

MASTER ROUTING BASICS, PART 1 p. 42



# WOODCRAFT® Projects, Techniques, and Products magazine

## Hand-Tool Cabinet

Custom storage for your  
go-to collection p.22



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- **Carved Picture Frame**
- **Finish Test: Water vs. Oil**

VOL. 7/NO. 40 APRIL/MAY 11

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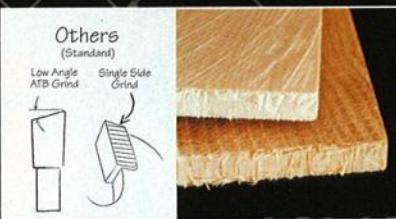
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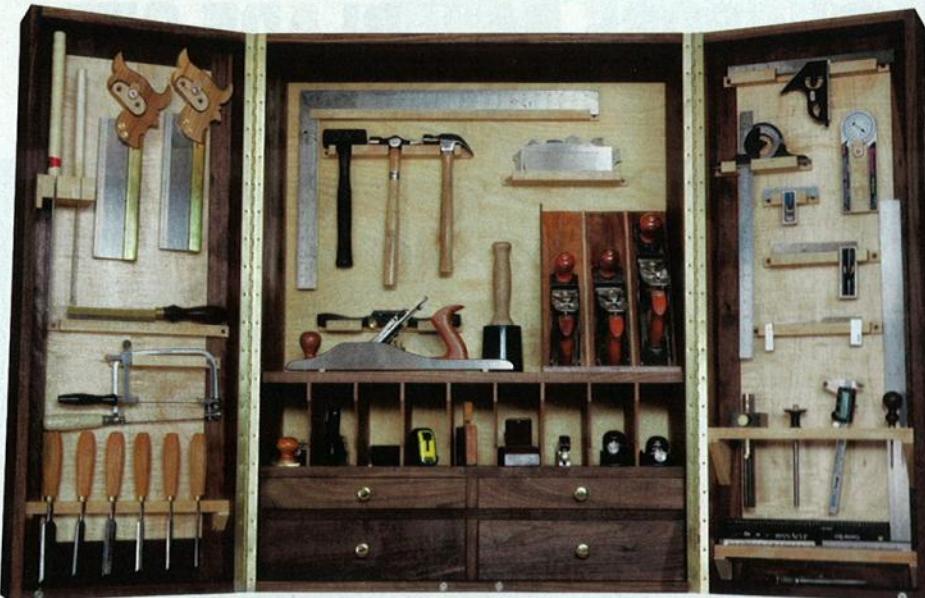
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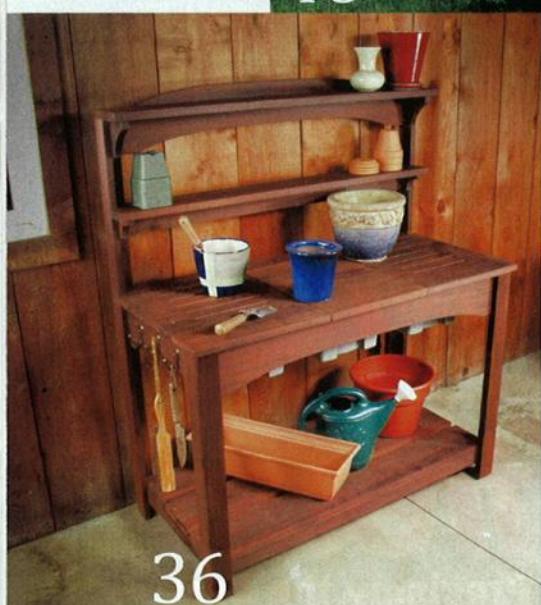
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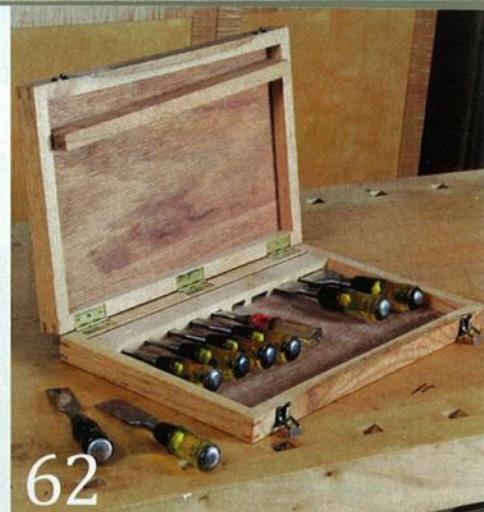
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# Legendary FEIN MULTIMASTER Durability

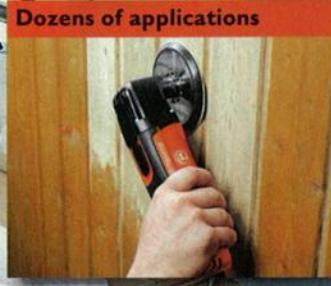
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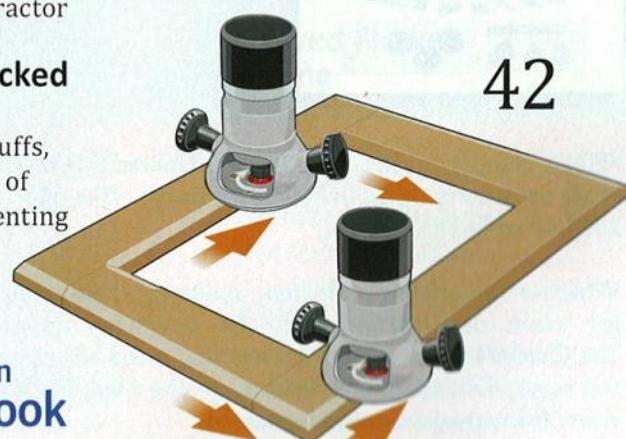
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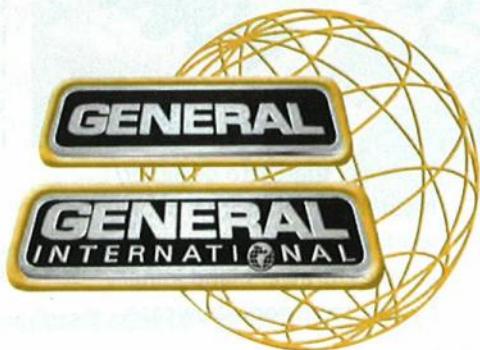


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## Single housing for hand tools

The course is inevitable, even predictable. The more time you clock in the shop, the more projects you take on, the more care you give to the making, the greater the desire and need for quality tools. And while your machines get spread throughout your floor space, your go-to hand tools, for practical reasons, require a step-saving single home. Answer: the hand-tool cabinet featured on page 22.

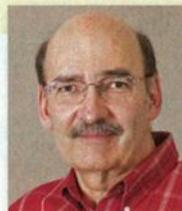
Some might quibble by saying that a shop drawer or two provides plenty of hand tool storage. Aside from being disorganized, such drawers can abuse precision tools. Drop a hammer on your caliper, chisels, or fine Starrett combination square, and you could chip away at your penchant for accuracy—the end game for all good woodworkers. Besides creating a proper place for your prized collection, a tool cabinet like the one featured lets you show off a little too. But to pull it off effectively, you need to determine what you want to store and how you want the items organized.

Whether you are designing a cabinet from scratch, reworking an existing design, or going with our featured project, you need to plan. Begin by laying out your selected tools on paper, cardboard, or, as in our case, inexpensive foam core. Arrive at a sensible formula. For instance, to relieve strain on the hinges and doors, we located our heaviest tools—planes and hammers—in the cabinet, reserving the lighter tools—saws and marking tools—for the doors. To protect our valuable collection, we made specialized holders for each type of tool. (See [woodcraftmagazine.com/onlineextras](http://woodcraftmagazine.com/onlineextras).) We safeguarded

the tools from falling off their holders, especially in the doors, with turn buttons, deep grooves and dadoes, and customized holes for chisels and marking tools. Because tool collections grow, become upgraded, and change, we machined tabs at the ends of many holders for quick and easy relocation. All in all, the entire journey proved rich in satisfaction and, now, yours for the taking. Do your hand tools need a home?



A special thanks to designer/builder Bill Sands (right) for working out the details of the cubbies, drawers, and joinery for our hand-tool showcase.



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Safety First! Working wood can be dangerous. Always make shop safety your first priority by reading and following the recommendations of your owner's manuals, using appropriate guards and safety devices, and maintaining all your tools properly. Use adequate sight and hearing protection. Please note that for purposes of illustrative clarity, guards and other safety devices may be removed from tools shown in photographs and illustrations in this publication and others.

A handwritten signature in cursive script that reads "Jim Harrold".



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## Nail gun gaffes revisited

I read "Air-gun gaffes" in the issue #39 "Mishaps" column, and I agree that a fastener needs to match the job and that the air pressure needs to match the gun and size of fastener. However, the major reason for a fastener blowing out of the side of the wood was not addressed: the orientation of the fastener to the workpiece.

The problem stems from the fact that, instead of a true point,

the tips on pneumatic finishing nails, brads, and pins are shaped more like the edge of a cold chisel. Because the edge of the tip runs parallel to the length of the nail gun clip, an errant nail will deflect to the side of the gun rather than above or below it. Therefore, when nailing into a workpiece edge, orient the gun perpendicular to the workpiece as shown in the photo at right. If a nail goes sideways,



it will bite into wood instead of breaking out of an adjacent face.  
—Les Worsley, Nashville, Tennessee

## Errata

In "Bookcase with Flair," Issue #38, the  $\frac{1}{4}'' \times \frac{1}{4}''$  notches shown in Figure 4 on page 36 should actually be  $\frac{1}{4}''$  high  $\times \frac{1}{2}''$  wide.

"Country Church Birdhouse" in Issue #39 contains dimensional errors. See corrections at [woodcraftmagazine.com](http://woodcraftmagazine.com).

## News Bulletins

### Delta Changes Hands

Stanley Black & Decker has sold the Delta brand of woodworking equipment to a Taiwanese company, Chang Type Industrial Co. Ltd. The company, renamed Delta Power Equipment Corp., will be headquartered in Anderson, South Carolina. The company will continue to design, manufacture, and market the UNISAW®, radial-arm saws, and Biesemeyer accessories in the U.S. The complete line of Delta woodworking equipment and Biesemeyer accessories will remain available through woodworking distributors and retailers. Delta and Biesemeyer customers can obtain parts and service by calling (800) 223-7278 or going to [deltamachinery.com](http://deltamachinery.com) or [biesemeyer.com](http://biesemeyer.com).

### Win a Day with Tommy MacDonald

Woodcraft invites you to enter the "Rough Cut Uncut – Win a Day with Tommy Mac" sweepstakes. The contest winner and a guest will travel to Canton, Massachusetts, in July to meet host Tommy MacDonald and watch one day of filming for his new public television show, *Rough Cut – Woodworking with Tommy Mac*. Visit your local Woodcraft store or [woodcraft.com/roughcut](http://woodcraft.com/roughcut) for entry details. Contestants may enter online, at stores, or by U.S. mail. Entry deadline is April 30, 2011.

## A welcomed response

In the last issue of *Woodcraft Magazine*, I asked readers for ideas to help wheelchair-bound woodworkers set up shop. To date, I've received nearly 30 emails and letters, many containing very good ideas. We'll work these into a magazine story for our December/January 2012 issue. To all who contributed, my sincere thanks.

—Jim Harrold, editor-in-chief

### Chime In

Have comments about the magazine, questions about an article, or something to share with your fellow *Woodcraft Magazine* readers? Send an email to [editor@woodcraftmagazine.com](mailto:editor@woodcraftmagazine.com) or a letter to *Woodcraft Magazine*, PO Box 7020, Parkersburg, WV 26102.

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## Hot New Tools

### Powerful palm-sized router

#### Porter-Cable 1 1/4 HP Compact Router Kit

The popularity of laminate trimmers in small shops has less to do with trimming laminate and more to do with the terrific maneuverability of such small routers. Because they're conveniently hand-sized, trim routers are used for a wide variety of edging and grooving chores. Unfortunately, most trim routers have rather rudimentary height adjustments, making precise depth setting difficult and mortising downright dicey.

Enter the Porter-Cable 450PK. Bridging the gap between laminate and full-sized routers, this palm-friendly 7 amp, 1.25 hp router comes with both plunge and fixed bases that resemble those used on larger Porter-Cable routers. The plunge base has a 2" plunging depth—deep enough for mortising—and turret



stops for making incremental cuts. The fixed base offers 1 1/2" of travel and has a depth stop ring for dialing cut depths to within 1/64".

The only minor disadvantage is that the router only accepts 1/4" shank bits. This prevents using profiles that are too large for the router, so if you've stocked up on 1/2" shank bits, it will add a few more to your arsenal.

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*Tester: Andrew Bondi*

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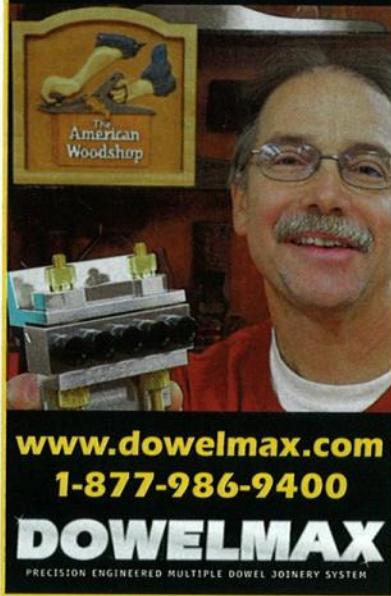
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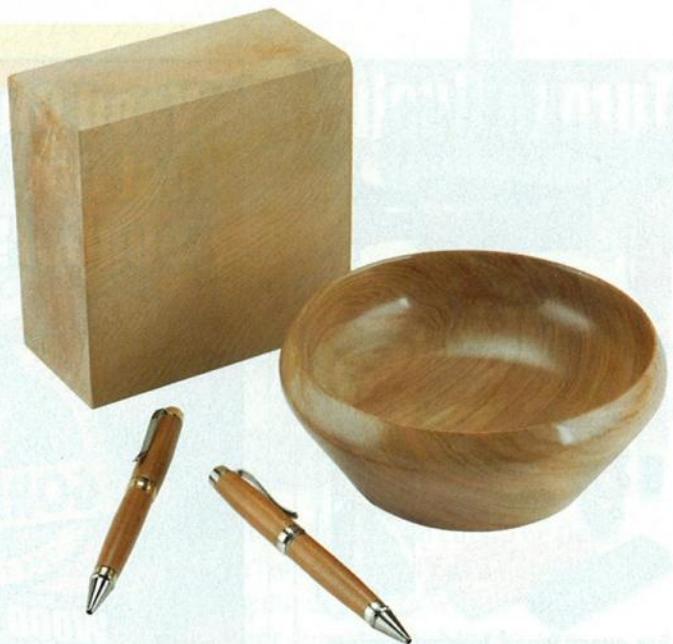
# Hot New Tools

## Wood that's so old, it's new

### Ancient Kauri Wood

Here's your chance to work some of the oldest workable wood in the world. Recovered from peat bogs in New Zealand, Woodcraft has obtained bowl and pen blanks from kauri logs dated at 50,000 years old.

Normally, wood this old would have petrified or have turned to coal, but I was pleasantly surprised to discover that kauri (technically a softwood) works much like cherry or soft maple. (Using a sharp tool really helped reduce any feathering.) The consistency of the stock is due in part to the ring density. Where most woods have just five or six rings per inch, kauri has more than 50.



Kauri's colors range from gold to dark caramel. Super-fine sanding (600 grit and above) brings out shimmering iridescent streaks.

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*Tester: George Snyder*

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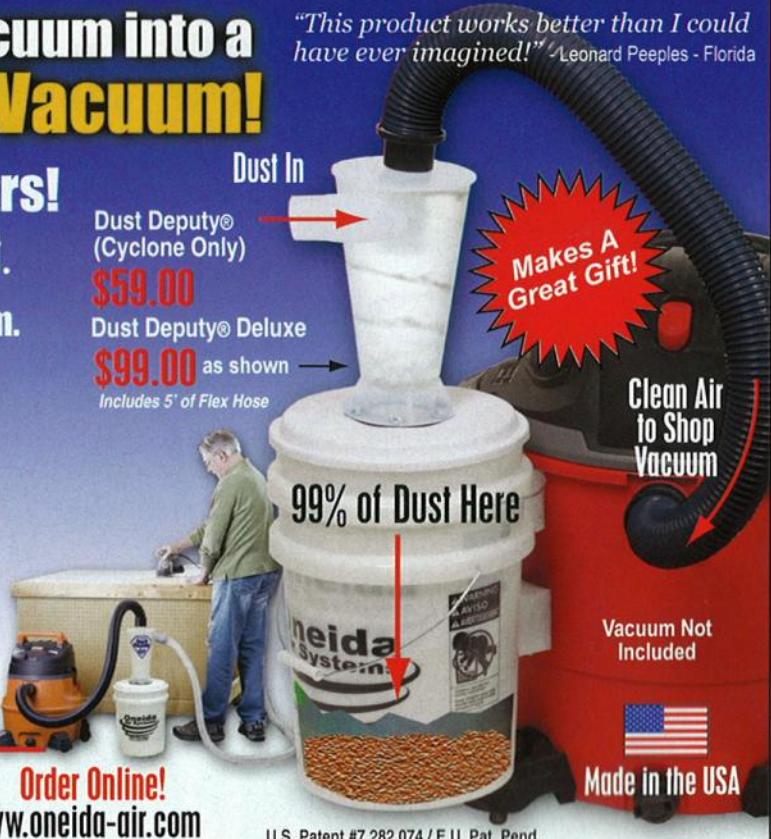
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## Hot New Tools

### Tough chisels at a tough-to-beat price

#### WoodRiver 6-Piece Chisel Set

When considering new chisels, the savvy woodworker has three primary questions: How tough, how comfortable, and, of course, how much? WoodRiver's newest chisels provide some happy answers.

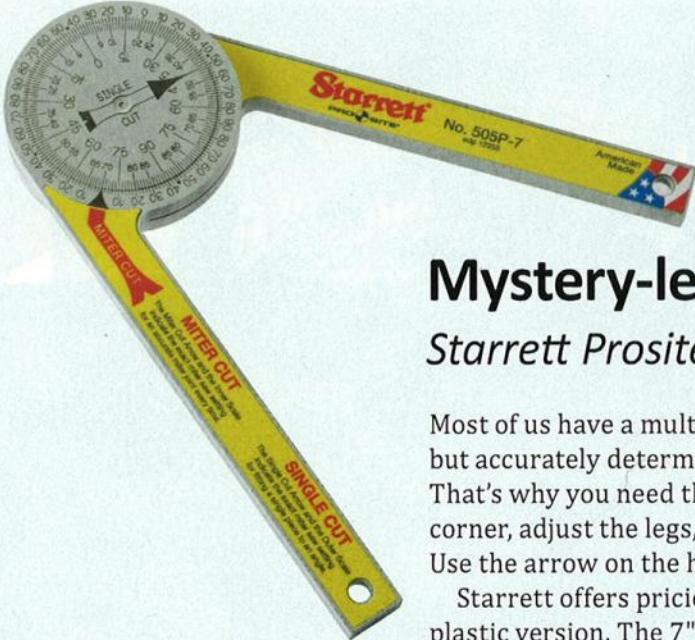
A refinement of WoodRiver's previous version, these chisels have chrome vanadium (CRV) blades with an average Rockwell hardness of 60 and reasonably comfortable bubinga handles. After lapping and polishing the backs, the metal held up nearly as well as some of my more expensive chisels. At 10", these chisels handle well for paring, although I found them a bit long for efficient chopping.



The really nice news is the price of the six-piece set, which includes  $\frac{1}{4}$ ",  $\frac{3}{8}$ ",  $\frac{1}{2}$ ",  $\frac{5}{8}$ ",  $\frac{3}{4}$ ", and 1" blade sizes. At around \$13 apiece, these competent chisels will be a solid set for those just starting a shop or for seasoned woodworkers looking for a backup set.

#151268 \$79.99

*Tester: Paul Anthony*



### Mystery-less miters

#### Starrett Prosolve Miter saw Protractor

Most of us have a multitude of ways to reliably measure 90° and 45° angles, but accurately determining the angles in between involves some hit or miss. That's why you need this protractor. To use it, simply place the tool into a corner, adjust the legs, and read the center arrow on the dial's outer scale. Use the arrow on the handle and the dial's inner scale for math-free miters.

Starrett offers pricier, all-metal models, but I recommend the cheaper plastic version. The 7"-long legs are the right size for measuring in tight quarters and for slipping in a tool belt or shop apron. What's more, the tool is priced so that you're more likely to use it for away-from-the-bench woodworking, such as installing crown molding or finishing up a deck. At this price, the tool can easily pay for itself by preventing a miscut or two.

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*Tester: Joe Hurst-Wajszczuk*

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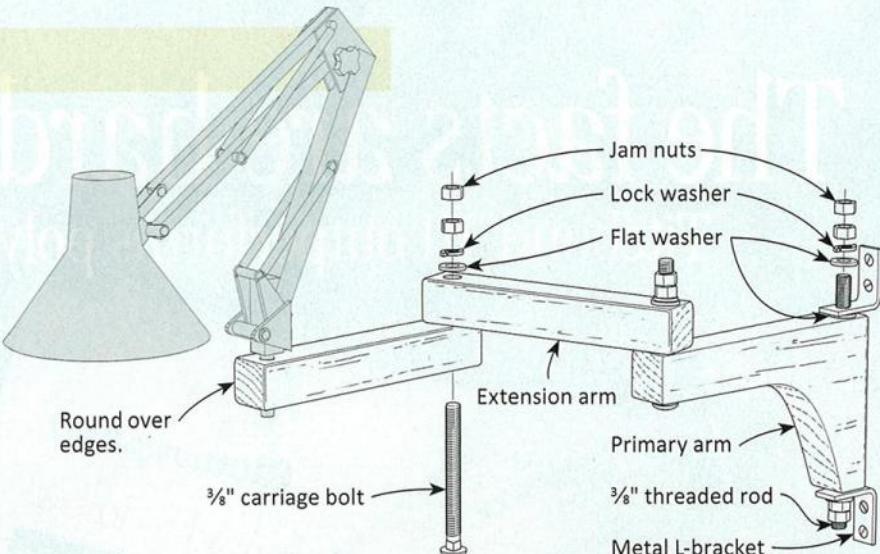
# Tips & Tricks

## TOP TIP

### Wall-mounted lamp arm

At my shop workstations, I like to use swing-arm lamps for adjustable task lighting. For convenience, I mount the lamp on a wooden arm that swings out from a nearby wall. Sometimes, a single arm does the trick, but when I need more reach and flexibility, I create an articulated arm by adding extensions as shown.

Make the primary arm from 1 $\frac{1}{4}$ "-thick hardwood about 5" wide, tapering out to 1 $\frac{1}{2}$ " at the end. Mine is 26" long, but suit yourself. Drill a  $\frac{3}{8}$ "-diameter hole through the wide end on the drill press, using a long bit. Bore as deep as your drill press allows, and then raise the table to complete the hole. Rout or sand a bullnose onto the wide end. You can drill a hole on the narrow end to carry a lamp, or add



an extension or two. Make an extension 1 $\frac{1}{4}$ " thick by 1 $\frac{1}{2}$ " wide and attach it to its mating arm with a  $\frac{3}{8}$ " carriage bolt, a washer, a lock washer, and a nylon nut or a pair of nuts jammed against each other. Tighten the hardware enough to provide both friction and adjustability. Mount two metal L-brackets to the primary arm, using a length of  $\frac{3}{8}$ " threaded rod secured at each end with a pair of jam nuts, and then screw the brackets to a wall stud.

—Mike Kehs, Quakertown, Pennsylvania

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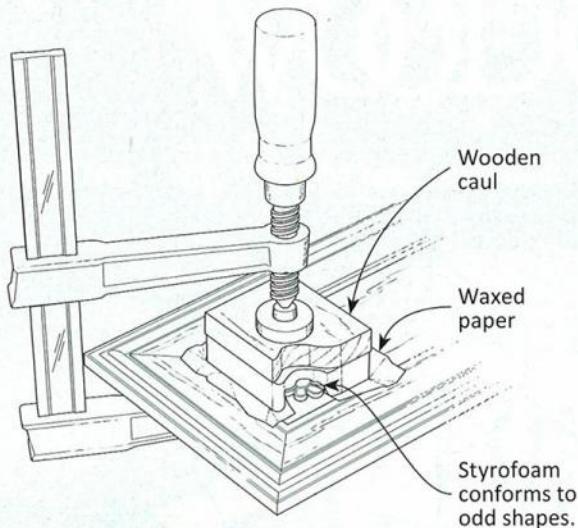
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## Clamping with Styrofoam

I do restoration work that often requires gluing on odd-shaped pieces such as moldings and carvings. I discovered that scraps of Styrofoam serve as great clamping cauls for pieces that lack flat clamping surfaces. Just cover the part to be clamped with waxed paper or cellophane, and then lay a piece of Styrofoam about 1" thick over it, topped with a wooden caulk for support. Under clamp pressure, the Styrofoam will compress over the part, providing fairly consistent pressure overall. This technique works not only for moldings and carvings, but also for inlay repairs where the patch might initially be a bit thicker than the underlying area.

—Brian Hillman, Stockbridge, Georgia

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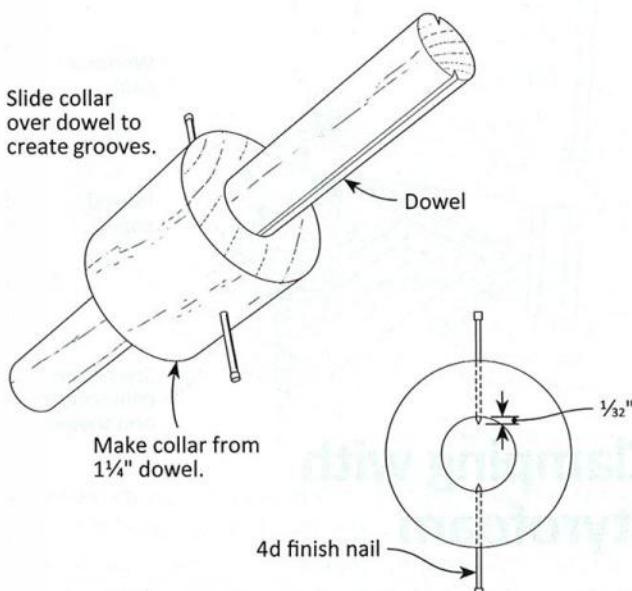


# Tips & Tricks

## Dowel-grooving collar

After seeing the "Grooving Dowels on a Tablesaw" tip in the last issue, I thought I'd share an approach that I've been using for years to groove dowels up to  $\frac{1}{2}$ " in diameter. My trick is to use a "collar jig" that has a feed hole through the axis, with nails projecting into the hole to create the grooves as the dowel is fed through the jig. I have several of these, each one suiting a particular dowel diameter.

To make a collar, drill through the axis of a  $1\frac{1}{4}$ "-long section of  $1\frac{1}{4}$ "-diameter dowel, using a bit that matches the diameter of the desired dowel size. Next, lay the collar on its side and use a  $\frac{1}{16}$ "-diameter bit to drill a hole completely through, intersecting the main hole at its center, and exiting the opposite side of the collar. Insert a 4d finish nail through each side hole, far enough for the tip to project into the center



hole about  $\frac{1}{32}$ ". Slide the collar down a length of dowel to create two opposing grooves, then reorient it  $90^\circ$ , and take a second pass to create a total of four grooves in a dowel. That'll do it.

—Gary Rohs, Cincinnati, Ohio

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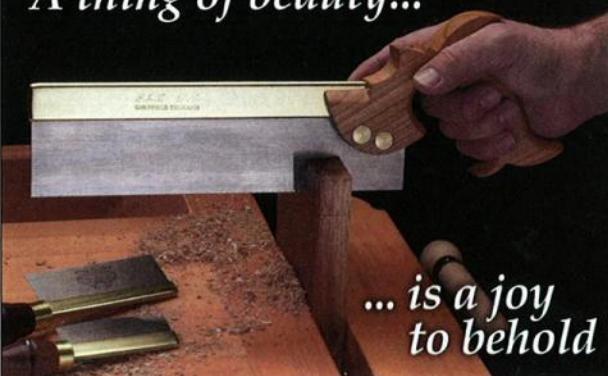
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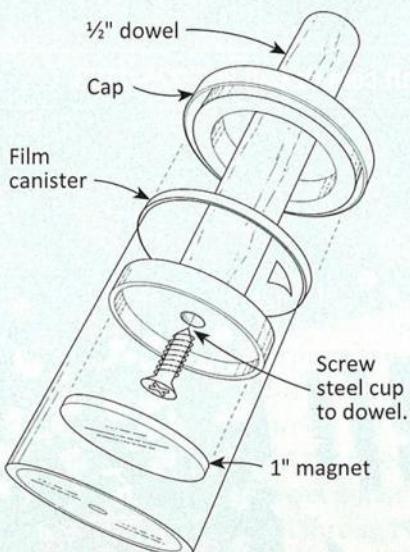


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## Tips & Tricks



### Quick-release magnetic pickup

It seems I'm always gathering up small screws and other hardware from the bench during hinge installation and other operations. I got tired of having to pick them up by hand, so I came up with this little solution. It's just a magnet attached to the end of a dowel that slides inside a 35-mm film canister. To "activate" the unit, slide the magnet to the bottom of the canister and pick up your hardware. To release the hardware, retract the magnet. Simple. It's also a great way to separate steel screws from brass and aluminum versions.

To make the pickup, attach a 1"-diameter rare-earth magnet (Woodcraft #150952) to the end of a 1/2"-diameter dowel about 3" long. I screwed on a 1" steel cup designed for attaching magnets (Woodcraft #150962), but you could use epoxy instead. Drill a hole in the canister cap to accept the dowel, put the parts together, and it's ready to go.

—Lee Dabkey,  
LaGrange Park, Illinois

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**Overall dimensions (open):  
64" w × 12" d × 40" h**

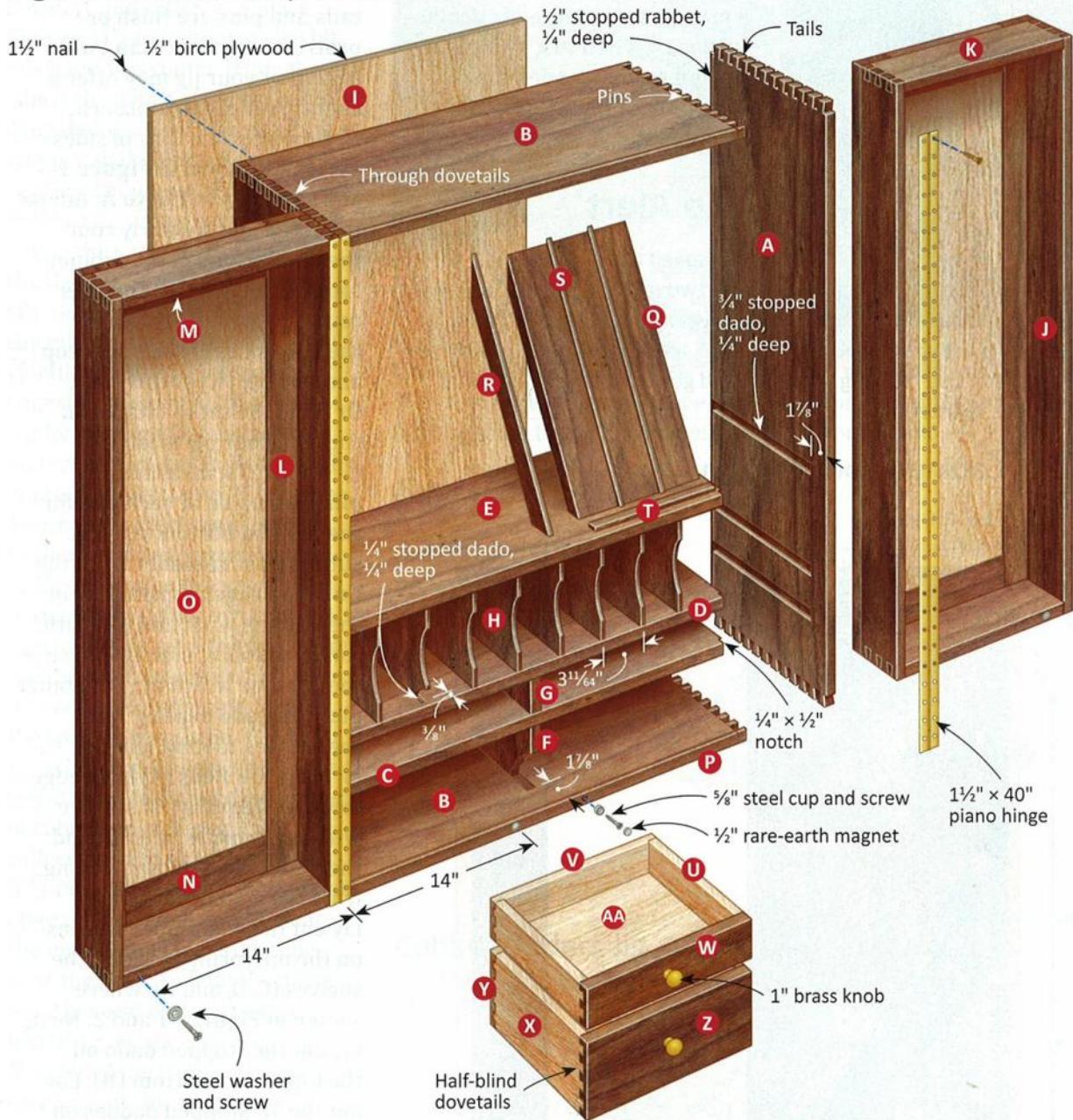
**Overall dimensions (closed):  
32" w × 16" d × 40" h**

dovetail jig, one that can make through and half-blind joints. (I used the Porter-Cable model 4212.) Don't own one? Then check out our **Convenience-Plus Buying Guide**.

In addition to the dovetails, you'll make a pair of simple jigs to rout stopped dadoes. You'll also machine raised-panel door fronts and learn tricks for attaching the clamshell doors and hanging a heavy cabinet.



**Figure 1: Cabinet Exploded View**

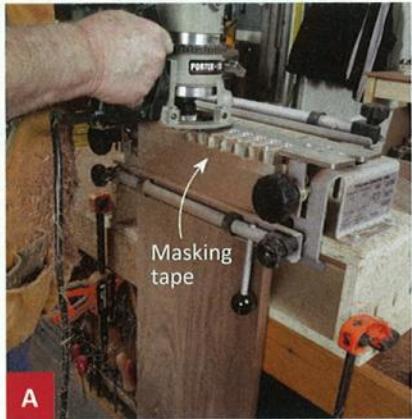


### Cut the cabinet parts

**1** Starting with  $\frac{4}{4}$  stock (I used walnut) mill enough stock for the cabinet sides (A), top and bottom (B), lower shelf (C), middle shelf (D), upper shelf (E), lower divider (F), and upper divider (G). You may need to edge-glue two or more boards to make up each wide part. Also consider milling the door sides (J) and the door top and bottom (K) at this time and extra

stock for jig setup. Now finish jointing and planing the stock to  $\frac{3}{4}$ " thick. Rip and crosscut the sides, top, and bottom to the dimensions in the **Cut List**. Rip the remaining parts to the finished widths but cut them long for now. Label "inside" and "outside" on the cabinet sides, top, and bottom. Also, label the mating dovetail ends. **2** Referring to the instruction manual, set up your through

dovetail jig to rout the tails in the  $12\text{"}$ -wide sides (A). (Because of the long length of the sides, I constructed a box-like plywood platform to elevate my jig to the needed height and secured it to my workbench.) Next, install the required dovetail bit and bushing in a handheld router, adjusting the cut depth. Using scrap the same width and thickness as the sides clamped vertically in place, rout "test" tails.



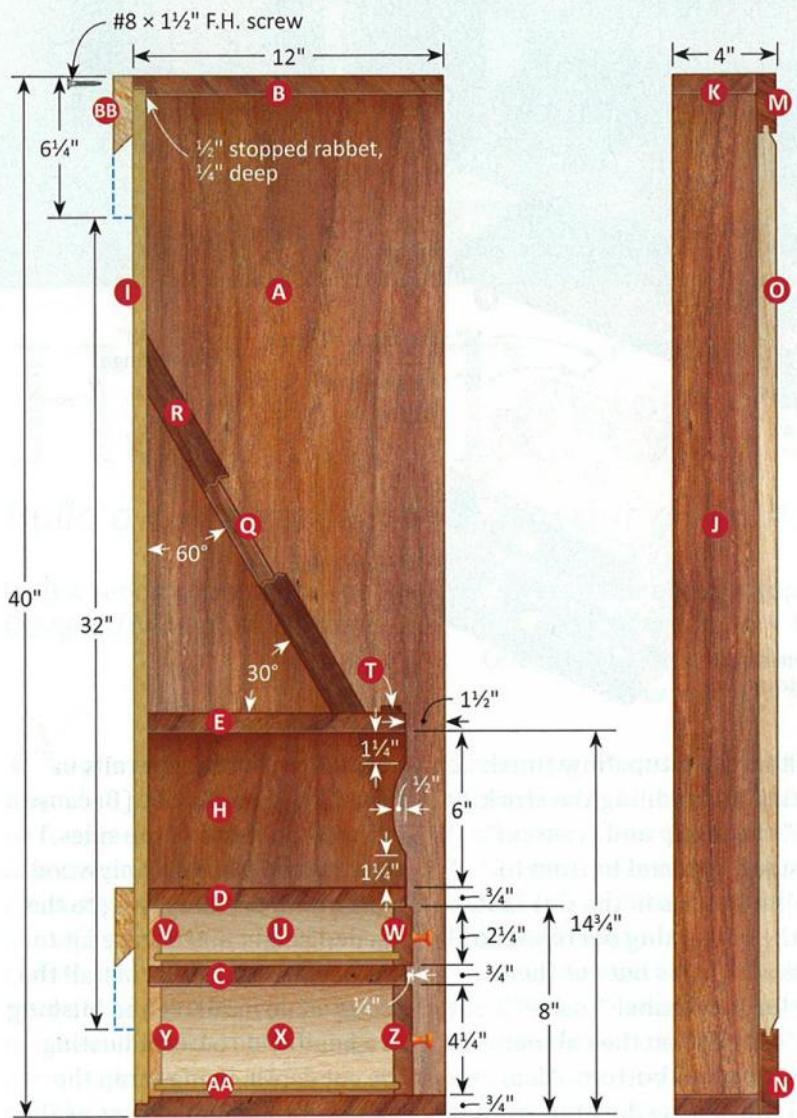
Rout the tails in the sides, guiding off the template. Use masking tape to reduce splintering.

Reverse the template and clamp a mating scrap piece vertically in place. Switch to a straight bit and recommended bushing and rout the pins. Check the fit. Ideally, you want a snug,

### Tip Alert

To speed the dovetail work, set up two routers with the specified dovetail bit and guide bushing in one, and the specified straight bit and guide bushing in the other.

**Figure 2:** Cabinet/Door Section View



flush fit and one where the tails and pins are flush or protrude no more than  $\frac{1}{32}$ ". Note that your jig may offer a slightly different approach.

**3** Now, rout the tails in sides (A) where shown in **Figure 1** and as shown in **Photo A**. Adjust the setup and similarly rout the mating pins in the cabinet top and bottom (B). Consider routing the tails and pins in the door sides (J) and door top and bottom (K) at this time. Or leave the setup intact and rout the door parts later.

**4** If it exists, measure any pin protrusion at each end for the top and bottom (B) and subtract that amount from the **Cut List** length dimension for the shelves (C, D, and E). With flush dovetails, simply measure the interior width of the cabinet plus the dado depths. Trim the shelves to final length.

**5** Place the sides (A) back edge to back edge on a flat surface with their inside faces up and their ends flush. Now, starting from the mated back edges, lay out the  $\frac{3}{4}$ " stopped dadoes on the mirroring faces for the shelves (C, D, and E), where shown in **Figures 1** and **2**. Next, lay out the stopped dado on the top face of bottom (B). Lay out the  $\frac{3}{4}$ " stopped dadoes on the bottom and top faces of the lower shelf (C), and the bottom face of middle shelf (D), noting the distance to the front edges.

**6** Make the stopped dado jigs to the dimensions shown in **Figure 3**.

**7** Align the sides and shelves jig with the bottommost stopped dado layout lines, and clamp the jig in place along the back edge of one side (A). Adjust the stop to terminate the dado where shown in **Figure 1** (the shelf dado

lengths differ from the sides and bottom), and clamp it in place. Chuck a  $\frac{5}{8}$ "-diameter pattern bit in a handheld router. Using the jig, adjust the depth of cut to rout  $\frac{1}{4}$ "-deep dadoes. Now, rout the first stopped dado. Relocate the jig to cut the remaining stopped dadoes in this side, as shown in **Photo B**.

Use the same jig to rout the dadoes in the bottom (B), the lower shelf (C), and the middle shelf (D).

**8** Mill at least 60" of stock slightly wider than 10" for the cubby dividers (H). Plane the material to  $\frac{1}{4}$ " thick. Now rough-cut the material into 7" lengths. These eight pieces will be cut to their finished length later.

**9** To determine the spacing between the cubby dividers (H), subtract their total thickness from the cabinet's interior width, then divide by nine. (On this cabinet the spacing measured  $3\frac{11}{64}$ ".) Keep in mind, however, that you might want to adjust the number of cubbies to suit your tool collection or to fit wider items.

**10** Place the shelves (D, E) back edge to back edge and flush at the ends. Apply masking tape over the seam to hold the parts together and to create better visibility for seeing layout marks. Now, working from the same end, lay out the spacing of the  $\frac{1}{4}$ " dadoes on the mirroring faces of the middle and upper shelves. From these marks, extend strips of masking tape perpendicular from the back edges at the cubby divider marks to reduce tear-out when routing the  $\frac{1}{4}$ " dadoes. Separate the shelves by knifing lengthwise through the seam tape.

**11** Using the cubby dividers jig in **Figure 3** and a  $\frac{1}{4}$ "-diameter router bit with a  $\frac{3}{8}$ " O.D. bushing, rout the stopped

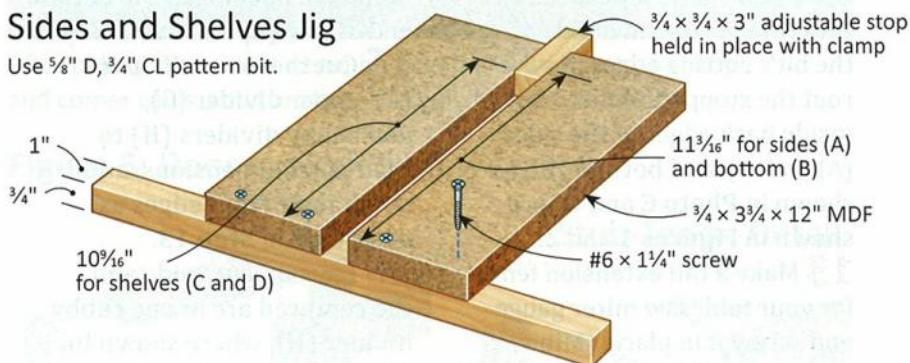


With the guide strip against the back edge, run the pattern bit's bearing along the jig to complete a clean stopped dado.

### Figure 3: Stopped Dado Jigs

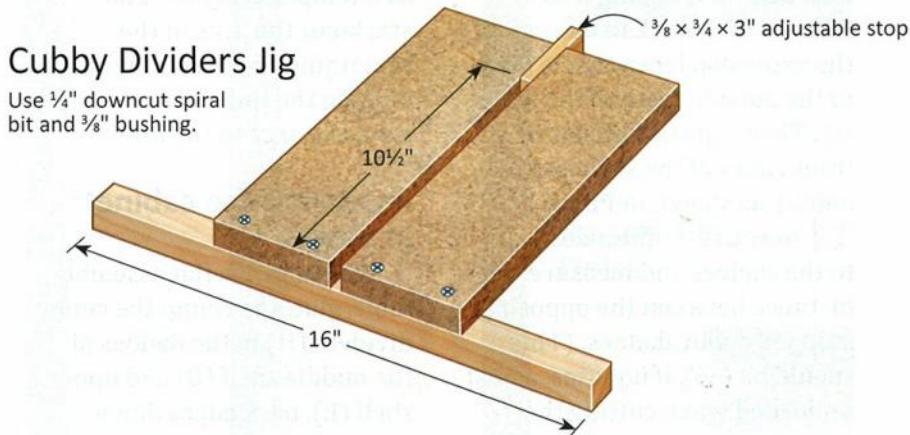
#### Sides and Shelves Jig

Use  $\frac{5}{8}$ " D,  $\frac{3}{4}$ " CL pattern bit.



#### Cubby Dividers Jig

Use  $\frac{1}{4}$ " downcut spiral bit and  $\frac{3}{8}$ " bushing.



dadoes  $\frac{1}{4}$ " deep for the cubby dividers (H) in the middle shelf (D) and the upper shelf (E).

**12** Install a rabbeting bit in a table-mounted router, and adjust the fence and bit to cut a  $\frac{1}{2}$ "-wide rabbet,  $\frac{1}{4}$ " deep.

#### Tip Alert

Layout marks show up better on masking tape than on dark wood like walnut, and it helps reduce tear-out.



C

Align the leading end of the workpiece with the start mark, make the cut, and stop when the trailing end of the board aligns with the (right-hand) stop mark.

Draw start and stop marks on the fence  $\frac{3}{4}$ " to either side of the bit's cutting edges. Now rout the stopped rabbets on the inside back edges of the sides (A) and top and bottom (B), as shown in **Photo C** and where shown in **Figures 1** and **2**.

**13** Make a tall extension fence for your tablesaw miter gauge and screw it in place. (Mine measured 12" high.) Now, install a  $\frac{1}{4}$ " dado set, raising it to  $\frac{1}{2}$ ". Clamp a stopblock to one end of the extension fence that is flush to the outside teeth of the dado set. Then, cut the notches in the front edges of the shelves (C, D, and E), as shown in **Photo D**.

**14** Now dry-fit the sides (A) to the shelves and measure the distance between the opposing stopped cubby dadoes. (This should be  $6\frac{1}{2}$ ". If it varies, adjust as needed when cutting the cubby dividers to final length.) For the length (height) of the upper divider (G), measure the distance between the middle shelf (D) and lower shelf (C) dadoes and add  $\frac{1}{2}$ ". To figure the length for the lower divider (F), measure from the lower edge of the lower shelf dado to the base

of the tail opening at the bottom end of side (A) and add  $\frac{1}{2}$ ".

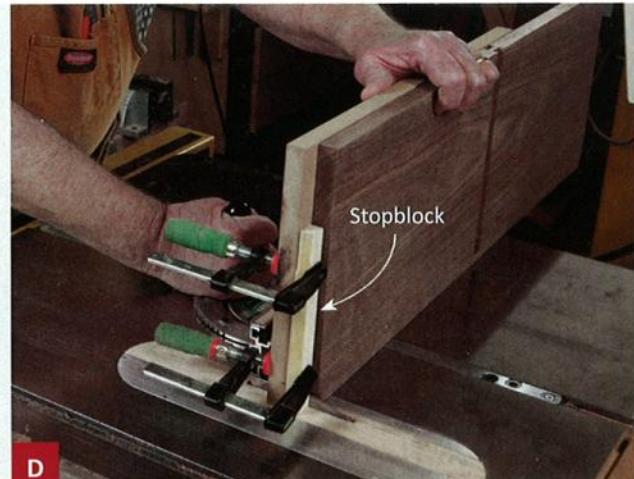
**15** Cut the lower divider (F), upper divider (G), and cubby dividers (H) to their final dimensions, and notch their front edges as described in **Step 13**.

**16** Lay out, cut, and sand the centered arc in one cubby divider (H), where shown in **Figure 2**. Using this piece as a template, lay out and stack-cut the arcs in the remaining dividers, staying just outside the line. Now, stack-sand the arcs to the line.

### Assemble the cabinet in stages

**1** Working on a flat assembly table, glue and clamp the cubby dividers (H) in the dadoes of the middle shelf (D) and upper shelf (E), back edges down. Square the subassembly, and ensure all front edges are flush. Let dry overnight.

*Note: For the more complex cabinet glue-up, gather the parts (including the cubby subassembly), clamps, glue, damp rag, tape, and brushes and consider inviting a helper to apply glue and clamps.*

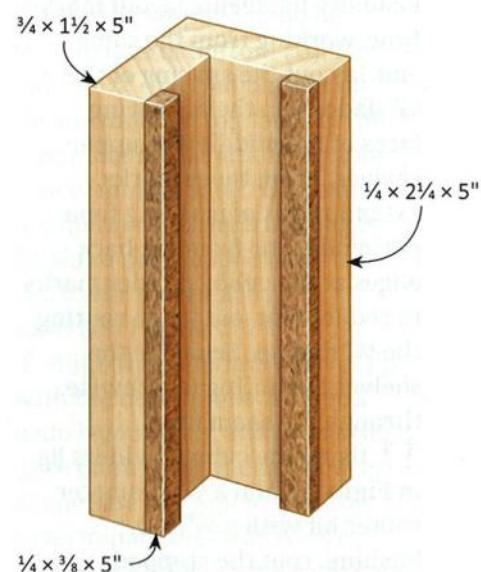


D

Notch the front corners of the shelves, using a tall miter gauge fence and stopblock to maintain workpiece control.

I used Titebond II Extend Wood Glue for a longer working time and made four 5"-long corner clamping cauls (**Figure 4**) to work with a strap clamp and apply even pressure around the center of the wide cabinet corner joints. The  $\frac{1}{4} \times \frac{3}{8}$ " edge strips raise the cauls off the joint, preventing interference and adhesion. Finally, I cut a  $\frac{1}{2}$ " piece of MDF to serve as a spacer below the cubby subassembly and lower shelf (C) to create the needed clearance for back (I).

**Figure 4:**  
Corner Clamping Caul



**2** Working quickly, apply glue to all joints—the tails and pins, the  $\frac{3}{4}$ " stopped dadoes, and shelf ends. With the back edges down and the spacer in place, fit the through dovetail joints together and the notched shelves into the stopped dadoes. Slip the strap clamp and corner cauls in place, tighten, and add the bar clamps at key joint locations (**Photo E**). Use a damp rag to remove any glue squeeze-out. Measure diagonally across the cabinet to check for square. Tap or apply clamping pressure across the cabinet, and pull it into square if needed. Let dry, and then remove the clamps and glue the lower and upper drawer dividers (F, G) in place. Flush up the corners and edges with planing or sanding.

**3** Using a chisel, square the corners where the rabbets along the back edges of the cabinet come together. Measure the rabbeted opening, and cut the  $\frac{1}{2}$ "-thick birch plywood back to fit. Set it aside.

### Make the clamshell doors and plane ramp

**1** If not done earlier, cut the clamshell door sides (J) and tops and bottoms (K) to the dimensions in the **Cut List** now. Adjust the tops and bottoms as needed so the assembled frames are within  $\frac{1}{6}$ ". Rout the tails and pins for the through dovetail joints (**Figure 5**).

**2** Rest the cabinet on its back edges on an assembly table. Now,

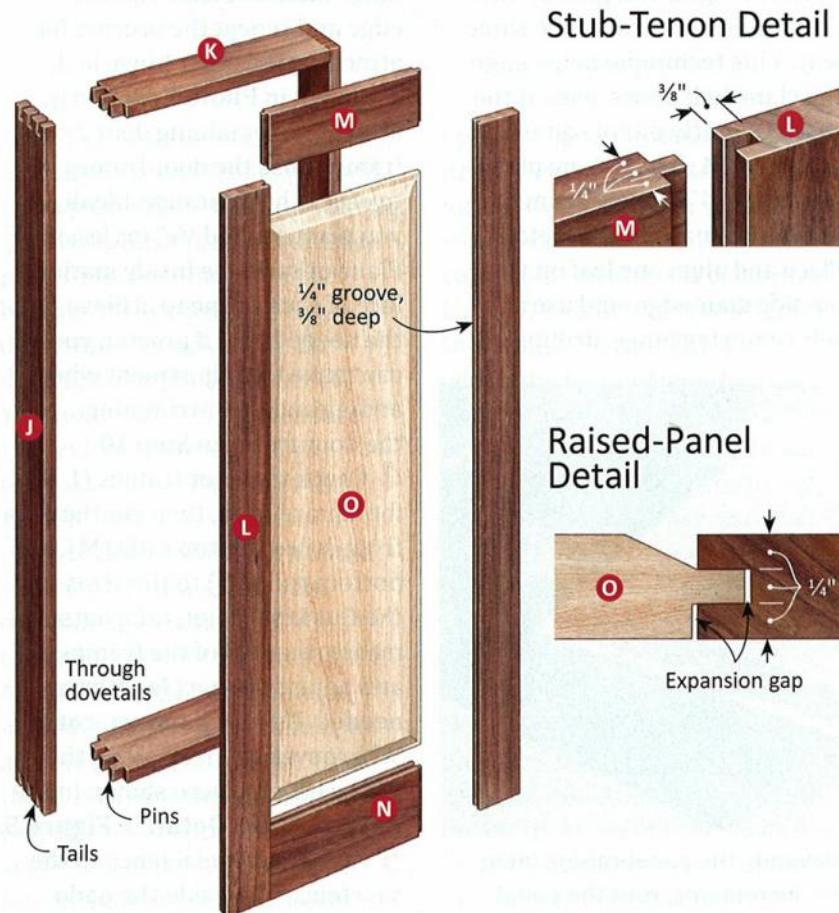
### Tip Alert

When gluing up the door on the cabinet, clamp scrap along the inside cabinet walls to ensure that the sides, top, and bottom conform to the cabinet's shape.



After pulling the cabinet assembly together with the strap clamp and corner cauls, add bar clamps to pull the joints tight.

**Figure 5: Door Exploded View**





F

To avoid stripping the heads or snapping the brass screws, drive them by hand instead of using a power drill.

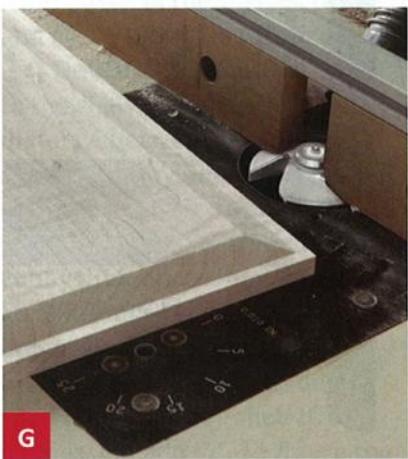
glue and assemble one clamshell door frame, door sides (J) and door top and bottom (K) in place *on the cabinet*, flush with the cabinet's walls. Mark the door as left or right, and glue up the remaining door frame the same way. This technique helps align the clamshell doors, even if the case is slightly out of square.

**3** Cut two  $1\frac{1}{2} \times 48"$ -long piano hinges to 40" at a leaf seam to prevent damage to the metal. Place and align one leaf on the outside door edge, and use a self-centering hinge-drilling bit

to drill the pilot holes. Carefully drive the hinge screws. Then, using clamped-on scrap for alignment on the cabinet's interior walls, rest the door frame and hinge on the outside cabinet edge and repeat the process for attaching the other hinge leaf, as shown in **Photo F**. Similarly, attach the remaining door frame. Close the door frames to check the clearance. Ideally, you want around  $\frac{1}{16}$ " (or less). Plane or sand the inside mating face of each frame to achieve the needed gap; if greater, you can make the adjustment when adding and flush-trimming the door fronts in **Step 10**.

**4** Check the door frames (J, K) for square. If so, then cut the door front stiles (L), top rails (M), and bottom rails (N) to the sizes in the **Cut List**. If not, take outside measurements of the frames and adjust the part lengths as needed. Using a dado set, cut the  $\frac{1}{4}"$  grooves  $\frac{3}{8}"$  deep along the inside edges where shown in the **Raised-Panel Detail in Figure 5**.

**5** Add a sacrificial fence to the saw fence alongside the dado set, and use the miter gauge to



G

Elevating the panel-raising bit in  $\frac{1}{16}$ " increments, rout the panel ends first, then the edges.

cut stub tenons on the rails (M, N), as shown in the **Stub-Tenon Detail in Figure 5**. Back the workpieces to avoid tear-out.

**6** For the panels, use wide boards or edge-join two boards of a contrasting wood to make up a blank for the door front raised panels (O). (I book-matched two pieces of figured maple cut from thicker stock, but you could book-match wide board panels as well.) Plane the blank to  $\frac{3}{4}"$  thick and cut the panels to  $12 \times 35"$ , trimming equally off both edges to maintain a centered joint line.

**7** Dry-fit the front frame (parts L, M, and N), and measure the distances between opposing groove bottoms. Subtract  $\frac{3}{8}"$  from these measurements for your final panel width. This size works if building the panels during a moist season. If you make the panels during a dry season or if you live in a dry desert-like climate, add  $\frac{1}{4}"$  to the final panel size width. Now trim the panels (O).

**8** Chuck a panel-raising bit in a table-mounted router and raise the panels (O), (**Photo G**). Check the fit of the panel in the grooves in the stiles and rails (L, M, N). Sand and finish.

**9** Glue and clamp the frame-and-panel door fronts together (parts L, M, N, and O), allowing the raised panels to float within the frame. Flush all joints and check for square. Let dry.

**10** Drive small brads into the outside edges of the installed door frames (J, K), one near each corner. Clip the heads of the

## Tip Alert

Use clipped brads when mating parts to maintain alignment and prevent glued surfaces from slipping.

brads  $\frac{1}{8}$ " above the edges. Apply glue to one frame and rest a door front assembly (L, M, N, O) on the clipped brads. Place the front on the frame, achieving a slight (if any) equal overhang all around. Then, using clamps, press the front onto the frame, sinking the brads into the wood. Ensure a firm bond along all edges, and wipe up any squeeze-out. Let dry and repeat for the other door. If overhang exists, plane or flush-trim the excess with a bottom bearing flush-trim bit.

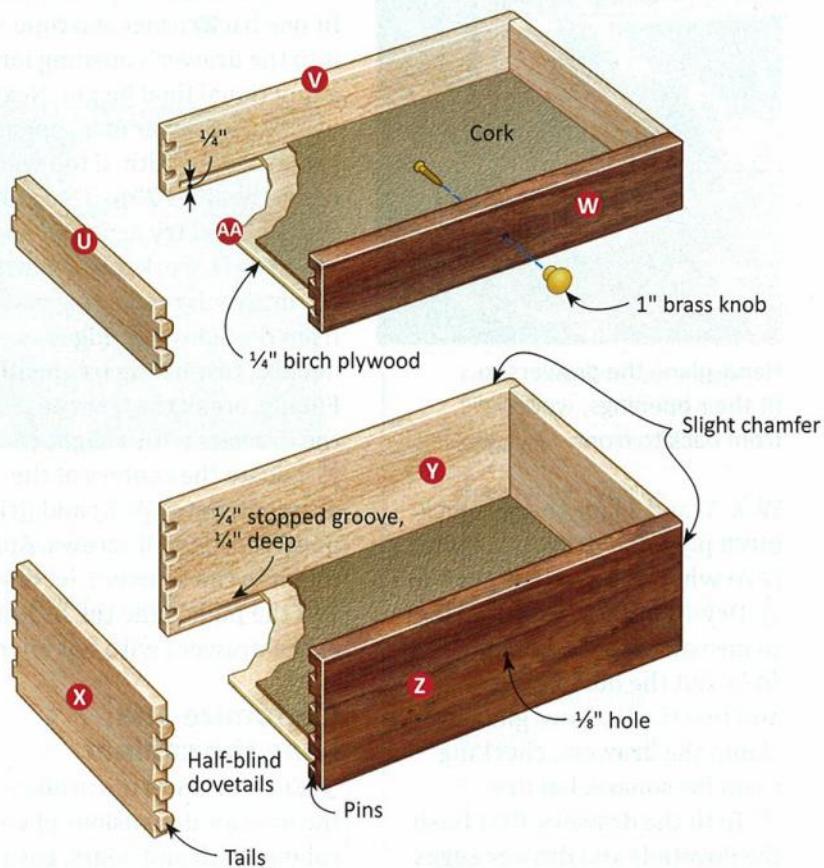
- 11** Measure the distance between the hinges at the cabinet top and bottom, and cut two top and bottom edging pieces (P) to this length from  $\frac{3}{16} \times \frac{7}{8}$ " strips. Glue and clamp the pieces in place and flush-trim or sand the proud edges.
- 12** Install the back (I) with glue and  $1\frac{1}{2}$ " nails.
- 13** Cut the plane ramp (Q), ramp edging (R), and ramp dividers (S) to the sizes in the **Cut List**. Use a tall fence and zero-clearance insert to cut the ramp's angles. Glue and/or pin-nail the ramp where shown in **Figure 1**. Test-fit the ramp edging against it and glue and/or pin-nail it in place. Add the dividers and cut and install the stop (T). See **Figure 2**.
- 14** Sand the cabinet and door unfinished parts through 220 grit. Wipe clean and finish.

## Make and fit the drawers

*Design Note: To add style, I extended the overall drawer lengths  $\frac{1}{4}$ " beyond the 10" drawer opening depth, creating a total drawer length of  $10\frac{1}{4}$ ".*

- 1** Mill your drawer stock to the thicknesses in the **Cut List**, and add  $\frac{1}{4}$ " to the lengths and widths for the small drawer sides (U), small drawer backs (V), small drawer fronts (W), large drawer

**Figure 6: Drawers Exploded Views**



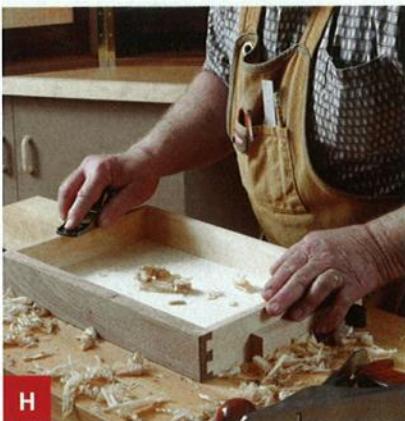
sides (X), large drawer backs (Y), and large drawer fronts (Z). Mill extra pieces for setting up your jig.

- 2** To establish finished drawer part sizes, first measure the heights of the openings to determine the widths of the drawer sides (U, X), backs (V, Y), and fronts (W, Z). Measure the widths of the openings to give you the lengths of the drawer backs and fronts.

**3** To establish the length of the sides (U, X), first set up your dovetail jig to make half-blind tails and pins and cut a test joint. Make the needed adjustments, according to the jig's manual, to achieve a snug, flush joint. Once there, measure the tail length (which is the depth of cut) of the vertical (side) test piece. Now, figure the inside dimension of the drawers from front to back

by measuring the depth of the drawer opening and adding  $\frac{1}{4}$ " for the overall drawer length from front to back. Subtract the combined thicknesses of a drawer back (V, Y) and front (W, Z) from this length (here,  $1\frac{1}{4}$ "), and add in the test tail length *twice*, accounting for the half-blind joint at the front and back. The result yields the needed lengths of the drawer sides. (I subtracted  $1\frac{1}{4}$ " from the overall drawer length and added a  $\frac{3}{8}$ " tail length to each end for a final side length of  $9\frac{3}{4}$ ".)

- 4** Cut the drawer parts to finished widths and lengths. Now, label the outside faces and the corner pairs 1-1, 2-2, 3-3, and 4-4. Rout the half-blind dovetails in the mating parts.
- 5** Locate and rout the stopped grooves  $\frac{1}{4}$ " from the bottom edges of the drawer parts (U, V,

**H**

Hand-plane the drawers to fit their openings, working from back to front.

W, X, Y, and Z) for the  $\frac{1}{4}$ "-thick birch plywood drawer bottoms, (AA) where shown in **Figure 6**.

**6** Dry-fit each drawer together to measure for the bottoms (AA). Cut the bottoms to size and test the fit. Now, glue up and clamp the drawers, checking them for square. Let dry.

**7** To fit the drawers, first flush the dovetails and drawer edges with a hand plane or sanding block. Then use a plane to form  $\frac{1}{16}$ " chamfers on the back corners of the drawers. Plane a shallow

arc on the bottom edges of the drawer backs (V, Y). Now test-fit one back corner at a time into the drawer's opening for a functional final height. Next, insert the drawer in its opening to check the width. If too wide, plane the sides 2" to 3" in from the back and try again. As shown in **Photo H**, work toward fitting the drawer by removing material from the sides and edges as needed, test-fitting frequently. Finally, break the front edges of the drawers with a slight chamfer.

**8** Locate the centers of the drawer fronts (W, Z) and drill the holes for the pull screws. Apply finish to the drawers, let dry, and add the pulls. Line the bottoms of the drawers with felt or cork.

### Customize and hang the cabinet

**1** Cut foam core or cardboard to the interior dimensions of your cabinet back and doors. Lay the material on your bench or an elevated sheet of plywood and use it to arrange your tool collection and size your customized holders.

### Online Extra

For customized tool holders visit [woodcraftmagazine.com/onlineextras](http://woodcraftmagazine.com/onlineextras).

**2** Using ideas from our Online Extra, along with several of your own, make customized tool holders for your collection. Fasten them in place.

**3** With a  $\frac{5}{8}$ " Forstner bit and a handheld drill, carefully bore two shallow centered holes where shown in **Figure 1** on the bottom edge of the cabinet for the rare-earth magnet catch system. Measure the steel cups to determine hole depths in the cabinet, and use the washer thickness for the bottom door edges. Screw in the hardware and add the magnets.

Special thanks to Starrett for providing selected measuring and marking tools. Go to [starrett.com](http://starrett.com) for more.

## Hanging Heavy Cabinets

When loaded with planes and other metal items, the weight of the tool cabinet can be significant. Consequently, you need to provide a stout hanging system mounted to studs or masonry. This French cleat system fills the bill. First, determine the location for the cabinet and height off the floor (the top of this cabinet measures a standard 84" from the floor). Next, cut four wall cleats (BB) to the size in the **Cut List**, beveling one edge of each piece at 45°. Glue and screw the top cleat to the cabinet back where shown in **Figure 2**, paying

attention to the bevel's orientation. Make a mark at 84" above the floor on the wall. Measure down 6 $\frac{1}{4}$ " and strike a level line. Strike a second level line 32" down from this line. Now, using the appropriate fasteners, attach the wall cleats, aligning their bottom edges with the level lines. Apply double-faced tape to the cabinet side of the bottom cabinet cleat. Rest this cabinet cleat on the bottom wall cleat in its proper orientation. (The tape helps locate the bottom cabinet cleat on the cabinet back.) Now, with a helper, temporarily hang the

cabinet on the wall, pressing it against the taped bottom cleat. Lift off the cabinet and fasten the lower cleat. Rehang the cabinet.



**4** From  $\frac{3}{4}$ " stock, cut four bevel-edged hanging cleats (BB) to the dimensions in the **Cut List**. Referring to **Figure 2**, see the sidebar, "Hanging Heavy

Cabinets" (below, left) for hanging instructions. Finally, add your hand tools. ■

### About Our Designer/Builder

An accomplished woodworker from Lubeck, West Virginia, Bill Sands is a regular contributor to *Woodcraft Magazine*, having built several shop projects. In addition, he teaches woodworking classes at the Parkersburg Woodcraft store.



### Tool Cabinet Cut List

	Part	Thickness	Width	Length	Qty.	Mat'l
A	Cabinet sides	$\frac{3}{4}$ "	12"	40"	2	W
B	Top and Bottom	$\frac{3}{4}$ "	12"	32"	2	W
C*	Lower shelf	$\frac{3}{4}$ "	10"	31"	1	W
D*	Middle shelf	$\frac{3}{4}$ "	10"	31"	1	W
E*	Upper shelf	$\frac{3}{4}$ "	10"	31"	1	W
F*	Lower divider	$\frac{3}{4}$ "	10"	$4\frac{3}{4}$ "	1	W
G*	Upper divider	$\frac{3}{4}$ "	10"	$2\frac{3}{4}$ "	1	W
H*	Cubby dividers	$\frac{1}{4}$ "	10"	$6\frac{1}{2}$ "	8	W
I*	Back	$\frac{1}{2}$ "	$31\frac{1}{2}$ "	$39\frac{1}{2}$ "	1	BP
J	Door sides	$\frac{3}{4}$ "	$3\frac{1}{4}$ "	40"	4	W
K	Door top and bottom	$\frac{3}{4}$ "	$3\frac{1}{4}$ "	16"	4	W
L	Door front stiles	$\frac{3}{4}$ "	$2\frac{1}{4}$ "	40"	4	W
M	Door front top rail	$\frac{3}{4}$ "	$2\frac{1}{4}$ "	$12\frac{1}{4}$ "	2	W
N	Door front bottom rail	$\frac{3}{4}$ "	$3\frac{1}{4}$ "	$12\frac{1}{4}$ "	2	W
O*	Door front raised panel	$\frac{3}{4}$ "	$11\frac{1}{8}$ "	$33\frac{1}{8}$ "	2	M
P*	Top and bottom edging	$\frac{3}{16}$ "	$\frac{3}{4}$ "	$30\frac{1}{2}$ "	2	W
Q	Plane ramp	$\frac{3}{4}$ "	10"	$15\frac{1}{8}$ "	1	W
R	Ramp edging	$\frac{1}{4}$ "	$1\frac{1}{8}$ "	$15\frac{3}{4}$ "	1	W
S	Ramp dividers	$\frac{1}{4}$ "	$\frac{1}{4}$ "	$15\frac{1}{4}$ "	2	W
T	Stop	$\frac{1}{2}$ "	$\frac{3}{4}$ "	$10\frac{1}{4}$ "	1	W
U*	Small drawer sides	$\frac{1}{2}$ "	$2\frac{1}{4}$ "	$9\frac{3}{4}$ "	4	M
V*	Small drawer backs	$\frac{1}{2}$ "	$2\frac{1}{4}$ "	$14\frac{1}{8}$ "	2	M
W*	Small drawer fronts	$\frac{3}{4}$ "	$2\frac{1}{4}$ "	$14\frac{1}{8}$ "	2	W
X*	Large drawer sides	$\frac{1}{2}$ "	$4\frac{1}{4}$ "	$9\frac{3}{4}$ "	4	M
Y*	Large drawer backs	$\frac{1}{2}$ "	$4\frac{1}{4}$ "	$14\frac{1}{8}$ "	2	M
Z*	Large drawer fronts	$\frac{3}{4}$ "	$4\frac{1}{4}$ "	$14\frac{1}{8}$ "	2	W
AA*	Drawer bottoms	$\frac{1}{4}$ "	$9\frac{1}{2}$ "	$14\frac{3}{8}$ "	4	BP
BB	Beveled cleats	$\frac{3}{4}$ "	$3\frac{1}{2}$ "	40"	4	M

\*Parts initially cut oversized and then trimmed to fit. See instructions.

**Materials:** W=Walnut, BP=Birch Plywood, M=Maple P=Plywood

**Hardware/Supplies:**  $1\frac{1}{2}$ " nails; #8 x 2" flathead screws;  $\frac{1}{2}$ "-thick birch plywood

### Convenience-PLUS BUYING GUIDE

<input type="checkbox"/> 1.	#146049	\$179.99
Porter-Cable 12" Dovetail Jig, Deluxe Model 4212		
<input type="checkbox"/> 2.	#129688	\$44.99
Rabbeting Bit Set ( $\frac{1}{2}$ " SH)		
<input type="checkbox"/> 3.	#129642	\$19.99
Pattern Bit, $\frac{5}{8}$ " D, 1" CL ( $\frac{1}{4}$ " SH)		
<input type="checkbox"/> 4.	#828781	\$21.99
Freud Downcut Spiral Straight Bit, $\frac{1}{4}$ " D, 1" CL, ( $\frac{1}{4}$ " SH)		
<input type="checkbox"/> 5.	#144689	\$7.19
Brass Router Bushing, $\frac{3}{8}$ " OD x $\frac{9}{32}$ " ID		
<input type="checkbox"/> 6.	#140442	\$7.99
Titebond II Extend Glue, 16 oz.		
<input type="checkbox"/> 7.	#141115	\$19.99
Corner Band Clamp		
<input type="checkbox"/> 8.	#152160	\$16.99 each
Piano Hinge, Brass Plated, $1\frac{1}{2} \times 48$ ", qty. 2		
<input type="checkbox"/> 9.	#830809	\$9.99
Snappy Hinge Bit, $\frac{5}{64}$ ", Self-centering, #2-#4 Screws		
<input type="checkbox"/> 10.	#50Y02	\$22.99
Finnish Birch Plywood, $\frac{1}{4} \times 24 \times 30$ "		
<input type="checkbox"/> 11.	#130159	\$6.99 each
Solid Brass Knob, 1", qty. 4		
<input type="checkbox"/> 12.	#150955	\$6.99
Steel Washers $\frac{5}{8}$ " OD for Rare-earth Magnets, 10 pcs. w/#4 x $\frac{1}{2}$ " Screws		
<input type="checkbox"/> 13.	#150960	\$5.99
Steel Cups for $\frac{1}{2}$ " Rare-earth Magnets, 10 pcs. w/#4 x $\frac{1}{2}$ " Screws		
<input type="checkbox"/> 14.	#150951	\$7.99
Rare-earth Magnets, $\frac{1}{2}$ " D x $\frac{1}{8}$ ", 10 pcs.		
<input type="checkbox"/> 15.	#123976	\$10.99
Watco Danish Oil Finish, Natural, 1 pt.		

Above items are available at Woodcraft stores, [woodcraft.com](http://woodcraft.com) or by calling (800) 225-1153. Prices subject to change without notice.



# Finish Test: Water vs. Oil

*Is it time to close the lid on oil-based poly?*

By Craig Bentzley

I opened my first can of water-based finish over 20 years ago. Lured by the promise of easy cleanup, low odor, fast drying time, and nonflammability, it seemed to be the perfect clear-coat solution. Unfortunately, these first-generation finishes were difficult to apply, didn't

hold up well, and just looked bad. Like many woodworkers, I closed the lid on these newcomers and stuck with solvent-based varnishes and lacquers.

Since then, stricter regulations limiting the amount of volatile organic compounds (VOCs) have driven manufacturers to further

develop better water-based formulas. Ready to give water-based finishes a second chance, I compared five commonly available products against two popular alkyd varnishes. Surprisingly, the results were convincing enough to make me reconsider my old go-to finishes.



A

A better brush can make a big difference. Flagged-tipped bristles create more bubbles and streaks than tapered-bristle brushes.

## Ease of application

All of the finishes sprayed nicely. Based on my results, it's hard to imagine a situation where a small shop woodworker would want to spray anything else. I was pleasantly surprised to discover that several of the finishes brushed out quite well (see chart, page 35)—provided that you use the right brush.

As shown in **Photo A**, above, garden-variety polyester brushes introduce bubbles and brush marks into the finish. Taklon brushes, available from art supply houses, or Wooster's "Alpha" brushes, available at paint stores, have soft bristles with straight or tapered ends that allow the finish to flow more smoothly.

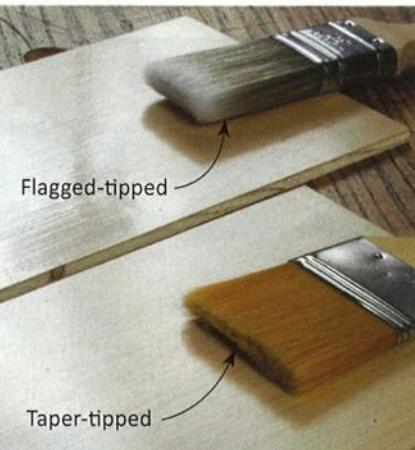
In terms of drying times, all of the waterbornes left the alkyds in the dust. Faster drying means that a project can be completed

in a fraction of the time required by oil-based counterparts. For example, a small side table can be finished with four coats in one day, versus a day and a half using traditional products. In all cases, the waterborne finish samples were ready for scuff-sanding well before the recommended (on average, two-hour) drying time. The samples sanded easily, producing fine dust without clogging the paper.

It's worth noting that grain-raising was a nonissue. I did not need to dampen the stock prior to applying the first coat.

## Appearance

First-generation finishes were criticized for having a bluish cast. These days, such is not the case. With one exception, the finishes dried crystal-clear, much like nitrocellulose lacquer.



## What's In The Can?



Getting manufacturers to divulge their product ingredients is tantamount to obtaining missile launch codes. At the risk of over-simplification, most water-based finishes fall into two categories: modified resins that are suspended in water, and hybrids made of water-absorbing resins.

You don't need a chemistry degree to understand that you get what you pay for. I had to apply more coats of the least-expensive finishes to match the look achieved with the pricier product, costing time and negating savings. Surprisingly, even with the additional coats, the less expensive finishes weren't as stain resistant as the pricier competition.



Minwax  
Water-Based  
Polycrylic

General Finishes  
Enduro-Var Water-  
Based Urethane



Minwax  
Fast-Drying  
Polyurethane

General Finishes  
Enduro-Var Water-  
Based Urethane

Minwax  
Fast-Drying  
Polyurethane



B

**Stopping stains:** Waterbornes are decent stain fighters, but steel wool and household cleaner turned out to be Achilles heels for a few.

In contrast, General Finishes Enduro-Var had a slight amber tone, similar to alkyd finishes.

If you're looking to enrich the color of woods like cherry and walnut, you'll need to add another step to your finishing process, such as staining the wood or tinting the finish. (I prefer staining the wood with aniline dyes, because they offer more control and dry quickly.)

Although all the finishes I tested were labeled "semi-gloss," the sheen varied from product to product. The Minwax Polycrylic was shinier than the other products, while the General Finishes Polyacrylic was

the flattest. Minwax's finish was also the least viscous and required more coats to achieve the same build as the other finishes.

## Durability

If you wipe up spills quickly enough, even a waxed surface can qualify as "stain-resistant." The real problems come from the messes that you fail to clean up. To that end, I prepared the sample boards, staining half with an oil-based stain, allowing 48 hours to dry, and then brushed on four coats of finish. After giving the finish samples a week to cure, I applied six

real-world staining agents: red candle wax, red wine, mustard, Fantastik spray cleaner, nail polish remover, and rusty steel wool soaked in vinegar and let them dry overnight (**Photo B**).

As expected, the most dramatic damage took place on the lower priced finishes, with the rusty steel wool/vinegar having the biggest impact on all samples. For complete results, see the chart at right.

To test heat resistance, I filled a ceramic cup with boiling water and placed it on each sample, allowing it to cool (**Photo C**). Surprisingly, none of the samples had objectionable damage, and all fared comparably to their alkyd counterparts.

To test for finish adhesion, I cut a grid of 10 squares to the inch into both the stained and unstained side of each sample with a knife (**Photo D**). A strip of clear packing tape was burnished over the grids and allowed to sit overnight before removal. All of the finishes performed well on the unstained section. Surprisingly, both alkyd finishes and the Enduro-Var had adhesion problems on the oil-stained surfaces.



C

**Handling heat:** Steaming hot cups can leave white rings, but waterbornes handle heat as well or better than alkyds.



D

**Sticking to it:** Scoring the finish and then applying packing tape tests for adhesion. Most held up well, but a few didn't stick to oil-stained wood.

# Finish Test: Water vs. Oil



	Minwax Polycrylic	General Finishes Polyacrylic	General Finishes High Performance	General Finishes Enduro-Var	Varathane Water-based Polyurethane	Minwax Fast-Drying Poly	General Finishes Arm-R-Seal
	Water-Based					Oil-Based	
Price/Qt.	\$16.99	\$19.99	\$24.99	\$26.99	\$18.99	\$9.99	\$14.99
Brush application	Fair	Fair	Good	Good	Good	Good	Fair
Color (when dry)	Clear	Clear	Clear	Amber	Clear	Amber	Amber
<b>Staining Agent</b>							
Red candle wax	1	2	2	0	2	1	0
Red wine	0	2	0	2	0	0	0
Mustard	1	1	1	0	1	0	0
Fantastik	3	1	1	2	2	2	2
Nail polish remover	2	2	1	0	2	2	2
Rusty steel wool	3	3	3	1	3	2	0
<b>Heat Resistance</b>							
Hot cup	2	2	1	1	1	1	1
<b>Adhesion</b>							
Adhesion (over oil stain)	0	0	0	2	1	2	3
Adhesion (unstained)	0	0	0	0	0	0	0
<b>Total</b>	12	13	9	8	12	10	8

**Damage Key:** 0=None 1=Minimal (Some effect or discoloration; refinishing not warranted.)

2=Noticeable (Effect or discoloration may be objectionable. Refinishing optional.) 3=Major (Refinishing needed.)

## Summary

Compared to the early generation of waterbornes, all of these finishes are winners, but General Finishes Enduro-Var impressed me the most. The Enduro-Var was easy to apply, provided a warmth that most resembled oil-based urethanes, and offered

the most protection. If I wanted to cut costs, or needed to pick up a can of finish at the hardware store, I wouldn't hesitate to use Varathane's polyurethane. For good protection without the amber color, I'd use General Finishes High Performance.

I'm not ready to surrender

shellac and may continue to use alkyd finishes for some projects, but after this test I'm making room for waterbornes in my workshop. If solvent-based lacquers and polyurethanes were to disappear from store shelves, I think woodworkers would do just fine without them. ■

# Full-Service Potting Bench

*Get the jump on spring with this mini garden center.*

By Ken Burton



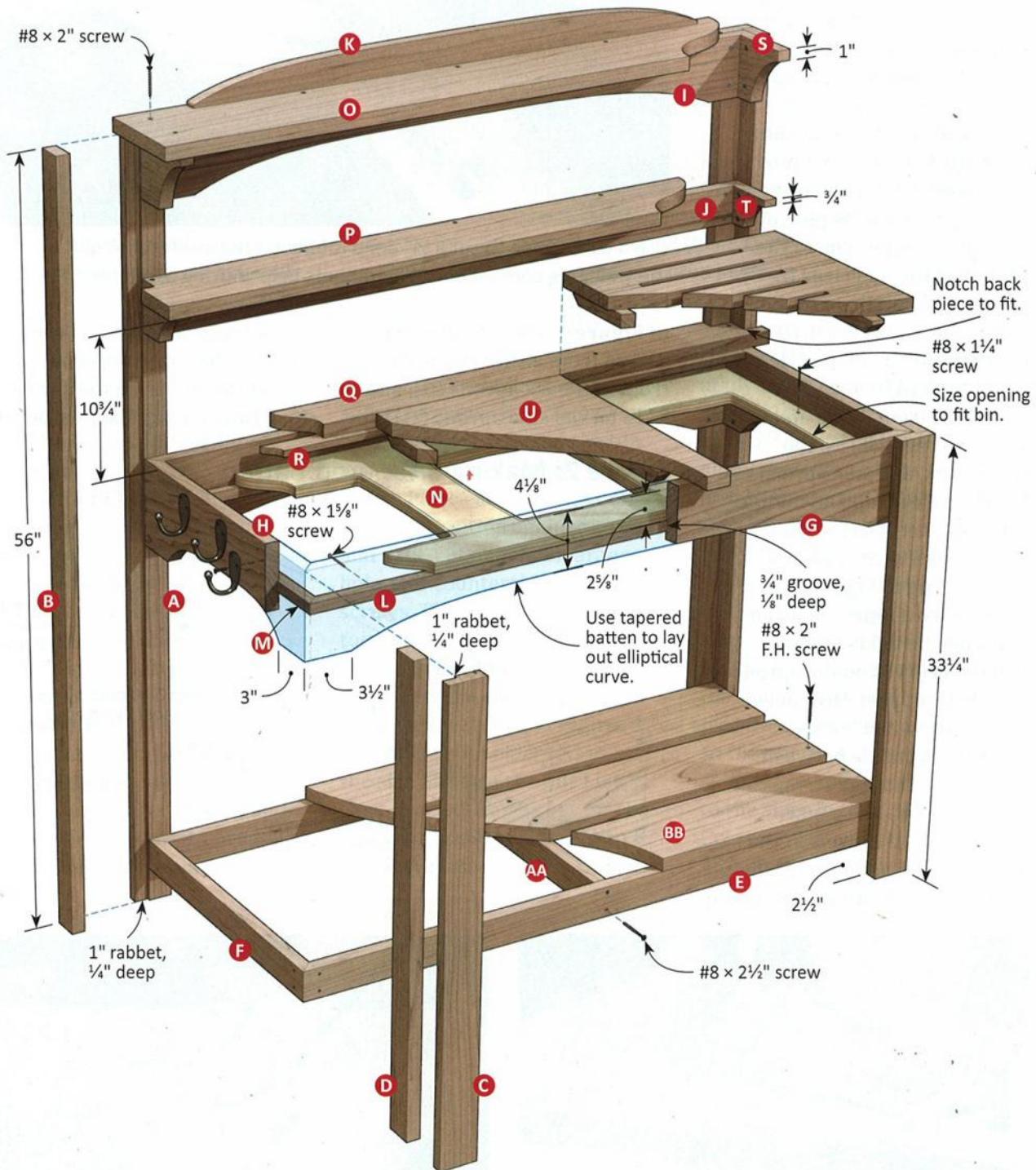
Overall dimensions:  
51" w x 23 $\frac{5}{8}$ " d x 59" h

You don't need a green thumb to appreciate that a potting bench is as much of a necessity to a gardener as a workbench is to a woodworker. For starters, a potting bench provides a comfortable work surface, enabling gardeners to tend seedlings and repot plants without having to work on their hands and knees. A good bench also keeps supplies, such as potting soil, pots, garden tools, and fertilizers, in one convenient location, so that gardeners can make the most of their green time.

The design shown here does all that in spades, combining form with function. In addition to its elegantly-arched aprons, it features a segmented work surface with three removable panels. Two of the panels are slotted, making cleanup a simple matter of brushing leftover soil into the bins below.

Construction is downright easy: basic butt and miter joints, a few rabbets and dadoes, followed by assembly with screws. (Check out the **Convenience-Plus Buying Guide**, page 41, for the list of materials.) You can build the bench in one or two weekends and make gardening easier for many seasons to come.

**Figure 1:** Potting Bench Exploded View



## Make the legs and stretchers

**1** Cut the wide (A, C) and narrow (B, D) pieces for the back and front legs to the sizes shown in the **Cut List**. Install a  $\frac{1}{4}$ " dado set in your tablesaw, adjust the dado height to match the thickness of your stock, and then rabbet the inside faces of the wide leg pieces as shown in **Photo A**. This rabbet provides a shoulder that will help align the leg pieces during glue-up.

Apply exterior glue to the rabbet on the wide legs (A, C), and then clamp them to their mating narrow legs (B, D) to make four "L-shaped" leg assemblies (A/B and C/D).

**2** Cut the front, back, and side stretchers (E, F), the front, back, and side aprons (G, H), and the top and middle shelf supports (I, J) to the sizes shown in the **Cut List**.

**3** Referring to **Figure 2**, at right, make a tapered batten and a buckle to lay out the elliptical curves on the aprons and shelf support. Drill holes in the batten and buckle.

Thread the buckle between the ends so that the string can be pulled taut, like a bow.

**4** Lay out the curves on the aprons (G, H) and the top shelf support (I) (**Photo B**). As shown



A

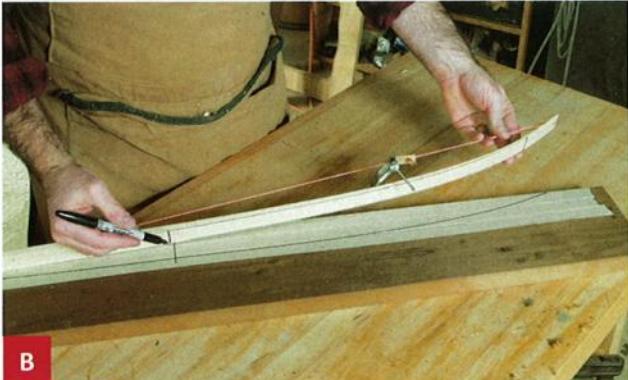
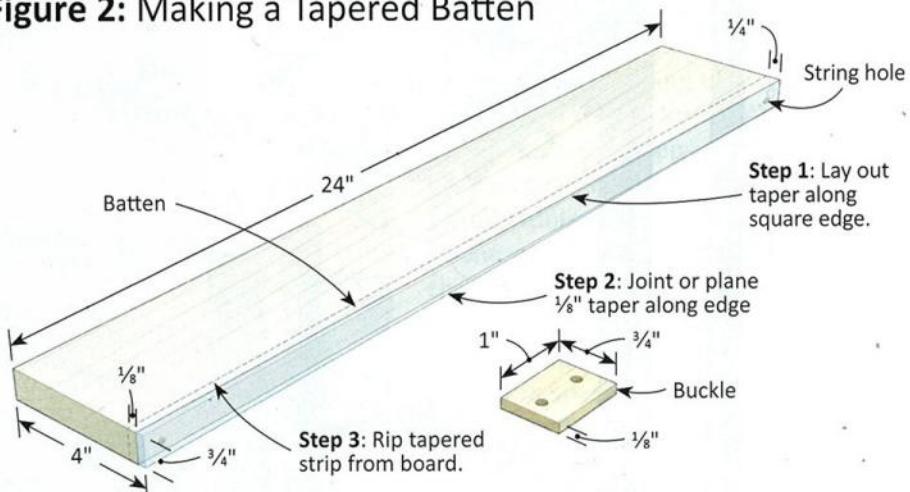
Use a dado blade to cut a  $\frac{1}{4}$ " deep rabbet on the inside faces of the wider leg components. The rabbets help with leg assembly.

in **Figure 1**, the curves start  $3\frac{1}{2}$ " in from either end of the front and back aprons (G), and 3" in on the side aprons (H). The

aprons and support are  $4\frac{1}{8}$ " wide at their center points.

**5** Cut the curves on the aprons (G, H) and the top shelf support (I)

**Figure 2: Making a Tapered Batten**



B

Clamp the string to the buckle to keep it taut; then trace the curve along the aprons. Mark the curve's start and end points on the batten.



C

Sand the curves on the aprons with a custom sanding block suited to the curve.



D

After drilling and countersinking screw holes through the stretchers and aprons, screw each part to its leg assembly.

with a jigsaw or a bandsaw. Save one of the cutoffs to use for the crest rail (K). Make up a curved sanding block, and sand the curves fair, using coarse sandpaper, as shown in **Photo C**. After removing any lumps, finish-sand through 220 grit.

**6** Cut  $\frac{3}{4}$ " wide by  $\frac{1}{8}$ " deep grooves on the inside faces in each of the four aprons (G, H) for the cleats (L, M) that support the bin holder (N), where shown in **Figure 1**. Miter-cut the cleats to the sizes specified in the **Cut List**. Fasten them in their grooves with exterior glue and  $1\frac{1}{8}$ " screws. Be sure to predrill for the screws to avoid splitting.

### Assemble the bench

**1** Using a miter saw, miter the ends of the front/back and side stretchers (E, F), front/back aprons (G, H), and the top and middle shelf supports (I, J) to  $45^\circ$ . Place each stretcher or apron in position against its leg, and drill a pilot hole, clearance hole, and countersink for  $1\frac{5}{8}$ " screws. Then screw the parts together using exterior glue, as shown in **Photo D**. Next, glue and screw the shelf supports in place where shown in **Figure 1**.

**2** Cut the bin holder (N) to the size listed in the **Cut List**. Next, trace the openings for the three bins as shown in **Photo E**. (Note: Almost any wide-lipped



E

Space the bins evenly across the bin holder and trace around them. Cut the openings so that the bins drop in place.

container will work. I purchased these four-gallon storage bins at my home center.) Make a second layout line  $\frac{1}{4}$ " inside each of the traced lines. Cut along these inner lines with a jigsaw. Screw the holder to the cleats (L, M) with  $1\frac{1}{4}$ " screws.

**3** Cut the top and middle shelves (O, P), the back piece (Q), and the ledger (R) to the sizes listed in the **Cut List**. Notch the back corners of the middle shelf and the back piece, as shown in **Figure 1**, so they fit inside the legs.

**4** Cut the shelf brackets (S, T) to the sizes in the **Cut List**. Crosscut one end of each at  $45^\circ$ . On the opposite end, trace

## Hot Stuff: Thermo-Wood

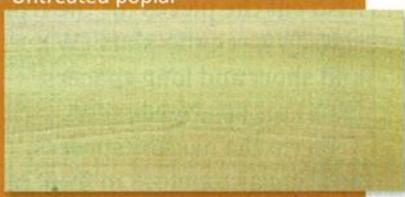
While cedar, cypress, and redwood make great choices for outdoor projects, I made this bench from thermally-treated (or "thermo-") wood. Thermo-wood is heated to temperatures much higher than normal kiln-drying ( $400^\circ$  F). In addition to changing the wood's color, the process makes the wood harder, more stable, and resistant to bugs and decay—without any chemicals. In my area, thermo-poplar costs about 30% more than regular poplar. I found it pleasant to work with, although it was dustier and

more brittle than normal kiln-dried stock. The color, similar to aged cherry, runs completely through the wood. It will fade if left untreated, but the wood will withstand decades of outdoor use. (For more information, see [thermotreatedwood.com](http://thermotreatedwood.com).)

Treated poplar



Untreated poplar





**F**  
Use the blunt end of a featherboard as a fence-setting stopblock when ripping a series of narrow strips.

a quart-sized can to lay out a decorative curve on the lower corner of each piece. Cut along your layout lines and sand the curves true. (Before cutting the curves, be sure each bracket is a mirror image of its partner, so you end up with the angled cuts on the inside face of each piece.)

**5** Drill and countersink the shelf brackets (S, T), and then attach them to the back leg assemblies (A, B) with exterior glue and  $1\frac{5}{8}$ " screws. Drill and countersink the ledger (R) and fasten it to the underside of the back piece (Q) with glue and  $1\frac{1}{4}$ " screws. Center the ledger from end to end with its front edge extending past the front edge of the back piece by about  $\frac{5}{8}$ ". Drill and countersink screw holes for the shelves (O, P) and the back piece (Q) and attach them with 2" screws.

### Make the top panels

**1** Cut the solid center panel (U) to the size in the **Cut List**. Edge-glue pieces as needed to make up the required width. Also cut the pieces for the front slats (V), regular slats (W), and short and long spacers (X, Y) to the sizes listed.

To rip the narrow spacers, position a stopblock in front of the blade to its left, as shown



**G**  
Tack the spacer slats to the regular slats prior to gluing to prevent the parts from slipping out of alignment under clamp pressure.

in **Photo F**. Set the stop so that the distance from its end to the blade path equals the width of the spacer. Move the rip fence over until your workpiece touches the stopblock and make the cut. Readjust the fence for each subsequent cut.

**2** To glue up the slotted panels, fasten one long spacer (X) and one short spacer (Y) to each of the regular slats (W) using exterior glue and 3d finish nails, as shown in **Photo G**. Glue six of the spacer/slat assemblies to each of the front slats (V).

**3** Cut the battens (Z) to the size listed in the **Cut List**. Check their length against your assembled bench: the battens should be about  $\frac{1}{8}$ " shorter than the distance from the front edge of the ledger (R) to

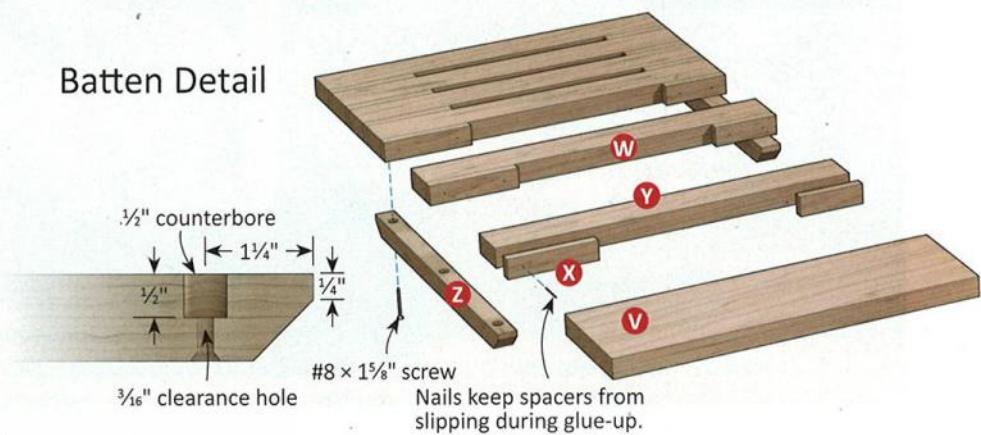
the inside of the front apron (G). Cut both ends of each batten at  $45^\circ$  creating a  $\frac{3}{4}$ " wide chamfer, as shown in **Figure 3**.

**4** Drill three  $\frac{3}{16}$ "-diameter holes through each batten (Z), a hole  $1\frac{1}{4}$ " in from each end, and one in the center. Countersink and counterbore the holes as shown in **Batten Detail**, below. This creates a little space for the screws to move as the panel expands and contracts with changes in humidity.

**5** Screw two battens (Z) to the underside of each top panel as shown in **Photo H**. Position the battens  $\frac{3}{8}$ " in from the ends of the solid center panel and  $\frac{3}{8}$ " in from the inside ends of the slotted panels. Position the second batten on each of the slotted panels so it will fall just inside the side

**Figure 3: Top Panel**

### Batten Detail



apron (H). From front to back, position all the battens so the rear edge of each panel sits on the ledger (R) with its back edge butted up to the back piece (Q).

## Finish up

**1** Sand the crest rail (K) to a smooth curve. Cut its ends to terminate with a  $\frac{1}{4}$ "-wide flat instead of a sharp point. Attach the rail by gluing it to the top shelf (O), and screwing it in place from underneath. Use 2" screws, and be sure to predrill the holes.

**2** Cut the center support (AA) to the size listed in the

**Cut List.** Center it from side to side between the front and rear stretchers (E), and screw it in place with  $2\frac{1}{2}$ " screws.

**3** Cut the bottom shelves (BB) to the size in the **Cut List.** Screw them to the side stretchers (F) and center support (AA) with 2" screws.

**4** Finish the bench with a clear outdoor finish. Screw the tool hooks in place along the side stretchers and start planting. ■

## Convenience-PLUS BUYING GUIDE

1. #145562 \$8.99

Titebond III Waterproof Glue, 16 oz.

2. #619107 \$8.89

#8 x 1 $\frac{1}{4}$  Stainless Steel Screws, 100 pc.

3. #619108 \$11.29

#8 x 1 $\frac{5}{8}$  Stainless Steel Screws, 100 pc.

4. #619109 \$15.19

#8 x 2 Stainless Steel Screws, 100 pc.

5. #619111 \$16.79

#8 x 2 $\frac{1}{2}$  Stainless Steel Screws, 100 pc.

Above items are available at Woodcraft stores, [woodcraft.com](http://woodcraft.com) or by calling (800) 225-1153. Prices subject to change without notice.



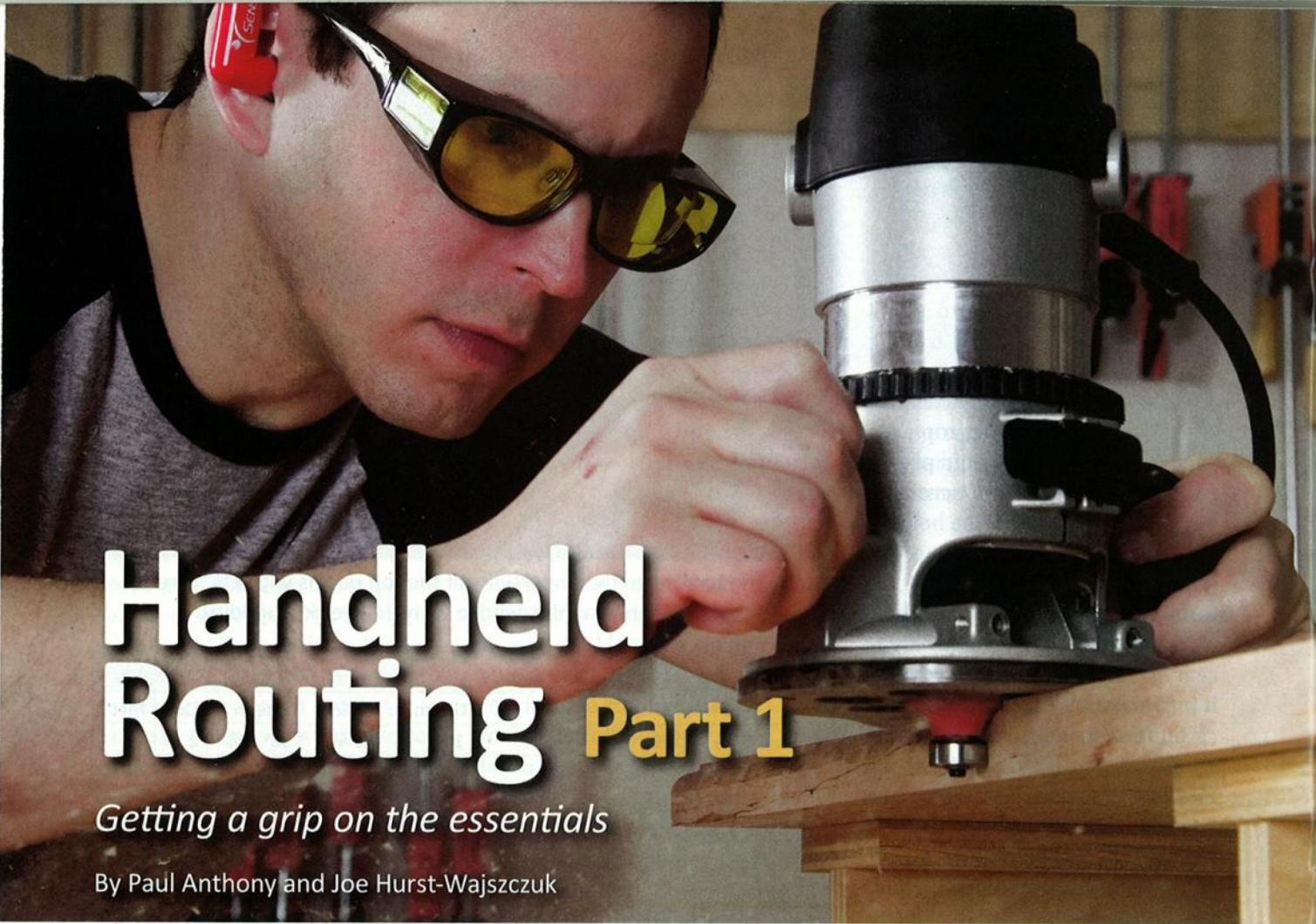
Fasten the battens to the undersides of the top panels with 1 $\frac{5}{8}$ " screws. Omit glue to allow the panels to move with changes in humidity.

## Potting Bench Cut List

Part	Thickness	Width	Length	Qty.	Mat'l
A Wide back leg	1	2 $\frac{3}{4}$ "	56"	2	TP
B Narrow back leg	1	2"	56"	2	TP
C Wide front leg	1	2 $\frac{3}{4}$ "	33 $\frac{1}{4}$ "	2	TP
D Narrow front leg	1	2"	33 $\frac{1}{4}$ "	2	TP
E Front/back stretcher	1	2 $\frac{1}{4}$ "	48"	2	TP
F Side stretchers	1	2 $\frac{1}{4}$ "	21 $\frac{5}{8}$ "	2	TP
G Front/back apron	1	6 $\frac{1}{4}$ "	48"	2	TP
H Side aprons	1	6 $\frac{1}{4}$ "	21 $\frac{5}{8}$ "	2	TP
I Top shelf support	1	4 $\frac{1}{2}$ "	48"	1	TP
J Middle shelf support	1	2 $\frac{3}{4}$ "	48"	1	TP
K Crest rail	1	2"	40"	1	TP
L Front/back cleats	$\frac{3}{4}$ "	$\frac{7}{8}$ "	46 $\frac{1}{4}$ "	2	TP
M Side cleats	$\frac{3}{4}$ "	$\frac{7}{8}$ "	19 $\frac{5}{8}$ "	2	TP
N Bin holder	$\frac{3}{4}$ "	19 $\frac{5}{8}$ "	46"	1	Ply
O Top shelf	1	7 $\frac{1}{4}$ "	51"	1	TP
P Middle shelf	1	6"	50"	1	TP
Q Back piece	1	3 $\frac{3}{4}$ "	51"	1	TP
R Ledger	$\frac{1}{2}$ "	1 $\frac{1}{2}$ "	46"	1	TP
S Top shelf brackets	1"	4 $\frac{1}{2}$ "	5 $\frac{1}{2}$ "	2	TP
T Middle shelf brackets	1"	2 $\frac{3}{4}$ "	4 $\frac{3}{4}$ "	2	TP
U Center panel	1"	20 $\frac{1}{2}$ "	15"	1	TP
V Front slats	1"	5 $\frac{1}{2}$ "	18"	2	TP
W Regular slats	1"	2"	18"	12	TP
X Long spacers	$\frac{1}{2}$ "	1"	4 $\frac{1}{2}$ "	12	TP
Y Short spacers	$\frac{1}{2}$ "	1"	3 $\frac{1}{4}$ "	12	TP
Z Battens	1"	1"	17"	6	TP
AA Center support	1"	2 $\frac{1}{4}$ "	19 $\frac{5}{8}$ "	1	TP
BB Bottom shelf board	1"	6 $\frac{1}{2}$ "	48"	3	TP

Materials: TP = Thermo-Poplar; Ply=BC Exterior Plywood

Supplies: (3) four-gallon storage bins; finish nails; (3) robe hooks.



# Handheld Routing Part 1

*Getting a grip on the essentials*

By Paul Anthony and Joe Hurst-Wajszczuk

**W**hen you get your hands on a router for the first time and turn it on, it's easy to be intimidated by the power that jumps to life in that small package. But once you learn to wrangle the little beast, you get to be fast friends as you realize all the tricks it can do, from shaping profiles and cutting joints to making perfect shapes and identically sized multiples.

Mastering the router starts with knowing how to set up the tool and guide it. Regardless of whether you're using a fixed-base router or a plunge router, successful work means getting clean cuts located exactly where you want them. There are two basic approaches to routing. The first is handheld routing,

which is taking the tool to the work. The second is mounting the router in a table, in which case you're bringing the work to the tool. Each approach has its advantages and disadvantages.

In this article, we'll focus on handheld routing, covering the fundamentals of tool setup, proper feeding technique, and basic router guidance for making common cuts.

## A Bit About Bits

Clean cuts depend first of all on using sharp, good quality bits. Carbide is the order of the day here. Don't expect high-speed steel (HSS) bits to keep their edges for long. Also, avoid suspiciously inexpensive bits, which are often poorly machined from inferior materials.

Many bits are available with either a  $\frac{1}{4}$ "- or  $\frac{1}{2}$ "-diameter shank, and most routers these days include interchangeable collets to allow use of either size. Select the larger shank when possible. It provides a better grip in the collet, and the extra mass minimizes chatter, especially on long or large bits. A notable exception here is a bit used for mortising. In that case, it's best if the shank is the same size or smaller than the diameter of the fluted area, because it allows you to plunge deeper than the fluted section.

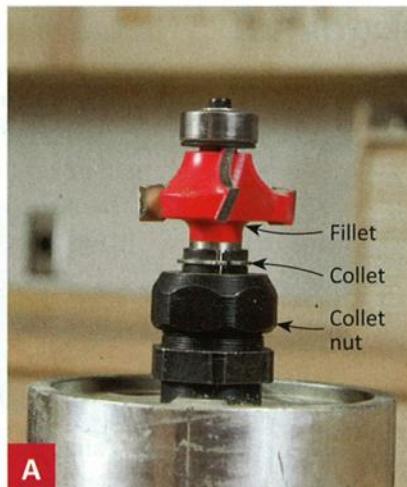
# Setting up

First things first: installing a bit. To ensure a good grip, don't let a bit drop fully down in the collet recess before tightening it. If the shank touches the bottom of the recess, tightening the collet nut may then jam the end of the shank against the bottom of the recess, making removal difficult. To prevent the problem, raise the bit  $\frac{1}{8}$ " or so before tightening the collet. If the top of the cutter is allowed to sit on top of the collet, the rounded fillet may prevent the collet from fully tightening on the shank (**Photo A**).

Again, lift the bit slightly before tightening the collet.

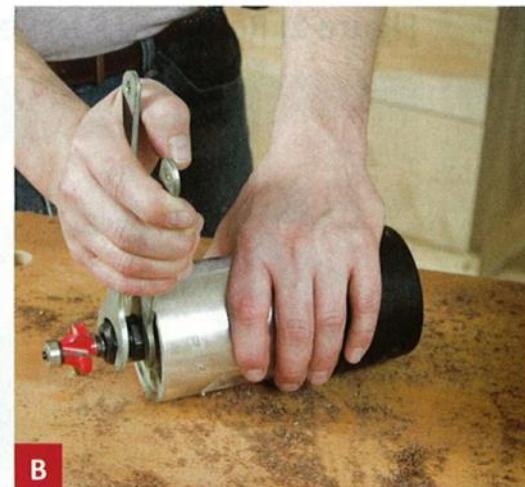
When tightening a collet nut, there's no need to bear down with killer pressure. If two wrenches are required for the job, squeeze them together with one hand as shown in **Photo B** to achieve proper tightness. To loosen the nut, reverse the wrench positions.

Securing the workpiece can be as important as securing the bit. Work that shifts or slides around invites miscuts



A

Raise the fillet above the end of the collet to ensure good purchase on the shank.



B

Tighten both router wrenches with one hand to apply appropriate force to the collet nut.

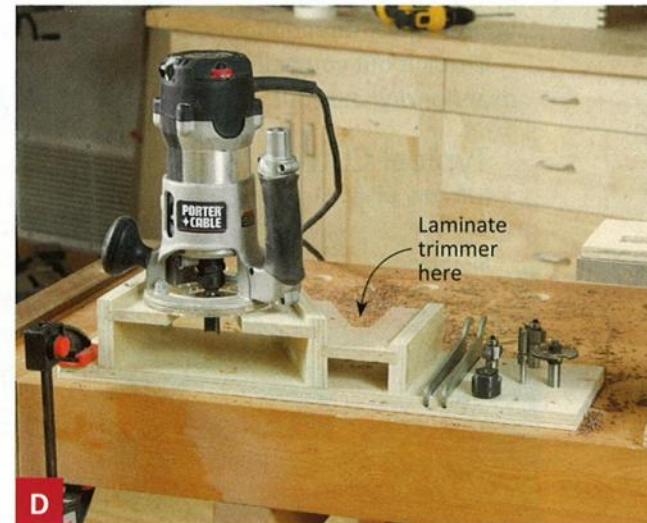
## Feeding a router

and possible injury. Use a vise, clamps, bench dogs, or whatever suits the piece. I-beam risers work great for holding panels up off the bench (**Photo C**). By clamping the risers to the bench, and the work to the risers, you can work at a more comfortable height, while a bit projecting below the panel is largely unobstructed. A portable router rest provides a protective platform for bits, as well as convenient storage for wrenches and bits in play (**Photo D**).



C

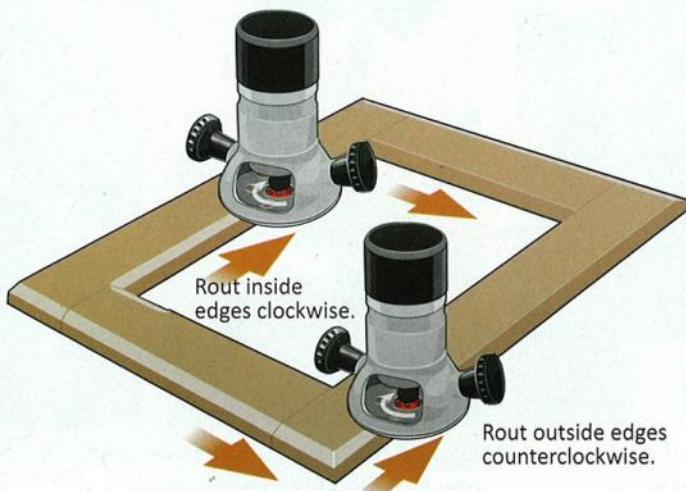
I-beam risers clamped to your bench provide a great routing platform for securing work while allowing easy router access to the edges.



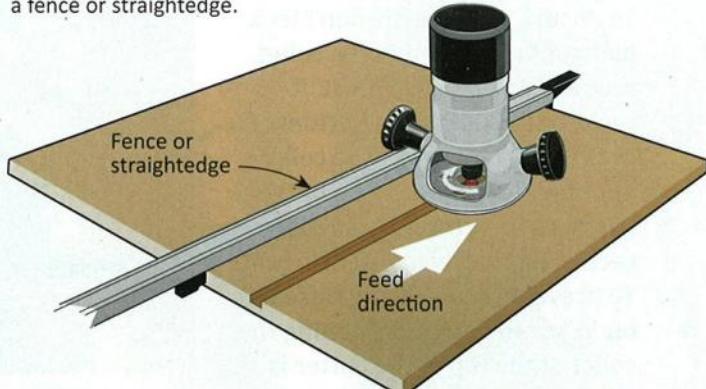
D

This router stand, with its V-notched risers, safely accommodates a full-sized router, a laminate trimmer, wrenches, and bits in play.

**Figure 1: Router Feed Direction**



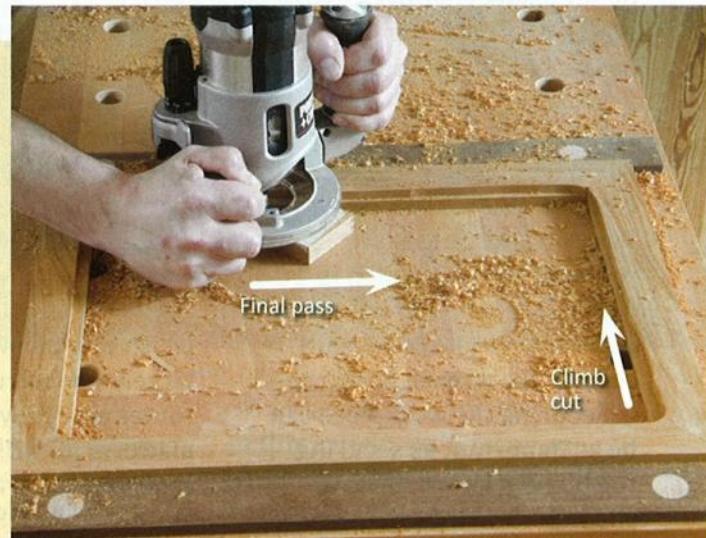
Feed router left to right when facing the bearing edge of a fence or straightedge.



## The Climb-Cutting Controversy

*Climb-cutting* means feeding a router "backwards" from the usual direction shown in Figure 1, above. Some woodworkers argue against this operation because it causes the router to self-feed, compromising control. However, climb-cutting can be valuable in that it eliminates tear-out because the bit is cutting downhill to the grain instead of lifting it up, as shown in the drawings below. For example, rabbeting the back of a picture frame often causes tear-out along the inner edge. To eliminate the problem, set your bit for full depth of cut, and then climb-cut for the first pass, disregarding neatness. Then follow up with a cut in the regular direction, as shown in the photo.

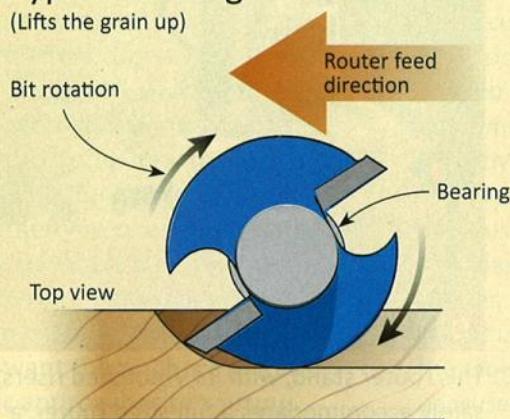
Check it out yourself next time you're experiencing tear-out. Just make sure when climb-



cutting to hold the router very firmly against the edge of the workpiece as you rout, and always finish up with a pass in the regular direction.

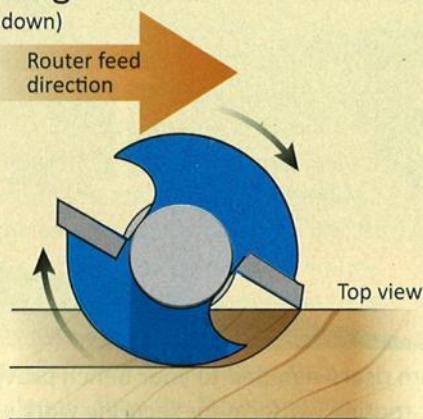
### Typical Cutting

(Lifts the grain up)



### Climb-Cutting

(Pulls the grain down)



an erratic cut. Climb-cutting does have its uses, as explained in the sidebar at left, but should only be used with bearing-guided bits, not with a fence.

Proper feed speed depends on the bite, the bit, and the density of the wood. Don't try to hog off too much at once, especially in dense wood, or you risk bit chatter or breakage. As a general rule, when dadoing, grooving, or mortising, take a series of  $\frac{1}{4}$ "-deep passes to get to the final depth you want. Most profiles can be cut in a single pass, but sometimes the cleanest profile is achieved with a first pass a hair shy of final depth, finishing up with a very light cut. This is a particularly good approach when routing woods that are prone to tear-out or scorching.

Pay attention to the sound and feel of the tool as you cut. If it seems to be straining, take a lighter cut and/or decrease your feed rate. Try to feed at a consistent speed; neither so fast that you stress the bit, nor so slow that you risk burning the wood. If you're relatively new to routing, the best thing you can do is to practice on scrap before laying into your project wood. Ideally, use scrap of the same species or density.

No matter how carefully you feed, the unsupported fibers at the end of a cross-grain cut are likely to blow out to some degree. When routing profiles, make it a practice to rout the end-grain edges of a workpiece first. The subsequent long-grain cuts will remove any tear-out (Photo E). If an adjacent long-grain edge isn't to be routed, you can back up the profile cut with a piece of scrap to eliminate tear-out (Photo F). When routing a dadoed board that terminates into an edge rabbet, as in common cabinet joinery, cut the dadoes first, as the subsequent rabbet will remove any tear-out (Photo G).

## Guiding a router

A router is seldom guided freehand. Its travel is usually directed by the pilot bearing on a bit, a template-guided bushing, or by a fence or edge guide. The approach you take depends on the availability of a suitable bit, the location of the cut on a workpiece, and whether you're using a template or not.

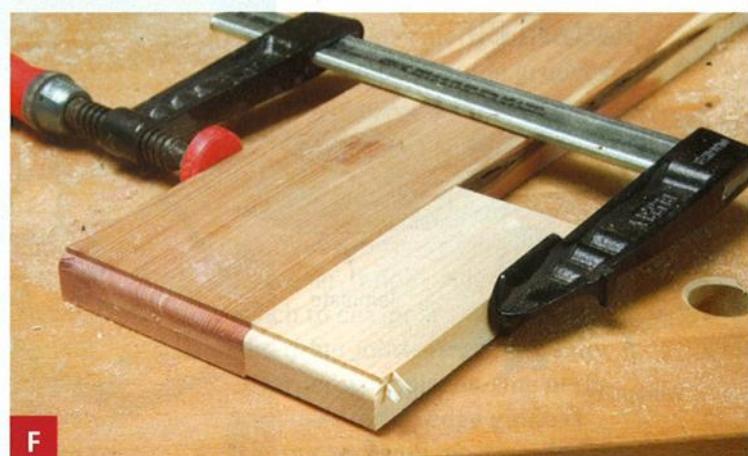
### Let the bit be your guide

A bearing-guided bit is a great option for precisely controlling a cut. The bearing on most bits sits below the cutter. This is the case with most profile bits, such as the one in the lead photo on page 42,

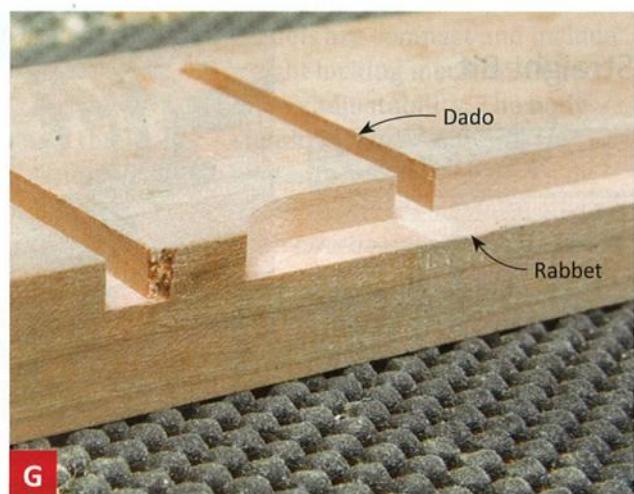
## Taming Tear-out



When routing a profile on a board, make the end-grain cuts first so that any tear-out will be removed by the subsequent long-grain cuts.



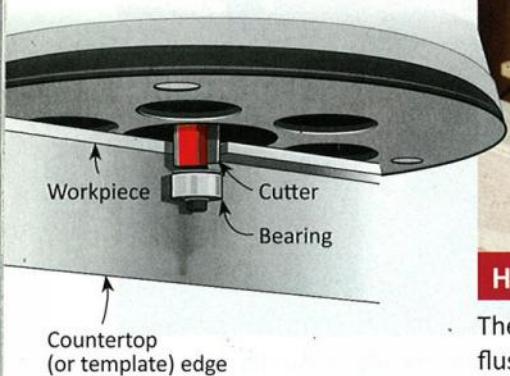
If adjacent long-grain edges won't be routed, prevent tear-out on an end-grain cut by backing it up with scrap.



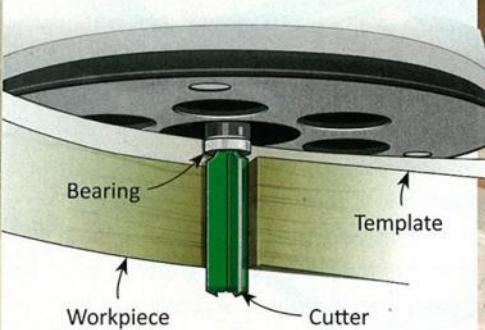
When dadoes intersect a rabbet, rout the rabbet last so it will remove any cross-grain tear-out.

# Bearings and Bushings

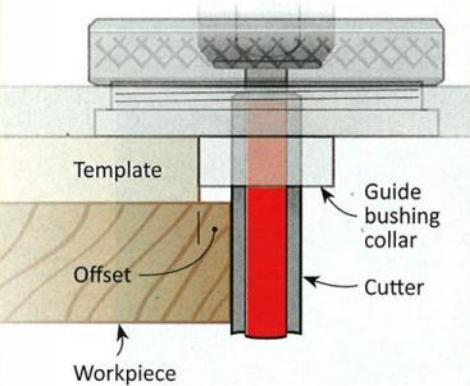
## Flush-trim Bit



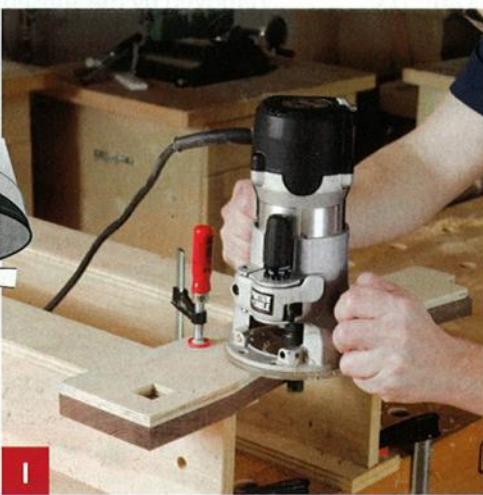
## Pattern Bit



## Straight Bit



The bottom-mounted bearing on a flush-trim bit rides along a reference surface below the piece to be trimmed.



The top-mounted bearing on a pattern bit rides along the edge of a template to trim the workpiece flush to the template.



A guide bushing runs along the edge of a template, allowing routing of hinge mortises and other shaped recesses.

as well as rabbeting bits, slot cutters, and others. The bearing rides along the edge of the workpiece, while the cutter above does the shaping work. A flush-trim bit is basically a straight bit with a bottom-mounted bearing whose diameter is just a few thousandths of an inch larger than the cutting diameter of the bit. This makes it the perfect choice for routing two surfaces flush to each other for operations like trimming laminate (**Photo H**). A pattern bit has a top-mounted bearing, which is designed to follow a template attached to the top of a workpiece (**Photo I**).

When using bearing-guided bits, it's important to prevent the router from tipping. To keep it flat, orient one handle over the workpiece, applying firm downward pressure as you work. When rounding a corner, rotate the router to maintain handle orientation and downward pressure over the workpiece. With a flush-trim bit, adjust the bearing so that it rides only  $\frac{1}{16}$ " or so below the top edge of the reference surface. That eliminates the possibility of the cutting flute scoring the surface.

Keep in mind that flush-trim bits and pattern bits aren't designed to hog a lot of material. With the exception of plastic laminate and other thin materials, a workpiece should first be rough-cut (usually with a saw) to within  $\frac{1}{16}$ " or so of the final edge before routing.

### Tip Alert

Before using any bearing-guided bit, make sure the workpiece or template edge is free of nicks and dents.



K

A self-clamping straightedge and offset blocks make for a quick fence setup. Alternatively, a jointed board can be clamped to the workpiece.

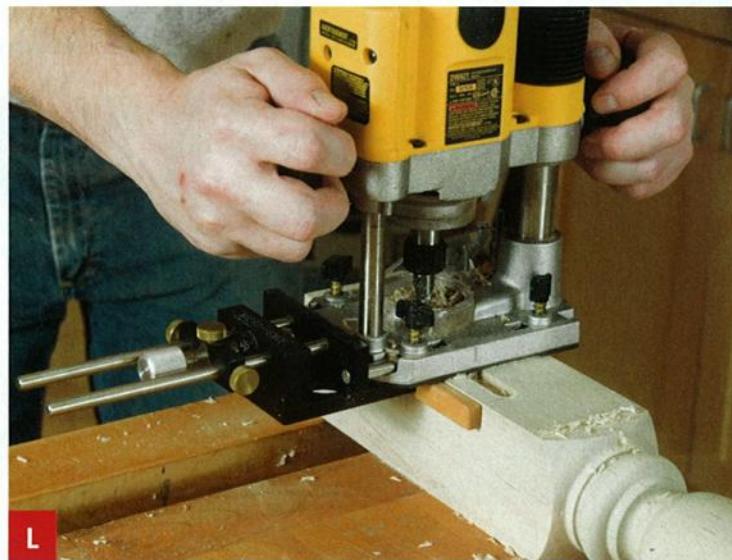
### Guide bushings for template routing

Guide bushings (also called template guides) are metal collars that attach to a router's sub-base. In use, a bit (usually straight) projects through the bushing, which rides along the edge of a template that's fixed to the top of the workpiece. Bushings are available in a variety of sizes to accommodate bits of different diameters.

Bushings are ideal for template-routing hinge mortises and other recesses (**Photo J**). You can also use them to create multiple identically-shaped parts in much the same fashion as you would use a pattern bit. However, when making a template, you'll need to account for the offset between the edge of the bushing collar and the cutting diameter of the particular bit you're using.

### Using a fence

One of the simplest router guidance methods is to run the edge of the base along a straightedge fence fixed to the workpiece. You can use a jointed



L

An edge guide is an excellent tool for routing mortises, grooves, or details parallel to the edge of a workpiece.

piece of wood or a proprietary self-clamping straightedge like the one shown in **Photo K** above. To set up the cut, draw a cutline on the workpiece, measure from the edge of the router base to the cutting perimeter of the bit, and then place the fence that distance from the cutline. For fast, efficient setup of multiple cuts made with the same bit, make up a couple of offset blocks to the distance required.

When routing against a fence, feed direction is important in order for the bit to pull the router against the fence instead of causing it to veer away. Always feed the router left to right as you face the bearing edge of the fence. Never climb-cut against a fence.

### Edge guides

An edge guide is basically an accessory fence that attaches to the base of a router via one or two extension rods. The fence attaches to the body of the edge guide, which can be adjusted to any location on the rods and then locked in place.

The fence rides along the edge of the workpiece to guide grooves, dadoes, mortises, and other cuts (**Photo L**). An edge guide fence typically extends about 8" from the bit, which is useful for routing grooves relatively near the edge. However, it doesn't have enough reach to cut most shelf dadoes and other joints near the center of larger workpieces. One of the best uses for an edge guide is cutting accurate mortises in table legs and other furniture parts.

Most manufacturers offer proprietary edge guides for their particular routers. Better models are compact and include a tight locking mechanism and micro-adjustability. The body should include a notch at the center to accommodate the bit when shaping workpiece edges with non-bearing-guided bits. ■

### Online Extra

For router maintenance and repair see **Router Health Care**, Issue 34, April/May 2010 or visit [woodcraftmagazine.com/onlineextras](http://woodcraftmagazine.com/onlineextras).



# Fast-and-Easy Sling Chair

*A portable folding seat for the park, pool, or beach*

By Chuck Hedlund

Open dimensions: 26½" w × 38" d × 32" h

**E**njoy nature's bounty in a comfy outdoor chair that loves you back with its comfortable, polyester sling and cushioned headrest. Made from cypress, the assembly weighs a modest 10 pounds, making it ideal for folding and toting from place to place. The secret behind its construction lies in the sturdy

connecting nuts and bolts and their precise locations on facing parts. Building shouldn't take more than a day. Use the day after to test the chair at a choice location with a favorite beverage.

See the **Convenience-Plus Buying Guide** on page 51 for the items used to make this project.

## Build the basic chair

**1** Cut the bottom seat stretcher (A), bottom back stretcher (B), bottom front stretcher (C), crest rail (D), leg braces (E), front legs (F), and rear legs (G) to the sizes in the **Cut List**. (Note that all the stock must be  $\frac{3}{4}$ " thick. Plane the stock if needed to achieve this thickness.)



**A**  
Rout radiused dadoes in the ends of the stretchers and crest rail, flipping the parts end for end.



**B**  
Use a round-over bit and backer fence to rout the radii on the stretchers, crest rail, and legs.

## Tip Alert

Mark opposing parts "left" or "right" and "inside face" to avoid confusion and miscuts.

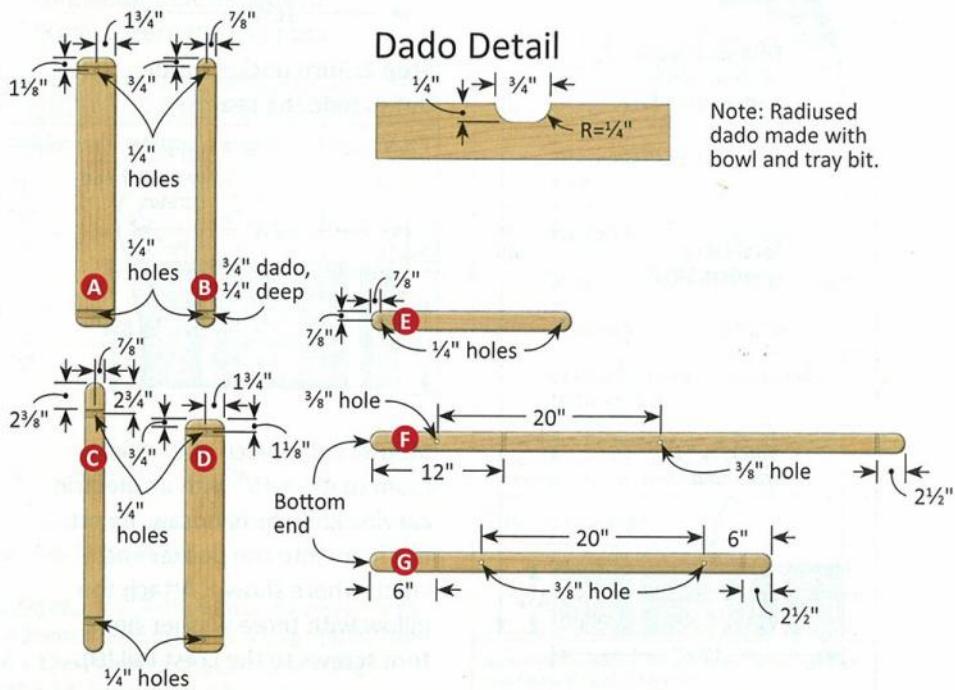
**2** Chuck a  $\frac{3}{4}$ " bowl-cutting bit in a table-mounted router and adjust the height for a  $\frac{1}{4}$ "-deep cut. Referring to **Figure 2** for fence adjustments, rout the dadoes on the stretchers and crest rail (A, B, C, and D) as shown in **Photo A** and the **Dado Detail**.

**3** Choose from one of two ways to cut the radiused ends on parts A through G. Referring to **Figure 2**, mark and cut the radii on a bandsaw and sand smooth. Or, to save time and create perfect radii, chuck a  $\frac{7}{8}$ " radius bit in your router table and rout the ends (**Photo B**).

**Figure 1: Sling Chair Exploded View**



**Figure 2: Stretcher & Leg Parts Views w/Dado Detail**



**4** Carefully lay out the holes for the connector bolts in the stretchers (A, B, C), crest rail (D), and leg parts (E, F, G), where shown in **Figure 2**. Note that parts A through E have  $\frac{1}{4}$ " holes; the front and rear legs (F and G) have  $\frac{3}{8}$ " holes.

**5** Chuck a  $\frac{1}{4}$ " brad-point bit in your drill press. Using a fence and stop, drill centered holes in

the faces of parts A through E where marked. Switch to a  $\frac{3}{8}$ " brad-point bit, and drill centered holes in the faces and edges of front and rear legs (F and G).

**6** Switch to a  $\frac{1}{4}$ " round-over bit, and rout a test piece to fit in a radiusized dado cut in **Step 2**. After achieving a snug fit, rout both faces of parts A through G. Sand smooth.

## Make the armrest assemblies

**1** Rip and crosscut enough  $\frac{3}{4}$ " blank material for the upper braces (H), armrests (I), and support brackets (J), referring to the **Cut List**. Temporarily bond each blank pair together with double-faced tape.

**2** Enlarge the **Sling Chair Patterns** on page 75 or download them from [woodcraftmagazine.com/patterns](http://woodcraftmagazine.com/patterns).

With spray adhesive, adhere the patterns to the appropriate blank pair for upper braces (H), armrests (I), and support brackets (J). Now, bandsaw the coupled parts to shape. Use a spindle and disc sander to sand the perimeter smooth.

**3** Mark the left and right top or outside faces of upper braces (H) and armrests (I). Referring to the patterns, use a  $\frac{3}{8}$ " brad-point bit to drill the  $\frac{3}{8}$ " counterbores  $\frac{1}{4}$ " deep where indicated, along with the shank holes for #8 x  $1\frac{1}{4}$ " flathead screws.

**4** Referring to the patterns, rout the  $\frac{1}{4}$ " round-overs where shown.

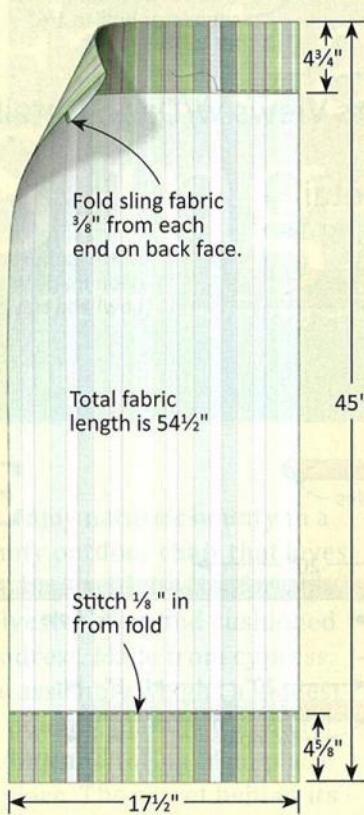
**5** Guiding off the shank holes, hold the armrest assembly parts together and drill screw pilot holes in the mating parts. Note that the inside faces of the upper braces (H) are flush with the inside edges of the armrests (I). Now with

## Fabric Fundamentals

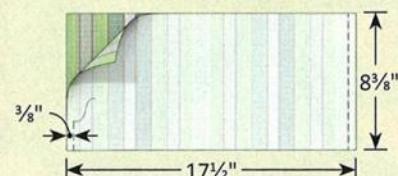
Using a rotary cutter or sharp blade and framing square, cut the fabric for the sling and pillow to the dimensions in the drawing below. Fold the ends of the sling fabric over, and sew at the stitch line where shown.

Next make the headrest pillow as shown in the three-step illustrations right.

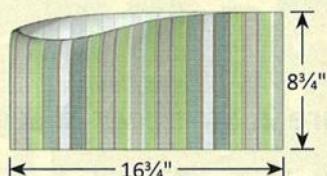
## Sling Detail



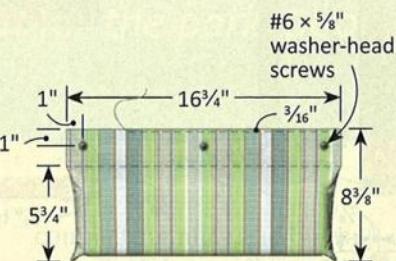
## Pillow Detail



**Step 1:** Fold  $16\frac{3}{4}$ " length of polyester fabric in half, and stitch where shown to create a pocket.



**Step 2:** Turn pocket inside out to hide the seams.



**Step 3:** Cut a piece of 2"-thick foam to  $4\frac{1}{2} \times 15$ " with an electric carving knife or bandsaw. Insert the foam into the pocket and stitch where shown. Attach the pillow with three washer-head trim screws to the crest rail (D).



With the upper brace held firmly in a bench vise, drive the screws to attach the armrest.

waterproof glue and exterior-grade screws, assemble the left and right armrests (**Photo C**). Add the support brackets (**J**).

- 6** Using a plug cutter, cut  $\frac{3}{8}$ " plugs from scrap, and glue them into the counterbored holes, aligning the grain. Trim the plugs with a chisel or flush-trim saw and sand flush. Then sand the armrest assemblies smooth.
- 7** Remove dust and apply an exterior grade oil finish.

### Assemble the chair

**1** Hacksaw  $\frac{1}{8}$ " off the  $\frac{1}{4}$ "-20  $\times$  40mm connecting bolts, shortening them to  $1\frac{3}{8}$ " for the leg assemblies. Also gather up the  $\frac{1}{4}$ "-20  $\times$  50mm connector bolts for attaching the stretchers.

**2** Referring to **Figure 1**, assemble the chair sides (**E, F, G, H**) with a  $\frac{5}{32}$ " Allen wrench, noting the locations of the connecting bolts, cap nuts, and  $\frac{1}{4}$ " fender washers. Attach the dadoed stretchers (**A, B, C**) and crest rail (**D**) onto the chair side assemblies.

**3** Cut and sew the sling and pillow as described in "Fabric Fundamentals" at left.

Remove the hardware from the left or right end of the bottom seat stretcher (**A**) and crest rail (**D**), and slip the sling sleeves over them.

**4** Center the pillow and attach it with trim screws where shown in **Figure 1**.

**5** With the chair fully assembled, prevent the bolts at the pivot points from working loose by applying a thread-locking compound (such as Loctite) to the threads as shown in **Photo D**. Quickly reattach the nuts for a permanent bond. ■



Spread Loctite on the connector bolt threads to firmly secure the cap nuts.



Folded dimensions:  
26½" w  $\times$  8" d  $\times$  48" h

### Convenience-PLUS BUYING GUIDE

<input type="checkbox"/> 1.	#150511	\$32.99
	Whiteside Bowl & Tray Bit with Double Bearing, $\frac{1}{4}$ " R, $\frac{3}{4}$ " D ( $\frac{1}{2}$ " SH)	
<input type="checkbox"/> 2.	#834262	\$93.99
	Freud Round-over Bit, $\frac{7}{8}$ " D ( $\frac{1}{2}$ " SH) (Optional)	
<input type="checkbox"/> 3.	#129659	\$18.99
	Round-over Bit, $\frac{1}{4}$ " R ( $\frac{1}{4}$ " SH)	
<input type="checkbox"/> 4.	#830850	\$6.99
	Snappy $\frac{1}{8}$ " Twist Bit Countersink (for #8 Screws)	
<input type="checkbox"/> 5.	#145560	\$4.50
	Titebond III Waterproof Glue, 4 oz.	
<input type="checkbox"/> 6.	#830818	\$13.99
	Snappy $\frac{3}{8}$ " Tapered Plug Cutter	
<input type="checkbox"/> 7.	#146945	\$13.50
	Watco Exterior Wood Finish, Natural, 1 qt.	
Above items are available at Woodcraft stores, woodcraft.com or by calling (800) 225-1153. Prices subject to change without notice.		
<input type="checkbox"/> 8.	\$17.21/yd.	
	Sling Chair Polyester (Phifertex) Fabric #3016026, Windsor Stripe Tropics, 54" wide, (2) yds.	
Above Item available from Fabrics Central, fabrics-central.com; (800) 742-9549.		

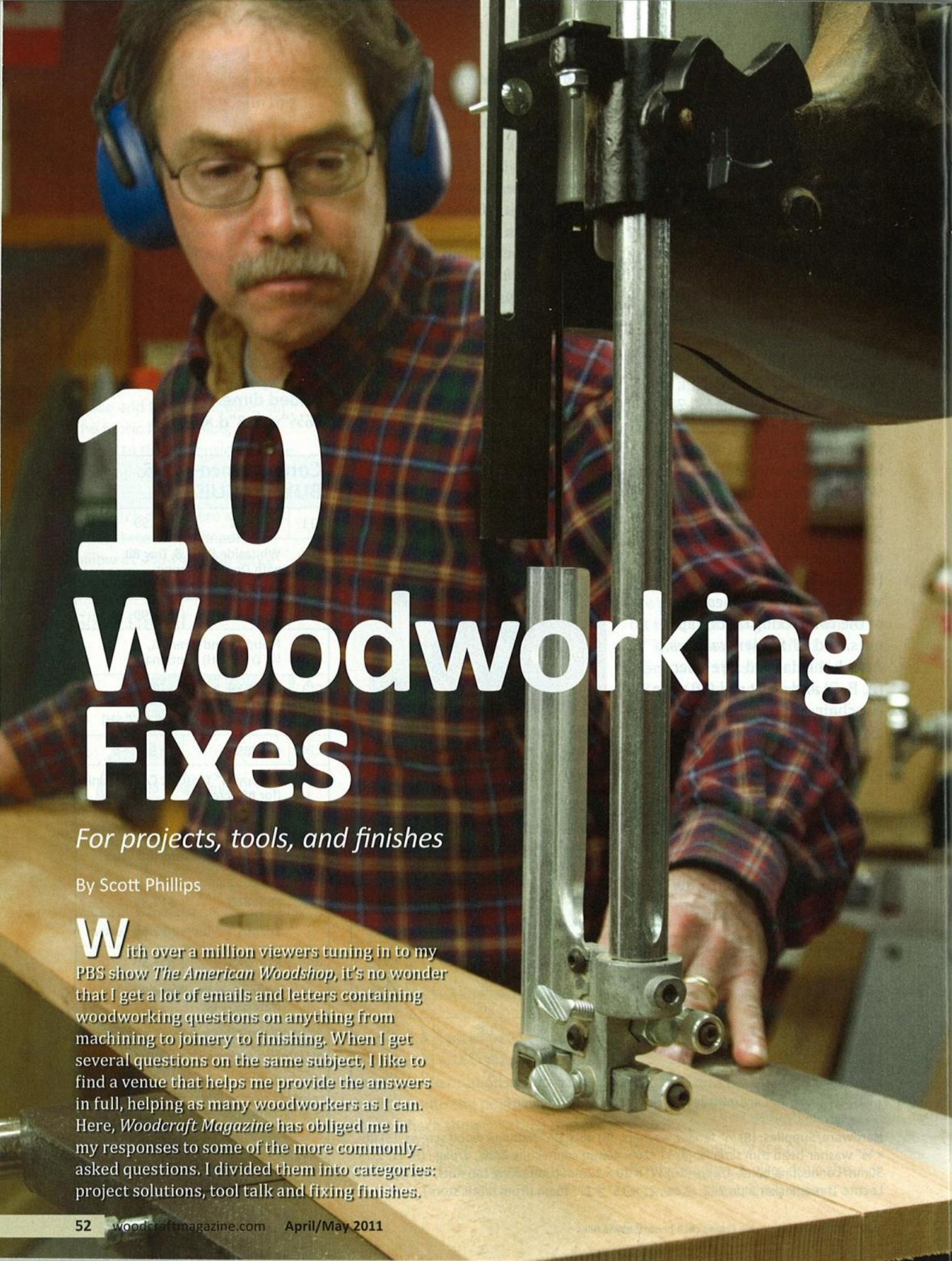
### Sling Chair Cut List

	Part	Thickness	Width	Length	Qty.	Mat'l
A	Bottom seat stretcher	$\frac{3}{4}$ "	$3\frac{1}{2}$ "	24"	1	C
B	Bottom back stretcher	$\frac{3}{4}$ "	$1\frac{3}{4}$ "	24"	1	C
C	Bottom front stretcher	$\frac{3}{4}$ "	$1\frac{3}{4}$ "	24"	1	C
D	Crest rail	$\frac{3}{4}$ "	$3\frac{1}{2}$ "	$20\frac{3}{4}$ "	1	C
E	Leg braces	$\frac{3}{4}$ "	$1\frac{3}{4}$ "	18"	2	C
F	Front legs	$\frac{3}{4}$ "	$1\frac{3}{4}$ "	48"	2	C
G	Rear legs	$\frac{3}{4}$ "	$1\frac{3}{4}$ "	36"	2	C
H	Upper braces	$\frac{3}{4}$ "	6"	18"	2	C
I*	Armrests	$\frac{3}{4}$ "	$3\frac{1}{2}$ "	$13\frac{1}{2}$ "	2	C
J*	Brackets	$\frac{3}{4}$ "	2"	3"	2	C

\*Indicates parts that are initially cut oversized. See instructions.

Materials: C=Cypress

Hardware/Supplies: (8)  $\frac{1}{4}$ " fender washers; (8) #8  $\times$   $1\frac{1}{4}$ " flathead wood screws; (3) #6  $\times$   $\frac{5}{8}$ " washer-head trim screws; (8)  $\frac{1}{4}$ "-20  $\times$  40mm connecting bolts, 4/pkg; (8)  $\frac{1}{4}$ "-20  $\times$  50mm connecting bolts, 4/pkg; (16)  $\frac{1}{4}$ "  $\times$  20  $\times$  12mm connecting cap nuts, 4/pkg; Loctite Threadlocker Blue 242, .2 oz.; 2"  $\times$  15"  $\times$  17" foam (from fabric store).



# 10 Woodworking Fixes

*For projects, tools, and finishes*

By Scott Phillips

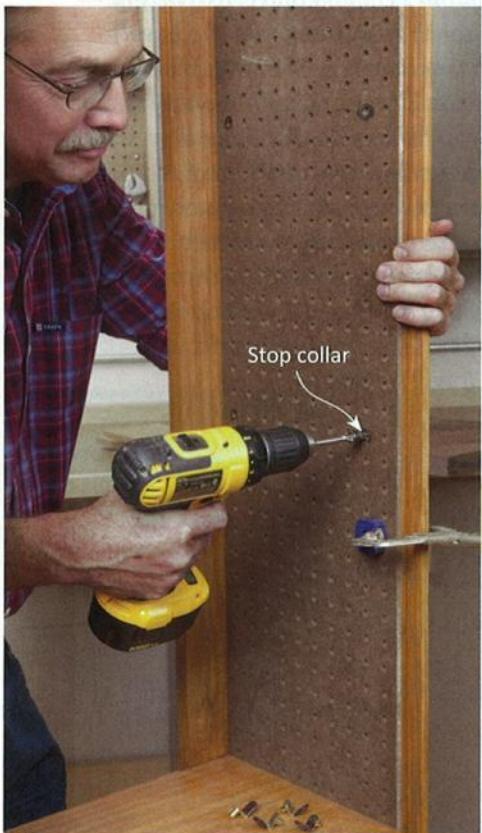
**W**ith over a million viewers tuning in to my PBS show *The American Woodshop*, it's no wonder that I get a lot of emails and letters containing woodworking questions on anything from machining to joinery to finishing. When I get several questions on the same subject, I like to find a venue that helps me provide the answers in full, helping as many woodworkers as I can. Here, *Woodcraft Magazine* has obliged me in my responses to some of the more commonly-asked questions. I divided them into categories: project solutions, tool talk and fixing finishes.

# Project Solutions

Scott, I've built some wall cabinets that I'd like to put adjustable shelves in, but I don't want to shell out money for a hole-drilling jig for the shelf-pin holes. Any ideas?

—Jason Freemont,  
Boulder, Colorado

A dirt-cheap answer may be buried in your sheet goods stash. It's pegboard. Measure the holes, and you'll find that they are  $\frac{1}{4}$ " diameter and spaced on 1" centers. Determine where you want your holes on the cabinet sides, and rip a pegboard strip to fit in the cabinet, designating one end the bottom. Mark the holes you want to drill on the pegboard, and clamp it in place. Now, use this "drilling jig" to drill evenly-spaced holes. Use a stop collar to establish the desired hole depth.



I want to take apart an old chair to restore and refinish it. What's the best way to loosen up a joint containing old glue?  
—Ben Ank, Hot Springs, Arkansas

*Old or antique furniture joints typically relied on hide glue. The bonding agent in more recent furniture may be yellow woodworker's glue (polyvinyl acetate or PVA). Here, use the same method for either glue. Reach for a heat gun or steam iron. Apply heat or steam around the joint while loosening the parts. (Clamps with reversible jaws prove helpful here.) When you heat the joint and glue to 200°, you compromise both types of glues (and possibly*



*the finish). The high heat allows you to separate the parts.*

*If you are worried about damaging the finish, try this. Drill a hole into the joint, and inject warm vinegar into the hole and around the joint with a syringe. Let the solution soften the glue for 30 minutes. Then separate the parts.*

**What is the suggested space allowance between and around inset cabinet doors (those that fit within a face frame or cabinet opening) when using European hinges?**

—John Butler, Midland, Texas

*I like a  $\frac{1}{16}$ " gap all the way around, or something about the thickness of a nickel. The great thing about European hinges—also known as concealed hinges—is that you can adjust and tweak the reveal to be even all around with a few turns of the alignment screws.*

**I'm thinking about buying a portable lumber mill that uses a chainsaw. What are the pros and cons?**

—Steve Rogers, Merrill, Georgia

*If you have access to hardwood trees and are in good physical shape, sawing your own lumber can be fun and a great way to save. An inexpensive chainsaw mill (costing between \$40-\$1,000) can help you rough-saw boards from 16" wide and up, depending on the model and size of your chainsaw. (Check the models at leevalley.com*

*and norwoodindustries.com.) Because of the portability of a chainsaw system, you can haul it right into the forest; however, you'll then need to carry out wet boards. Also, be aware that these systems take time to set up and require the same precautions and safety gear for any chainsaw work.*

*If you have just a few logs to cut, consider hiring the owner of a portable bandsaw mill to saw your material on site. Some charge by the foot; others, by the hour. To find one, call Wood-Mizer at (800) 553-0182 or visit woodmizer.com.*

## Tool Talk

**Is there a cure for "drift" that causes crooked cuts on the bandsaw?**

—Michel Duggan, Springfield, Pennsylvania

*Drift describes a bandsaw blade's tendency to cut to the left or right of a workpiece cutline when using the rip fence. Assuming that your guides are adjusted, and that your blade is properly tensioned, follow this regimen to correct the problem. Strike a straight line 1" in from the straight edge of a flat board that's slightly longer than the depth of your table. Now, carefully freehand-cut along the line until the trailing edge of the board is even with the front edge of your table. Stop the saw mid-cut, and clamp the board in place without disturbing its orientation. Place a sliding bevel against the front edge of the table and the straight edge of the workpiece, and lock the blade in place, capturing the*



*"drift angle." Next, locate the sliding bevel alongside the fence (locked in place) and against the front edge of the table. Follow your saw's manual for loosening the fence. Now, adjust it to agree with the sliding bevel's angle. If using a shop-made wood fence, adjust it as needed. With the angle secured, make a test cut.*



**I purchased an older tablesaw. The cast-iron top is covered with rust. I would like to know the best way to clean it up.**

—Dan Monroe, Blair, Wisconsin

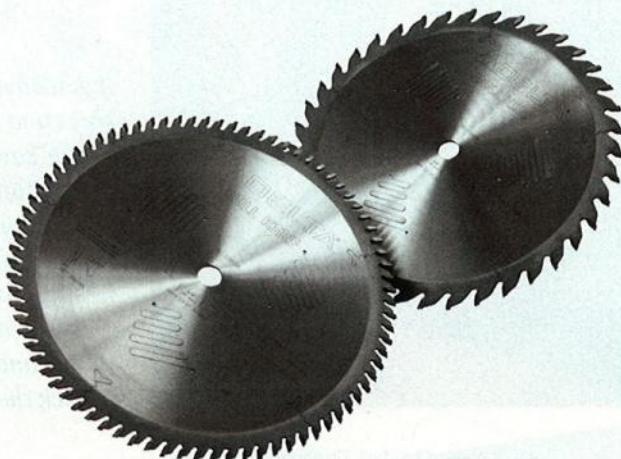
*Fact of life, Dan: steel rusts. Sand the top, moving from 150 to 220 grit using a random-orbit sander. If needed, scrub any pitted areas with a steel wire brush and WD-40 or other lubricant. Once clean, lubricate and protect the surface with paste wax or a dedicated commercial sealant. To simply remove a fine film of rust, pick up a bottle of Empire TopSaver. This user-friendly product removes rust, lubricates, and seals metal surfaces (#148040, 8 oz., \$19.99). I also like T-9 Rust Protectant for its similar benefits (#03Q56, 12 oz., \$17.99).*

**I'm new to woodworking and need to know what is the best all-around tablesaw blade? Should I have two blades, one for hardwoods and one for plywood?**

—Paul Pyle, Nampa, Idaho

*For an all-purpose quality ripping and crosscutting blade, go with a 40-tooth ATB (alternate top bevel) model or a 50-tooth combination ATBR (alternate top bevel with raker) blade. Either one of these will handle 90% of the cutting you'll likely do. Good quality versions cost in the neighborhood of \$80 to \$110.*

*At some point you might want to add other blades to your collection. For tear-out-free crosscutting in plywood and panels, pick up a quality 80-tooth ATB blade in the \$120 price range. A flat top ripping blade in the 24-30-tooth range works well for general ripping. It will set you back \$60.*



**The two pushpads that came with my jointer make me think that I am applying uneven pressure to the workpiece as I pass it over the cutter. Is there a more effective pushpad I can buy?**

—Arnie Brandstad, Gainesville, Florida

*There is, and you don't have to buy it. Using  $\frac{3}{4}$ "-thick plywood and scrap stock, I made this 20"-long pushblock that gives me complete control when face-jointing boards under 4' in length. It consists of a plywood cutout in the shape of a hacksaw (my template for the design), a pair of glued and screwed-on strips that serve as the base, and a pusher cleat at the back end. The shape gives me a long handle that fits comfortably in both hands. For stock longer than 4', I employ pushpads to help start the board through and then finish with my pushblock.*

## Online Extra

For a simple plan of this jig, go to [woodcraftmagazine.com/onlineextras](http://woodcraftmagazine.com/onlineextras).



## Finishing Fixes

**Are there easy ways to remove white water ring marks on furniture?**

—William Owens, Omaha, Nebraska

*Absolutely. Items like a hot teapot or a sweaty cool drink can both result in white rings in a furniture finish. A common way to remove them is to place a lint-free cloth, such as a T-shirt rag, over the affected area. Then, with an iron set at medium, iron the cloth. Lift the cloth to see if the white water stain is gone. Repeat if it's not.*

*If worried about damaging the finish, a safer option is Liberon Furniture Ring Remover (Woodcraft #826133, \$18.50). Apply the liquid with a cloth and rub the area in a circular motion. Let dry, then buff.*



**What's the best way to finish pine for a blotch-free appearance?**

—Ned Gelinas, Waverly, Virginia

*Pine can be a tricky wood to stain. The lighter, softer earlywood in pine grain absorbs stain much more than the harder, darker latewood. Add in the very absorbent end grain, and it's understandable why many woodworkers simply clear-finish pine or paint it. I first*

*sand the pine parts through 220 grit and sand end grain up to 320 grit to help control absorption.*

*While some use a sanding sealer for stain control, I wipe on a nonpenetrating gel stain (such as Gel Stain by General Finishes); it builds color without blotching. Try it on a sample first to see how the product works. After application, allow the gel stain to dry for a day before finishing with your favorite oil-based urethane. ■*



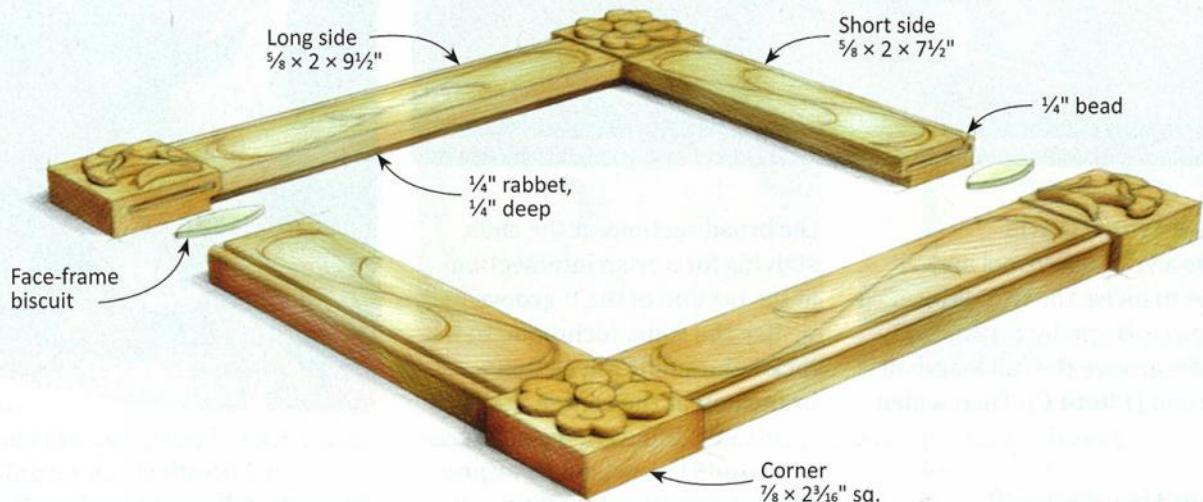


# Carved Flower Frame

*Use simple techniques to create  
an heirloom for Mom.*

By Mike Kehs

**Figure 1:** Frame Exploded View



**S**he's your mother. She gave you life, nurtured you, loves you, and puts up with your occasional nonsense. For this Mother's Day, instead of getting her a bouquet of short-lived flowers, consider presenting her with this heirloom picture frame of carved wooden flowers from your own heart and hands. It's easy to build, and it is carved with just a V-tool, a few gouges, and a knife. If you don't already have carving tools, you'll find the V-tool and gouges that you need in the six-piece set of Flexcut tools that I used. The knife is additional.

(See the **Convenience-Plus Buying Guide** on page 60.)

This frame is made from cherry, a great carving wood. It's sized to display the latest  $8 \times 10$  photo of the kids or grandkids, but you can adjust the dimensions to suit any picture. Carve the two daffodils and two dogwood flowers as shown, or any variation you like. You'll find the full-sized patterns on page 74.

**Prepare the frame parts**

**1** Mill the frame sides to the sizes shown in **Figure 1**. Then rout a  $\frac{1}{4}$ " bead along one edge of each piece (**Photo A**).

**2** For the frame corners, make two pieces of stock  $\frac{7}{8} \times 2\frac{3}{16}$ "  $\times$  about 8" long. (This allows easy clamping for carving a flower at each end, which will be cut free later.) Saw a  $\frac{1}{16}$ "-deep groove along the edges and ends  $\frac{5}{8}$ " up from the bottom face of each piece to establish the background or *field*. Also groove the top face  $2\frac{3}{16}$ " in from the end.

**3** Copy the patterns on page 74, and attach them to the side and corner pieces with spray adhesive. Trim away the upper waste, using a wide-sweep gouge (**Photo B**).



**A**

Rout a bead along one edge of each side piece, using a shaper or router table outfitted with a  $\frac{1}{4}$ " beading bit.



**B**

Establish the carving field for the flowers by sawing a groove into the corner stock, and then trimming away the upper waste.

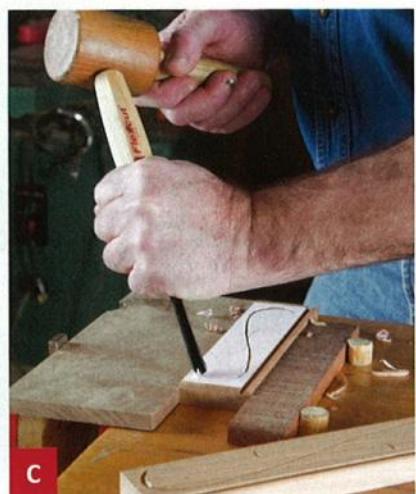


### Carve the fronds

**1** Use a  $\frac{3}{8}'' \times 60^\circ$  V-tool and mallet to incise the fronds on each side piece. Begin by carving a shallow groove the full length of the frond (**Photo C**). Then widen

the broad sections at the ends, striving for a crisp intersection at the bottom of the V-groove.

**2** Use the same technique to incise the small leaves that branch off at the center.



### Carve the daffodil

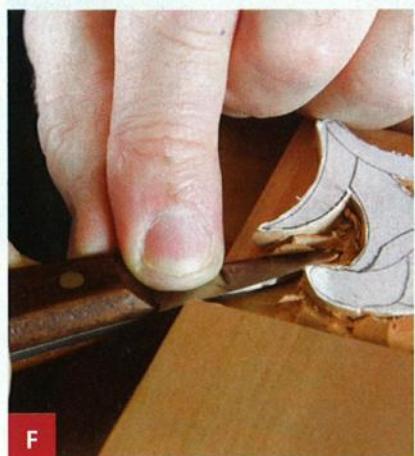
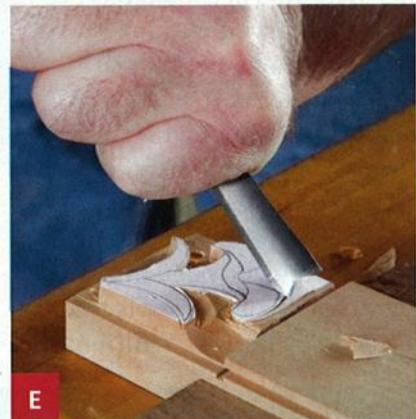
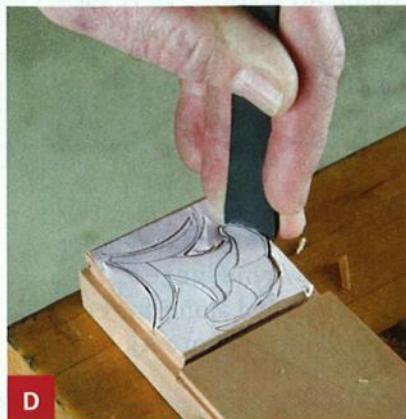
**1** Define the perimeter by tapping in a series of stop cuts with a  $\#3 \times 1''$  sweep gouge (**Photo D**). Stay slightly outside your pattern lines. Don't cut too deep initially, or you risk breaking away fragile sections. Reattach any broken

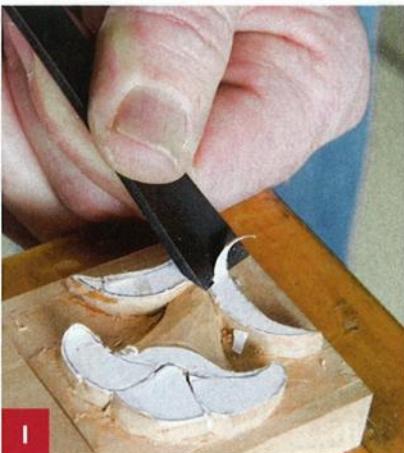
pieces immediately, using cyanoacrylate (CA) glue.

**2** Begin lowering the field by taking shallow gouge cuts outward from your stop cuts (**Photo E**). Don't carve down quite as far as the saw cuts you made. After removing some of the waste, go back and deepen your

stop cuts, followed by removing more waste. As you approach the final depth, use a knife to clean up in tight areas (**Photo F**).

**3** Make stop cuts to define the segments of the petals, as was done in **Step 1**, using gouges with sweeps that approximate the curves.





I



J



K

Then cut along the lowest petal using a V-tool (**Photo G**).

**4** Tap a gouge to make stop cuts to define the upper edges of the leaves where they cross each other or the trumpet-shaped body. Then use a #5 ×  $\frac{11}{16}$ "

sweep gouge to round over the trumpet-shaped area (**Photo H**).

**5** Use a #3 × 1" sweep gouge to shape the concave face of each leaf (**Photo I**).

**6** Round petal faces with an inverted #5 ×  $\frac{11}{16}$ "

sweep gouge (**Photo J**).

**7** With the bulk of the carving completed, use a V-tool to clean up at intersections and sharpen details (**Photo K**). A knife also helps with detailing. Similarly, carve the other daffodil(s).

## Carve the dogwood flower

**1** Use a #5 ×  $\frac{11}{16}$ " sweep gouge to make a series of stop cuts to define the perimeter of the dogwood petals, in the same fashion as described in **Step 1** of carving the daffodil.

**2** Carve away the background waste in the same manner as described in **Step 2** of carving the daffodil.

**3** Use a #10 ×  $\frac{3}{16}$ " sweep gouge to make a series of arced stop cuts around the center of the flower.

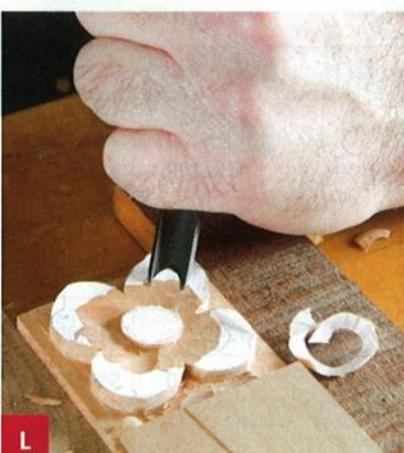
Then scoop out the center section of each petal with a #5 ×  $\frac{11}{16}$ " sweep gouge, taking a series of gradually longer strokes inward toward the center (**Photo L**).

**4** Use a #3 × 1" sweep gouge in stop-cut fashion to define and separate the innermost edges of the petals (**Photo M**).

**5** Tap a notch in the outer edge of each petal using a #11 ×  $\frac{1}{4}$ " sweep gouge (**Photo N**).

**6** Inverting a #5 ×  $\frac{11}{16}$ " sweep gouge, round over the perimeter of each petal, extending the

edges all the way toward the center (**Photo O**).



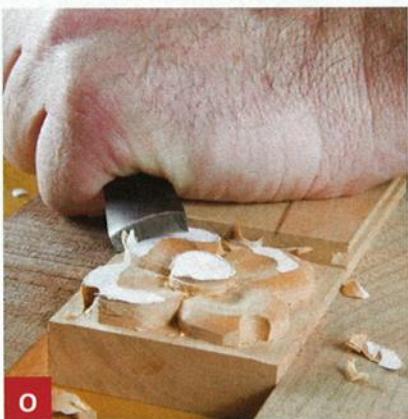
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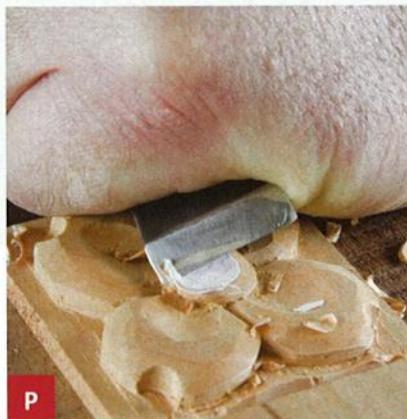
M



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O



P



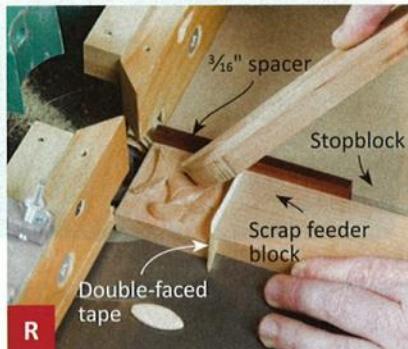
Q

**7** Round over the center using the corner of an inverted #3  $\times$  1" sweep gouge (**Photo P**). Then use a V-tool to crosshatch the center (**Photo Q**).

### Assemble the frame

**1** Crosscut the flowers from their blanks. Flatten any areas of the field that were difficult to access before and mark the locations of the offset biscuit slots on the edges of the corner pieces to prevent confusion when routing.

**2** Use a slotting cutter to rout the slots for the face frame



R



S

biscuits. See **Figure 1**. For efficiency, set up your router table with a stopblock and a  $\frac{3}{16}$ " spacer (**Photos R and S**). Set the stopblock  $1\frac{3}{16}$ " from the center of the bit. Rout both ends of each frame side and the right-hand edge of each corner with the spacer against the stopblock. Remove it to rout the left-hand edge. For safe feeding, secure the corner piece to scrap using double-faced tape.

**3** Sand a slight chamfer on the top edges of the corner blocks

and the ends of the side pieces to create a small reveal at the joints. Use 220-grit paper backed by a hardwood block.

**4** Glue up the frame and rout a  $\frac{1}{4}$ "-wide rabbet  $\frac{1}{4}$ " deep in the back, and then chisel the corners square. Clean away finger oil and residual paper with mineral spirits before applying a finish. I wiped on two coats of Watco Danish Oil, but you can use any finish you like. Install a photo of your choice. ■

### About Our Author

**Michael Kehs** has been carving and turning wood for 30 years. In addition to creating award-winning designs for commission and exhibition, he teaches woodcarving and turning at his studio in Bucks County, Pennsylvania, and at the local Woodcraft store in Allentown, Pennsylvania.



### Convenience-PLUS BUYING GUIDE

<input type="checkbox"/> 1.	Antique Beading Bit, $\frac{1}{4}$ " D ( $\frac{1}{4}$ "SH)	#129680	\$29.99
<input type="checkbox"/> 2.	Flexcut Mallet Starter Set, 6-pc.	#151122	\$144.99
<input type="checkbox"/> 3.	Chip-Carving Knife	#15U21	\$19.99
<input type="checkbox"/> 4.	Titebond Instant Bond CA Adhesive, Medium, 4 oz.	#149434	\$21.50
<input type="checkbox"/> 5.	Whiteside Biscuit Bit (Slotting Cutter), $\frac{1}{4}$ " SH	#24D71	\$19.99
<input type="checkbox"/> 6.	Porter-Cable Face Frame Biscuits (175)	#813370	\$10.99

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# Chisel Box

*Organized storage  
for protection of  
sharp edges*

By Paul Anthony



When it comes to hand tool storage, chisels present a special challenge. Their sharp edges can inflict damage as well as suffer it, so if your chisels are rattling around in a drawer, or still in flimsy original packaging, consider making a box to protect and organize them for easy retrieval. I based this design on a very old version that I once saw for carving tools. It's simple, ingenious, and can be sized to suit any chisel set. The chisels slip neatly into dadoes in a separator block while a retaining strip attached to the box top keeps them in place when carrying the closed box around the shop or to a jobsite. The box requires just a few lengths of  $\frac{3}{4}$ "-thick solid wood for the walls and some

$\frac{1}{4}$ " hardwood plywood for the top and bottom. Construction is simple, because you assemble the box as a closed unit and then rip through its center to create the top and bottom.

## Sizing the box

To determine the front-to-back interior length (IL) of the box, measure the length of your longest chisel and add  $1\frac{1}{4}$ ". Next, lay out your chisels side by side in ascending length, with the bevels facing downward. (Work on a surface where you can leave the layout undisturbed while making the box.) Space them apart about  $\frac{1}{2}$ ". Measure the span of the set, and then add 1" to determine the box's interior width (IW). To calculate the interior height

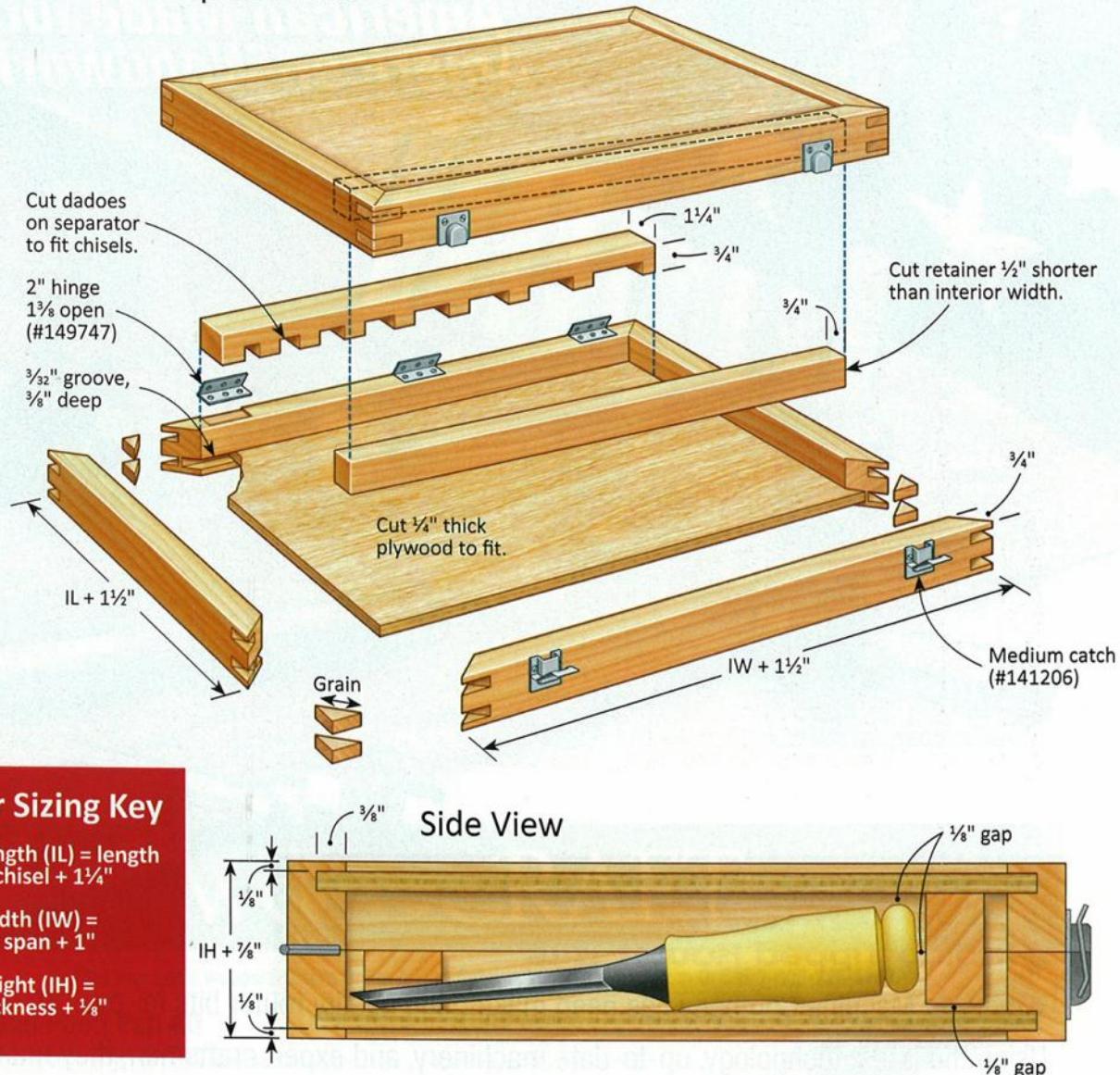
(IH), lay a strip of wood atop the chisel butts and add  $\frac{1}{8}$ " to that height. Now you can determine the finished lengths and widths of your box sides using the equations in **Figure 1**.

## Build the box

**1** From  $\frac{3}{4}$ "-thick hardwood, cut the sides to size and miter both ends of each. Saw the  $\frac{3}{8}$ "-deep panel grooves  $\frac{1}{8}$ " in from each edge, making them just wide enough to snugly accept  $\frac{1}{4}$ "-thick hardwood plywood (which is actually about  $\frac{3}{32}$ " thick).

**2** Dry-clamp the sides together with a band clamp, measure for the panels, and cut the two plywood pieces to size. Apply glue to the grooves and mitered ends, insert the panels, and then clamp the box together. Make

**Figure 1: Chisel Box Exploded View**



sure the assembly is flat and square under clamp pressure.

**3** Lay out and saw four spline slots in each corner, accounting for the kerf you'll make when sawing the sides apart. Glue splines in the slots. When the glue dries, trim them flush.

**4** Adjust your tablesaw blade height to  $\frac{7}{8}$ ", and set the fence to slice the sides down their center. Cut through three sides, and then clamp shims into the kerfs before making the final cut. The shims will keep the separated sides from collapsing onto the blade at the end of the cut.

**5** Make the separator from a piece of  $\frac{3}{4} \times 1\frac{1}{4}$ " hardwood, crosscutting it to fit between the box sides. Then take the separator over to your organized chisels, place its edge against the chisel tips, and transfer their blade widths to the edge of the separator. Cut the dadoes, test the chisels for fit, and glue the separator to the box bottom. (You can slide the separator closer to the chisel handles to close up gaps above the chisel blades.)

**6** Mortise the box bottom and top for two or three

hinges and install them. Also, install the catches.

**7** Finally, make the retainer from  $\frac{3}{4}$ -thick stock, crosscutting it about  $\frac{1}{2}$ " shorter than the interior box width. Rip it to a width equal to the box interior height, and apply double-faced tape to one edge. Place it tape side up in the box bottom about  $\frac{1}{8}$ " from the chisel butts, and press the lid against it. Open the lid, trace around the retainer, remove it, and rip  $\frac{1}{8}$ " from one edge. Glue and clamp it in place within your traced lines. Done. ■

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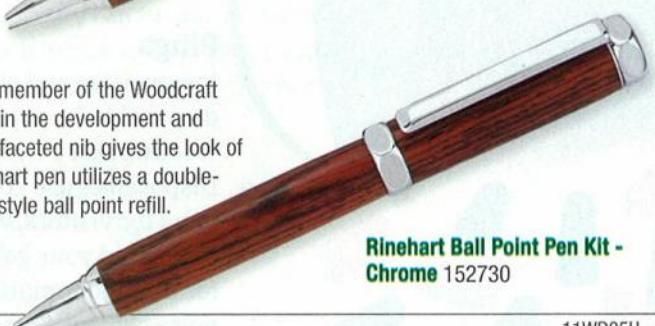


**Triton Ball Point Pen Kit - Chrome w/Gold** 152727

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**Rinehart Ball Point Pen Kit - Chrome** 152730

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# Hearing Protection

*Sound advice made loud and clear*

By Matthew Teague

**H**earing loss may not be the most dramatic or painful shop-related injury, but it may be the sneakiest. That's because unlike a sudden encounter with a blade or bit, hearing damage is both gradual and cumulative. Exposure to any noise over 85 decibels (dB) destroys nerve cells deep in the cochlea of the inner ear. Woodworkers claiming that they've "grown used" to the sound of a tool are already experiencing some hearing loss. In time, they'll notice the loss outside of the shop, but by then it will be too late to do anything about it.

Fortunately, protection is cheap and easy. Here's a selection of plugs, bands, and muffs that can save you from becoming a statistic. Choosing hearing protection involves considering comfort, convenience, and cost. The "best" is the one that gets used.

Note that hearing protectors are frequently ranked by Noise Reduction Rating (NRR), a measurement in decibels of how well a device reduces noise. In theory, exposure is equal to the noise level minus the NRR of the hearing protectors in use, but experts point out the numbers are based on ideal testing conditions. Most conventional hearing protectors, when properly sized and fitted, and consistently worn, can fulfill that requirement.

### Plugs

Inexpensive and effective, disposable foam plugs are a woodworker's first line of defense. Disposables are good to have on hand for visitors, when you've misplaced your go-to set, and for use under muffs for extra noise control. Some find plugs difficult to install. The trick is to roll them between your fingers to compress the foam, set them



MSA 80 Pair Bulk Pack Ear Plugs  
#844524, \$18.99



Industrial Multi-Position Muff  
#152165, \$19.99

MSA Safety Works  
Ear Plugs  
#141920, \$4.99

into the outer ear canal (it helps to raise the upper lobe using your free hand), and then let the foam slowly regain its shape.

Made of soft plastic or silicone, reusable plugs are easier to remove and reinserst than disposables, and can be cleaned for daily use. Like disposable plugs, they are convenient when wearing safety glasses or goggles.

While the less expensive plugs simply block out sound; newer pricier plugs, such as the Noise Breakers, provide variable levels of protection, reducing all noise to safer levels. Allowing normal conversation and music, variable protection encourages users to wear the plugs more often.



Zem Hearing Protection  
#832898, \$19.99

### Reusable plugs and bands

Hearing bands are essentially caps, attached to a spring-action strip, that block the passage of airwaves into the ear canal. A good middle-ground protector, bands are easier to put on and take off (and to find on a crowded bench), than plugs, but are lighter and more comfortable than muffs. Like

the pricier plugs, better bands provide smarter sound control. Zem's acoustic band dampens and cancels certain frequencies, controlling loud noises and allowing users to hear normal conversations.

Rad Band  
#141162, \$8.99



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Braker® Standards  
[www.noisebrakers.com](http://www.noisebrakers.com)  
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Radio and Hearing Protector  
#150261, \$69.99

### Muffs

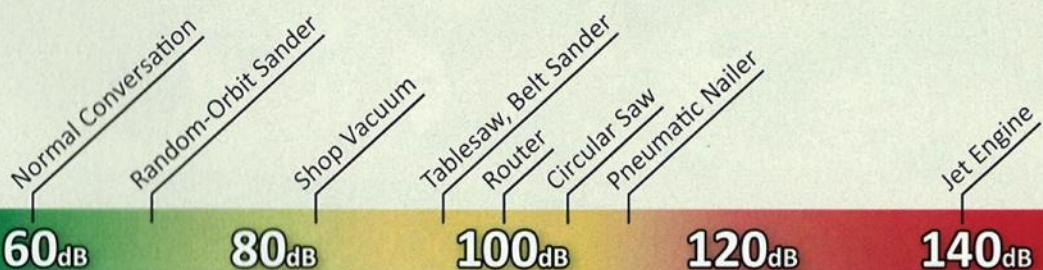
Ear-covering muffs are a good choice if you take hearing protection on and off frequently throughout the course of the day. Fitting over the ear makes them practical for multiple users, and size alone makes them easier to spot when hearing protection is needed. On the downside, muffs can be hot and heavy, and they don't work with most full face masks. Safety glasses may break the seal of the muff against your head and reduce the amount of protection.

Most muffs simply block noise passively, but high-end muffs employ mechanical or electronic baffles that let in safe levels of noise but shut out noise above

85 dB. To encourage users to wear them even when they're not needed, a few are available with microphones (which help with conversation), AM/FM receivers, and jacks for MP3 players. ■

## Which Tools Cause Hearing Damage?

Woodworkers know they need hearing protection when using a router or planer, but many don't realize that long-term exposure to "quieter" machinery can be just as damaging. For example, a half-hour in front of the tablesaw can be as harmful as 15 minutes with a handheld router. For every 3dB increase above 85dB, permissible exposure levels drop by half.



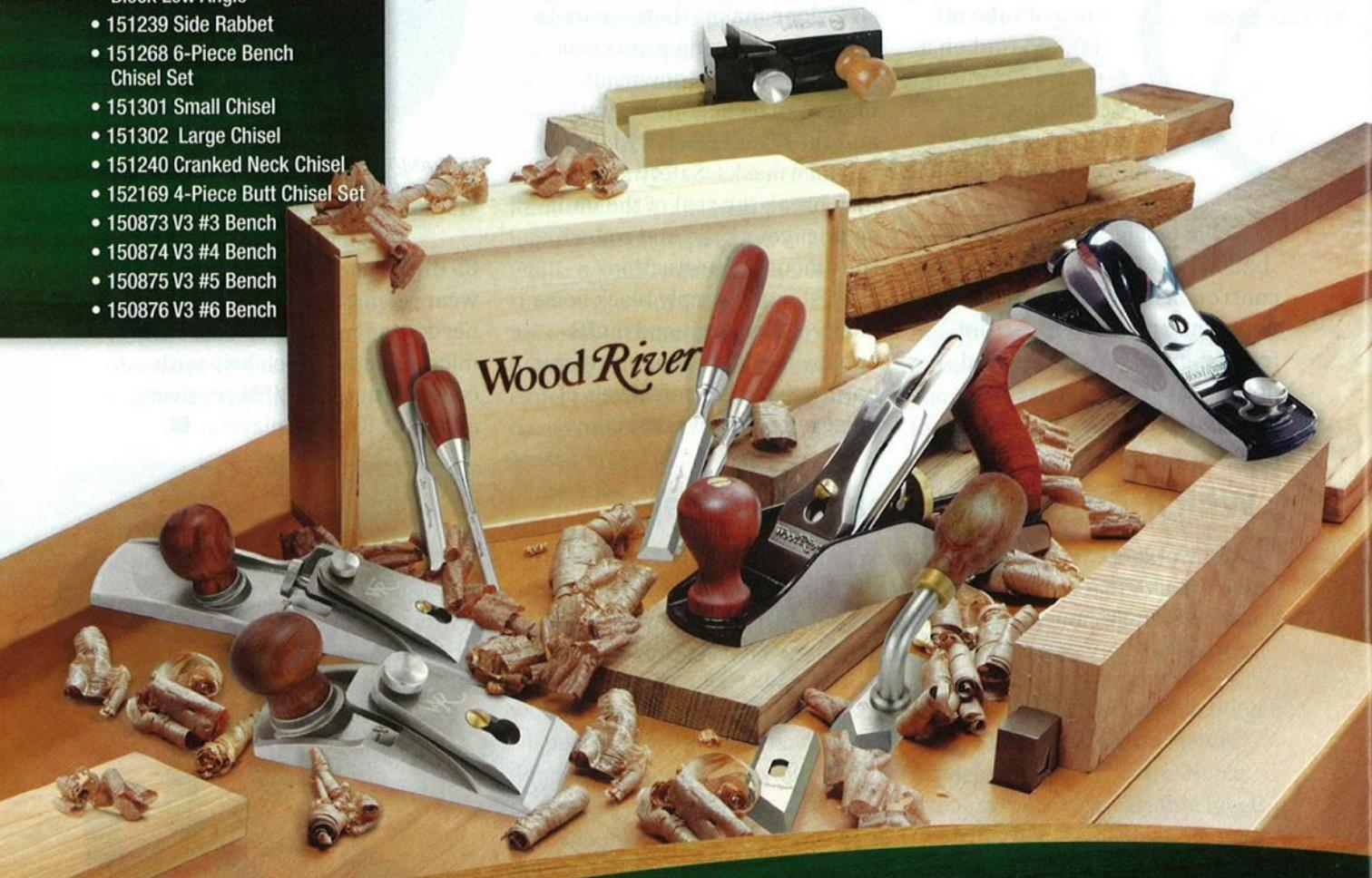


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- 150873 V3 #3 Bench
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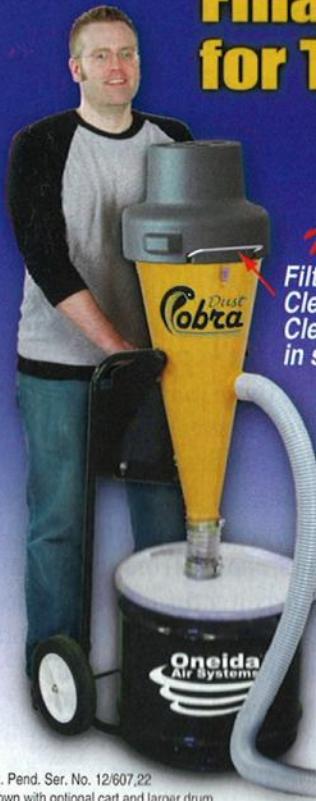
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# Spotlight on Redwood

*Long-lived lumber from California's land of the giants*

By Pete Stephano

**A**merica's coast redwood (*Sequoia sempervirens*) rates as nature's plant giant, because it towers 350' or more. Yet given redwood's height, it's not a tall and lanky tree—a redwood felled in the early 1900s had a 26'-diameter trunk that yielded 344,000 board feet of lumber. The redwood is also the world's second-oldest living thing. Ranking second only to the bristlecone pine, coast redwood specimens have been found that were close to 3,000 years old!

There are two other species in the redwood family, neither of which becomes commercial lumber. California's giant sequoia (*Sequoiadendron giganteum*) grows only in about two dozen protected groves and at higher elevations than the coast redwood. China is the home to the third, the dawn redwood (*Metasequoia glyptostroboides*).

Clear flat grain  
with sapwood

## History in woodworking

Ever since it was first harvested in 1777 to build a mission in Santa Clara, California, redwood has been employed in construction for everything from exposed beams and posts to panels and siding. It's also been relied upon in the past for large water tanks and vats, because natural chemicals in redwood's heartwood resist water, insects, and decay-causing fungi, yet they impart no odor or taste to liquids. Today, it's a favorite material for hot tubs. In and close to its growth range, redwood remains the favored species for grand homes, elegant outdoor structures, decks, fences, and furniture.

## Where the wood comes from

As its name implies, the coast redwood only grows in a narrow coastal mountain range some 500 miles long from near Monterey, California, to Oregon.

But it's this mountainous habitat that

provides the fastest growing of all conifers the rain and fog needed for moisture. And it's interesting to note that commercial harvesting of redwood occurs on private lands in only the upper elevations of its range, representing about 10 percent of its growth area. The rest of the redwood forests are protected in parks and preserves.

Supplementing the natural supply, redwood from buildings, tanks, vats, and other structures is salvaged, resawn, and sold as recycled lumber. Because much of this recycled wood originated in larger, old-growth trees that yielded more heartwood with tighter grain, it is quite valuable.

## What you'll pay

At a mill there may be several dozen grading designations for redwood lumber, but you needn't know them all. Simply remember the following. For furniture and cabinets, choose from these kiln-dried "architectural" grades: clear all-heart, which is all heartwood (the most durable) with minor defects on one side; clear, with minor defects on one side, but includes sapwood; and B-grade, a mixture of heartwood with

Burl veneer



sapwood and some tight knots. Also available are less expensive, air-dried "garden" grades (construction heart, construction common, merchantable heart, and merchantable). Keep in mind that projects built on or near soil require using all heartwood. For projects not touching the ground, you can use lumber with sapwood.

Redwood also comes as flat grain (that actually looks wavy, but was sawn at an angle to the growth rings) or vertical grain (looks straight, but sawn across the growth rings).

As with other softwoods, redwood lumber is sold in nominal sizes, for example, 2×4, 1×6, and so on, in up to 20' lengths, yet the top grades carry

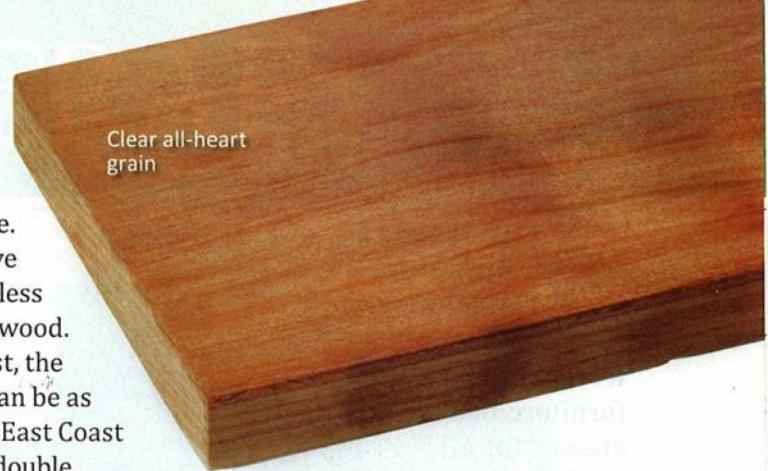
a board-foot price. The closer you live to its source, the less you'll pay for redwood. On the West Coast, the board-foot cost can be as low as \$3; on the East Coast it may be nearly double.

Redwood plywood isn't available. However, you can find exquisite (and quite expensive) veneer cut from redwood burl and some turning blanks.

### How to select the best stock

Select redwood lumber first for intended use, and then for appearance. If you don't need decay resistance and durability in contact with the ground, use less-costly heartwood with sapwood grades. You might, though, prefer the look of top-grade vertical grain for cabinets and furniture.

Keep in mind that redwood heartwood looks salmon pink when first cut, but after exposure to air and sunlight it changes to dark red. Its sapwood remains white. Outdoors without finish protection, redwood heartwood eventually turns a silvery gray.



chipping and tear-out. You'll have no problem ripping redwood, but use a fine-tooth blade for crosscutting. Remove no more than  $\frac{1}{16}$ " at a time in jointing. And be sure to use a backing board when routing across grain.

- **Sanding.** The contrasting hardness/softness of earlywood versus latewood can result in a wavy surface when hand-sanding, so always use a sanding block.
- **Assembly.** All glues work well. To avoid splitting, drill clearance and pilot holes before driving screws. For outdoor projects subject to heavy use and abuse, rely on the joint strength provided by nuts, bolts, and washers. To prevent black stains, use non-corrosive fasteners.

## Redwood Quick Take

Cost - High

Weight - Light

Hardness - Low

(Less than white pine)

Stability - High

Durability - High

Strength - High

Toxicity - None

Tool type - Hand and power tools

Common uses - Cabinets, furniture, millwork, fencing, outdoor structures such as gazebos and decks, paneling, siding, signs, water tanks, and tubs

### Working redwood in the shop

Although light and straight-grained, redwood has excellent structural strength and generally machines quite well. Yet lumber from young second-growth trees and lower grades does tend to splinter and split. Also, the wood is basically softer than white pine, so it's easily dented. With that in mind, follow these suggestions:

- **Planing, ripping, routing, and jointing.** In planing, take only a shallow cut to avoid

### Deciding on the right finish

Redwood readily accepts all interior finishes. Outdoors, however, redwood needs the protection of specially formulated penetrating oils with ultraviolet light (UV) inhibitors. Without UV protection, clear film finishes will quickly break down after prolonged exposure to direct sunlight. Another outdoor solution is semi-transparent stain. This adds color without completely masking the wood grain. ■

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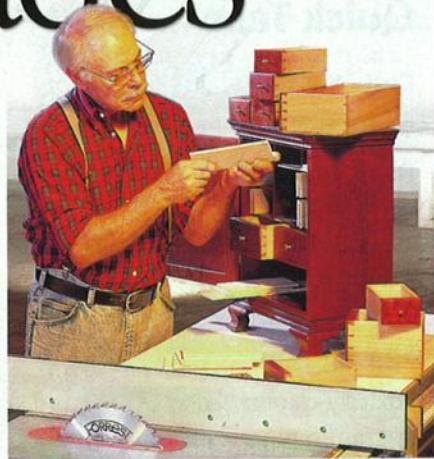
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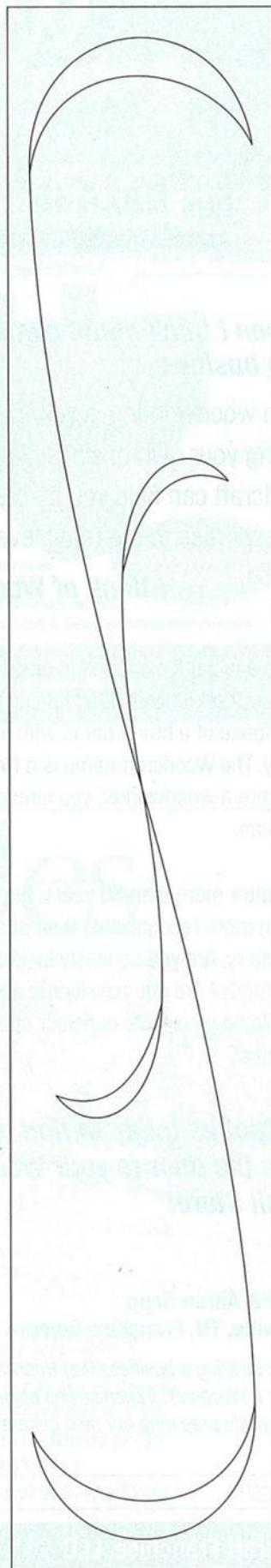
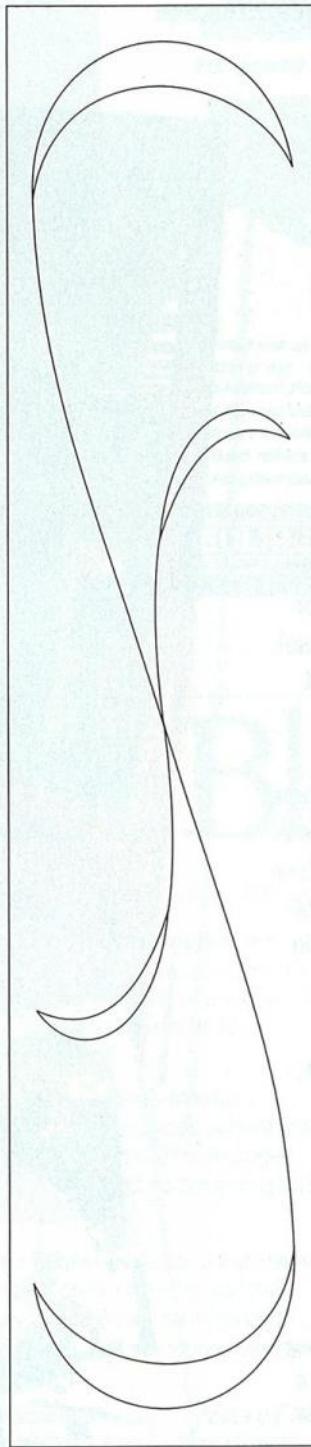
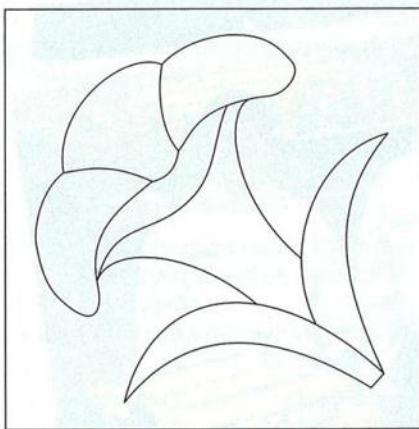
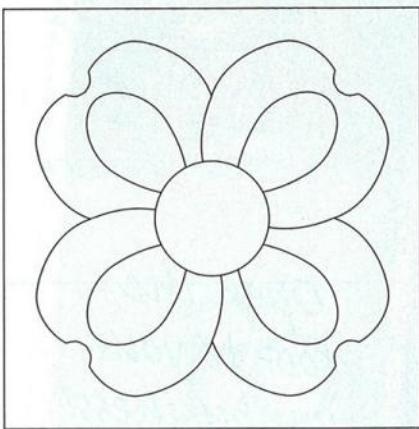
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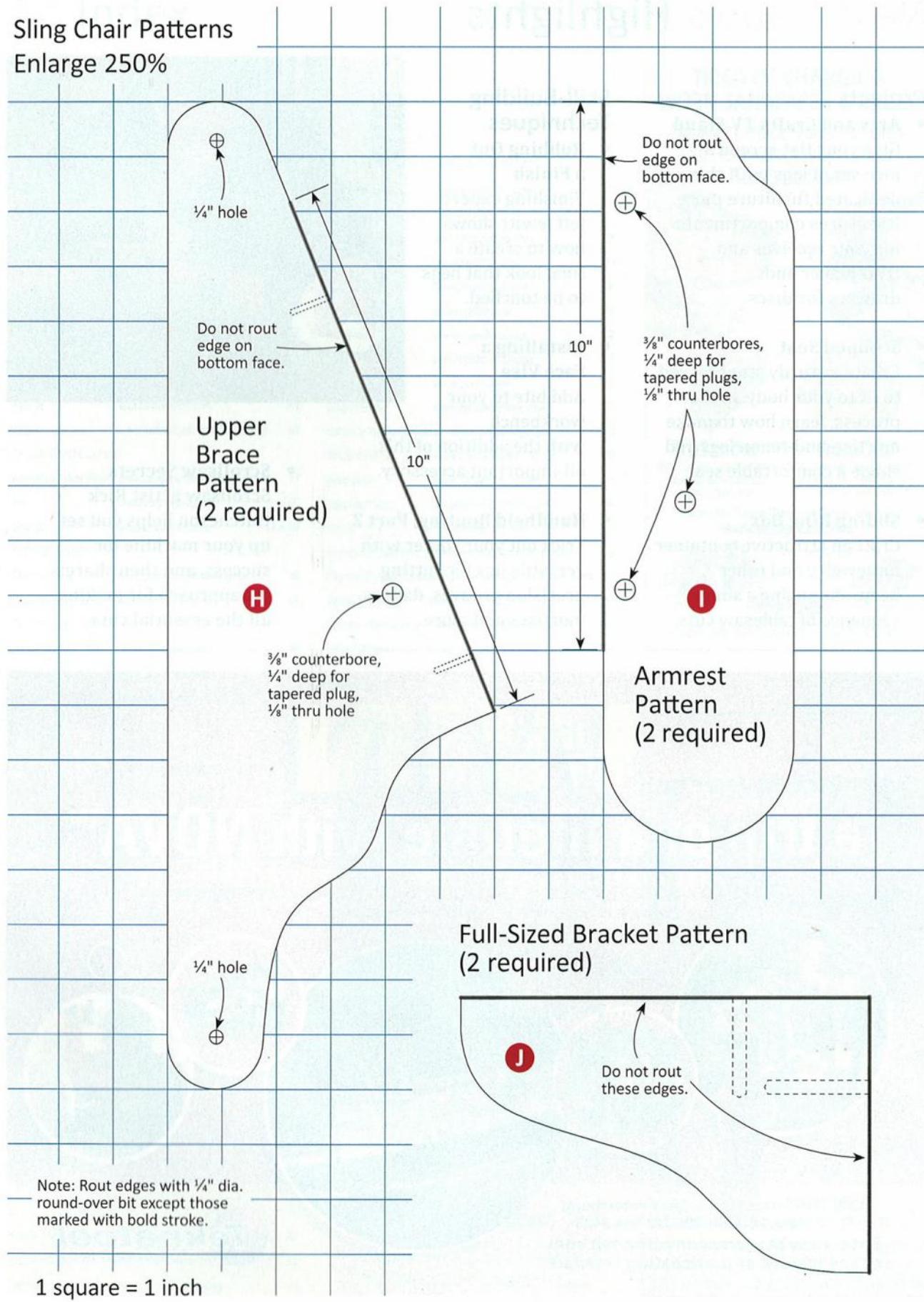
## Carved Flower Frame

### Full-Sized Patterns



## Sling Chair Patterns

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## Projects

- **Arts and Crafts TV Stand**

Give your flat-screen a nice set of legs with this dedicated furniture piece. It features compartments for your receiver and DVD player and drawers for discs.

- **Scooped Seat**

Create a sturdy stool carved to fit to your body. In the process, learn how to make mortise-and-tenon legs and shape a comfortable seat.

- **Sliding Ring Box**

Craft an attractive container for jewelry and other keepsakes using a simple sequence of tablesaw cuts.

## Skill-Building Techniques

- **Rubbing Out a Finish**

Finishing expert Jeff Jewitt shows how to create a final look that begs to be touched.

- **Installing a Face Vise**

Add bite to your workbench with the addition of this all-important accessory.

- **Handheld Routing, Part 2**

Trick out your router with versatile jigs for cutting precision grooves, dadoes, mortises and more.

- **Scrollsaw Secrets**

Scrollsaw artist Rick Hutcheson helps you set up your machine for success, and then shares his approach for making all the essential cuts.



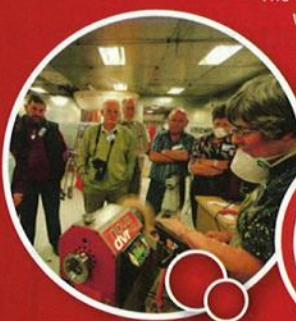
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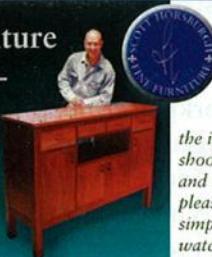
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# Workshop Mishaps

## Accident-free woodcarving

### The story

My fascination with carving stems from my Boy Scout days when I received my first pocketknife. Unfortunately, it's been an activity fraught with hazards. Recently, I endeavored to shape a series of small animals "in the round," using palm-sized pieces of scrap wood. For this, I bought the four-blade whittler's knife kit, figuring it would do the job. To reduce cleanup chores, I set up on the patio with a Cardinals baseball game on a small TV to keep me company and popped a cold one. Things were going well as I roughed out a dog shape from a piece of red oak. But by the third inning, my hands grew tired as the knife lost its edge, and making chips required more effort. Then, in a split second, the session came to a painful halt when the blade skipped over the wood and into my thumb. I grabbed an ice cube from the beer cooler, pressed it against the cut, and wrapped both with a towel for my trip to the hospital. In spite of my stitches, my interest in carving remains. Only now I want to prove I can do it safely, but I need help.

### Case analysis

John Severdija of St. Louis, Missouri, could have avoided seeing red had he stuck to a few basic woodworking rules in addition to some very specific carving techniques. The basic rules are easy: avoid



distractions, such as TV and alcohol. As far as carving strategies, holding a small workpiece with unprotected fingers is simply asking for it. And that's just a start.

When a carving knife slips on the wood, it sometimes indicates a dull blade. John didn't say he kept a sharpening stone in easy reach, but frequently honing the knife helps maintain a razor-sharp edge. Here, it seems, as John applied more pressure to cut with a dull edge, he increased the risk of blade slippage.

John also could have chosen a better carving wood than red oak. It features a wide grain pattern that can split off, unlike a soft, tight-grained wood such as basswood. This wood lets you cut cleanly both with and across the grain, while allowing for carving fine details.

### Shop-smart strategies

When John adopts these tips, he'll reserve his cutting for wood only.

- If shaping rough-outs, remove as much waste as possible on a bandsaw or scrollsaw before carving.
- Keep knives super-sharp with regular honing.
- Pay attention to grain direction, and plan your cuts to avoid carving against the grain.
- Use a carver's vise to firmly hold a carving at any angle, reducing the danger in manual holding (Woodcraft #144743).
- When manually holding a workpiece, protect your holding hand with a Kevlar carving glove (#06163). To keep your other thumb safe from knife slips when performing pull cuts, use a thumb guard (#16V24). ■

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