COMPLETE GUIDE TO WORKSHOP LIGHTING p.54

WOODCRAFT® magazine

Projects, Techniques, and Products

Build this

Classic Wardrobe

See p.38

MORE PROJECTS

- Arts & Crafts Ottoman
- Walrus Toy
- Bagel Slicer
- 8 Bench Stops and Hooks

EXTRA:

MAKE PERFECT FLAT-PANEL GLUE-UPS p.50

VOL. 10/NO. 57 FEB/MAR 14

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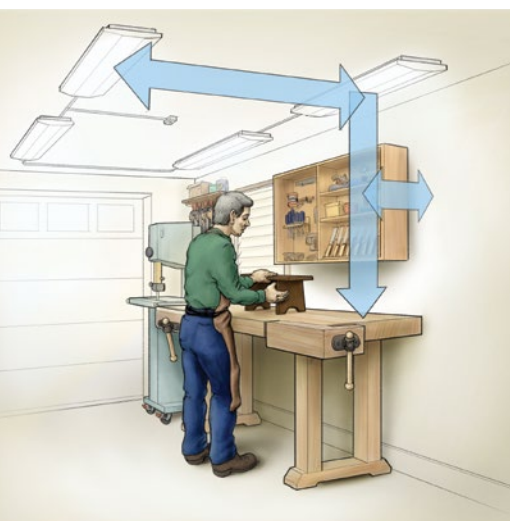
Contents: Tools & Techniques



Departments

WHITESIDE

PEN MAKING
Accessories

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Mottos Worth Adopting

Scouting organizations and others across the globe subscribe to a motto that woodworkers would be wise to adopt: "Be prepared." The United States Coast Guard's motto reads similarly: *Semper Paratus*, which is Latin for "Always Ready." Anyone who has built a woodworking project with several parts and assembly stages can easily see how these mottos come into play. The idea of launching into a woodworking project unprepared without a sense of direction or the right tools and materials on hand at key moments can prove disastrous and result in an unplanned pile of firewood.

The subject for this column came to me at Jim Probst's shop during the construction and photography of the wardrobe on page 38. At one point, Jim needed to glue the face frame to the case, an assignment that called for over 25 clamps. Achieving a complete bond along the edges of the case sides, bottom, and subtop was absolutely critical to a successful glue-up. Fortunately, Jim was well-prepared for the moment, but it made me wonder if readers interested in building the wardrobe would be. Would they have the needed number of clamps? Would they need to borrow clamps from their woodworking buddies? If so, would they think to do so in advance of the glue-up? Again, the motto: Be prepared.

Whether you intend to build the wardrobe or some other project from a plan, consider these tips to keep yourself ready every step of the way:

- Before cutting anything, read through the project plan to get an understanding of how it's built and the key assembly moments. Study the illustrations and photos.
- Gather the needed tools and materials in advance, including any hardware. Plan to have some extra wood on hand for test cuts.
- As you work through the building steps, rehearse every machining, assembly, and finishing step with safety in mind.
- Finally, test all critical setups and machining operations with scrap to ensure you get the desired result.

Good luck with all future projects, and note that your luck will improve when you are prepared.

WOODCRAFT magazine

Feb/Mar 2014
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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 machine 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.

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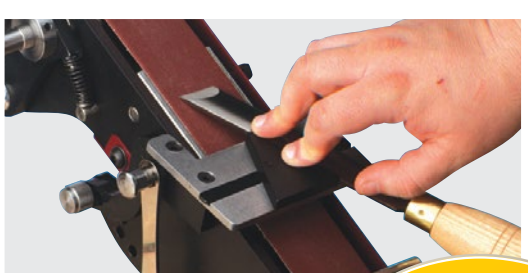

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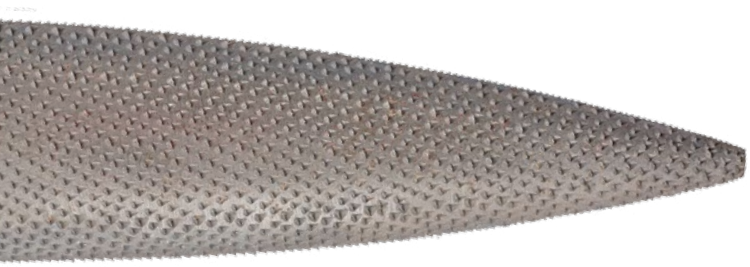

Chime in

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* or a letter to ***Woodcraft Magazine*, PO Box 7020, Parkersburg, WV 26102**.

A better grasp on rasps

Gentlemen, please define the meaning of "hand-stitched" for me as it pertains to rasps. I encountered the word in the "Rasps and Files" story in the Aug/Sept 2013 issue of *Woodcraft Magazine*. My mother used to hand-stitch my torn clothes, but I'm still a babe in the woods regarding the finer tools of woodworking and how they are made.
—Winston Barney
Fort Worth, TX

Winston, the term "hand-stitched" when referring to wood rasps means that each individual tooth is raised by hand–an ancient and time-consuming method for manufacturing rasps. It is a costly and dying art, but the final product is superior to machine-made rasps, resulting in improved cutting speed and quality. Go to http://www.forge-de-saint-juery.com/ and http://www.hand-stitched-rasp-riffler.com/ for more.
—Contributing editor Craig Bentzley, Chalfont, Pennsylvania

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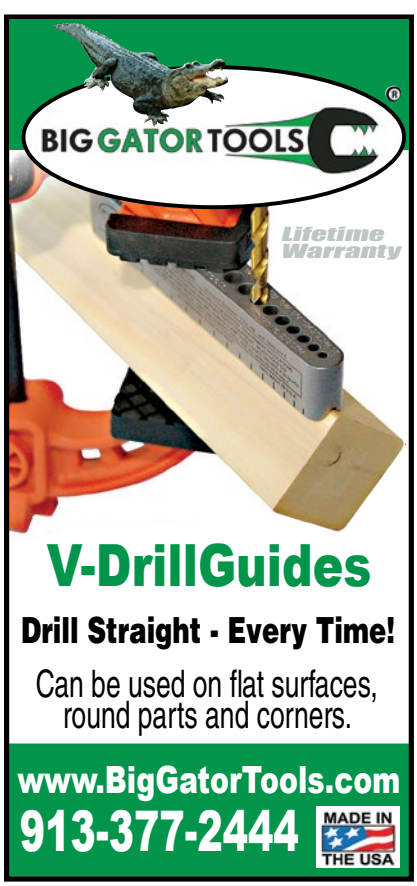
—*Jim Harrold, editor-in-chief,* Woodcraft Magazine

Errata

As careful as we are, errors occasionally find their way into articles. If you spy an apparent mistake, particularly in a project article, please visit *woodcraftmagazine.com* and click on "corrections."



Rasp photo: Larry Hamel-Lambert

Plane royalty

Crown Wooden Planes

The Crown Plane Company is one of the granddaddies of boutique plane makers. Decades ago, Leon Robbins began making a few specialty tools for Windsor-chair wizard Mike Dunbar. Over the years, he continued to work with Mike and his students and gradually developed a small line of wooden-bodied planes. (Leon sold the company to Jim White in 1999. He remained a consultant until his death in 2007.)

As they did in Leon's day, Crown planes represent a fine blend of old and new toolmaking technologies. For example, A2 steel has replaced O1, but each blade is still custom-fitted to its solid wood body, and every plane is tested before it's shipped. In addition to standard jack, scrub, and block planes, Crown offers several specialty planes that do not have metal-body counterparts. Due to the company's fastidious manufacturing processes and small production runs, you may need to wait a few weeks for the next batch of planes. However, if you're lucky, you might find a few at your local Woodcraft store, where you may try them out for yourself.

#158514-158521, **$99.99-179.00**
Tester: Kent Harpool

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Tester: Joe Hurst-Wajszczuk

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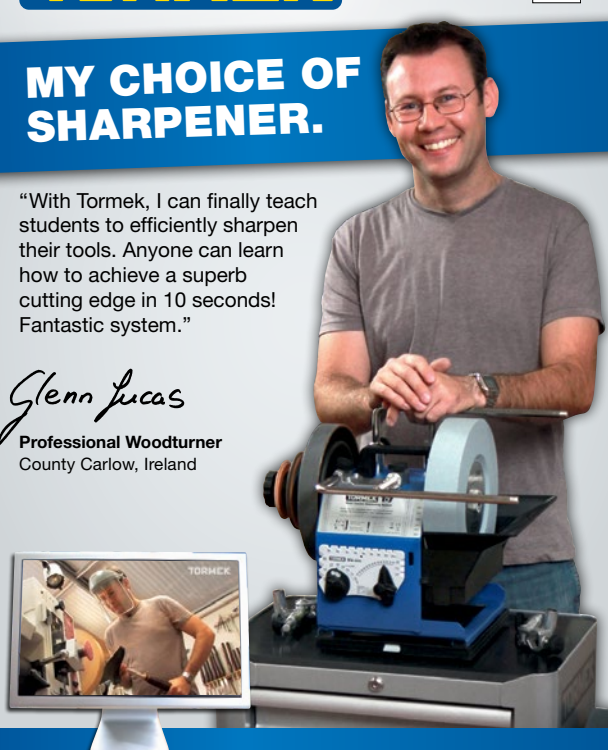

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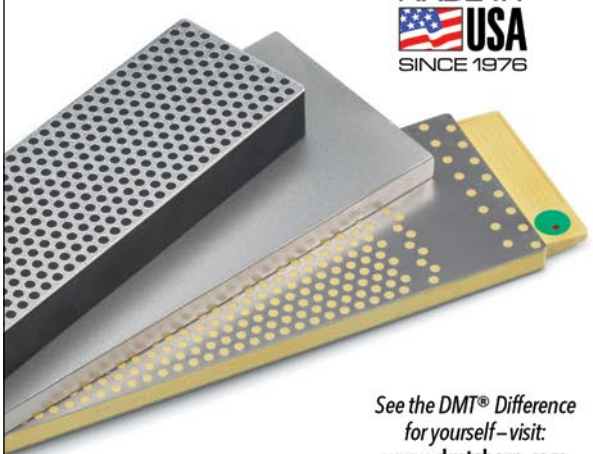

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#155437, **$14.99**
Tester: Kent Harpool

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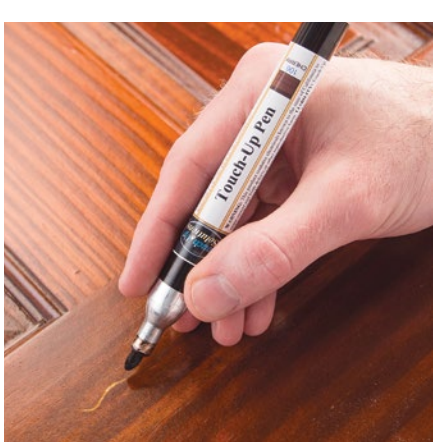
Touch-Up Solutions Stain and Finish Pens

Here's the best finishing solution that you may never see in your shop. Stain pens offer a simple on-site solution for the scratches that come with life–without the hassle or mess associated with cans, brushes, or spraying. With 12 colors to choose from (see *Woodcraft.com*), you'll likely find a close match, or you can mix several colors to make a perfect patch. Once you've colored the scratch, finish it off with a dab of clear finish using one of Touch-Up's lacquer pens.



#158304-158344, **$6.99**
Tester: Kent Harpool

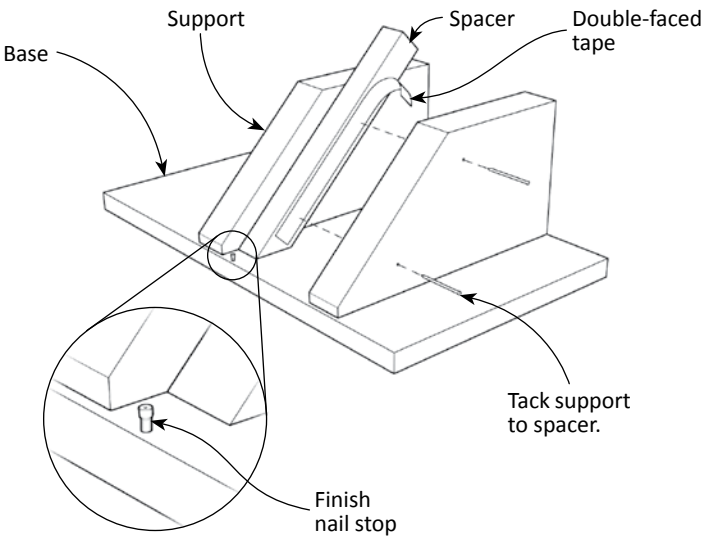
TOP TIP

Chamfer-sanding jig

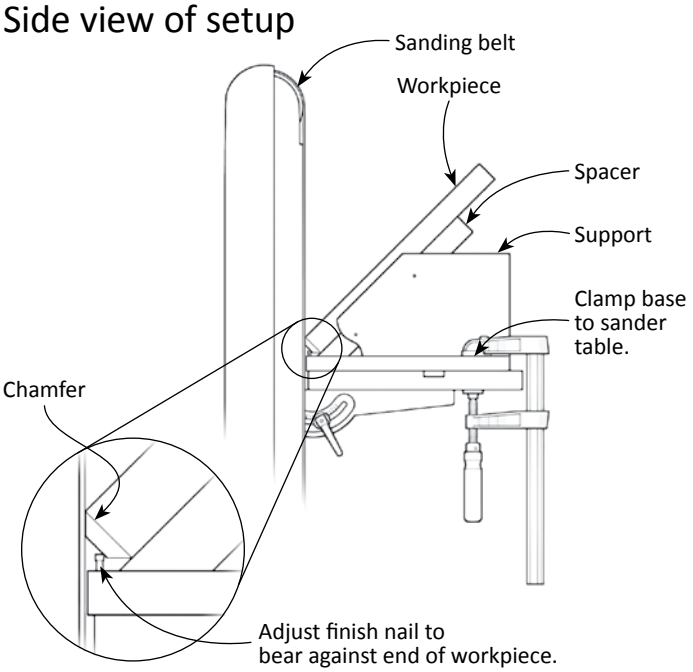
A recent project called for making a lot of small square pegs in which both ends needed to be encircled with small chamfers. I tried to create the chamfers by touching the angled pegs lightly against the belt sander, but the results were inconsistent at best. In frustration, I improvised this simple jig, which works great with a stationary belt sander. The jig is essentially a chute that holds the workpiece at the desired angle and distance from the sanding belt. As shown, the workpiece rests on a spacer that's sandwiched between two angled supports. A finish nail driven into the base near the bottom of the spacer serves as a stop to limit the amount of sanding, to ensure consistent chamfers.

Build the jig to suit the size of your sander table and pegs. The only dimension that's critical is the thickness of the spacer, which should match the thickness of your peg stock. Lay out the slope of the supports to suit the chamfer angle, and then bandsaw to your cutline. Apply double-faced tape to both sides of the spacer before nailing it between the supports to widen the channel for an easy sliding fit for the workpiece. Then tack or screw the support/spacer sandwich to a base that's sized to your sander table. Finally, install a finish nail near the front of the base. Adjust its height and angle to contact the center section of the workpiece end. Clamp the base to your sander table, load a test workpiece into the chute, and adjust the location of the base to create the desired chamfer. Then get to quick work chamfering your pegs.

—Cliff Charron, Baker, Florida



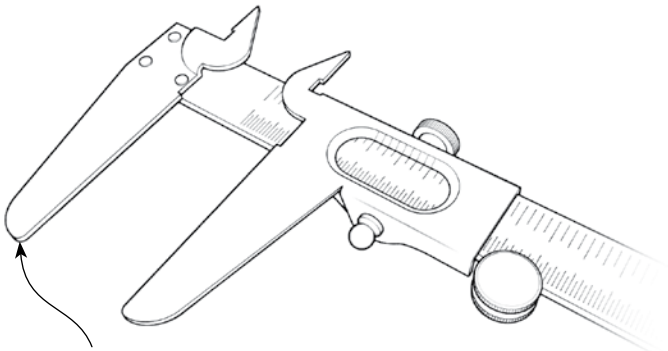
Side view of setup



Share a Slick Tip. Win Cash or a Prize!

Here's your chance to help someone become a better woodworker and to get rewarded for the effort. Next issue's **Top Tip** will receive a **Woodcraft Gift Card worth $250**. Runners-up will receive **$125** for an illustrated tip; **$75** for an non-illustrated one. Winning entries become the property of *Woodcraft Magazine*. Send your original ideas to:

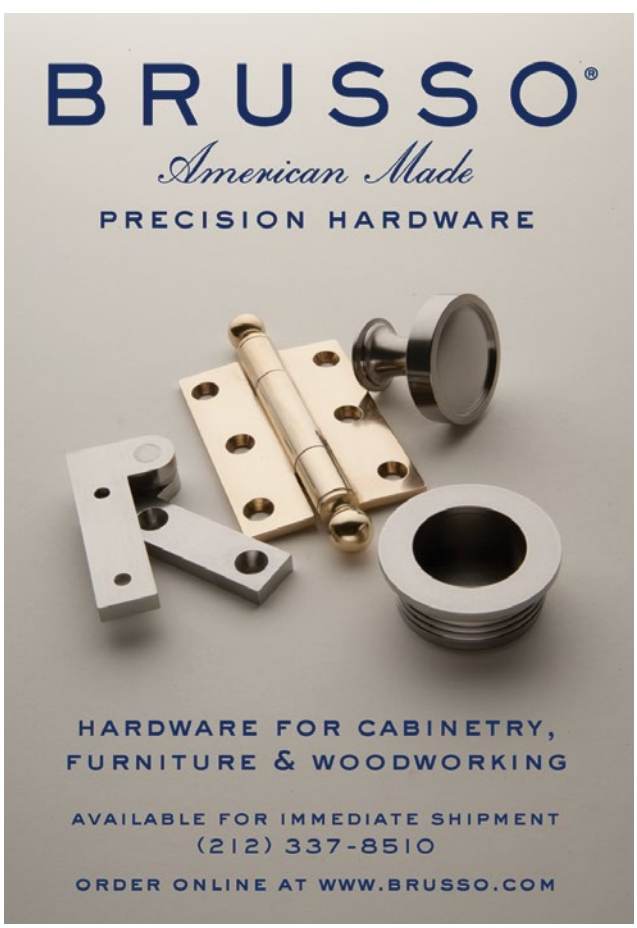
Tips & Tricks, *Woodcraft Magazine*, P.O. Box 7020, Parkersburg, WV 26102-7020 or email editor@woodcraftmagazine.com. Important: Please include your phone number, as an editor will need to call you if your trick is considered for publication.



Round tips of jaws to prevent catching on spinning work.

Non-catch calipers

I use Vernier calipers to measure my progress when turning tenons. I set the caliper jaws to the desired diameter of the tenon, and then hold the jaws against the turning in progress until they slip over the tenon section. To prevent the tips of the caliper jaws from catching on the spinning workpiece, I grind a slight radius on them. This also allows them to easily slide onto the tenon once it reaches the proper diameter.
—Judy Silfer, Tucson, Arizona



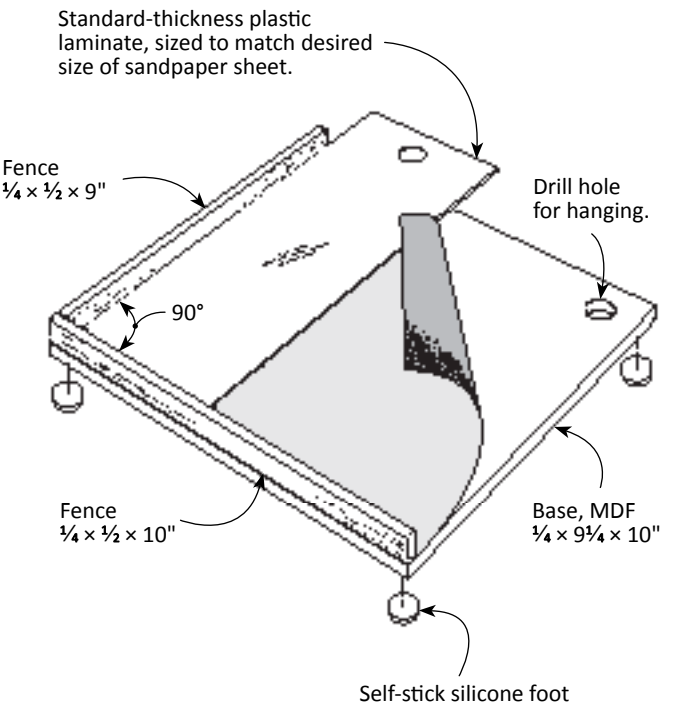
Illustrations: Christopher Mills

Sandpaper sizer

This is a speed machine that will net you a lot of sized sandpaper in a hurry. It's nothing more than a platform, outfitted with two adjacent fences and a piece of standard-thickness plastic laminate as wide as your desired paper size and at least as long. You can stack your sandpaper in this jig to tear several sheets at a time, depending on the grit and weight of the particular paper.

To use it, place your paper grit-side down and against both fences with the laminate on top and against the fences. Press down on the laminate while tearing off two or more sheets with your other hand. As you proceed, remove some of the sized sheets and continue tearing. When the first stack is done, butt the remaining sheets against the fences and repeat until you've got all the sized paper you need.

—Andy Rae, Asheville, North Carolina



Coffee can connector

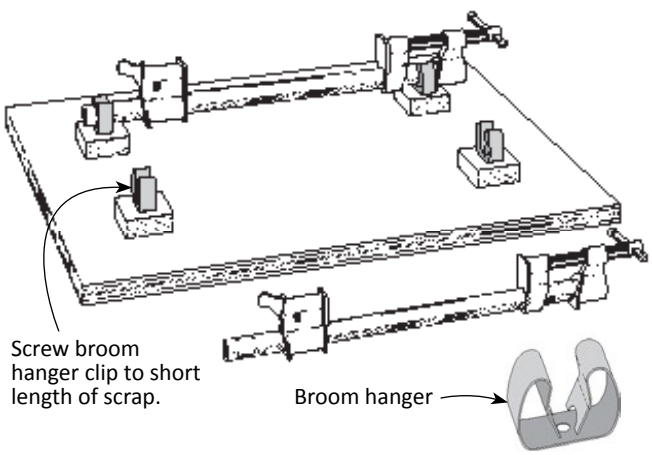
Have you ever accidentally ripped a dust-collector hose and found yourself wishing you had a connector to fix it? Or have you ever wanted to connect a couple of shorter dust-collector hoses to give you extra reach but didn't have the connector to do the job? Well, maybe you did after all. It's a good bet you have a 1-lb. coffee can sitting around your shop full of nails or other hardware. Just cut off the bottom of the can and–voila!–instant 4"-diameter dust-collector connector.

—Thomas Lagreca, Lockport, New York

Pipe clamp stands

For some time, I struggled with gluing up projects with my vintage ¾" pipe clamps. Their narrow footing often caused them to tip when loading boards onto them. During a glue-up one day, I realized that the answer was right in front of me on the wall, holding my shop brooms. These metal spring clips–designed for storing housekeeping equipment–can be screwed to stands made of shop scrap. As an added benefit, the setup raises the clamps enough to facilitate easier turning of the clamp handles.

—Robert Smith, Churchville, New York



Illustrations: Chris Glowacki

Waddling Walrus

Clever toy chomps, waddles and rolls.

By David Wakefield

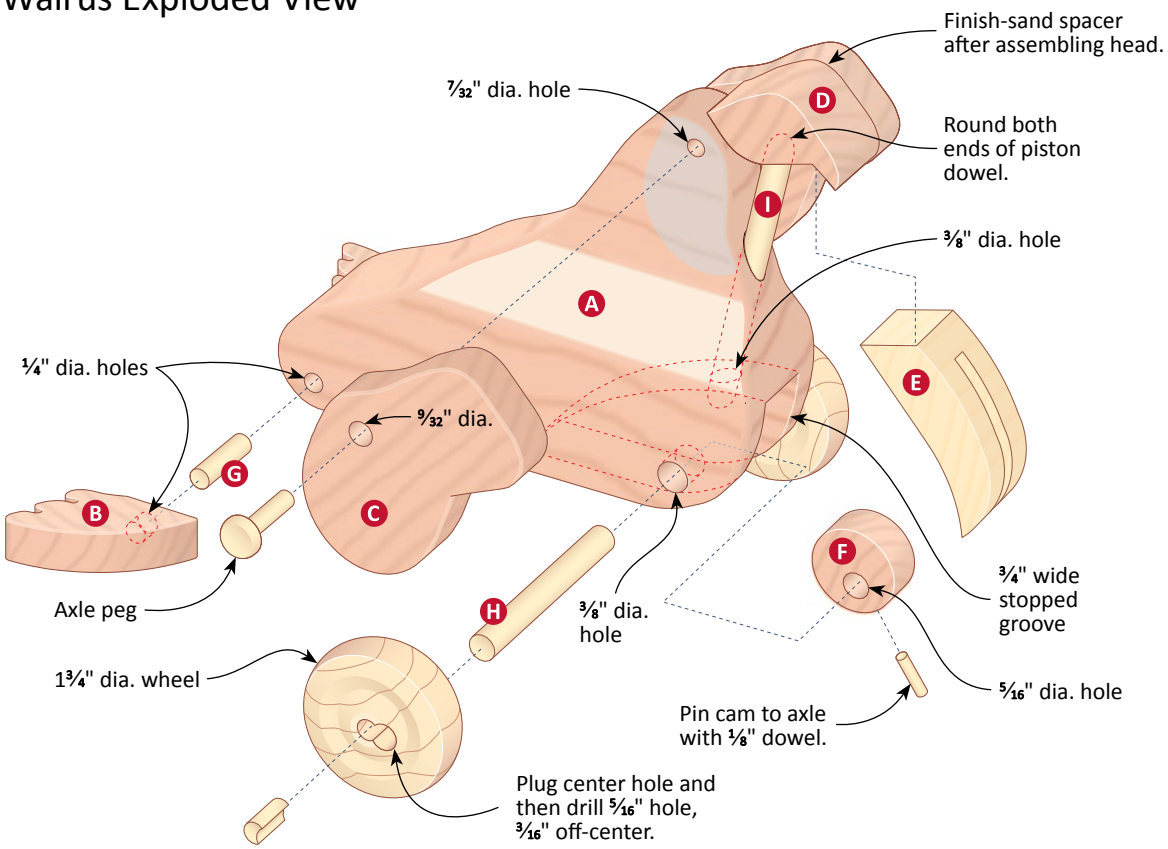
Since I began designing animated toys three decades ago, I continually strive to make my toys more than what most folks expect from a block of wood. My secret is to incorporate simple mechanisms that make the playthings come to life. This walrus is a case in point. Unlike most other toys that simply roll, this fellow has eccentric wheels that create an ambling gait as he's pushed across the floor. Thanks to a cam and piston hidden within the body, the tusked head rises and falls as he's rolled in either direction.

This toy is easy to make, but requires some patience and precise work to guarantee that the parts operate smoothly. Of course, special care should be taken when machining small parts. I've provided advice to help keep your fingers away from blades and bits, but if any procedure seems too close for comfort, stop and use another, safer method.

Note: I hope that you enjoy making this toy for your friends and family, but I trust that you will honor my copyright and not make this or any of my designs for sale.



Figure 1: Walrus Exploded View

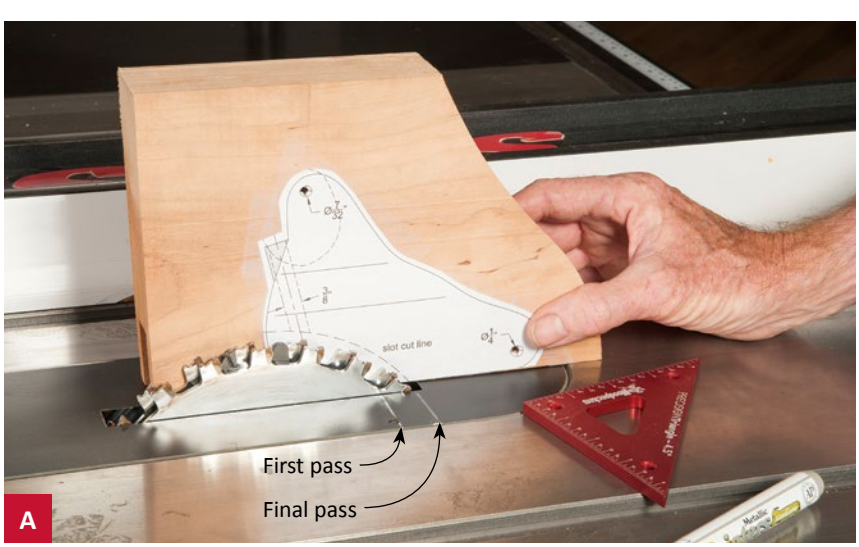


Make the body

1 Cut out and affix the full-sized body (A) pattern onto a block that's a few inches longer and slightly wider than the dimension in the **Cut List,** which will make it safe to hold for initial machining. (I prefer cherry, but any relatively light, strong hardwood will do.) Position the pattern so that its bottom edge is adjacent to the bottom edge of the block.

2 Referring to the pattern, use a drill press to bore the holes for the fins, head, and axle.

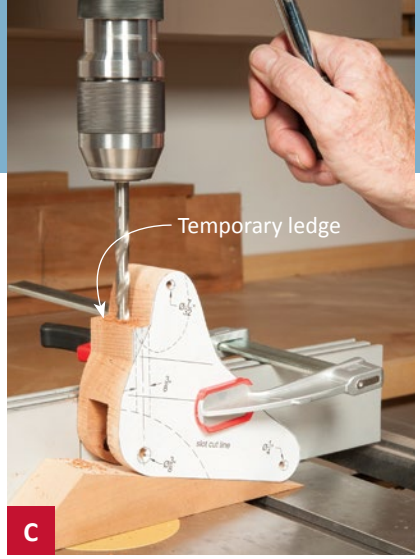
3 Referring to **Figure 1** and the body pattern, lay out on the block's front edge the entry end of the ¾"-wide × 1½"-deep stopped groove, centering it across the thickness of the body. Next, set up a ½"-wide dado head on your tablesaw, adjust its height to ¾", and strike a line on your saw



After raising the dado head for each of the two height settings, mark the location of the cutter's front edge on the table for your stopping mark.

Advance the block until the line on the pattern line meets the stop line on the saw. Wait for the blade to stop before removing the block.

Photos: Morehead Photography; Illustrations: Mario Ferro



Use a wedge to position the body and a square to verify that the hole layout lines are perpendicular to the table. Then drill the hole.

table indicating where the front of the cutter meets the plane of the table. Adjust the fence to saw to one of the groove shoulder lines, and start the cut. When the trailing end of the groove profile line on the pattern meets the mark on your saw, hold the workpiece in place while you turn off the saw and wait for the blade to stop. Next, adjust the fence to cut to the opposite groove shoulder, and make the second cut in the same manner. Now, using the pattern as a guide, raise the cutter to final 1½" height, mark the table again (**Photo A**), and complete the stopped groove using the same two-step approach (**Photo B**).

4 Outfit your bandsaw with a ¼"-wide 4-6 TPI blade, and cut out the body profile. Leave the ledge in the front of the head for now, as you'll need it to drill the piston hole.

5 At the drill press, position the body (A) so that the piston hole layout lines are perpendicular to the table, and then drill the hole (**Photo C**).

6 Saw off the ledge, and then sand the edges and both faces through 120 grit. (*You can use an oscillating spindle sander, but I prefer a 1"-wide belt sander. To handle inside curves, I ripped a 1"-diameter dowel in half and attached it to the sander platen. See **Photo F**, at right.*) Now rout the entire profile with a ¼"-diameter quarter-round bit.

7 Referring to **Figure 1**, lay out the shoulder cuts that reduce the thickness of the walrus' neck section. Use your bandsaw's fence when cutting the straight neck sections (**Photo D**), then remove the fence, prop the body on a ¼"-thick scrap, and saw the walrus' shoulders with a nice sweeping curve (**Photo E**).

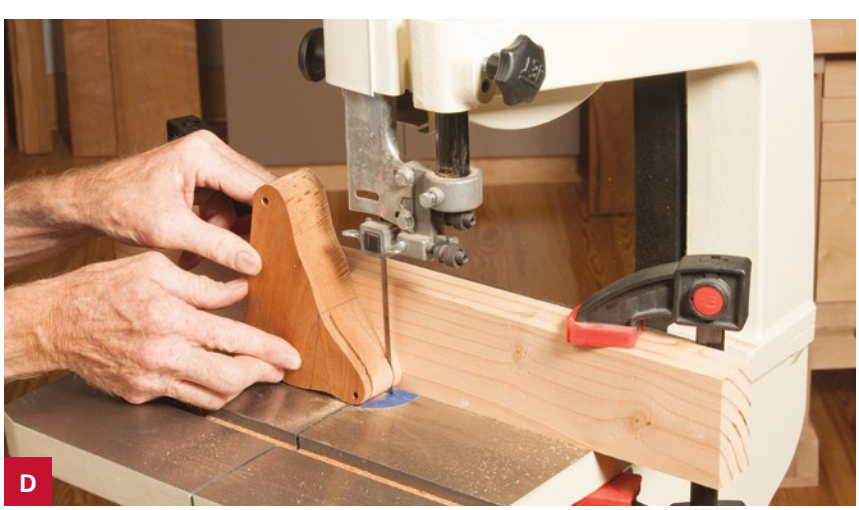
8 Edge-sand the neck/shoulder curves through 120 grit, as shown in **Photo F**, and then round over all the edges of the sawn area by hand-sanding.

Make the flippers and head

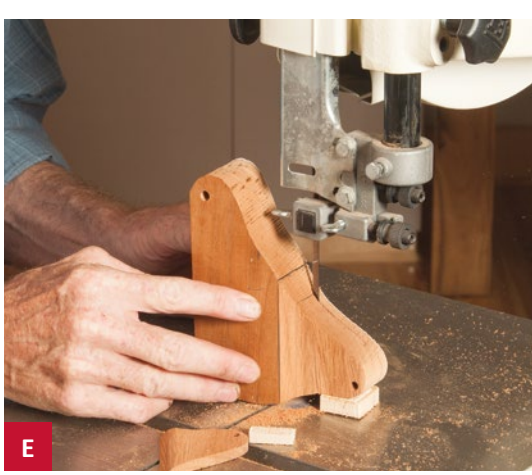
1 Attach two ½"-thick pieces face-to-face with doublestick tape, and then affix the flipper pattern, positioning its inside edge adjacent to the edge of your stock. Using a drill press, drill the ¼"-diameter holes for the flipper dowels into the edges. Next, drill ⅓₂"-diameter holes through the faces, where shown, to simplify shaping the tight curves.

2 Dry-fit a ¼" dowel into a flipper (B) to provide a hand-hold, and then cut out the pattern on the bandsaw. Finish-sand the edges, then split the flippers apart and sand both faces.

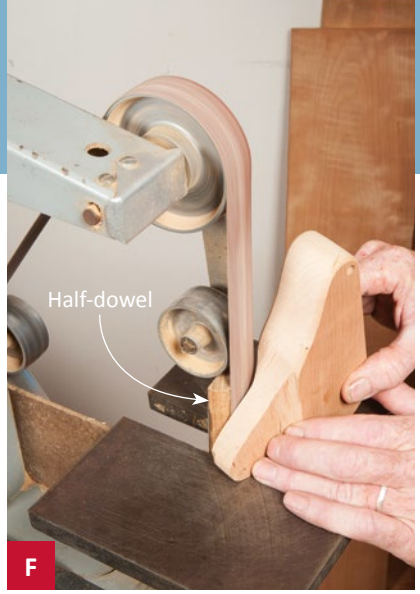
3 Temporarily join two ½"-thick pieces face-to-face and affix the head (C) pattern. Drill the eye/pivot hole, and



Using a fence to guide the initial straight cuts ensures a neck of consistent thickness.



Prop the neck section on a ¼"-thick block, and then saw each shoulder with a single, sweeping cut.



By attaching a short half-dowel to the belt sander's platen, tight curves, such as the shoulders, can be easily sanded to shape.

saw and sand the profile. Separate the twin head pieces, and finish-sand their faces.

4 Affix the head spacer (D) pattern on ⅞"-thick stock. *(For safer sawing, use a piece that's a few inches longer than needed.)* Saw out the piece, and then sand the inside edges. Set this piece aside for now.

5 Affix the tusk (E) pattern on ⅞"-thick stock. Using a bandsaw, saw out the tusks, but leave a few inches of extra material along the blunt end. Finish-sand the edges and faces, and then cut the notch to create the individual tusks, as shown in **Photo G**. Clean up by hand-sanding, and then saw off the extra wood on the blunt end.

6 Build the assembly jig shown below. Now apply a little glue on both faces of the head spacer (D) and the mating face of each head piece (C). Position the assembly on the jig, as shown in **Photo H**, and glue in the tusks (E). When the assembly has dried, edge sand where the spacer meets the outer head pieces. (Be careful not to mar the edges of the tusks.) Hand-sand the assembly through 120 grit.

Make the mechanism and assemble the walrus

1 Make the cam (F) by drilling into ½"-thick stock with a 1⅛"-diameter holesaw. Use dowels to plug the center hole in the cam and each wooden wheel, and then drill offset axle holes where shown on the pattern page.

2 Cut the flipper (G) dowels to length, and chamfer their ends to ease insertion. Put a bit of glue in the flipper holes, a little glue

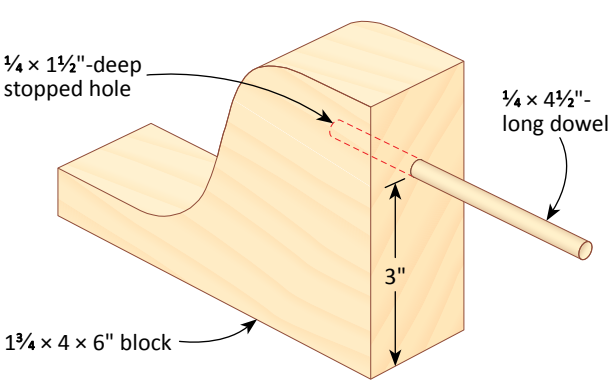
Use a bandsaw fence to make the initial straight cuts to define the tusks. Then remove the fence to nibble away the waste.

on the edge of the flipper (B) where it touches the body (A), and attach the flippers. (*To avoid smearing glue on the body, twist the flippers in place until they're almost touching the body, then tap them home.*) Make sure that the flippers are parallel to the bottom of the body and to each other.

Tip Alert

To minimize squeeze-out, apply glue sparingly, particularly near the edges of the parts.

Figure 3: Assembly Jig



Using the assembly jig to align the parts ensures that the head operates when it's attached to the body.

Use a slotted ⅛"-thick spacer when driving in the eye pegs and wheels so that the parts have adequate clearance to operate smoothly.

3 Cut the axle (H) to length, and chamfer the ends. Apply glue inside one wheel hole, and tap in the axle. Next, insert the cam (F) in the body (A), and twist the axle through both. Now place the remaining wheel beneath the body, and set the axle just into the hole. Offset the eccentric holes 180° to create the walrus' waddle, apply a bit of glue on the axle between the body and wheel, and tap the axle into the wheel.

4 Drill a ⅛" hole through the center of the edge of the cam (F) and through the axle (H). Glue a ⅛"-diameter dowel in the hole. When the glue has set up, trim and file the dowel flush so that it doesn't interfere with the smooth movement of the piston (I).

5 Cut the piston (I) to length, and dry-fit the head to test the mechanism. (You may need to adjust the piston length a bit so that the head starts to lift as soon as the cam engages the dowel.) When you have the perfect length, round off both ends of the dowel, reinsert it in place, apply glue into the eye holes, and tap in the axle pegs to attach the head to the body (**Photo I**).

Finishing touches

I finish most of my toys with food-grade mineral oil because it's nontoxic and easy to use. Simply apply it liberally with a rag, let it soak in, and then wipe away any excess. Reapply if the wood begins to look dry. ■

Walrus Cut List

	Part	Thickness	Width	Length	Qty.	Mat'l
A*	Body	1½"	5"	6½"	1	C
B*	Flipper	½"	1¼"	1¾"	2	C
C*	Head	1½"	1⅞"	2⅞"	2	C
D*	Head spacer	⅞"	1⅝"	1⅜"	1	C
E*	Tusks	⅞"	1"	1¼"	1	M
F	Cam	½"	1" dia.		1	C
G	Flipper dowel		¼" dia.	¾"	2	B
H*	Axle		⅜" dia.	2¾"	B	B
I	Piston		5/16" dia.	3⅜"	1	B

Materials: C=Cherry, M=Maple, B=Birch
*Indicates that parts are initially cut oversized. See instructions.

Convenience-*PLUS* BUYING GUIDE

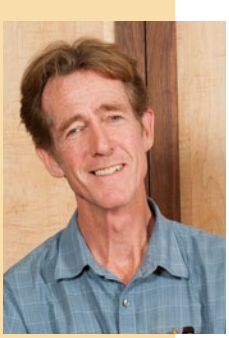
☐ 1.	5/16" diameter × 36" Birch Dowel	#848489	$0.99
☐ 2.	¼" diameter × 36" Birch Dowel	#50D01	$0.89
☐ 3.	Wheels 1¾" diameter, ½" wide, ¼" axle hole, (12)	#50S61	$5.29
☐ 4.	Axle Pegs 7/32" diameter × 1-3/16" long, (8)	#155341	$14.00
☐ 5.	5/16" diameter × 36" Birch Dowel	#848489	$0.99
☐ 6.	General Finishes Butcher Block Oil	#124024	$9.99

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

Tip Alert

If you're going to use paint or apply a hard finish, do so before assembly; otherwise, excess finish may gum up the inner workings of your toy.

About Our Author
David Wakefield has been designing and building wooden mechanical toys for more than 30 years. To purchase ready-made toys and learn more about the animals that inspire his designs, check out *Wildlife-toys.com*.



Walrus Full-Sized Patterns

1 square=1"

Patterns also available for download on *woodcraftmagazine.com/magpatterns.html*

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Sawing Small Parts

Making little cuts with big tools

By Paul Anthony

Using a tablesaw or power mitersaw to cut small parts may seem akin to chopping a twig with an axe. That's one reason we so often reach for hand tools that are better sized for the job. However, if used correctly, a large power saw provides a perfectly good approach to cutting small parts. In fact, if you're not deft with handsaws, planes, and chisels, a stationary saw will quickly yield the kind of clean, square cuts that you're unlikely to accomplish by hand.

The difficulty in cutting small-scale parts with large-scale tools is securely holding the parts while keeping your fingers a safe distance from the blade. When you want to cut identical multiples, the problem is compounded by the fact that stopblocks may sit too close to the blade for comfort and workpieces pinched between the blade and stopblock may kick back after the cut. But not to worry; here, I'll show you how to safely and securely handle tiny tablesaw tasks and chop saw challenges with aplomb (instead of with an axe).

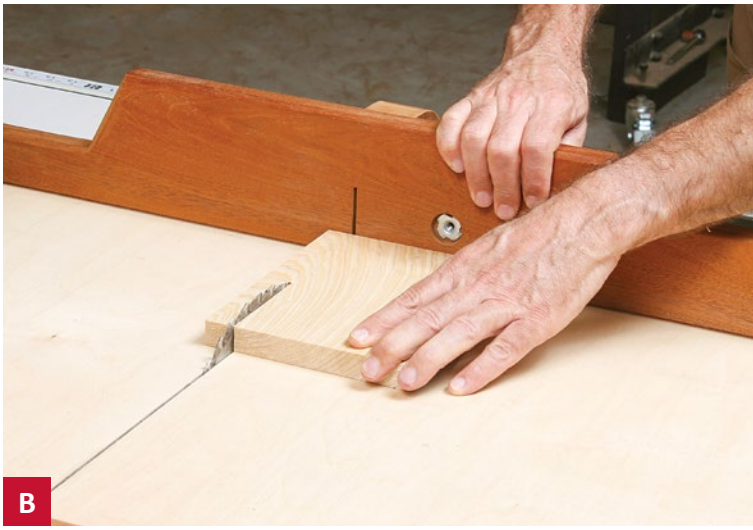
About Our Author
Senior editor Paul Anthony is the author of Taunton's *Complete Illustrated Guide to Tablesaws* (Taunton Press).

Photos: Paul Anthony

Ripping short lengths

A

To rip short pieces, use a shoe-style pushstick with a straight sole to ensure maximum contact with the workpiece.



B

You can rip short, wide pieces easily and safely using a crosscut sled.

Ripping pieces from a short length of wood on the tablesaw can be dicey because the wood may be completely or nearly separated before it reaches the splitter, inviting kickback. It's usually best to crosscut shorter pieces from a long ripping. However, sometimes only short pieces of your chosen wood are available.

It is certainly feasible to rip short pieces in the regular fashion–just make sure to use a shoe-style pushstick with a straight sole to maintain firm contact along the length of the workpiece (**Photo A**). You can glue a strip of fine sandpaper to the sole to improve friction and aid in holding the piece sideways against the fence. It's best to outfit your saw with a zero-clearance throat plate to provide maximum bearing for very narrow pieces.

If you're ripping pieces from a wide board, it's safer to use a crosscut sled, as shown in **Photo B**. To ensure a ripping of consistent width, make sure that the ends of the board are square to its edges. The drawback of using a sled is that making multiples of identical width isn't as easy as feeding against a rip fence because you don't have the immediate registration that the fence offers. If you need to rip short multiples using a sled, you can set up the cuts with a stopblock and spacer, as shown on page 30.

If you often work with small pieces, you may want to invest in a GRR-Ripper (**Photo C**). This tool is a highly configurable pusher with a non-skid bottom, an adjustable center leg to keep the offcut from straying after the cut, and an outer leg that can be adjusted up or down to create solid, level footing on the workpiece and saw table. In my experience, it's the quickest, safest way to rip most small pieces.

C

The GRR-Ripper is a highly configurable pushblock that's ideal for ripping short workpieces.

Tip Alert

If the prospect of ripping small pieces makes you nervous, soothe your nerves by practicing the maneuver a few times with the blade fully lowered below the saw table.

Crosscutting short lengths

It's a normal enough tablesaw operation to crosscut small pieces from the end of a stick guided by a miter gauge. The problem is that the "keeper" pieces–which are actually the offcuts in this case–tend to dangerously cluster around the running blade, getting thrown when they wander into it. The easy fix is to outfit your miter gauge with an auxiliary fence that extends a few inches beyond the blade (**Photo D**). The extra length will push the offcuts past the blade where they'll sit safely until you're done.

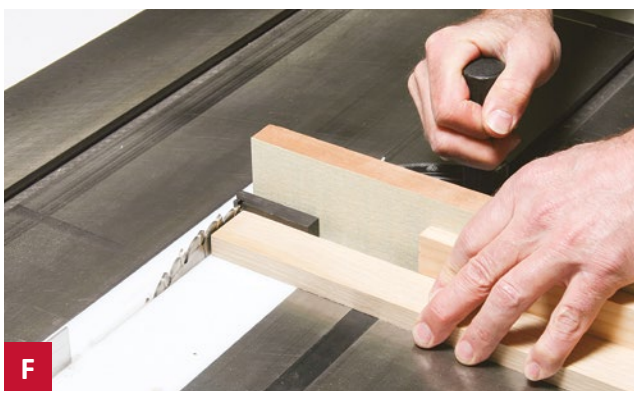
The real challenge when crosscutting small pieces arises when you're working with stock that is short to begin with. This is often the case when making drawer pulls and other small parts from offcuts of precious woods you've saved. In these cases, I've found that the best trick is to employ what I call "bridge-clamping" in which the workpiece is held down with a stick that bridges over from a piece of riser scrap that is exactly the same thickness, or just a hair thinner, than the workpiece.

This is most safely done on a crosscut sled because the sled supports all of the components completely throughout the cut, with no frictional drag against the saw table (**Photo E**). Alternatively, you can set up the cut in a similar fashion against a sandpaper-faced auxiliary miter gauge fence that extends all the way to the blade (**Photo F**).

A power mitersaw is a great crosscutting tool, but it may need to be accessorized to work with small pieces. The problem is that the blade slot and the gap in the fence tend to be fairly wide. Therefore, small workpieces are prone to flight when cut free. The solution is to outfit the saw with a zero-clearance auxiliary deck, as shown in **Photo G**.

An auxiliary miter gauge fence that extends past the blade will safely carry small offcuts completely past the blade.

This small ebony workpiece is held down on a crosscut sled using a stick that bridges over from a scrap riser.



Bridge-clamping can also be done against an auxiliary miter gauge fence that extends all the way to the blade.

An auxiliary deck on a power mitersaw makes for cleaner cuts and prevents "keeper" offcuts from being thrown backwards by the blade.

Ripping short multiples with a sled

1


2


3


4

You can cut identical multiples on a sled using a stopblock and spacer. Using a spacer prevents trapping the offcut between the blade and stopblock at the end of the cut, which can cause a piece to kick.

Begin by placing your workpiece in position for the desired ripcut, and butt a short piece against it to serve as a spacer (**Photo 1**). Then butt a stopblock against the spacer, and clamp the stopblock to the sled fence (**Photo 2**). Keeping the workpiece in position, remove the spacer and make the cut (**Photo 3**). Pull the sled back away from the blade before taking away the newly cut piece, and then repeat each subsequent rip in the same manner.

As the workpiece gets narrower, keep it perpendicular to the fence by placing a squared panel against its edge. Use a panel that is the same thickness as the workpiece so that it also serves as a riser to help support a thick hold-down block (**Photo 4**).

Tips for Cutting Puny Pieces:

Mind your blade: Use a sharp, 40- or 50-tooth ATB premium-quality blade to produce pieces that need minimal sanding or other cleanup.

Provide backup: To minimize tear-out and provide maximum workpiece support, outfit your tablesaw with a zero-clearance insert, and use an auxiliary deck on your power mitersaw.

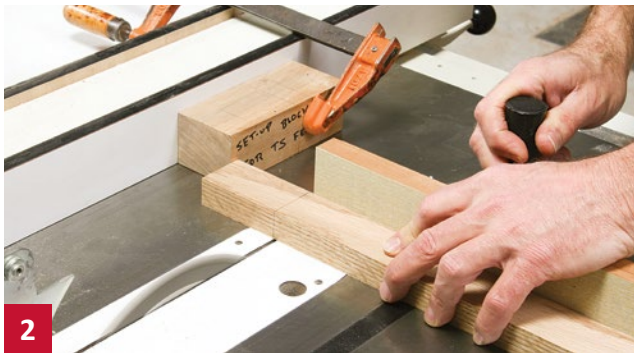
Carry on: If a piece is too small to safely hold down next to the blade, you can use glue or double-faced tape to temporarily affix the piece to a carrier board that can then be fed against the rip fence or held against the miter gauge fence.

Prevent slap-downs: Keep thin strips from slapping and possibly shattering by covering them with a thick piece of scrap that extends nearly to the blade to serve as a hold-down.

Crosscutting multiples with a fence block

When crosscutting short multiples, never use the rip fence as a stopblock. This is because the offcut "keeper piece," which is pinched between the blade and fence at the end of the cut, will kick back once freed. Instead, register the work against a setup block to give the freed piece room to move. To begin, place the piece against the miter gauge fence, and align the teeth with the cutline. Clamp the stock to the miter gauge, and pull it forward of the blade a distance equal to the width of the stock plus an inch or so. Clamp a thick, wide setup block to the fence with the block's leading end approximately aligned with the leading edge of the workpiece (**Photo 1**). Carefully slide the rip fence over until the setup block touches the end of the stock, and lock the fence in place. Now make each cut by registering the end of the workpiece against the setup block before advancing it across the blade (**Photo 2**).

1



2

Crosscutting multiples on a power mitersaw

You can crosscut short multiples on a power mitersaw by employing the same spacer-and-stopblock principle shown on the previous page for ripping short multiples on a sled. It's best when cutting very small pieces to outfit your saw with an auxiliary deck to fully support the offcuts and minimize tear-out.

To set up for the cut, place the workpiece on the deck, and align the cutline with the blade. Without nudging the workpiece, carefully place a spacer against its end, and then place a stopblock against the spacer. Finally, clamp the stopblock to the fence of the auxiliary deck, as shown in **Photo 1**. Remove the spacer, and make the first cut. Set up each subsequent cut against the spacer as well, removing it before making the cut (**Photo 2**). ■

1

2

Elegant Ottoman

Treat your feet to something sweet.

By Robert Spiece
Design by Jeffry Lohr

Overall dimensions: 21⅛"w × 21⅛"d × 11¼"h

A few months ago, in Issue #55, I showed you how to build Pennsylvania craftsman Jeffry Lohr's version of the beloved Morris chair. Here, I show you how to make the perfect companion piece to that chair. This ottoman serves as a handsome footrest or even a comfortable stool. Like the chair, I made this piece from cherry to give it modern appeal, eschewing traditionally used quartersawn white oak.

Note: Because upholstery is beyond the skill set of most woodworkers, I'll provide a sidebar that briefly explains how the cushions are made along with my source for having them made and shipped. Feel free to use your own local source, drawing from the information provided.

Make the legs

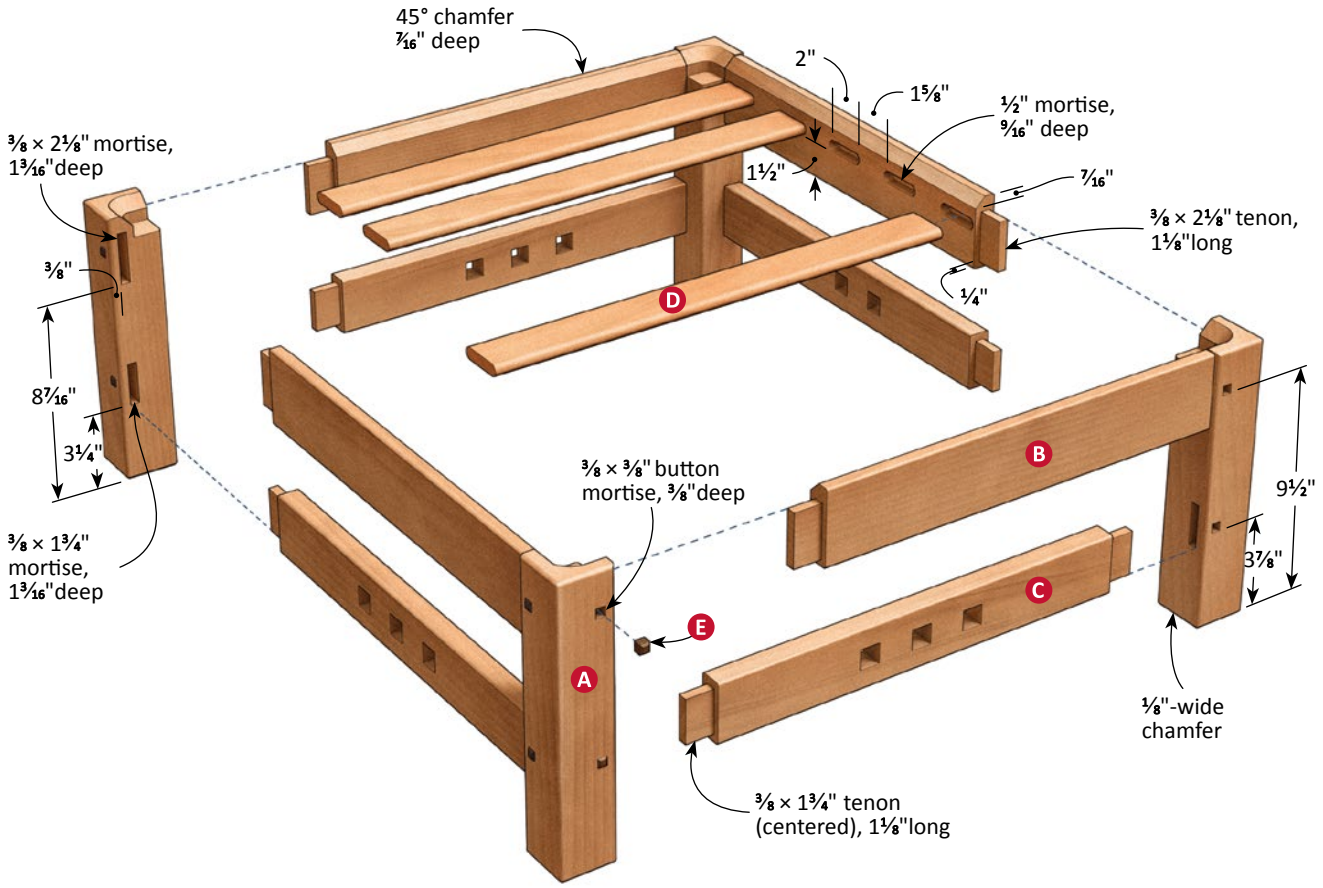
1 Mill two pieces of 2½ × 2½ × 24" stock, which will yield 4 legs (A) while leaving the pieces initially long enough for safe feeding through your machines. If you don't have 10/4 (2½"-thick) material for the job, you can laminate 5/4 (1¼"-thick) stock to create the necessary thickness. (See sidebar opposite.)

2 Crosscut the legs (A) to the length shown in the **Cut List**.

3 Lay out the leg mortises, where shown in **Figure 1**. Note that you only have to lay out complete mortises on one leg, which you can then use to set up your mortiser or router fence. Only the ends of the mortises on the other legs need to be laid out.

4 Cut the mortises to 1³⁄₁₆" deep. I did the work with a hollow-chisel mortiser, as shown in **Photo A**. Instead, you could use a router, rounding the edges of the tenons later to match the rounded ends of the mortises.

Figure 1: Ottoman Exploded View

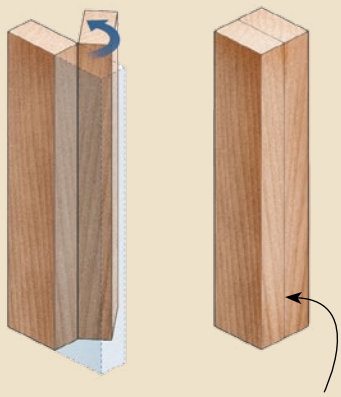


A

When using a mortiser, plunge both ends of the mortise first, and then remove the remaining waste in intermittent steps.

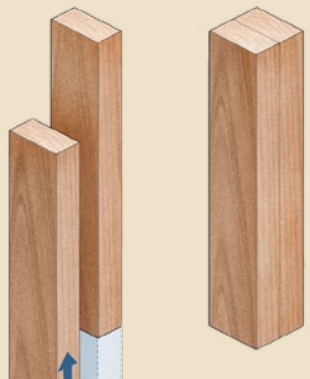
Grain-Matching Laminated Legs

For the best grain match on laminated legs, use straight-grained stock, and join the pieces using either method shown below.



BOOK-MATCH
Rip board, and flip the halves back onto themselves to create a symmetrical match on one edge.

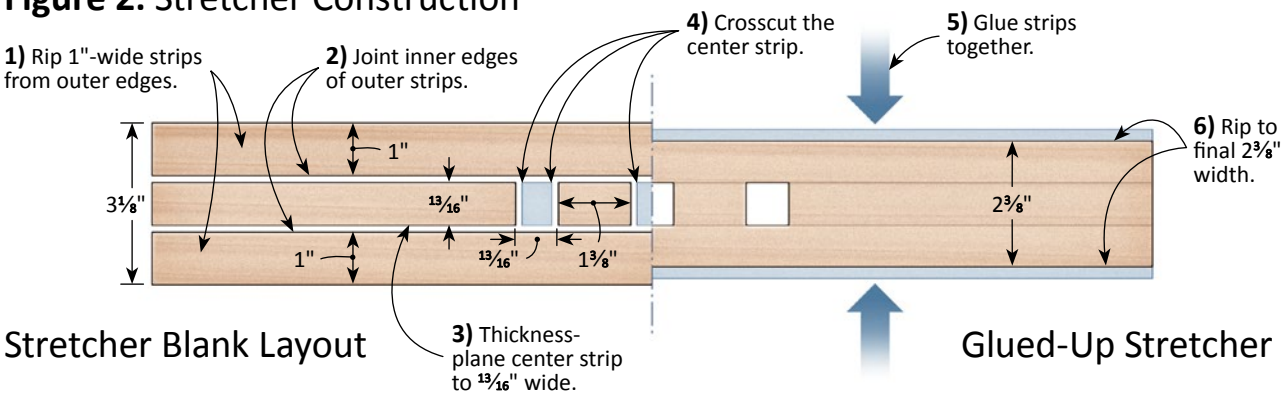
Orient book-matched face prominently on piece.



SLIP-MATCH
Crosscut board and lay one half on top of the other in the same orientation to create edges with similarly sloped grain.

Opening photo: Larry Hamel-Lambert; Project photos: Paul Anthony; Illustrations: Christopher Mills

Figure 2: Stretcher Construction



Make the rails and stretchers

1 Mill enough stock to yield the rails (B) and stretchers (C), leaving the material 1" thick for now. Cut the rails (B) slightly oversized in width and length, and set them aside. Cut the stretcher (C) blanks to 3⅛" wide by 20" long.

2 Draw out a full-sized pattern of the stretcher blank, as shown in the left-hand section of **Figure 2**. (Although this isn't strictly necessary, I recommend it, as it provides a crystal clear reference for the cuts.)

3 Mark a series of triangles across each blank for reorientation of the parts after ripping. Also assign a number to all the parts for each stretcher. Then, as shown in the first three steps of **Figure 2**, rip a 1"-wide strip from each outer edge, joint the sawn edges, and plane the center strip to 13⁄16" wide, removing equal amounts from each edge to preserve the grain match.

4 Make a story stick the same size as the center strip, laying out on the story stick the locations of the crosscuts to be made. Then mark out the cutlines, as shown in **Photo B**.

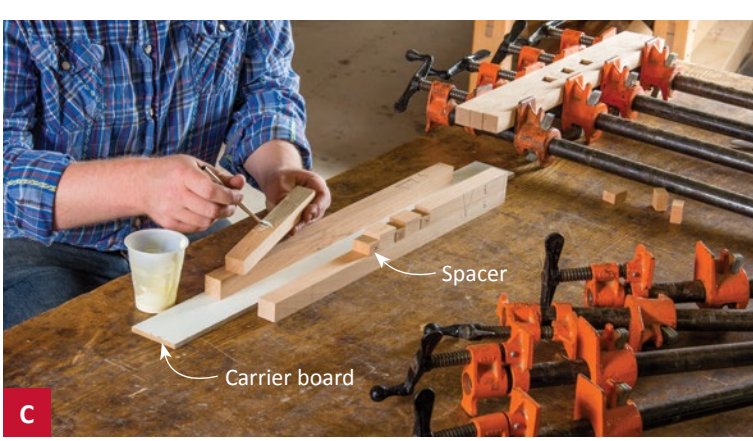
5 Cut the sections from the center strip, saving the offcuts. As I work, I make sure to keep all of the parts for each stretcher properly oriented on a carrier board to keep things organized. Make the carrier board 2¾"-wide so it can be used to place the parts in clamps during glue-up.

6 Glue up each stretcher, using the center strip offcuts as spacer blocks, rotating them 90° from their original orientation (**Photo C**). Immediately after clamping a stretcher, pop out the spacers, and use a wet toothbrush to scrub away any excess glue in the openings.

7 After the glue dries, joint one face of each stretcher (C), and thickness-plane it to 15⁄16". Do the same for the rails (B).

8 Edge-joint and rip the stretchers and rails to the widths shown in the **Cut List**. (Make sure to rip an even amount from each edge of the stretcher, as shown in **Step 6** of **Figure 2**.) Then lay out and crosscut the parts to 19" long, keeping the stretcher openings centered along the length of each piece.

Align the story stick with each stretcher's center strip, and transfer the cutlines across the strip.



Glue the stretcher parts together using the offcuts from the center strip as spacers to create the openings. Use a carrier board to load the parts into the clamps.

Tip Alert

It's unrealistic to expect a tablesaw setup to produce perfectly identical cuts. So, saw tenon cheeks for a too-tight fit in their mortises, and then plane, pare, or scrape them at the bench for a perfect fit, marking the mating parts for future reference.

To keep the cutter well away from the rip fence when sawing tenon cheeks, register the workpiece against a stand-off block that aligns the blade with the tenon shoulder.

Cut the joints and chamfers

1 Cut the rail and stretcher tenons to the sizes shown in **Figure 1**. I do the work on a tablesaw outfitted with a dado head (**Photo D**). Creep up on the tenon thickness by raising the dado head a bit at a time and then flipping the stock to cut into each face. After sawing all of the cheeks, readjust the blade height, and stand each piece on edge to cut the narrow shoulders on the stretchers and then the rails.

2 Mark out the ends of the ½"-wide × 2"-long slat mortises on the inside faces of two opposing rails (B), where shown in **Figure 1**. Outfit your plunge router with an edge guide, and rout the mortises to 9/16" deep in two passes. Rout carefully to your layout lines, as there are no tenon shoulders on the ends of the slats to hide miscuts. Although it takes more time, you can set up stops for greatest accuracy.

3 Using a 45° chamfer bit, rout a chamfer on the inside top edge of each rail (B), where shown in **Figure 1**.

Make the slats and mortises for the buttons

1 Mill the slats (D) to the thickness and width shown in the **Cut List**, but leave them slightly oversized in length for now. Also rip a narrow strip of straight-grained stock to about 1/8" thick by about 20¼" long to create a "spring stick" for measuring the necessary slat length.

2 Dry-fit the legs (A), rails (B), and stretchers (C) together, and flex the spring stick into two opposing slat mortises. Trim the length of the stick until it's about 1/16" shy of the internal dimension. Then cut your slats to that length.

3 Round over the edges of each slat with a ¼" round-over bit. Then disassemble the legs (A), rails (B), and stretchers (C), and fit the slats into their mortises. Number each for proper reassembly during glue-up.

4 Sand the legs through 180 grit, and then lay out the locations of the 3/8" button mortises, where shown in **Figure 1**. Cut them on the mortiser or drill, and chop them out.

Tip Alert

Before cutting button mortises, always sand the workpiece through 180 grit, as any heavy sanding done after cutting risks exposing torn end-grain fibers.

Assemble the ottoman

1 In preparation for assembly, rout the exposed edges of the legs (A), rails (B), and stretchers (C) using a 3/16" round-over bit. Sand a 1/8" chamfer at the bottom of the legs, and smooth all parts through 220 grit.

2 Dry-fit the legs onto their stretchers and the mortised rails to check joint fits and to rehearse your clamping procedure. Then

First glue up the two opposing side assemblies that include the mortised rails. Use plywood pads to protect against clamp damage.

F

To rehearse the final glue-up, slip a side assembly onto the stretcher tenons, and then pivot it onto the rail tenons while working the slats into place.

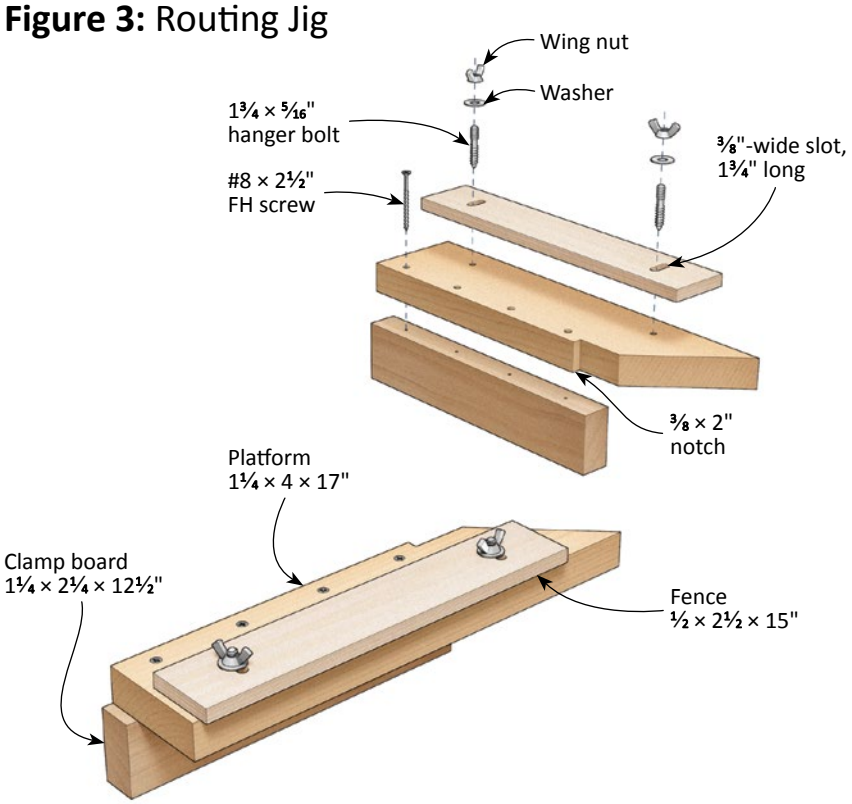
G

Rout the notch in the top of each leg using a ½"-dia. straight bit, guiding the router against jig fences set up for a cut that's flush to the faces of the rails.

disassemble the parts, apply glue to both the mortises and tenons, and glue up these two opposing assemblies (**Photo E**).

3 After the glue cures, perform a complete rehearsal of the final assembly (**Photo F**). Then, with your preset clamps at the ready, apply glue to only the mortise-and-tenon joints (not the slats or their mortises), and clamp the whole unit together. Finally, stand it on a dead-flat surface, and adjust the clamps if necessary to bring the unit into square.

Figure 3: Routing Jig



Rout the cushion recess

1 Make the routing jig shown in **Figure 3**. (*Exact dimensions aren't critical. Just ensure that the faces of the clamp board and platform are flat and truly square to each other.*)

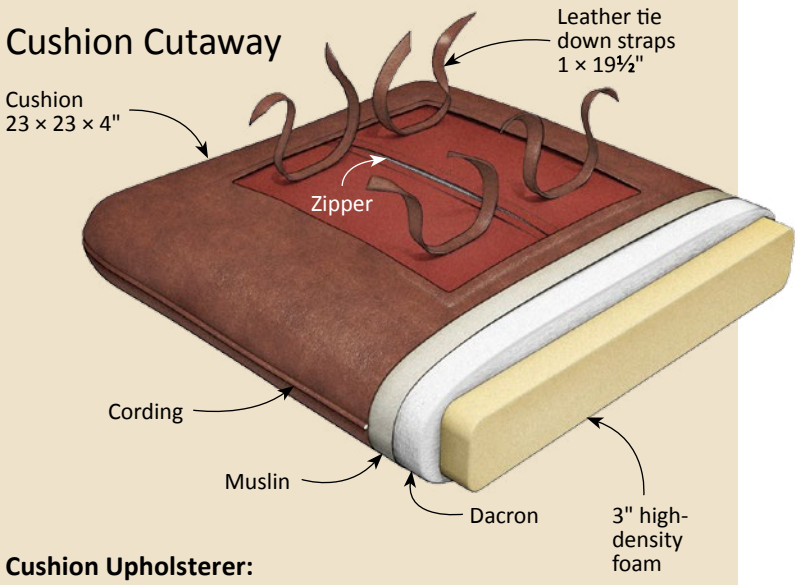
2 Clamp the two jig halves onto adjacent rails, carefully aligning the top of each platform with the top of a leg and parallel to the top of the rail. Outfit your plunge router with a ½" straight bit, and adjust each jig fence so that the perimeter of the bit barely touches the inside face of each rail with the router subbase riding against the jig fence.

3 Routing in subsequently deeper passes, cut out the notch in the top of the leg to a depth that sits flush to the tops of the slat mortises (**Photo G**). Repeat for the other legs.

4 Again using the jig in the same fashion, but with a 45° chamfer bit in your router, chamfer the notch edges to

Upholstery

Making the ottoman cushion upholstery begins by cutting the leather (or fabric) pieces to size and sewing them together, leaving an open square on the underside. A patch of complementary material is sewn into the open square with a zipper to accommodate the stuffing. The stuffing consists of 3"-thick high-density foam, which is first wrapped in dacron to soften any hard edges, and then with muslin to maintain the integrity of the foam. The corners of the cushion are also stuffed with loose dacron to fill out the shape. Finally, leather straps are sewn to the bottom, providing a way to tie the cushion to the slats. If you don't want to take on the upholstery, hire it out. You can use my upholsterer if you like.



Cushion Upholsterer:
Ann Brandenberger, Renaissance Upholstery, 658 Pennfield Dr., Hatfield, PA 19440
renaissanceupholstery.com, (215) 362-5642

align with the rail chamfers. Then clean up with sandpaper.

Buttoning up

1 To make the buttons (E), mill a 20" length of walnut to ⅜ × ⅜". Sand a small ⅛" chamfer on each end before crosscutting off a ⅜"-long section with a handsaw. Repeat the process to yield at least 16 buttons. I sand the chamfers by eye on a disc sander. Alternatively, you can use a jig, as shown on page 16.

2 Install the buttons as shown in **Photo H**.

3 Apply your favorite finish. My technique is to first flood the surface with boiled linseed oil and let it soak in for 10 minutes to pop the color and grain. I then wipe the piece dry and let it sit for 5 days before applying 5 or 6 coats of wiping varnish 24 hours apart, rubbing the dried finish with 0000 steel wool between coats. ■

Apply a dab of glue to each button mortise before tapping the button in place with a smooth-faced hammer.

About our Builder/Author
Mentored by renowned craftsman Jeffry Lohr, founder of the J. D. Lohr School of Woodworking in Schwenksville, Pennsylvania, Robert Spiece is an established furnituremaker and woodworking teacher at the school. He also designs and builds furniture for sale. For more on the school, go to *JDLohrSchoolofWoodworking.com*.

Ottoman Cut List

	Part	Thickness	Width	Length	Qty.	Mat'l
A	Legs	2 3/16"	2 3/16"	11¼"	4	C
B	Rails	15/16"	3"	19"	4	C
C	Stretchers	15/16"	2⅜"	19"	4	C
D	Slats	½"	2"	19 15/16"	5	C
E	Buttons	⅜"	⅜"	⅜"	16	W

* Indicates parts are initially cut oversized. See directions.
Materials: C=Cherry, W=Walnut

Overall dimensions: 42⅜"w × 24"d × 72"h

Traditional Cherry Wardrobe

Bedroom storage never looked better.

By Jim Probst

For centuries, wardrobes stood out as symbols of affluence. Kings and queens used them to store their showy garments, as did the wealthy. Today, they provide additional closet space in the bedroom for hanging and folded clothing. This accommodating cherry and poplar piece, with its understated traditional design, features fixed and adjustable shelves, closet space for hanging clothes, and four drawers.

When building it, you'll learn how to glue up large panels, assemble casework in stages using biscuits, machine and install a tongue-and-groove paneled back, build and hang raised-panel doors, and make and install simple but sturdy drawers. You'll also discover my tricks for dealing with wood movement. Keep your clamps handy for this project, as you'll find yourself using them several times during the construction. Now, let's make an heirloom.

Prepare the case parts

1 Referring to the **Cut List** and **Figure 1**, prepare the cherry and poplar from 4/4 stock for the solid-wood sides (A), bottom (B), divider (C), fixed shelves (D), adjustable shelf (E), subtop (F), lower drawer supports (G), medium drawer support (H), upper drawer support (I), top (J), face-frame stiles (K), bottom rail (L), and top rail (M). After planing to just over the thickness in the **Cut List** (13⁄16"), crosscut the pieces, making up the solid wood panels and face frame to 2" longer than the finished length of each piece. That makes them easier to handle and joint. Now, joint and rip the pieces to make the initial panels about ½" over final width. By contrast, rip and joint the face-frame stiles and rails to final width at this time.

2 Lay out the boards for creating attractive side panels while paying attention to color and grain. When you find the best match, mark them for reference when gluing the pieces together. *(Note: For more on gluing up flat panels, see "Perfect Flat-Panel Glue-ups" on page 50.)*

3 Glue up stock to make oversized panels for the sides (A), bottom (B), divider (C), fixed shelves (D), adjustable shelf (E),

A

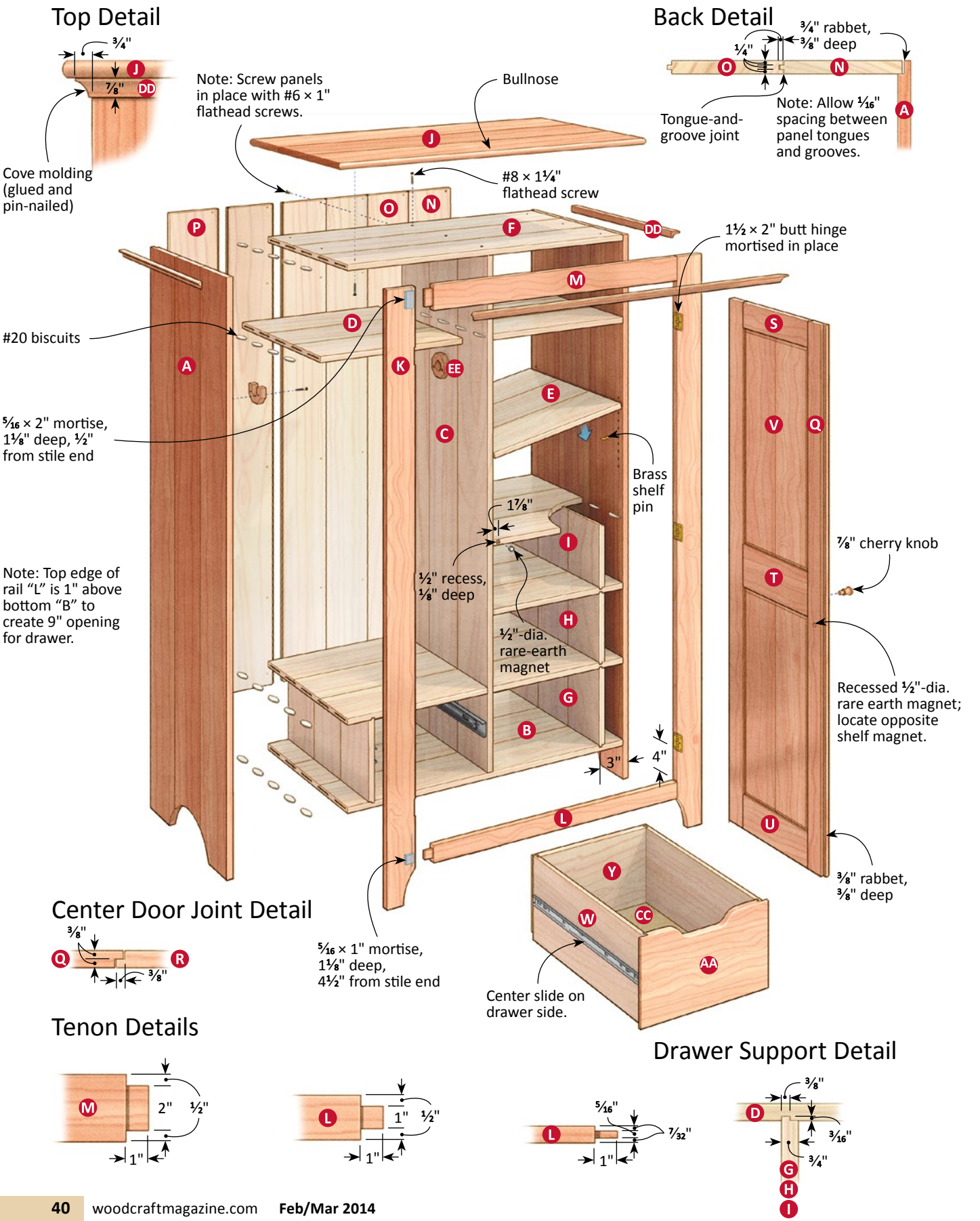
To glue up flat panels, use bar or pipe clamps for edge-to-edge bonding and smaller F-clamps at the joint ends to make them even.

B

Scrape, plane, and sand the panel surfaces until they're flat. Work the plane diagonally across the boards.

Opening photo: Larry Hamel-lLambert; Project photos: Morehead Photography

Figure 1: Case Exploded View



subtop (F), large drawer supports (G), medium drawer support (H), small drawer support (I), and top (J), as shown in **Photo A**. *(To make the drawer supports, I glued up a long panel first to rough width, and later cut the parts from it.)*

4 After the glue dries, scrape away the squeeze-out, then plane the boards flat to ¾" thick, and sand (**Photo B**). Check across the panels for flatness, using a straightedge. *(A wide-belt or large drum sander would save time while prepping the panels, if you have access.)*

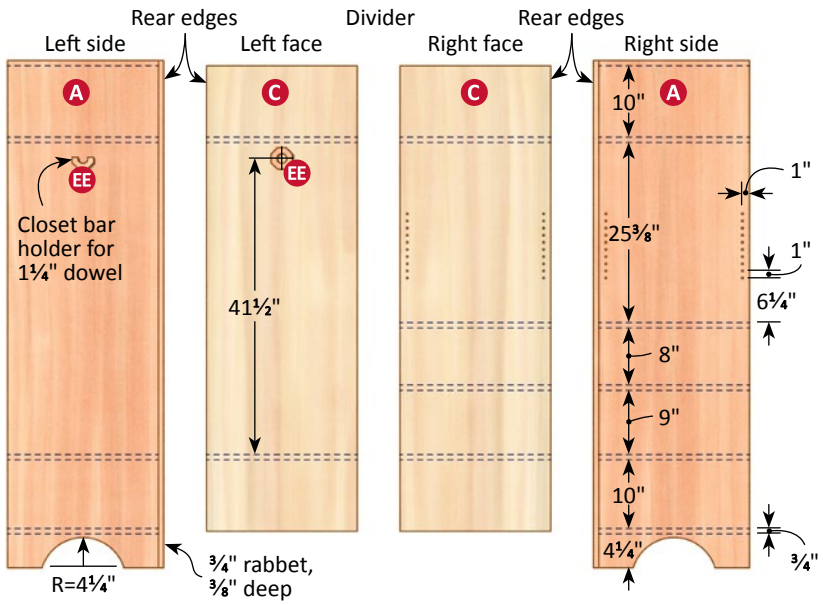
5 Rip the sides (A) to final width and mark them "left" and "right." Using a handheld router, cut ¾" rabbets, ⅜" deep on the inside faces of the panels along the back edges, where shown in **Figure 2**.

6 Measure from the front edge of a side (A) to the rabbet. Use this dimension to determine the width of the bottom (B), divider (C), fixed shelves (D), adjustable shelf (E), subtop (F), large drawer supports (G), medium drawer support (H), and small drawer support (I), Now, rip these panels to final width.

7 Crosscut the sides (A) to length at the tablesaw using a panel or crosscut sled, as shown in **Photo C**. Similarly, crosscut the bottom (B), divider (C), fixed shelves (D), adjustable shelf (E), subtop (F), large drawer supports (G), medium drawer support (H), and small drawer support (I) to length. *Note: If you don't already own a crosscut sled, consider making one using the Dead-Accurate Crosscut Sled plan (Woodcraft #150983D) available as a download at woodcraftmagazine.com.*

8 Lay out the part and the #20 biscuits locations in the sides (A), bottom (B), divider (C), fixed shelves (D), and subtop (F),

Figure 2: Biscuit Placement Part Views



where shown in **Figure 2**. I start at one top end of the sides and mark down the thickness of the subtop and strike a line. I then clamp the mating part, in this case the subtop, to the *lower edge* of the line. Next, I use a story stick to establish the locations for five biscuits evenly spaced from front edge to back edge in the parts, as shown in **Photo D**. *Note: After establishing the lines to locate the mating parts, be sure to indicate which side of the line the part is clamped to by noting the biscuit locations.*

9 With the biscuit joiner, plunge-cut biscuit slots for #20 biscuits in the faces of the sides (A) and in the ends of the subtop (F), as shown in **Photo E**.

10 On a large flat surface, dry-fit the subtop in place using #20 biscuits and clamps. Cut a 10 × 21" spacer from scrap plywood and place the long edge against

Use a crosscut sled to cut the panels to length. A roller stand with multiple rollers supports the far end of long panels, keeping them from tipping in mid-cut.

Illustrations: John Hartman

Use a story stick to mark the biscuit locations on mating pieces and to establish consistent biscuit spacing from part to part.

With the biscuit cutter aligned with the marks, cut slots on the mating parts.

the bottom face of the subtop (F). Draw a line at this location on the sides and on both faces on the top end of the divider (C). Now disassemble the sides and subtop, clamp the mating shelf to the *top edge* of the line, use the story stick to mark the biscuit locations from front edge to back edge, and cut the slots in both parts.

11 Referencing **Figure 2** and following the procedures described in the previous steps, work from the bottom ends of the sides (A) and divider (C) to cut the biscuit slots for the bottom (B) and lower fixed shelves (D). Use a fixed shelf to establish the line for locating the divider at the center of the bottom and subtop (F).

12 Install a ⅜" dado set in your tablesaw, and cut ³⁄₁₆"-deep dadoes in the bottom (B) and fixed shelves (D) for the lower, middle, and upper drawer supports (G, H, I), where shown in **Figure 1**.

13 Attach a sacrificial fence to the tablesaw fence, move it alongside the dado set, and cut the ³⁄₁₆" rabbets, ⅜" deep in the large, medium, and small drawer supports (G, H, I), where shown in **Figure 1**. See also the **Drawer Support Detail**.

14 Sand the case parts to 220 grit. Because it is easier to apply finish to some parts now than after assembly, finish the cherry parts that will be exposed on the cabinet's inside. (While you can use Watco Oil Finish, Natural, I wiped on a clear wax to prevent having an unpleasant finish odor in the case.) Avoid getting finish on the surfaces receiving glue.

Assemble the case

Note: Due to the project's size and complexity of the glue-ups, I assembled the case in three stages, soliciting a helper. Using glue with an extended working time is helpful here. Also, because the biscuit slots for the fixed shelves (D) that are on each side of the divider (C) at the same location intersect one another, you'll need to narrow the width of the biscuits to fit. I do this by sanding a concave edge along one edge at the drum sander and the checking the fit against the mating biscuit.

1 For stage one of the case assembly, test-fit the bottom (B), divider (C), and subtop (F) on a large flat surface. Apply glue to the biscuit slots, insert the biscuits, and assemble the parts. Check that the front edges remain flush. Drill screw pilot holes through the bottom and subtop and into the divider. Now, screw the assembly to pull the joints together. Square the bottom and subtop to the divider. After any excess glue skins over, peel it off with a sharp chisel. Let the assembly dry.

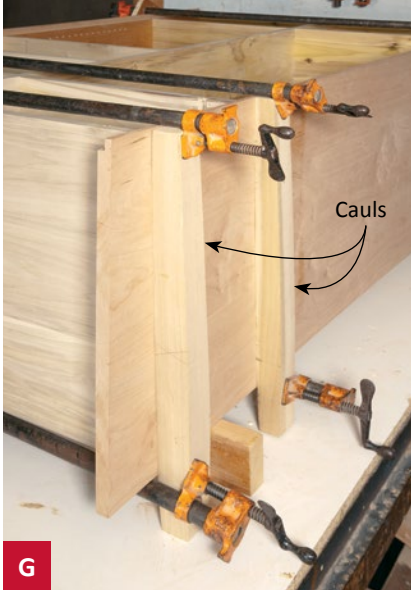
2 For stage two, test-fit the fixed shelves (D) for the right half of the case, along with the right side (A), ensuring the parts are all flush along the front edges. With your helper, apply glue to the biscuit slots, insert the biscuits, and clamp up the assembly making up the cabinet's right half. Tap the

Tip Alert

In large case glue-ups, I use cambered clamping cauls. These are strips of wood that are slightly curved along one edge at the bandsaw. The caul's curved edge is placed over the joint to spread even pressure at the center of the joint beyond the reach of clamp jaws and at the ends of the joint.

F

With the partial case assembly on the floor on its side, biscuit-glue the left side shelves in place, and then add the left side.



G

Use cambered cauls with the clamps to apply pressure over the lengths of the biscuit joints.

pieces to coax them into place, and use clamping cauls along the joints to ensure a complete bond. Remove any squeeze-out, and let the assembly dry.

3 For stage three, use your helper to set the partial case assembly on the floor and on its right side (A) to better manage the glue-up. Test-fit the remaining case parts, including the left side (A) and two fixed shelves (D). Now, apply glue and biscuits, and add the parts to the partial case assembly, as shown in **Photo F**. Tap the parts together, and then carefully place the entire assembly onto the assembly table once more. Set it on 2× blocks to provide clearance for clamp access underneath. Now, clamp the case assembly parts together by using clamping cauls along the joints, as shown in **Photo G**. Check the assembly for square, clean up any squeeze-out, and let the case dry.

4 Measure the distances between side (A) and divider (C) and the width of the divider. Cut the adjustable shelf (E) to those measurements minus ⅛" in both length and width. Test its fit in the case. Then sand it and set it aside.

5 Using a hole drilling template and ¼" drill bit and stop, drill four sets of 10 shelf-pin holes ½" deep, where shown in **Figure 2**.

Add the face frame

1 Retrieve the face-frame stiles (K), bottom rail (L), and top rail (M). Temporarily clamp the stiles to the case front, flushing the top ends with the case. Extend the outside edges of the stiles ⅛" beyond the sides (A). Mark the stile bottom ends where they intersect the ends of the sides to establish their length. Also, measure the distance between the inside edges of the stiles, and add 2" to the measurement (for the 1"-long tenons) to establish the lengths of the rails. Using stops at the mitersaw, crosscut the stiles and rails to their final lengths.

2 Lay out the mortises and tenons for the face frame parts referencing **Figure 1**. Now, using a mortising machine and a 5/16" mortising bit, bore centered the mortises 1⅛" deep, in the stiles (K), as shown in **Photo H**. Clean up the mortises with a chisel if needed.

3 At the tablesaw, set up a tenoning jig to cut centered 5/16"-thick × 1" tenons on the face-frame rails, as shown in **Photo I**. (Note that the bottom rail [L] tenon will later be trimmed to 1" wide, and the top rail [M] tenon will be trimmed to 2" wide.) For dead-on 5/16" tenons, I cut a spacer and painstakingly planed it to 5/16" plus the blade's kerf width. Note that this is a trial and error procedure. (My spacer measured 7/16".) I then set up my tenoning jig so that the right-hand side of the blade aligned with the left-hand cheek of the tenon and made the

H

Adjust the fence for a centered mortise and plunge the bit into each end of the layout. Remove the waste between the cuts.

Using the spacer, clamp the workpiece in the tenoning jig, and cut the second tenon cheek in the rail ends.

With the stop set, cut through the rail ends to establish the edges of the tenons.

Using a raised stop on your tablesaw sled, trim off the tenon waste from the rails.

first cheek cut. I added the spacer for the right-hand cheek cut, resulting in a 5/16"–thick tenon.

4 Fit a sled onto the tablesaw. Place the workpiece vertically against the fence, and adjust the blade height to match the kerf depth. Align the blade with the layout line, clamp a stop in place, and then make the cuts along the edge of the cheeks on both ends of the face frame rails (L, M), as shown in **Photo J** and where shown in **Figure 1**.

5 Adjust the blade height to remove the cheek waste. Reset the stop to create a 1"-long tenon. With a rail lying on one face, crosscut the tenon waste from the end. Flip the piece to the opposite face, and again remove the waste (**Photo K**). Repeat the process for the remaining rail ends. Adjust the blade height, and remove the cheek waste from the edges. Do all four rail ends.

6 Lay out the scallop cuts on the inside bottom ends of the stiles (K) by enlarging and applying the pattern in **Figure 3**. Now, bandsaw or jigsaw the stile ends to shape. Clean up the sawn edges with an oscillating spindle sander.

7 Working on a flat surface, glue up the face frame, ensuring that it is flat and square.

8 Check that the edges of the shelves do not extend beyond the case edges. (Plane them off if they do.) Now, attach the face frame (K, L, M) to the case with glue and multiple clamps, as shown in **Photo L**, achieving a 1/8" overhang along each side. Ensure that the frame is flush with the case top and bottom end of side (A). Note in **Figure 1** that the bottom rail extends above and below the edge of the bottom (B).

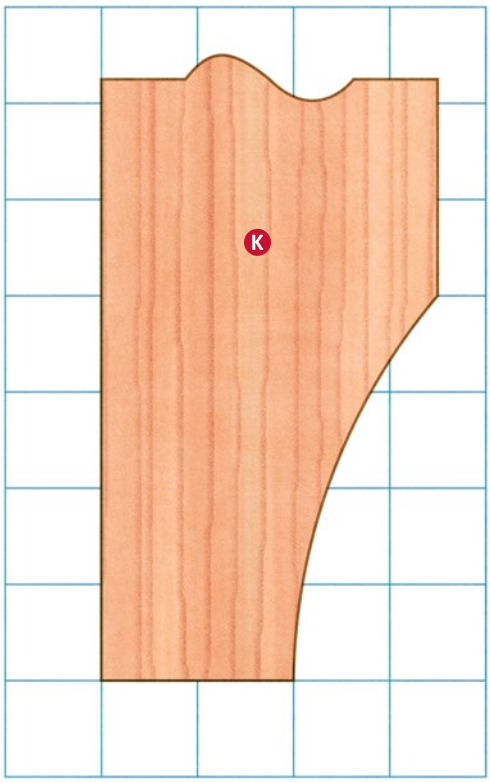
9 Plane the face frame's edges flush with the case.

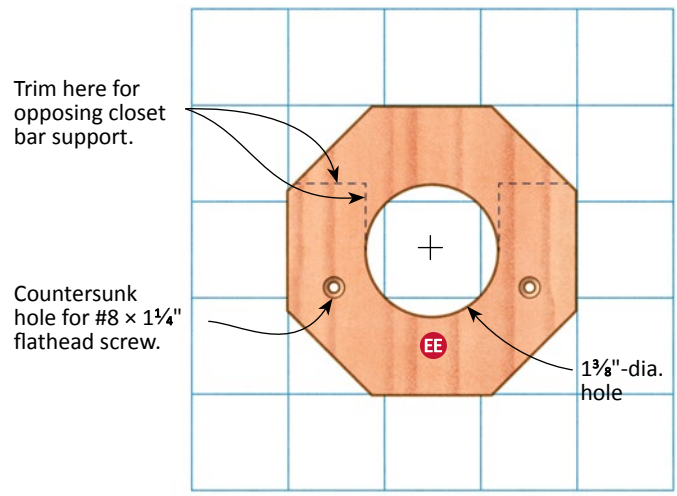
Work to position the face frame on the case front, adjusting the clamps as needed. Once satisfied, add multiple clamps around the glue-up for a complete bond.

Tip Alert

Prior to gluing face frames to cabinets, protect the case surfaces from runny glue squeeze-out using painter's tape.

Figure 3: Scallop and Closet Bar Support Half-Sized Patterns





1 square=1"

Half-sized pattern, enlarge 200%

Full-sized pattern available for download on *woodcraftmagazine.com/magpatterns.html*

Mill and screw on the back panels

1 Mill enough stock for the six tongue-and-groove back panels (N, O, P), referencing the **Cut List** and the **Back Detail** in **Figure 1**. When ripping the panels to width, take into account the ¼" tongues on parts P and O. Also, make the right and left back panels (N and P) slightly wider at first. Note in the figure that the panels fit between the rabbets in the back edges of the sides (A).

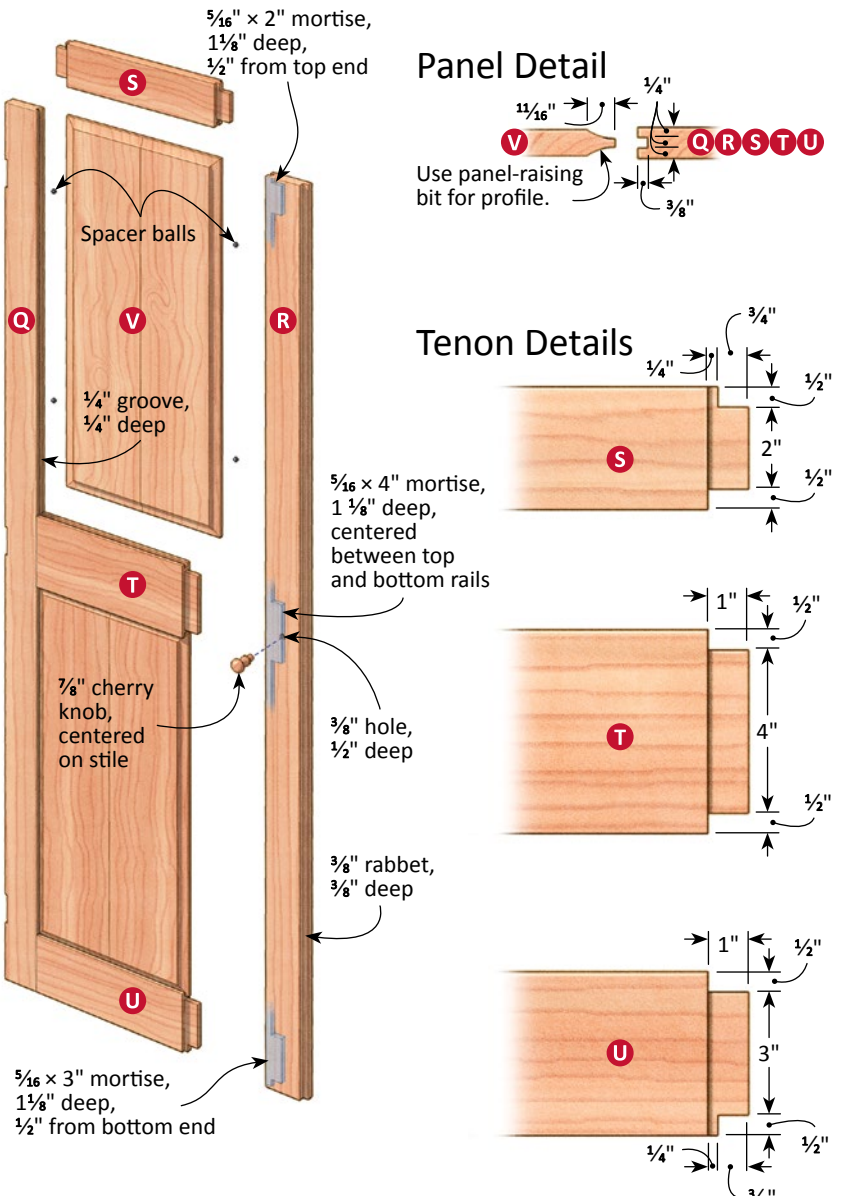
2 Measure from the bottom face of the bottom (B) to the top face of the subtop (F) and add 1". Use this dimension to crosscut the panels (N, O, P) to final length. The lower ends of the panels extend beyond the bottom.

3 Install a tongue-and-groove bit in your router table, and rout centered ¼ × ¼" tongues on one edge of the four middle panels (O) and left panel (P). With the groove cutter, cut the ¼" grooves, ¼" deep, in the mating edges of the middle panels (O) and the right back panel (N).

4 Dry-fit the panels (N, O, P) together on the back of the case. (Check to make sure that the center seam does not align with the divider [C].) Allow a 1/16" gap between panels and between the outside panels (N, P) and the sides (A) for wood movement. Now, mark and rip one outside panel to final width. Starting 1/16" from the rabbet's wall, install one panel at a time. Mark and drill countersunk screw holes centered on the width of the outside panel (N) and centered on the edges of the bottom (B), center divider (C), fixed shelves (D), and subtop (F). Drill countersunk holes 1" in from the left-hand edges (viewed from the back) of the middle panels and over the mating edges. Add end panel (P), drilling centered countersunk holes over the mating edges. Secure the panels with #6 × 1¼" flathead screws, as shown in **Photo M**.

Install the tongue-and-groove panels by starting at one end and fitting them together, making sure to leave a 1/16" gap.

Figure 4: Left Door Exploded View



5 Make the cutouts on the bottom ends of sides (A), referencing **Figure 2**. To do this, find the centers between the front face of the face frame and back edges of the sides, and mark them along the side's, bottom edges. Place the point of a compass at the marks, and scribe 4¼"-radius arcs. Now, jigsaw the cutouts, keeping the blade just inside the scribed lines. Use a spokeshave and curved sanding block to clean up and smooth the side openings.

Build the doors

1 Mill enough stock for the three narrow door stiles (Q), wide door stile (R), top rails (S), middle rails (T), and bottom rails (U). Now, rip the pieces to the final widths in the **Cut List**.

2 Before crosscutting the stiles (Q, R) and rails (S, T, U) to length, place the stiles on the face frame opening and mark them to establish their final length. You want to start with a snug fit at first. Next, mark the center of the top face frame rail. Place the door stiles for the right-hand door together along the inside edge of the right face frame stile. Measure the distance from the face frame center mark on the rail to the edge of the door stiles. Add 2" to this measurement to get the length of the rails of both doors, while allowing for the 1" tenons. *(Note that the left-hand inside door stile is ⅜" wider to accommodate the overlap. See **Figure 1**.)* Cut the door stiles and rails to length.

3 Referring to **Figure 4**, lay out and cut the mortises and tenons in the door frame parts (Q, R, S, T, U) using the same procedures as for the face frame. Note that the top and bottom rails have haunched tenons and will need to be trimmed where shown.

4 Cut ¼" grooves, ⅜" deep along the inside edges of the door-frame parts (Q, R, S, T, U) for the panels. Dry-assemble the door frames to check the fit, making any needed adjustments. Use a rabbet plane or sanding block to touch up the tenons.

5 With the doors still dry-assembled, measure to see if the openings between the rails are the same. Measure one of the openings, and add ½" to the width and length to arrive at the size for the raised-door panels (V). (As shown in **Figure 4**,

Tip Alert

For the best grain match in the door frames, I rip the neighboring inside door stiles from the same board. The two outside stiles can come from a second board similar in grain and color or from the outside edges of an 11"- or 12"-wide board from which you cut inside stiles. The rails should also come from one board.

N

Rout the door panel ends first and then the edges in ⅛" increments. With each set of passes, flip the panels and cut the profile on the opposite faces.

O

Glue and assemble the doors as shown, inserting space balls in the grooves. Apply the clamps.

the extra ⅛" in the mating grooves allows for seasonal wood expansion.) Now, make up the door panels for each door from two-board glue-ups that measure at least 52" long for the best grain match from top to bottom. Once dry, plane the panels to ⅝" thick, and cut the door panels to size.

6 Install a raised-panel bit in your router table (see the buying guide), and form the profile on the door panel edges on both sides, as shown in **Photo N** and the **Panel Detail** in **Figure 4**.

7 Sand the door parts (Q, R, S, T, V, U) through 220 grit. Finish the panels.

8 Glue and clamp the doors (Q, R, S, T, V, U) using space balls, as shown in **Photo O**, to prevent the door panels from rattling in their frames while allowing for wood movement. Check for square and let the door assemblies dry.

9 Using a dado set in your tablesaw, cut mating (overlapping) ⅜ × ⅜" rabbets along the inside edges of the doors, where shown in the **Center Door Joint Figure 1**.

10 Carefully lay out the three hinge locations on the doors, where shown in **Figure 4**. Cut the mortises using a trim router, cleaning up the corners with a chisel. Mount the hinges using steel screws at first. Center the doors in the opening, and mark the hinge locations on the face frame. As mentioned, you want to maintain a reveal around the doors equal to the thickness of a dime. Cut these mortises, and install the doors on the case to test their fit. Mark where you need to trim the doors, and then, as needed, shave the ends at the tablesaw using the sled and joint the inside edges. Retest the fit of the doors in the opening. If okay, replace the steel screws with the brass screws that came with the hinges.

Tip Alert

Mount the hinges initially with steel screws in pilot holes. Then, for the final installation, replace the steel screws with brass screws.

Make the drawers

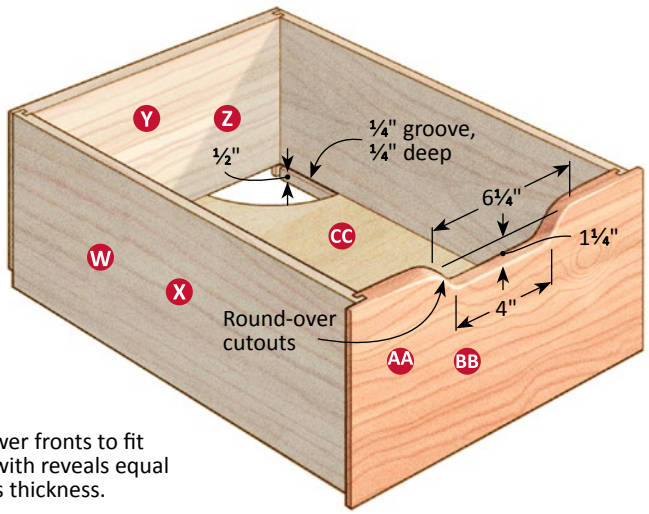
1 Mill the needed poplar and cherry drawer box stock for the drawers, working from the dimensions in the **Cut List** and the drawer box openings in the case. Note that the drawer box widths should be 1" less than the side-to-side measurement of the openings to allow room for the drawer slide hardware. Now, cut the small and large drawer sides (W, X) to size. Cut the small and large drawer backs (Y, Z) to length, but not width.

2 To properly size the small and large drawer fronts (AA, BB), measure the drawer openings, allowing for a dime's clearance around all four edges. Now, cut the fronts to size.

3 Lay out the pull openings on the top edges of the drawer fronts as dimensioned in **Figure 5**. Bandsaw or jigsaw the openings to size, and sand or rout a slight round-over along the edges of the just cut-out areas.

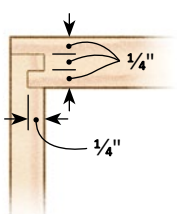
4 Using a dado set, cut the ¼" grooves ¼" deep in the drawer sides (W, X) and the drawer fronts (AA, BB), where shown in **Figure 5**. The drawer backs

Figure 5: Drawer Exploded View

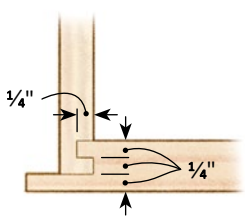


Note: Drawer fronts to fit openings with reveals equal to a dime's thickness.

Rear Drawer Joint



Front Drawer Joint



Convenience-*PLUS* BUYING GUIDE			
☐ 1.	Milescraft 28-Count #20 Biscuits, (3 pkg. needed)	#153577	$2.75
☐ 2.	Cove Panel-Raising Router Bit, 2"D	#129673	$41.99
☐ 3.	Space Balls, 100/pkg.	#142284	$6.29
☐ 4.	Titebond II Extend Wood Glue, 16 oz.	#140442	$8.39
☐ 5.	¼" Tongue and Groove Router Bit, ½" SH	#140802	$59.99
☐ 6.	Accuride 7232 20" Full-Extension Drawer Slides, (4 pr. needed)	#131199	$18.99
☐ 7.	Rare-Earth Magnets, ½ × ⅛" (12.7mm x 3mm), 10 pcs.	#150951	$13.69
☐ 8.	Flat Spoon Style Shelf Pins, Brass, ¼", 25/pkg.	#27I11	$3.25
☐ 9.	Watco Danish Oil Finish, Natural, 1 qt.	#123976	$12.25
☐ 10.	Briwax, Clear, 16 oz.	#85C25	$18.99
Above items are available at Woodcraft stores, *woodcraft.com* or by calling (800) 225-1153. Prices subject to change without notice.			
☐ 11.	Cherry Shaker Knobs, ⅞"-dia. × 1 1⁄16" projection, ⅜ × ½" L tenon, (2 needed)	#TK78	$1.31
Above items are available at *www.niceknobs.com*, or by calling (908) 832-2723. Prices subject to change without notice.			
☐ 12.	Horton Precision Butt Hinges, Solid Brass, 1½ × 2", 2 pr.	#PB-407	$18.50
Above items are available at *www.horton-brasses.com*, or by calling (800) 754-9127. Prices subject to change without notice.			

(Y, Z) sit on the drawer bottom (CC). Elevate the dado set and cut the backs to the exact needed width at this time.

5 Referring to the **Front** and **Rear Joint Details** in **Figure 5**, use a dado set to cut the corner joints in the drawer sides (W, X), backs (Y, Z), and fronts (AA, BB). Test-fit the pieces. Measure the side-to-side distance in the drawer, and add ½" for the width of the drawer bottom (CC). For the drawer bottom length, measure the length of the drawer box opening and add 1". Cut four drawer bottoms to size.

6 Now, rabbet the front and side edges of the plywood drawer bottoms (CC). Dry-fit the drawer boxes together. Make any needed adjustments, and then glue and clamp up the four drawers. Do not glue in the bottoms. Instead, tap in centered 1" nails through the bottoms and into the drawer backs (Y, Z) to hold them in place.

7 Install the drawer boxes in the wardrobe case, where shown in **Figure 1,** using the slide hardware listed in the **Convenience-Plus Buying Guide**.

Add the top, finish, and remaining hardware

1 Cut the case top (J) to finished size and rout a bull-nose profile on the ends and front edge, where shown in the **Top Detail** in **Figure 1**. Sand the top to 220-grit.

2 Center the top (J) from end to end on the case, and flush its back edge with the case back. Clamp it in place, and then secure it to the case by driving #8 × 1¼" screws in countersunk holes through the subtop (F) and into the top. Remove the clamps.

3 Rip a 4 × 48" piece of ¾" cherry for the cove molding

(DD). Install a ¾" cove bit in your table-mounted router, and rout the profile shown in the **Top Detail** in **Figure 1** along both edges of the board. Next, rip ⅞" molding strips from the workpiece. Miter-cut the ends of the front piece, and glue and clamp it in place. Miter-cut the mating ends of the side pieces, and cut the other ends flush with the case back. Glue the miters and pin-nail the parts in place.

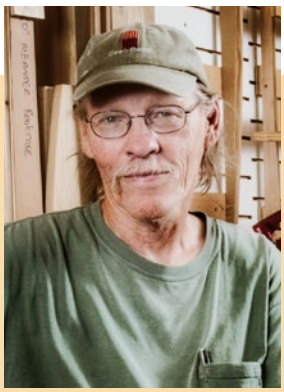
4 Finish-sand the unfinished portions of the case, doors, and drawers to 220-grit.

5 Drill the ⅜" holes just over ½" deep for the door pulls, where shown in **Figure 1**. Now, glue the pulls in place.

6 Lay out two closet bar supports (EE) on a piece of ¾" cherry, referring to **Figure 3**. Drill 1⅜" holes where indicated, and then cut the supports to shape. Cut the top end off one of the supports where shown. Sand smooth and screw them inside the case, where shown in **Figure 2**. Cut a 1¼"-diameter closet bar to fit inside the case in the supports.

7 Drill the shallow recesses for the rare-earth magnets, where shown in **Figure 1,** to serve as door catches. Adhere them in place with two-part epoxy. (I bore a slightly deeper recess for the door magnet and hid it with a piece of cherry veneer.)

8 Finally, remove the doors, drawers, and hardware, and finish the cabinet. (I wiped on Briwax, Clear, furniture wax, on the cherry and poplar parts, coating the wood while adding a pleasant odor. I wiped up any excess wax and let the project sit for 24 hours. This finish choice should not contaminate clothing stored inside.) Add the doors, drawers, and hardware. ■



About Our Designer/Builder

Jim Probst is an award-winning designer and builder who has crafted fine furniture for over 32 years at his shop in Hamlin, West Virginia. It's here where he produces several furniture lines that sell through galleries nationwide. For more, go to *ProbstFurniture.com*.

Wardrobe Cut List

	Part	Thickness	Width	Length	Qty.	Mat'l
A*	Sides	¾"	21⅞"	71⅛"	2	C
B*	Bottom	¾"	21⅛"	38⅜"	1	P
C*	Center divider	¾"	21⅛"	65¼"	1	P
D*	Fixed shelves	¾"	21⅛"	18¾"	6	P
E*	Adjustable shelf	¾"	21"	18⅝"	1	P
F*	Subtop	¾"	21⅛"	38⅜"	1	P
G	Large drawer supports	¾"	21⅛"	10⅜"	2	P
H	Medium drawer support	¾"	21⅛"	9⅜"	1	P
I	Small drawer support	¾"	21⅛"	8⅜"	1	P
J	Top	¾"	24"	42⅜"	1	C
K*	Stiles	¾"	3½"	71⅛"	2	C
L	Bottom rail	¾"	2"	35"	1	C
M	Top rail	¾"	3"	35"	1	C
N*	Right back panel	¾"	7"	68"	1	P
O	Middle back panels	¾"	7¼"	68"	4	P
P*	Left back panel	¾"	6 ¼"	68"	1	P
Q	Narrow door stiles	¾"	2½"	62⅛"	3	C
R	Wide door stiles	¾"	2⅞"	62⅛"	1	C
S	Top rails	¾"	3"	13½"	2	C
T	Middle rails	¾"	5"	13½"	2	C
U	Bottom rails	¾"	4"	13½"	2	C
V	Door panels	⅝"	12"	25½"	4	C
W	Large drawer box sides	½"	8⅞"	20"	4	P
X	Small drawer box sides	½"	7⅞"	20"	4	P
Y*	Large drawer box backs	¾"	8¼"	14¼"	2	P
Z*	Small drawer box back	¾"	7¼"	14¼"	2	P
AA*	Large drawer box fronts	¾"	8⅞"	15¼"	2	C
BB*	Small drawer box front	¾"	7⅞"	15¼"	2	C
CC	Drawer bottoms	½"	20"	13⅝"	4	Ply
DD*	Cove molding	¾"	⅞"	48"	2	C
EE*	Closet bar supports	¾"	3"	3"	2	C

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

Materials: C = Cherry, P = Poplar, Ply = Plywood

Hardware/Supplies: #6 × 1¼" flathead screws; #8 × 1¼" flathead screws; 1¼"-diameter closet bar, 36" long.

Photo: Jim Osborn

Perfect Flat-panel Glue-ups

Discover Jim Probst's Four-step Process for Seamless Panels.

By Craig Bentzley

Conquer the challenges of wide flat panel construction with a proven routine that makes glue-up glitch-free and a lot faster.

For many beginning woodworkers, one of the most intimidating aspects of solid wood furniture construction is gluing up wide flat panels for large project parts. That's because, unlike other jobs, slow and steady won't win this race. Once you spread the glue, you have less than 10 minutes to pull everything together.

Professional woodworkers like Jim Probst (see "Traditional Cherry Wardrobe," page 38) rely on a step-by-step routine to ensure that glue-ups go glitch-free. Blend his techniques with your own, and your glue-ups are guaranteed to go faster and easier.

Step 1: Go for Good Looks

Too often, woodworkers get so involved with the mechanics of a glue-up that they forget about the most important end result–aesthetics. Few things look worse than poor grain matches. If possible, buy boards that come from the same log and are long enough to get at least two top pieces from each. Allow about 30% extra for waste. Here are some other tips to help you work with stock you have on hand.

If your boards are rough-cut, and you can't make out the grain patterns, skim the surfaces on your jointer or with a hand plane. If you can afford to lose some width, rip off any sapwood or other blemishes. (Sometimes you can "hide" sapwood by putting it on the underside of your top.)

Lay the boards edge to edge and then slide each board back and forth, or rearrange the order, until the grain patterns blend harmoniously. (See the opposite page, bottom right). Once the boards are arranged to your liking, cut them to rough length–about 2" longer than needed. The extra length gives you the freedom to slide the boards slightly during glue-up. (Later, after assembly, you'll trim the panel to size.) Surface and thickness-plane

Panel-Making Myths

Occasionally, a myth is repeated so many times that it becomes accepted as fact. Here are some common myths about glue-ups.

Myth 1: Alternating the growth rings on flat-sawn stock is the best way to minimize cupping.
Fact: Matching for looks is more important. (In fact, some cabinetmakers prefer orienting boards so that the center of the tree faces up because the "inside face" has a richer appearance.) As long as the top is properly attached to a base, movement isn't an issue.
Myth 2: For a really strong edge joint, you need to use dowels or biscuits.
Fact: Not true. Dowels and biscuits can cause more problems than they solve. Dowels do not expand and contract along with the rest of a top and can actually force a good joint apart. Biscuits swell enough to make raised areas along a glue line. Also, if a panel is sanded too soon after glue-up, when the moisture from the glue in the biscuit pocket finally evaporates, you may end up with depressions on the surface where each biscuit is located. Realize that with a good joint and fresh glue, a simple edge joint is stronger than the surrounding wood. The only time you might consider using biscuits is if your boards are slightly bowed. In these situations, the biscuits need not be glued and only serve as alignment aids.
Myth 3: Too much clamping pressure will "starve" a glue joint.
Fact: There is some truth to this but the fact is, most woodworking clamps are not capable of exerting too much clamping pressure. Bar clamps and pipe clamps apply the most pressure of commonly available clamps. If you snug them up firmly, you should be just fine. More important is to use enough clamps for the job. Clamping force radiates out 45° from the clamp head, so you want to space the clamps in such a way that you end up with even pressure along the entire glue joint.

your boards about 1/16" thicker than the finished dimension.

You're ready to joint the edges and test-fit your top. Rather than aim for a dead-straight edge, plane a tiny dip in the center of each board. (When the boards are placed edge to edge, a hint of light should peek from the middle of the joint.) This "sprung joint" helps compensate for future moisture loss at the panel's outer edges. If gaps exist at the outer edges of the joints, it's almost certain that they will open up regardless of the glue strength.

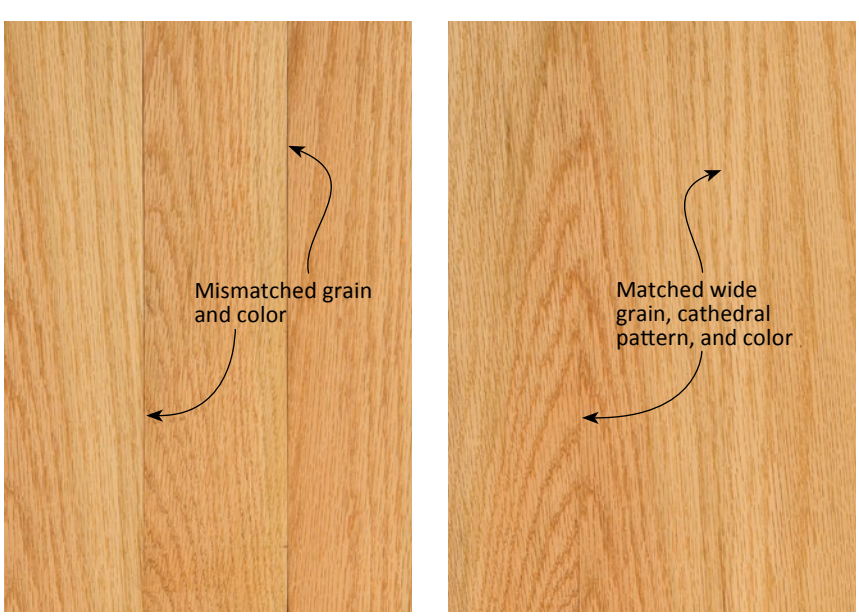
After jointing the mating edges, lay your boards out again and check the pattern. Once satisfied, mark a V across the faces with a pencil or chalk to correctly reposition them later. Leave an extra 1/4" on the outermost edges to protect the panel from dents and dings. After assembly, you'll trim the panel to final width.

Step 2: Get Ready to Glue

Now's the time to gather your clamps and other supplies. There's nothing worse than being in the middle of a glue-up and having to search for something you forgot. First you need a flat surface to work. If this is your workbench, you may want to cover it with cardboard or kraft paper.

Now pull out your clamps. You'll need at least five clamps for a panel over 4' long. You should have a couple extra clamps at the ready to help flatten your panel,

Two arrangements of the same three boards



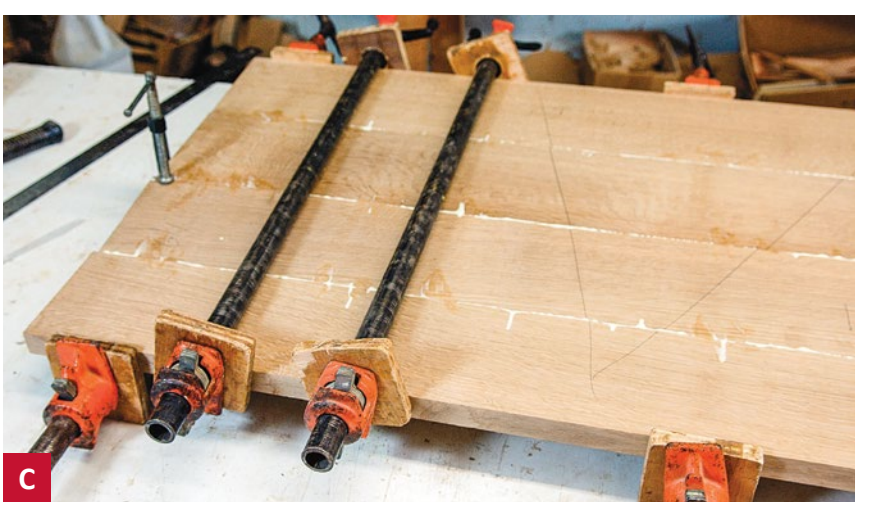
Photos: Ken Brady

A

Use finger pressure or a light tap from a dead-blow hammer to align the edges of the boards. A C-clamp can help flush up joints at the outmost ends of the panel (inset).

B

Balance the clamping pressure on both sides of the panel. With equal clamping pressure, you should see an even bead of squeeze-out along the joints. Use a straightedge to check for flatness.



C

It's handy to have an extra clamp. Using one more clamp along the top persuades the panel to bow away from the bar and flatten itself out.

Tip Alert

Yellow glue normally has a five-minute open time. Titebond Extend has a 15-minute open time that helps when tackling complex glue-ups.

if necessary. You should also use clamp pads to spread out the pressure and prevent the clamps from marring your work. A nifty solution is to make clamp pads that stay on the clamps using scrap plywood about 4 × 4" with a 1¼" hole in the center. Additionally, you'll also want to have a few C-clamps, a straightedge, and a dead-blow hammer. Don't forget the glue. Regular yellow glue works fine for panel glue-ups. Use a disposable plastic knife for a spreader.

You're almost ready to glue. Prearrange the first three clamps on your bench. Center one clamp in the middle of your assembly bench, and position the other two about 6" in from the ends of your boards. Take a minute to adjust the clamping heads so that you'll only need to tighten them once you've applied the glue.

Step 3: Glue and Clamp

Once glue is applied, you have about 5 to 10 minutes to accomplish your task, and there's no turning back. The best way to prevent panic is with preparation. Do a dry run.

Tip Alert

To prevent the black stains that can occur when metal clamps come in contact with glue and wood, you might want to run a strip of masking tape down the length of your clamps.

After the glue congeals and it's safe to remove the clamps, use a scraper to clean up the joints.

Working diagonally across the panel, use a #4 bench plane to quickly level the boards, or go with a belt-sander for similar results.

A no-glue clamp up is the best way to check for any glitches you might encounter. Don't apply heavy clamp pressure on a dry run. Do just enough to see if you have any issues with the seams closing completely. If necessary, you may need to re-joint an edge or two. Unclamp the assembly.

Stand your boards on edge and apply a bead of glue on each mating surface. Then spread the bead out evenly. The amount of glue you use is a judgment call. You want enough glue to get nice even squeeze-out. If there is no ooze, you haven't applied enough. If glue is dripping everywhere, you've applied too much.

Next, pull everything together. Lay your boards down, and match up your pencil lines. Tighten the center clamp until the glue begins to ooze; then lightly tighten the end clamps. Now, starting at the center of your panel, align each joint as closely as possible, as shown in **Photo A**. Sometimes the joints need some persuasion from a dead-blow hammer to fall in line. Use C-clamps at the ends of the panels to make them even, as shown in **Photo A Inset**.

The problem with the bottom-clamp only arrangement is that the panel is likely to cup. To counteract this tendency, you want to add clamping pressure across the top of the panel. Using your straightedge, check the flatness of the panel as you go, as shown in **Photo B**. Sometimes, you may need to use extra clamps to pull the assembly flat (**Photo C**). Once all is as it should be, tighten each clamp and then do one final flatness check before you take a break and let the glue dry.

Step 4: Cleanup

After an hour, the glue will be at 80% strength, but the squeeze-out should still be gel-like. At this point you can remove the clamps and begin the cleanup. First, use a hook-type scraper, as shown in **Photo D**, which will do a fine job of removing the partially cured glue. If you encounter tear-out, try scraping from the opposite direction. When done, wipe the surface with mineral spirits to highlight any missed spots.

After scraping off the glue, give the panel at least 24 hours to dry. This might seem excessive, but the extra time allows the wood alongside the joint to release the moisture it absorbed from the glue. If you smooth the panel too soon, the swollen wood around the glue line will dry and shrink, resulting in a visible dip.

Once the panel is dry, knock down any out-of-level joints. To do this, use a #4 bench plane, as shown in **Photo E**, to smooth out the entire panel. Since a little tear-out is inevitable, finish up with a card scraper, as shown in the opening photo.

To avoid the risk of rounded-over edges, don't trim the panel to final dimensions until you are done sanding both sides through 180 grit. After trimming to size, a final hand-sanding with 220 grit is all that's needed before applying your stain or finish. ■

Tip Alert

If you apply glue to an edge and are interrupted or decide not to continue, it's not enough to remove the uncured glue with water. When the board is dry, re-joint the edge to expose a fresh surface for a strong bond.

Tip Alert

If you have an unusually large top, glue the boards one-by-one. There's nothing wrong with doing glue-ups in stages.

Light Right

A how-to guide for a better, brighter shop

By Joe Hurst-Wajszczuk

For additional task lighting solutions for your shop, go to *woodcraftmagazine.com* and click on online extras.

Lighting isn't the first thing woodworkers think about when planning a workshop, but with the flick of a switch, many quickly discover that it's the one component they can't do without. Even those who have successfully worked out their lighting will eventually need to rethink their plans. Because our eyes gradually lose their ability to absorb light, we'll all need about 50% more light at age 40 than we did at 20, and 100% more at 70 than at 40.

To shine a light on the murky science of workshop lighting, here's a primer with a two-pronged plan for brightening any workspace. As you'll see, good shop lighting hinges on two components: ambient (overall) illumination and task lighting.

After you familiarize yourself with lighting terms, you can focus your attention on the solutions that meet your needs. For a step-by-step strategy for planning out ambient lighting, including tools for appraising existing lighting, go to page 56. To augment your existing lighting and to get a grip on the new types of lights that are replacing incandescent bulbs, skip ahead to the "Task Lighting" section starting on page 58.

To make sense of package labels and to communicate your needs to an electrician or lighting designer, take a few minutes to study up on the science of lighting with the lessons below.

Lesson 1: When choosing bulbs, watch the watts, but count the lumens.

Back when incandescent lighting was the main game in town, we equated "wattage" with "light intensity." Now that there are several new players on the field, it's time to set the record straight: wattage is the measurement of the energy required to light a lamp (or bulb). The quantity of light produced is measured in lumens (lm). When replacing incandescent bulbs, it's tempting to believe the "equivalent to X watts" icon on the package, but it's better to check the fine print for the actual lumen rating (see photo, above right).

Lesson 2: At the bench, think foot-candles & luxes

To measure the quantity of light reaching your benchtop, you'll need to understand two more terms: foot-candles (fc), and luxes (lx). As the name suggests, one fc is equal to the illuminance cast on a surface by one candle, one foot away. Foot-candle ratings still appear in building codes, but lighting calculations are often done in luxes (lx). One lux is equal to one lumen per square meter. For side-by-side comparisons, note that l lx = 0.1 fc.

100-Watt "Equivalent" Bulbs

Lower wattage bulbs cost less to use, but pay close attention to the lumens. Some replacement bulbs produce considerably less light than others.

Lesson 3: With lighting, "color" starts with "K"

Back when your choices were "warm" incandescents and "cool" fluorescents, you didn't need to worry too much about color temperatures. Now that bulbs come in a wider array of colors, knowing the Kelvin temperature (K) can help you pick and stick with the light you want.

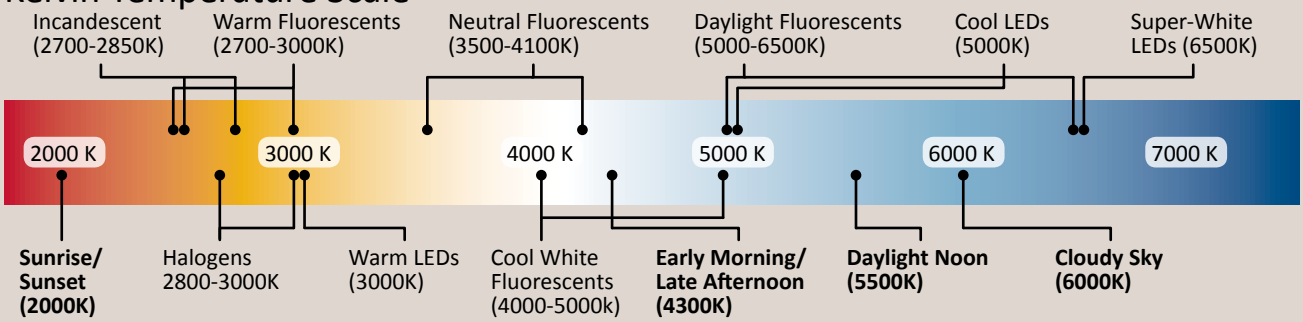
Choosing the right bulb by name can be confusing because the terms coined by manufacturers to describe their bulbs seem to run contrary to the Kelvin scale (see chart, below). If you want a warmer light, look for a lower K; for cooler, bluer light, choose a higher K.

"Daylight" bulbs are the most confusing. For starters, these bulbs don't really replicate the sunlight during the most pleasing times of day. And with the widest temperature range, the color produced by these bulbs varies greatly from one manufacturer to the next.

Lesson 4: High K = more light, less color

The light frequency of higher K-temperature bulbs activates our scotopic vision (this is the part of our eye that is more sensitive to black-and-white contrast), causing our eyes to perceive this light as brighter. By triggering our pupils to dilate, these bulbs can sharpen vision and reduce glare. The downside is that it comes at a loss of color perception.

Kelvin Temperature Scale



Opening photo: Brian Francis; Product photos: Gary Tramontina

Before you start hanging lights, it helps to do some homework. Here is the five-step strategy that I followed when I converted my 20 × 20' garage into a full-service workshop, plus some lessons that I learned since then.

Step 1: Decide on the quantity of light

Ambient household light varies from 30-50 fc (300-500 lx), but for tackling detail work, you should aim for twice that amount. For planning purposes, I estimated my needs at 75 fc. (I'm certain that my request surprised my electrician, but after listening to my stories about dovetails and microbevels, he agreed that the amount was right for such detail work.) If you're over 50, you may want to shoot for 100 fc, especially to illuminate your workbench and most-used machinery areas.

Step 2: Pick your fixture

Because they're efficient and inexpensive, fluorescent tubes (either T8's or T5's) are the first choice for ambient shop lighting. The real decision is picking the right overhead fixture. Compared to so-called bargain fixtures, better quality alternatives direct more light where it's needed and can protect the bulbs from accidental contact. (You can compare the effectiveness of different fixtures in **Step 3**.)

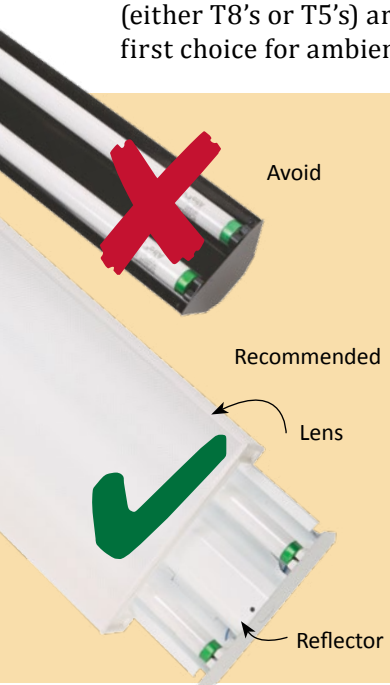
My advice? Don't skimp. I paid around $50 apiece for 4-bulb lensed fixtures, and still consider the money well spent. For specific advice about what to look for, see the sidebar below.

Step 3: Draft a plan

If you can find a designer, provide him or her with shop-specific details, including the shop's overall dimensions, your desired foot-candles, fixture type, ceiling height, and work surface height, and then let them draft a plan. If you can't, you can download Visual Basic at *www.visual-3d.com*, a free download, and let your computer do the hard work (see photo, above right). The program automatically calculates a plan to create an even illumination plan, but you can also adjust the fixture positions and review the illumination effects.

Visual Basic (*www.visual-3d.com*) turns lighting design into a computer game. Fill in your shop's parameters, and the program will generate a lighting plan for you.

In order to maximize the ambient light at the workbench and tablesaw, I adjusted the fixture positions to correspond to the Fixture Placement Guidelines at right. Repositioning the fixtures to one side of



Flourescent Fixtures

All fixtures are not created equal. Here's what to look for to get the most from your fluorescent tubes:

Reflectors - Reflector-less fixtures that rely on the ceiling to reflect the light are less efficient than those with reflectors, and ineffective in shops with exposed joists. Reflector-clad fixtures cost more, but help the lamp deliver light were you want it.

Lenses - A lens spreads out light and protects bulbs from dust (dust build up can reduce light output by 10% each year). Besides reducing cleaning chores, a lens protects the bulbs from accidental collision with a long board or bar clamp.

Ballasts -The ballast supplies a high initial voltage to light the lamp and prevent flickering. Today, electronic ballasts are standard, but if your fixtures are more than three years old, you might consider an upgrade. Magnetic ballasts cause lights to buzz and flicker, and are slow to start in cold weather. (In some instances, magnetic ballasts can create a strobe-effect that can make a rotating saw blade appear stationary.)

my garage bumped the light at my bench and tablesaw to more than 100 fc. The light on the storage-side of my garage is still a respectable 60 fc.–more than enough light for non-woodworking chores.

Step 4: Call in a pro

Adding breakers is best left to a licensed electrician, but you can do some of the work yourself and save money.

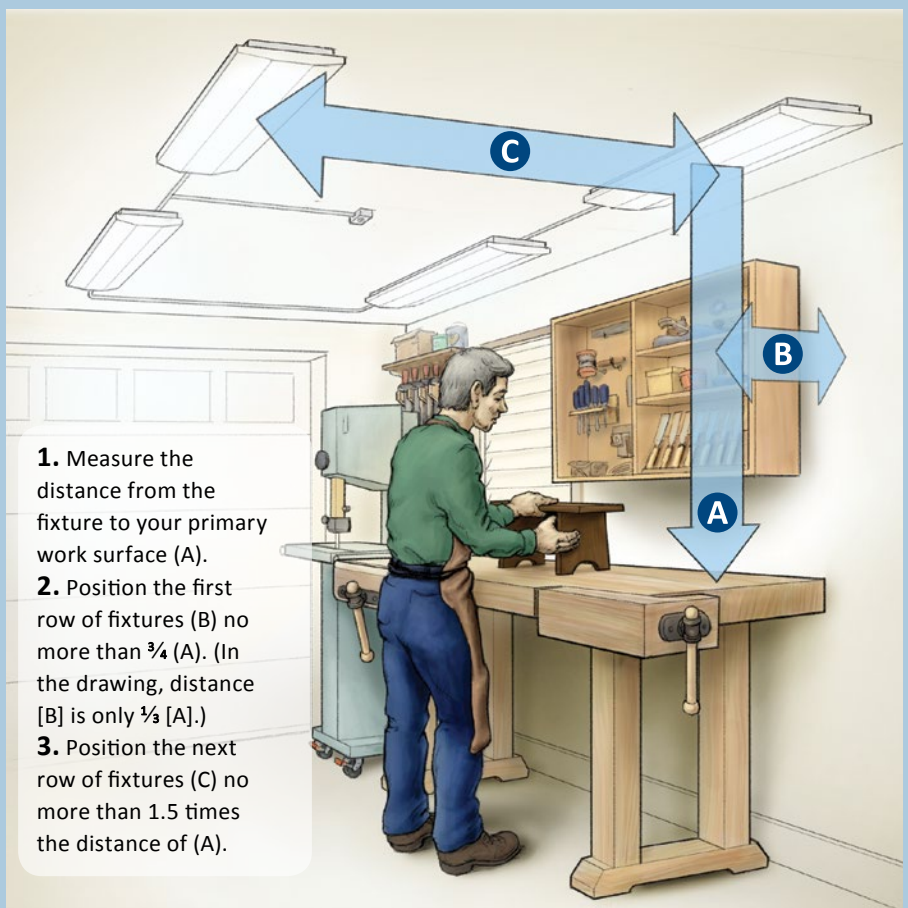
To prepare my shop, I cleared out the work zone and mapped out the exact arrangement of the fixtures with string and cardboard templates. The electrician installed and wired a shop's worth of fixtures in two days.

Step 5: Buy bulbs and test your setup

Because color is influenced by the colors of your shop, the types of woods you use, and even your age, Kelvin color preferences vary from one woodworker to the next.

To discover what works for you, you'll need to buy bulbs (I suggest a pair) in a variety of different color temperatures. If you're interested in a warm look, try lower-K bulbs in the 2,800-4,100K range. If you're looking for clarity, start with 4,100K bulb and work your way up. Mark the bulbs to avoid accidental mix-ups, and then install them into a single fixture and check the light. When you find a comfortable color temperature, buy a case of the bulbs, and install them in all the fixtures. At this point, you can test-run your shop. A lighting meter (sidebar, right), can help you find the dark spots.

Fixture Placement Guideline



1. Measure the distance from the fixture to your primary work surface (A).
2. Position the first row of fixtures (B) no more than ¾ (A). (In the drawing, distance [B] is only ⅓ [A].)
3. Position the next row of fixtures (C) no more than 1.5 times the distance of (A).

Meters: Lighting by the Numbers

By gauging the quantity and quality of existing light, a light meter can help you determine if it's time to replace a few bulbs (many dim as they age), install additional fixtures, or add a few task lights.

Battery-powered digital meters are the easiest to use: simply set the light-sensitive cell in the desired location and check the readout. Because the readout changes as quickly as you move the sensor, look for a meter that offers a means of holding a reading.

If you own a tablet or smartphone, you can download an app that can turn your device's camera into a light meter. Free apps are available, but I purchased the LuxMeterPro's "advanced" for $2.99. In addition to a basic meter, this version includes a color spectrum analyzer that can identify the K-temperature of fluorescent lights.

App, LuxMeter Pro, $2.99 (*itunes.apple.com*)

Digital, (Sinometer LX1010B, Around $15, *amazon.com*)

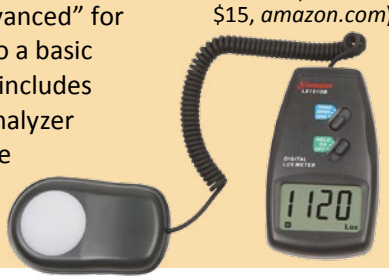


Illustration: Chuck Lockhart

Task Lighting – Bulb Basics

Since 100W incandescents were phased out in 2012 to make room for energy-efficient alternatives, buying a bulb isn't as easy as it used to be. If you're nearing the end of your stockpile, don't stress out; there are several suitable substitutes to choose from.

Updating the bulbs in your home can shave hundreds from your annual utility bill, but if you only spend a few hours a week in your shop, it will take years to recoup the cost of super-efficient replacements. For shop satisfaction, focus your attention on light intensity (lumens) and color temperature (K), and then on longevity and power consumption.

Rough Service, $4.16
1,230lm, 2,700K, 100W
900 hours

Utility, $2.58
2,740lm, 2,850K, 150W,
750 hours

Flood, $7.98
510lm, 2,650K, 65W
2,000 hours

Incandescent

Incandescent bulbs work by heating a tungsten filament to produce warm, but woefully inefficient light. (Only 5-10% of the electricity becomes light, the rest of the energy consumed becomes heat). These bulbs are inexpensive, but short-lived. Incandescents also get darker as they burn, causing an old bulb to produce only 82% of the light it did when new. Despite government restrictions, if you want to stick with incandescents (and keep your electric meter spinning), you can still find 100W and 150W "service bulbs" at most hardware and home stores.

Frosted, $4.50
800lm, 2,700K, 15W
8,000 hours

Twist, $3.50
1,600lm, 2,700K, 23W
10,000 hours

Flood, $8.98
750lm, 2,700K, 15W
10,000 hours

Full-Spectrum, $49.99
6,200lm, 5,000K, 105W
8,000 hours

Compact Fluorescent (CFL)

First-generation CFLs started off on the wrong foot. They were slow to start, they cast a ghastly blue light, and their oversized coils stuck out of most fixtures. Today, the coils on most are compact and/or concealed, and the bulbs have been tailored to produce light that's nearly indistinguishable from incandescents. Most importantly, CFL prices have plummeted, offering an easy way to save money. However, CFLs aren't perfect. The larger-lumen bulbs still may not fit some older fixtures. Also, a CFL's lifespan can be shortened by vibration.

Halogen

Close cousins to incandescents, halogens also employ a tungsten filament, but because they are more efficient, they meet government regulations. In some cases, a halogen bulb's lifespan isn't much longer than an incandescent, but it doesn't darken with age; old bulbs produce 94% as much light as did when new. In comparison, with CFL's and LED's, halogens cost less up-front and throw more lumens, but cost more to operate. A halogen bulb's real Achilles' heel is that it runs much hotter than a CFL or LED. For that reason, it's important to keep bulbs away from flammables and flesh, and to make sure that the bulb size does not exceed the fixture's wattage capacity.

Worklight, $32, 8000lm (x2),
2,800K, 500W (x2)
1,000 hours

Frosted, $8.98
1,280lm,
2,800K, 72W
2,000 hours

Flood, $7.98
600lm,
2,800K, 60W
2,000 hours

Clear, $3.27
1,490lx,
3,000K, 72W
1,000 hours

Light-Emitting Diodes (LEDs)

The newest bulbs on the block, LEDs produce little heat, run on few watts, withstand vibration and shock, and last for decades. LEDs are suitable for many applications, provided that you pay close attention to the label. First check the lumens. Many "replacement" LEDs do not provide as many lumens as the bulbs they're replacing. Next, check the color temperature. In order to boost perceived output, many lower-lumen LEDs produce cold, high-K light. ■

Worklight, $60
1,681lm, 6,800K, 63W
50,000 hours

High-output, $22.98
1,100lm, 3,000K, 16W
25,000 hours

Flood, $7.98
600lm, 2,800K, 60W
2,000 hours

Frosted, $20
500lm, 5,000K,
5W 30,000 hours

Dual-Power Shop Light, $50
250lm, 5,000K, 3W
25,000 hours

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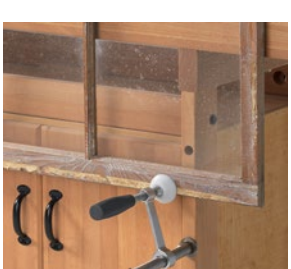

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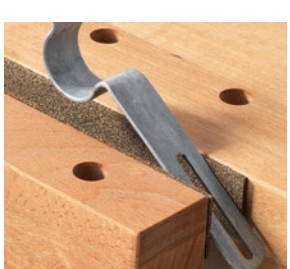

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Bench Stops and Hooks

Eight stone-simple designs for gripping your work

By Andy Rae

Until woodworkers evolve a third hand, we will continue to search for new ways to clamp or hold work to our workbenches. This humble-looking collection of stops and hooks still ranks at the top of my list. As far as shop-made tools go, these extra hands are stone-simple to make and, more importantly, just as easy to use.

Bench stops and hooks work by preventing a workpiece from wandering while dressing it with a hand tool. In many cases, this mechanical advantage provides all of the holding power you'll require to complete a particular task without the need for additional levers or hold-downs. Because no fussy adjustments are necessary, these stops and hooks enable you to shift quickly and seamlessly from one step to the next.

Most of these "bench" aids don't actually require a bench. In fact, with a few clamps or screws, they can transform any work surface into a serviceable workbench. Wherever they're used, these simple jigs will give you a firm grip on your work.

Bench Stop Tips

- Lightly chamfer the bottom "working" edges of stops and fences to provide clearance for dust and debris.
- Finish your jigs with a couple of coats of shellac or varnish. One or two thin coats should suffice. Be careful not to overdo it; a thick finish may cause your tools to stick instead of slide.
- Wax the soles and sides of the planes that contact the jigs for better control and an easier cut.
- Drill hanging holes through your stops, and then position them on a nearby wall or under your bench so that they're ready when you are.

Photos: Andy Rae

Simple Stops

A bird's mouth

One of the simplest types of bench stops is a bird's mouth. As the name suggests, this jig is a board with a V-notch cut that holds boards entirely by friction. Although it does require a clamp in order to secure it to your workbench, once it's attached, you can get a quick grip on thick or thin workpieces for edge-planing without the tedium of clamping, unclamping, and re-clamping each piece. Unlike a bench vise, this setup keeps stock from bending by allowing it to rest on the surface of your bench.

I made this stop from a 1 × 4 × 10" block of hardwood. The 7"-long notch can be cut by hand or on the bandsaw. I sized the opening about 1½" wide, but you can adjust the size to accept your thickest boards.

Fitting a board into the bird's mouth jig provides plenty of support for edge-planing. To switch boards, simply lift one board out and slide in the next.

Slide-up stops

Slide-up stops fit snugly in slots cut into your benchtop. When you need the stops, simply tap them upward from underneath to project the necessary amount. They register and hold all kinds of work, but they're particularly useful for restraining thin stock.

Rout or chisel a pair of ¼"-wide × 2"-long through-slots into the left-hand section of your bench. (If you're a lefty, cut them into the right-hand section.) Use a dense and resilient wood such as rosewood to make the stops, and thickness them for a snug, sliding fit in their slots. I recommend aligning both slots with a bench dog hole, which will allow you to register wide work against three points.

Pop these slide-up stops above the bench for thick or thin work.

Aligning the slots with a bench dog provides three points of support for wide boards.

Planing stick

A pint-sized version of the planing beams used by Japanese craftsmen, a planing stick offers a simple, solid surface for smoothing thin and narrow sticks using the holding power of a single nail. Mill a 1 × 1½ × 24" stick from softwood, snip a 6d nail to about ¾" long (keeping the head end), and drive the nail into one end of the stick so that the head protrudes about ⅛" above the surface.

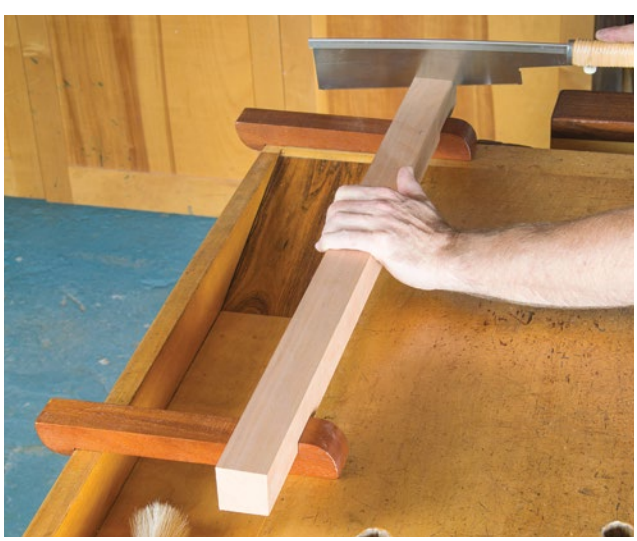
Depending on how you secure it to your benchtop, this jig works equally well with Eastern- or Western-style planes. For pull cuts, clamp the stick between bench dogs so that the nail is at your end. For push cuts, flip the stick so that the nail is at the far end.

(*Note: This jig doesn't require any finish. A freshly-planed surface gives the right amount of grab to hold the work.*)

Clamped between dogs, a stick and a nail may be all the jig you need when planing thin, narrow work.

Cutoff hooks

By raising boards above the work surface, cutoff hooks can help you start and finish a cut without slicing up your benchtop. How you position them depends on the type of saw used for the cut. With Japanese (pull-style) saws, register the hook against the rear edge of your bench. If you use Western (push-cutting) saws, reverse the hooks so they engage the front edge of the bench. Choose a straight-grained hardwood for the hooks, and bandsaw them to the profile shown below.



Hook the rear edge of your bench when making crosscuts with a pull-style saw.

Hook the front edge of your bench when using a push-cutting saw.

Half-sized pattern; enlarge 200%

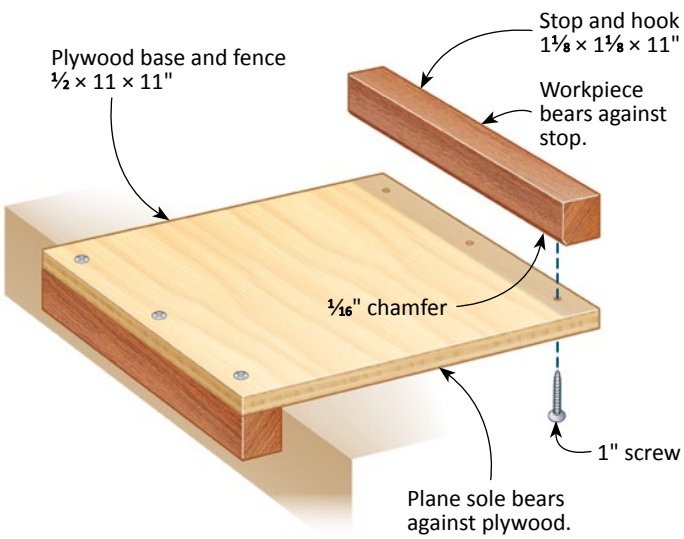
Full-sized pattern available for download at *woodcraftmagazine.com/magpatterns.html*

1 square= ¼"

Note: Bandsaw hook made from 1¾ × 1⅝ × 11" hardwood block.

Shooting Boards

Shooting refers to the process of hand-planing edges flat and straight. Most jigs are designed for 45° or 90° angles, but you can make one for any angle. Shooting partially slices into the fence, but as long as the plane's blade is not as wide as its sole, enough of the fence remains uncut to serve as a guide.



This bench hook's broad surface protects your bench from the scars that can come from chiseling, sawing, and slicing small parts.

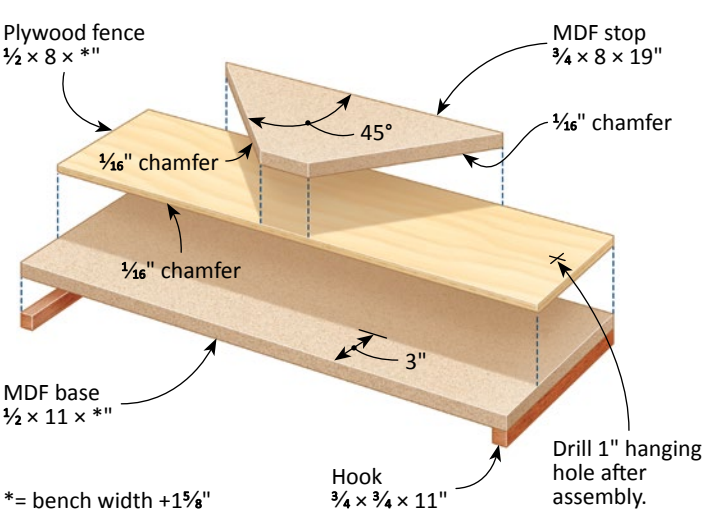
Shooter/chopping hook

Arguably my most-used bench stop, this jig serves several purposes. By hooking one edge against my bench and then using the opposing hook as a stop and the edge of the base as a guide, this jig serves as a basic shooting board, as shown on page 65. In addition, it doubles as a place mat when chopping, sawing, or slicing small parts. (To increase its working life when the primary chopping surface wears out, simply flip the board over and use the opposite side.)

Flat-miter shooting board

Fitting miters can be fraught with frustration. Typically, it's the last corner that needs some tweaking for a tight-fitting frame. This flat-miter shooting board tackles the most common miters, letting you fine-tune joints on flat frames, such as picture-frame miters or even three-way miters. With a hook on each end, you can trim miters from either direction; simply flip the jig end for end. (This feature also lets you tackle miters that have only one flat reference edge by enabling you to register your work against the most appropriate edge.)

This double-ended shooting board lets you trim mitered work, such as this three-way miter joint, using either a push or pull cut.

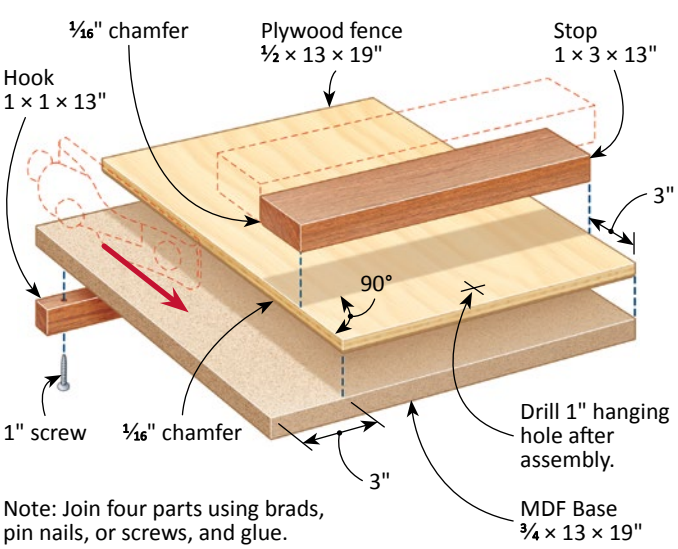


By enabling you to shave the end of work straight and square without leaving your bench, a shooting board quickly earns its keep.

End-shooting board

Because so much of my work involves square cuts, this is my most used shooting board. With it, I can trim a board for an exact fit, one plane shaving a time, or correct a mis-cut end to precisely 90°.

Make the fixture as shown below, ensuring that the stop is perpendicular to the fence. Position a workpiece so that its end sits a hair past the end of the stop. Set your blade for a super-light cut, and lay the plane on its side. Next, register the plane's sole against the fence, and swiftly and firmly push the plane past the workpiece while pressing the work steadily against the plane sole. (Small planes such as block planes work fine for small work, but I generally prefer longer, heavier planes because the extra mass helps power the cut. For best results on end grain, use a plane with a low cutting angle.)



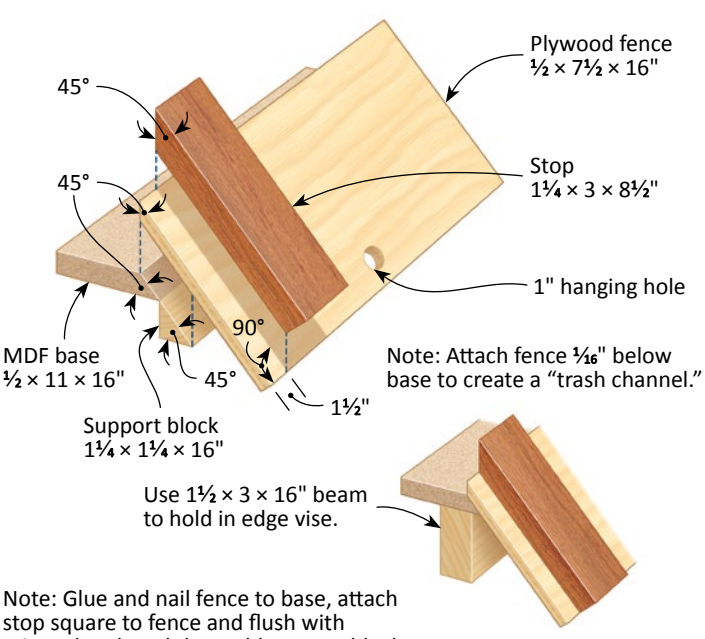
Note: Join four parts using brads, pin nails, or screws, and glue.

With steady pressure against the stop, even heavy boards can be held in place with one hand.

Edge-miter shooting board

An edge-miter shooting board (also known as a donkey's ear for its floppy-looking shape), is a welcome aid for tuning long or short miters to precision. This stop is a bit more elaborate than the other stops, but when you need to fine-tune wide or standing miters, such as those found in a mitered box or the corner of baseboard molding, this jig is worth the time it takes to assemble.

Despite its appearance, the jig is easy to make. If your bench has dog holes, simply build as shown below, and grasp the jig between dogs, as in the photo. (If you prefer to use your vise to secure the jig to your bench, attach a beam to the underside as shown below.) Whichever design you choose, take care to accurately rip the ledge to 45°. You may also want to assemble this jig with screws in case you want to shim the fence to fine-tune its angle. ■



Note: Glue and nail fence to base, attach stop square to fence and flush with mitered end, and then add support block.

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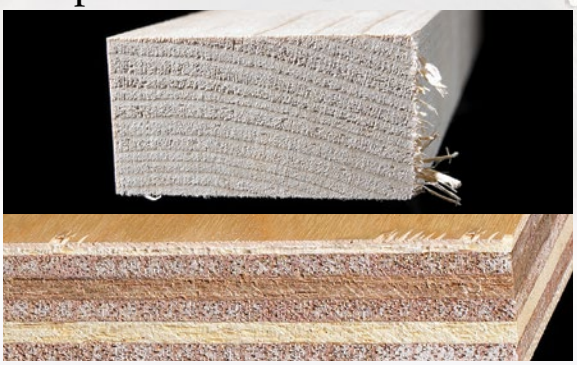

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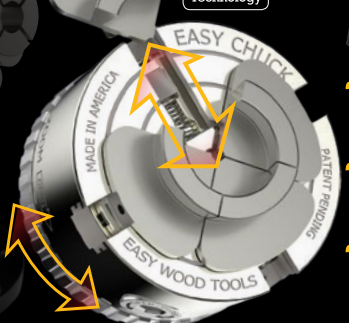

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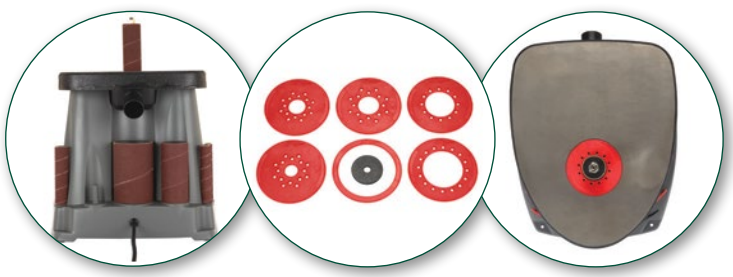
- **Overall Dimensions: 15 9/16" W x 14⅛" D x 17" H; Weight: 34 lbs.**



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Super-Safe Bagel Slicer

Break bread easily with this simply-made breakfast champion.

By Marlen Kemmet

Say good-bye to the dangerous circus trick of holding a bagel in one hand while trying to knife it into two equal halves with the other. Say hello to this simple scrapwood project that lets you slice bagels safely with a bread knife while ensuring perfect cuts every time.

For the slicer body, I went with cherry for the supports, divider, and base. To dress up this kitchen accessory, I glued on figured sides made from quartersawn sycamore. Let's build one.

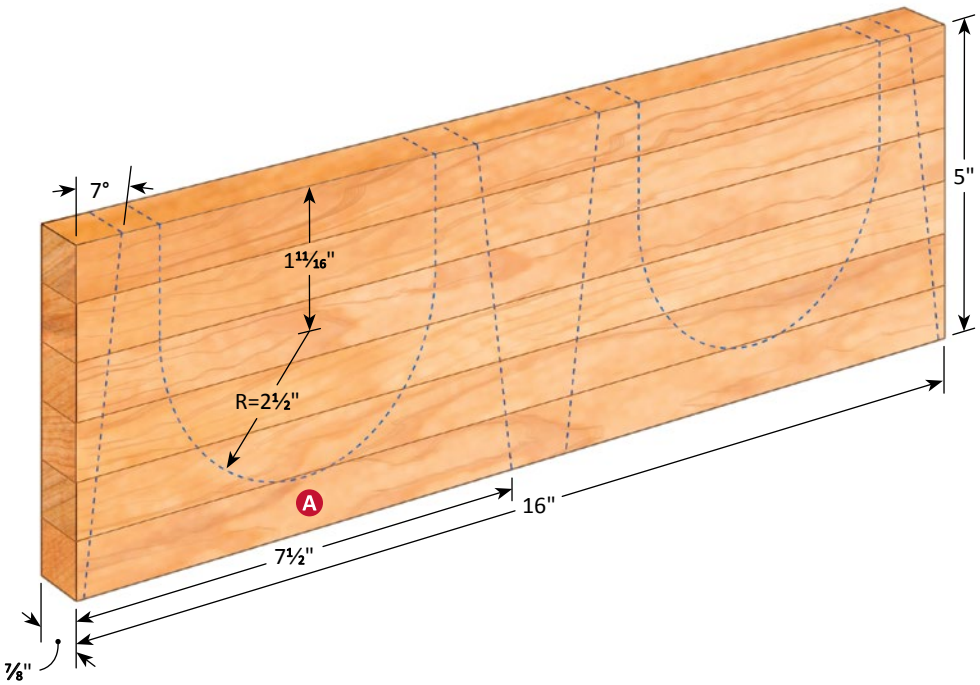
Start with the bagel supports

1 To create the bagel supports (A), rip enough ¾"-thick cherry to ⅞" wide by 16" long to create the lamination shown in **Figure 1**. (If you have ⅞"-thick stock, skip the lamination step.) Laminate the pieces together face-to-face for a ⅞"-thick lamination, keeping the surfaces and ends flush.

2 Remove the clamps, and scrape or wipe off the excess glue. Let dry and then plane or sand the two faces smooth. Rip the lamination to 5" wide.

3 Set your mitersaw at 7°, and miter-cut two 7½"-long pieces from the lamination. Using double-faced tape, adhere the

Figure 1: Bagel Supports



two interior support pieces (A) together with the miter-cut ends and edges flush.

3 Lay out the U-shaped interior cutline on the top blank, and bandsaw the opening to shape, as shown in **Photo A**. Sand the bandsawn edges smooth using a drum sander or oscillating spindle sander. (I used a 3" drum sander.) Separate the pieces, and remove the double-faced tape.

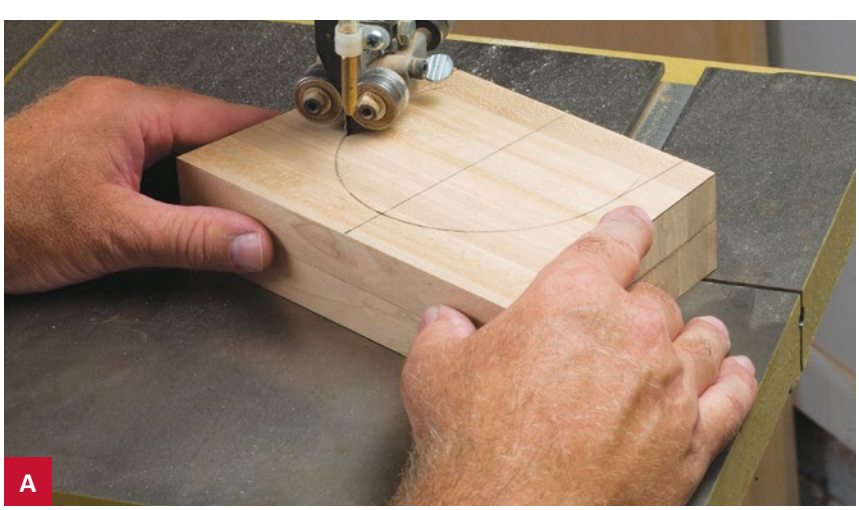
4 Plane or resaw a piece of hardwood. (I used quartersawn sycamore) to ¼" thick × 5" wide × 17" long. Plane or sand both faces of the exterior blank smooth.

5 Using one of the bagel supports (A) as a template, mark the 7° profile for the two sides (B). Miter-cut the side pieces to the same length and shape as the bagel supports.

6 Adhere the two sides (B) together with the miter-cut ends and edges flush. Use a compass to mark a 2" radius on the top piece, where shown in **Figure 2**. Bandsaw the cutouts in the taped-together pieces, and drum-sand the bandsawn edges smooth.

7 Spread glue on the mating surfaces of the supports and sides (A, B). Now, adhere and clamp one side to one support with the edges and ends flush. Wipe off any excess glue with a damp cloth. Repeat for the other support and side.

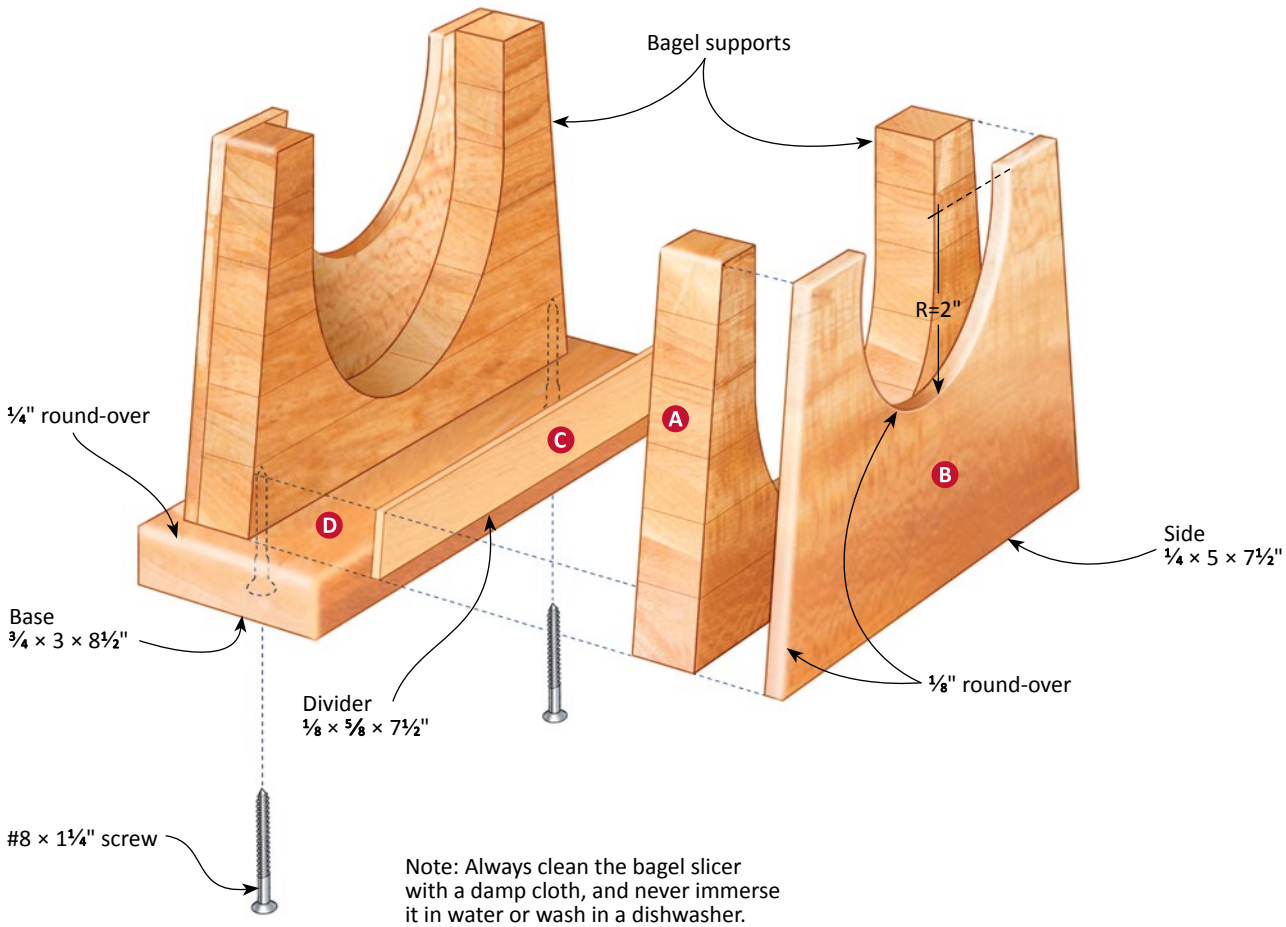
8 Cut the ⅛"-thick divider (C) to size plus 1" in length. With a ½" overhang at each end, glue it between the outside assemblies



With a ¼" or ⅜" blade, bandsaw the marked radius to shape.

Opening photo: Morehead Photography

Figure 2: Bagel Cutter Exploded View



Note: Always clean the bagel slicer with a damp cloth, and never immerse it in water or wash in a dishwasher.

(A, B), checking that the assembly edges are aligned (**Photo B**).

9 Trim the divider (C) flush with the top assembly halves. Sand the miter-cut edges of the sides flush with the supports (A). Sand a ⅛" round-over along the miter-cut edges of the body assembly. (See **Figure 2**.) Sand a slight round-over along the radiused edges of the sides (B).

10 Cut the base (D) to size, and rout a ¼" round-over on the top edges. Drill countersunk holes 1" in from the edges and 1½" in from the ends. Sand the parts to 220 grit. Center the body (A, B, C) on the base (D). Glue and screw together. Apply finish. (I used Behlen's Salad Bowl Finish.) ■

Rest the halves against a flat surface, set the clamps, and then use a square to align the mitered ends.

Project photos: William Hopkins; Illustrations: Melanie Powell

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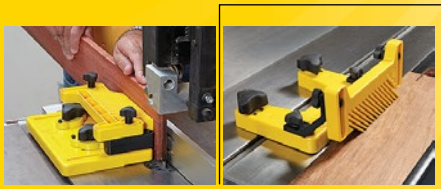

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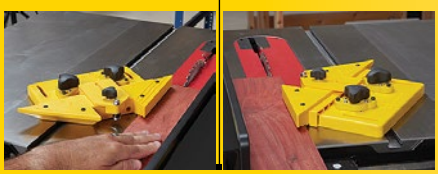

Thin Stock Hold Down Attachment safety

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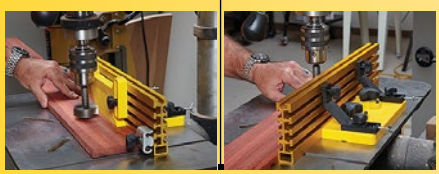
- » Thin stock hold near blade.
- » Clean cuts with strong hold near blade.
- » Cut thin strips with roller guide.



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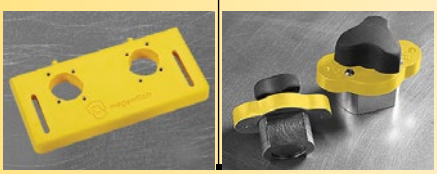

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Spotlight on Koa

An amazing Hawaiian wood in short supply

By Dr. Sara Robinson
Technical consultant: Larry Osborn

If you're lucky enough to live on one of the Hawaiian islands, then you are no doubt intimately familiar with koa – a wood of rich browns and reds, which tends to display interlocking grain and, in some cases, eye-popping figure.

Unfortunately, for most of us, koa wood can be hard to come by (and it's pricey!). The koa tree (*Acacia koa*) grows natively only in Hawaii and while previously prevalent, it is now increasingly sparse due to logging and the clearing of land for pastures. The tree itself can reach around 80', taller if growing in volcanic ash. Koa is a member of the pea family and as such produces pod-like legume fruits.

Most koa for sale ranges from stock having a golden brown color to mahogany-like reddish browns to darker walnut-like browns. Color can vary widely within a growth ring, thus color banding similar to that in zebrawood can sometimes result. Curly, wavy, and interlocked grain are also common. Koa has no natural decay resistance and is a favorite of termites, hence exterior buildings do not frequently contain koa.

History in woodworking

Before fiberglass entered the scene, Native Hawaiians utilized koa for body boards and *alaia* (finless or skegless) surfboards, as well as dugout outrigger canoes. Due to deforestation, koa trees of the necessary size for larger projects are harder to come by. Today, many woodworkers in Hawaii turn to koa for furniture, decorative boxes, turnings, and carvings, with many of these items sold to tourists. In addition, a substantial industry has cropped up around the use of koa for guitar veneer and for the guitar body itself. It is routinely seen in ukuleles as well. The reason: koa is considered a "tone wood," making it suitable for the building of select musical instruments.

It's a fact that...

Koa is one of the most unique tone woods. Its static quality is very similar to maple. However, as the guitar is played, it has a tendency to open up considerably and tune into more of a mahogany on steroids. Those who own and play a koa guitar often recommend that you play the instrument regularly to keep it sounding at its best.

Where the wood comes from

Koa only grows on the islands of Maui, Hawaii, Oahu, Kauai, Lānai, and Molokai. The ideal growing range is from around 2,000 to 6,000 feet above sea level where the trees take root in a rich, dark volcanic soil. Harvesting koa is highly regulated, and much of what is used now comes from reclaimed wood. There is a koa plantation north of Hilo, Hawaii, where patient investors can buy young trees, have them planted, and then sell the wood years down the road once the trees mature.

What you'll pay

Koa is increasingly expensive. Because of its limited distribution, you will just as likely find yourself purchasing specific pieces in addition to buying koa by the board foot. It comes down to availability at the time of purchase. Some sample online prices include the following: a 2 × 13 × 71" board of curly koa, $900; a curly koa turning blank of 5 × 5½ × 11", $90; and, by contrast, an unfigured 2 × 4½ × 38" board,

Curly koa

Crotch-figure koa

Banded koa

$75. You can generally find better deals on eBay, but be warned – you may find that even though the wood looks like koa in the picture, it may turn out to be something entirely different. Some suppliers in the islands dry, sell, and ship 4/4 boards that measure up to 8" wide × 8' long. One such supplier sells plain-sawn 4/4 stock for $19.95/board foot and full curly koa for $44.95/board foot. Another prices curly koa veneer at $80 for a 6¼ × 81" piece.

How to select the best stock

Koa is available in a variety of colors as mentioned earlier, as well as grain patterns. These typically include plain-sawn, crotch, semi-curly, full-curly, and everything in between. Some dealers will email photos of pieces they have on hand for your approval. For projects, be sure to go with a consistent color and figure. Ask about the drying and sealing. You don't want your shipment of koa to have checked ends when it arrives due to mainland climate differences. Ask if the wood came from the same island and elevation, too. That can make a slight difference in appearance. The best case is when the pieces in your koa order originate from the same tree.

Working koa in the shop

Because of the high prevalence of interlocked grain and figure in koa, machining requires care. End grain can chip and tear out when crosscutting and routing, so slow feed rates are crucial, as well as the use of sacrificial backers. Figured koa can tear out during planing. Here, feed the stock at an angle and take only very fine cuts. A drum sander may be needed for a gouge-free surface. By contrast, standard plain-sawn koa machines easily much like walnut, producing a smooth finish when jointed or planed. Koa has a relatively high density, so when turning, employ sharp tools and a steady hand. As with planing, end grain tear-out is common on the lathe, especially when working figured koa.

Koa can eat through sandpaper, but finishes to a high luster and is worth the sanding effort. The wood does not have an odor, but like many tropical woods, koa wood dust can be a nasal irritant, and a mask should always be worn when working it. Extractive content is low in koa, making gluing and staining a breeze. Oil-based stains and finishes highlight the wood's beauty, as do water-based topcoats. Because koa is only minimally an open-pore wood, filling is not needed. ■

Koa Quick Take	
Cost	High
Weight	Moderate/high (comparable to cherry)
Hardness	High (slightly less than cherry)
Stability	Moderate
Strength	Moderate
Toxicity	Skin and nasal sensitivities
Tool Type	Hand and power tools
Common Uses	Ukuleles, guitars, furniture, carvings

Photo: Larry Hamel-Lambert; Illustration: Steve Sanford

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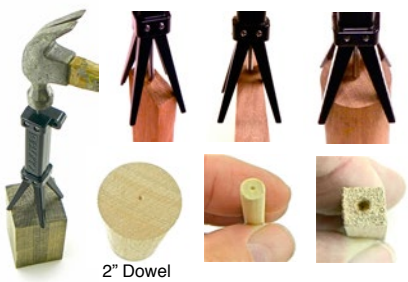

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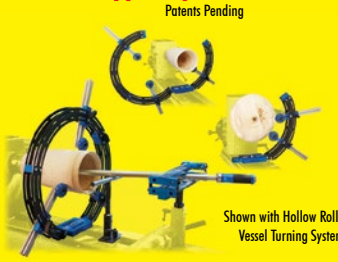

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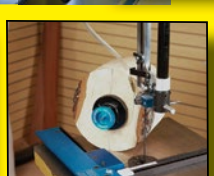

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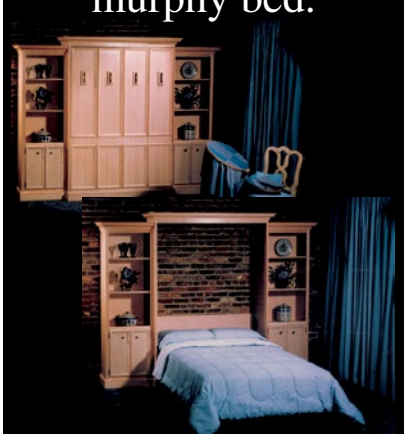

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Woodcraft is privileged to partner with Rob Cosman, "Your Hand Tool Coach," featured on the educational handtoolworkshop.com.

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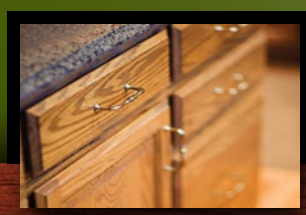

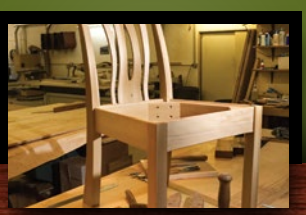

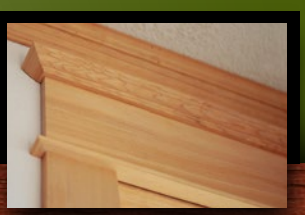

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