? We put seven bandsaws priced under $900 through their paces. Find out which ones came out on top.



Raised-panel doors made easy

Add a touch of class to your projects with this traditional design element. Here's how we build them safely *and* quickly in the *WOOD*® magazine shop.

Shop heating

Woodworking sure is fun when you're not freezing. Here's a look at the best ways to keep your shop cozy in the winter months ahead.