CREATE 6 PROFILES FROM 1 ROUTER BIT p.24

ISSUE 240 JULY 2016

Better Homes and Gardens®

WOOD®

The World's Leading Woodworking Resource

Greene & Greene Server

p.44

- Curio Cabinet p.30
- Hall Bench p.58
- Horizontal Mortiser p.72
- Hidden-hook Coat Rack p.68

Plus 3 Free Shop Plans

See page 39 for details

Simple Secrets to Hand Planing p.26

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- Amps: 11A at 110V, 5.5A at 220V
- Table size: 14" x 14" x 1½" • Table tilt: 10° L, 45° R
- Floor-to-table height: 43"
- Cutting capacity/throat: 13½"
- Max. cutting height: 6"
- Blade size: 93½" (⅛" to ¾" wide)
- Blade speed: 1800 and 3100 FPM
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- Approx. shipping weight: 247 lbs.

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- Motor: 1 HP, 110V/220V, single-phase, prewired 110V
- Swing: 17"
- Drill chuck: 1/64"–⅝" • Drilling capacity: 1" steel
- Spindle taper: MT#3 • Spindle travel: 4¾"
- Speeds: 210, 310, 400, 440, 630, 670, 1260, 1430, 1650, 2050, 2350, 3300 RPM
- Quill flange/collar diameter: 2.85"
- Precision-ground cast iron table
- Table size: 13⅝" square • Table swing: 360°
- Table tilts: 90° left & right
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- Heavy-duty motor: 1½ HP, 120V/240V, single-phase
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- Precision-ground cast iron table
- Table size: 20¼" x 18"
- Floor-to-table height: 33½"
- Spindle travel: 3"
- 2 interchangeable spindles: ½" and ¾"
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- Cast iron 25" x 25" • Table tilts: 45° left, 15° right
- Ten spindle sizes: ¼" x 5", ⅜" x 6", ½" x 6", ⅝" x 6", ¾" x 9", 1" x 9", 1½" x 9", 2" x 9", 3" x 9", 4" x 9", tapered and threaded
- Floor-to-table height: 35½" • 1725 RPM spindle speed
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- Amps: 20A at 110V, 10A at 220V
- Precision-ground cast iron table size: 17" x 17" x 1½" thick
- Table tilt: 10° left, 45° right
- Floor-to-table height: 37½"
- Cutting capacity/throat: 16¼"
- Blade size: 131½" long
- Approx. shipping weight: 342 lbs.

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15" PLANER

- Motor: 3 HP, 240V, single-phase, 12A
- Max. cutting width: 15" • Max. cutting depth: ⅛"
- Max. stock thickness: 8"
- Min. stock thickness: 3/16"
- Min. stock length: 8"
- Feed rate: 16 and 20 FPM
- Cutterhead diameter: 3"
- Cutterhead speed: 5000 RPM
- Solid steel infeed roller
- Table size: 41¾" x 16"
- Overall dimensions: 38" W x 42½" H x 42" D
- Approx. shipping weight: 585 lbs.

Reviews & Awards grizzly.com

Wood Magazine Top Tool Approved

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12" DISC SANDER WITH BUILT-IN BRAKE

- Motor: 1 HP, 120V, single-phase, 9.5A, 1720 RPM, capacitor-start with brake
- Table size: 15½" x 15"
- Base size: 16½" L x 16½" W
- Sanding disc size: 12"
- Power transfer: Direct
- Table tilt: +15° to -45°
- Dust port: 2½"
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Old meets new

The other day, while looking up a project for a reader, I had to dig through some very early issues of *WOOD* magazine. Before long, I found myself completely distracted (squirrel!) and immersed in old-school *WOOD*. Back in the day, we often showed how to make your own shop tools—not just hand tools, but even stationary power tools, such as a surface sander (issue 7), scrollsaw (issue 12), and lathe (issue 16).

As woodworkers, we make our own furniture, though it's often cheaper to buy it. Why? A lot of reasons, really, but mostly because we can. So why *not* build your own tools? In this issue, I invite you to try your hand at making a router-powered mortising machine. It's easy to build, affordable, and dead-nuts accurate.

Ironically, design editor John Olson used high-tech 3D drafting software to "build" a virtual prototype of the low-tech machine to test its articulation before ever picking up a tool. Then he built it according to the plans that start on *page 72*. It worked so well, he built another one for his own shop, this time using a CNC router to shape the pillow blocks and yokes. And to tell you the truth, I think he preferred making those parts on the CNC.

I shouldn't be surprised. One thing I've always admired about John is that, despite being a hand-tool junkie, he always chooses the *right* tool for the job, whether hand tool, power tool, or a computer-controlled one.

High-tech woodworking tools, such as CNC routers, laser engravers, and 3D printers, get more affordable every year. And, like them or not, it appears they're here to stay. Check out the many ways you can use them to enhance your own woodworking projects with Nate Granzow's article on *page 62*.

See you in the shop!

Dave Campbell
dave.campbell@meredith.com
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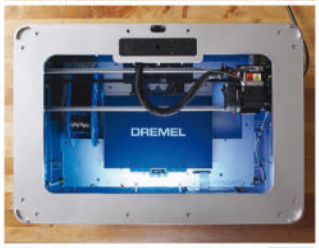

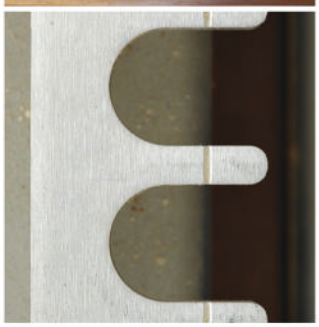

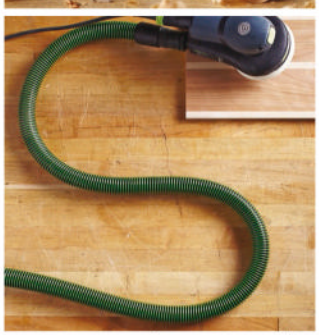

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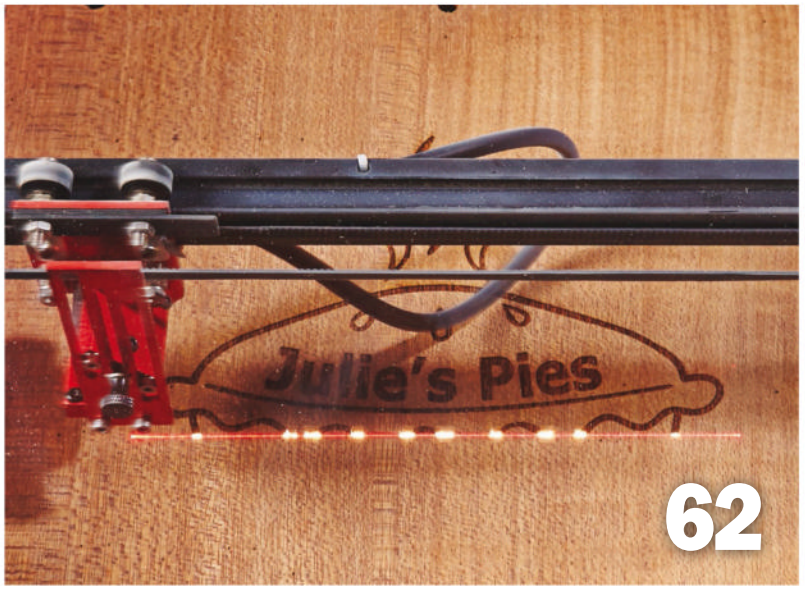
In This Issue of WOOD®

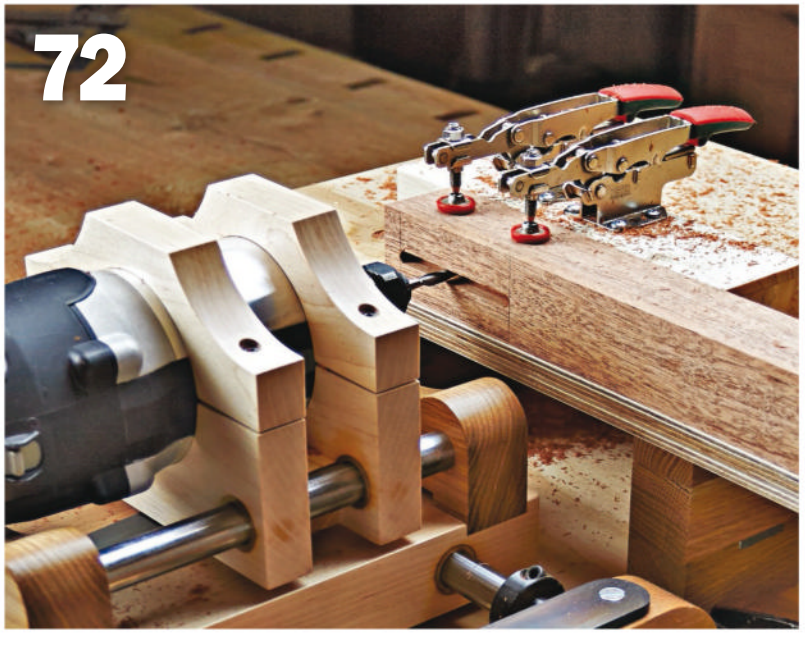
JULY 2016 · ISSUE 240

PLANS

TOOLS & TECHNIQUES

DEPARTMENTS





NO NAMBY-PAMBY REVIEWS

Before you buy, put on your big-kid boots and read real reviews from real woodworkers about real woodworking tools. These folks aren't opening paint cans with their chisels or coordinating the colors of their drills. They put tools to the test in their shops and tell you the straight poop.

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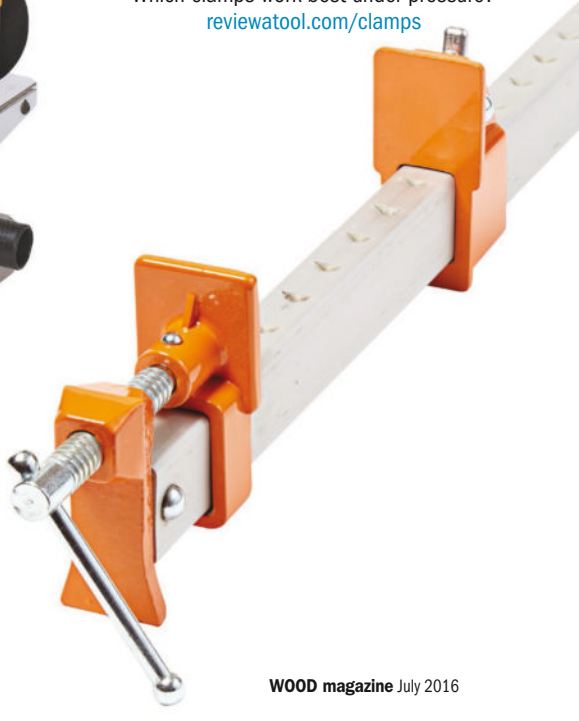

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Nook banning?

Before building the Neighborhood Book Nook (issue 238, March 2016), check with local authorities. Some jurisdictions have zoned these little libraries out of existence, even on private property. And homeowners' associations and covenants can be stricter than ordinances.

—Don Schmidt, Fargo, N.D.

That's good advice anytime you're building an outdoor structure, Don. Most, if not all, jurisdictions also require calling 811 (or visiting call811.com) a few days before you dig to have underground utilities located.

Idea Shop inspires, irks

As a woodworker for more than 40 years, I've pretty much seen and done it all. But your Idea Shop 6 is truly a new and novel approach. Very well done! If "beerstorming" results in such great ideas—please, continue to drink up!

—Robert Sigler, via e-mail

You guys must live a totally different life than I do. I cannot come up with a time in my working life that I would have had an extra $150 per pay period for buying tools for my shop. It looks to me like there was a bit too much liquid refreshment flowing when you came up with this idea.

—James North, Decatur, Ill.

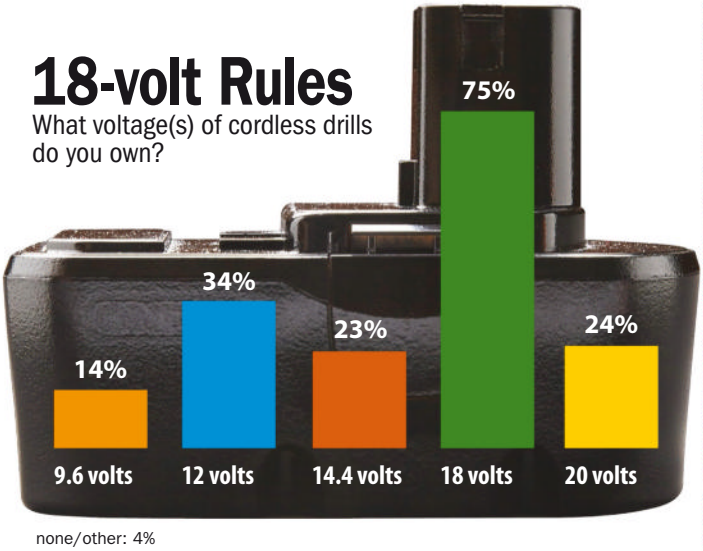
Hub flub

While building the AC-130 in issue 236 (November 2015), I discovered that the pin for the hub-cutting jig on page 50 should be marked ¾" from the bottom edge of the jig, not ⅜" as listed.

—Donovan Trejo, Vincennes, Ind.

18-volt Rules

What voltage(s) of cordless drills do you own?



none/other: 4%
Source: WOODPulse Survey, December 2015

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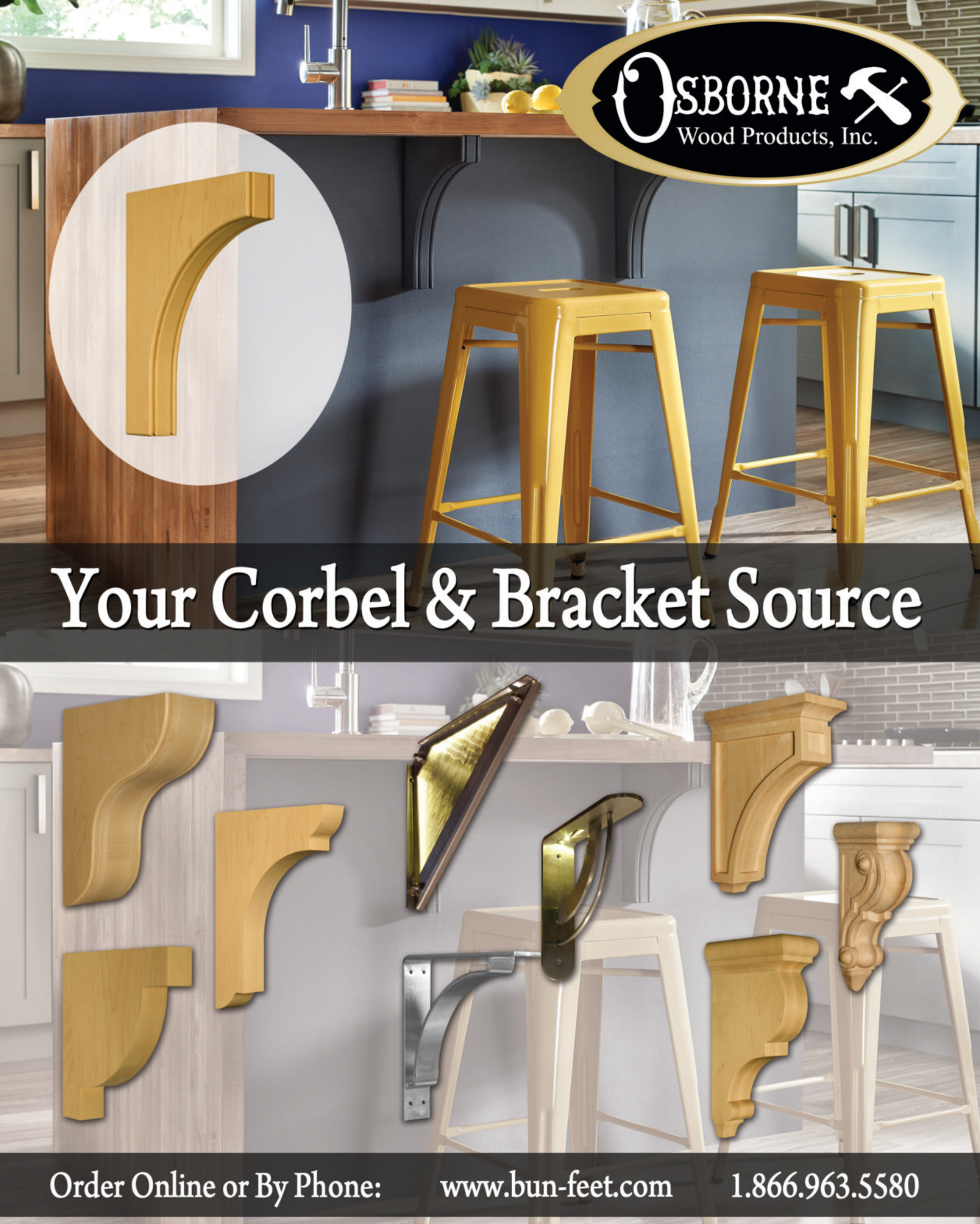
Cabinet clarifications

In **Drawing 2** of the Window Cabinet project in issue 237 (Dec/Jan 2015/2016, page 53) parts C and I should not be visible. They actually align with part B—beneath it in that view.

Also, the rear edges of the fixed shelves (F) should not be notched despite showing them that way in the **Exploded View** on page 51. (What appear to be layout lines for the notch in **Photo C** actually delineate the glue area.) In the editing process, it seems we outsmarted ourselves.

continued on page 8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Carver/painter/photographer/Renaissance man ***Barry Scharf*** *of Redmond, Wash., designed his 13"-tall Cobra Box to disguise the removable lid (*below*). A false bottom conceals the counterweight that stabilizes the leaning box.*

Jeff Shulz *of Waukesha, Wis., stretched the plans for our High-Style Hutch (issue 229, November 2014), and built it from urban-harvested walnut and maple.*

Angelo Varisco *of Coral Springs, Fla., built his Snake Leg Table from one 1½× 3½× 96" mahogany board (and a few slivers of maple veneer) for a "2×4 Challenge" within the South Florida Woodworking Guild.*

This boat bar, built by ***Al Sabrowsky****, of Eagle River, Wis., features steam-bent mahogany with black walnut accents. It was his first attempt at steam bending.*

continued on page 10

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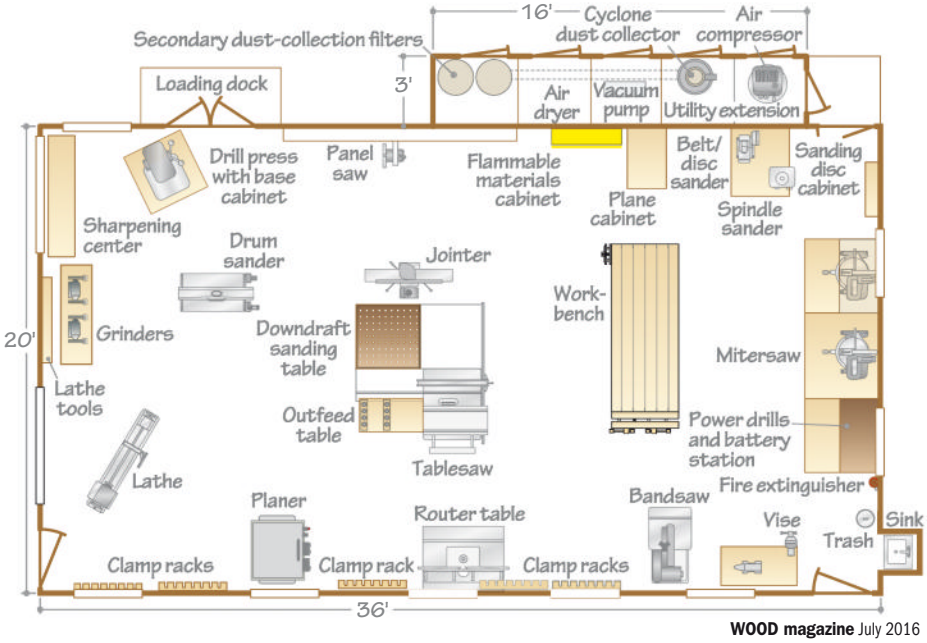
Tyme's shop is a model of cleanliness and comfort. Dust filters housed outside his shop mean almost no dust anywhere. Excellent lighting and cushioned floor mats cover all work areas. See more photos at woodmagazine.com/tymeshop.

The California shop of Tyme (he goes by the single name), adjacent to his home, used to be a bait shop. "It had the original coin boxes, everything from the old store, and was still painted government green on the inside," he recalls.

Outfitted with 2×6 walls, dual-pane windows, R-16 insulation, and redwood siding on ¾" plywood sheathing, very little noise escapes. Tyme beefed up the floor by covering the original 2×6 joists with 1×6 Douglas fir and a 1½"-thick layer of tongue-and-groove plywood topped with #3-grade oak flooring. A 3×16' shop extension divided into closets houses the noisy stuff, including his vacuum pump and air dryer.

Tyme made lever-operated retractable caster assemblies he activates by foot for



Tyme's shop has entrances near all four corners. The utility extension muffles his air compressor and dust collector. He vents the dust collector outdoors because in his mild climate, it's not removing heated or cooled air from the shop.

Aligning the mitersaw station with a door at each end allows for cutting long stock by opening one or both doors. A shroud fronted by plastic sheeting keeps sawdust contained.

Every tool in the shop has dust collection. Ducts drop to all major machines, while portable vacuums handle spot-collection tasks. Ten large windows on three sides of the shop allow in lots of natural light.

many of his tool bases and his bench. Eighteen flourescent light fixtures mounted flush in the ceiling provide plentiful light while protecting the bulbs from breakage. Many cabinets, shelves, and drawers sport prominent labels because "I'm teaching my grandkids. I want them to learn to put tools back where they should go."

Show us your shop

Send high-resolution digital photos of your shop to woodmail@woodmagazine.com *and we may showcase it in the magazine!*

Don't be confused by pneumatic couplers

I went to the store to buy fittings for my compressor and brad nailer but was confronted with a dizzying array of types. What's the difference between automotive, industrial, and universal air fittings? Which should I use?

—Glen Ramey, Yuba City, Calif.

Quick-connect air couplers look similar, but they come in at least 10 different styles that often don't play well together, Glen. Further confusing matters, some styles carry multiple names; for example, automotive, T-style, and Tru-Flate all refer to the same fitting. Fortunately, a universal coupler (the female socket) will usually accept the two most popular male fittings, industrial and automotive, commonly available in home centers and hardware stores. In the end, the choice boils down to personal preference, or even your best guess. One hint: If your workplace or the buddy you borrow tools from uses a particular style, that's as compelling a factor as any as to which you should choose. Whichever you go with, make sure you have all your tools similarly equipped.

Keep your clamps in top shape

I've seen tips for removing dried glue from my bar and pipe clamps, but is there any other regular maintenance I should be doing to them?

— Rajko Malik, Portage, Ind.

Simple preventive maintenance is all you need, Rajko. First, remove any dried glue by softening it with a hot rag or heat gun and then scraping it off. Next, use a mill file to remove any burrs on the bar or pipe. Finally, apply to the bar or pipe a light coat of wax or petroleum-free dry lubricant, such as PG2000 (which goes on wet, but penetrates and dries). This will make future glue drips easier to remove. Also, spray the lubricant onto the head-jaw screw threads and tail-jaw clutch mechanism to keep them working smoothly.

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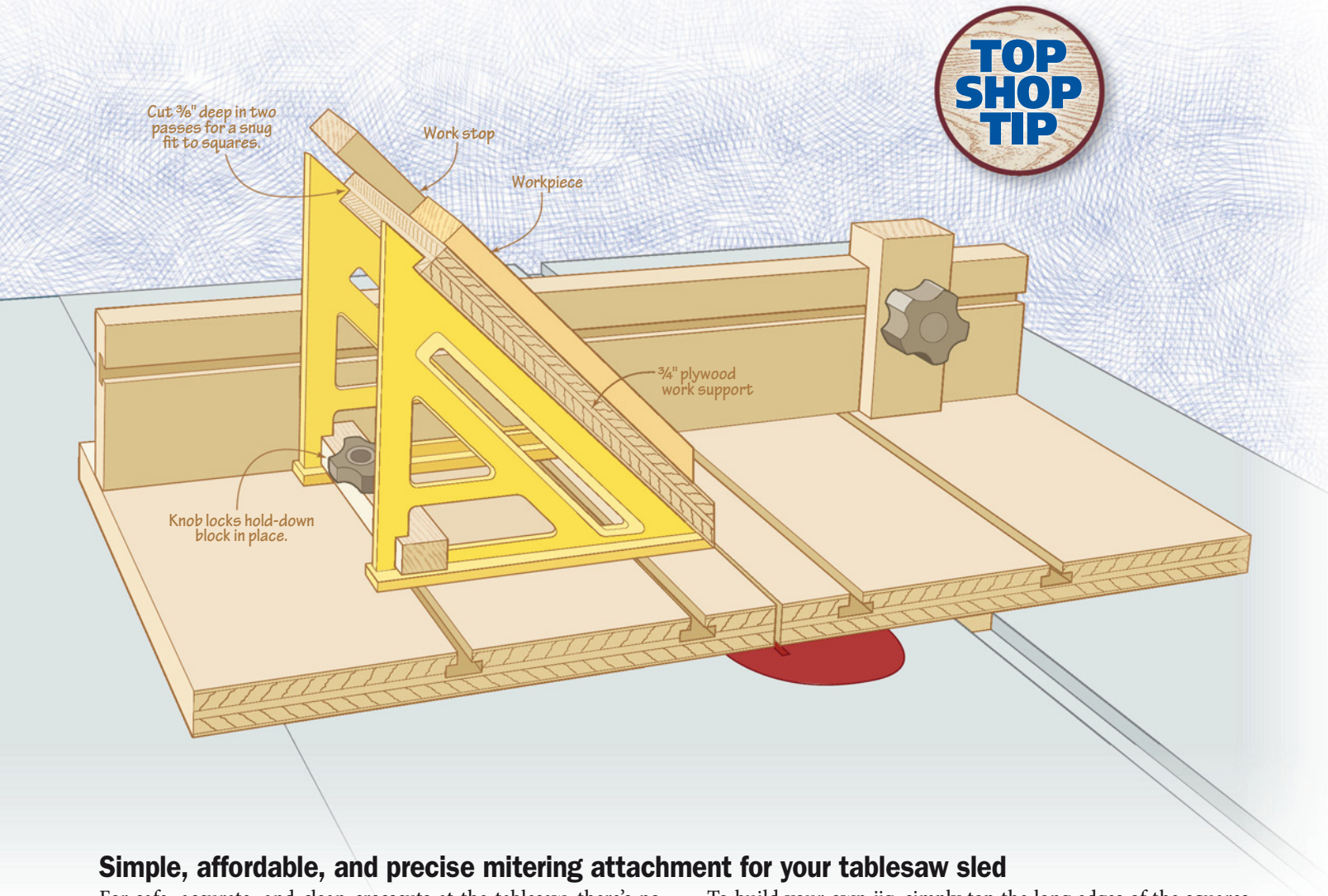

Simple, affordable, and precise mitering attachment for your tablesaw sled

For safe, accurate, and clean crosscuts at the tablesaw, there's no beating a basic shop-built sled. Because I make a lot of small boxes with mitered corners, I sought a simple but super-precise way to cut miters on such a sled. One day it occurred to me: Build a mitering attachment around a pair of plastic rafter squares (sometimes called by the brand name Speed Square). They're dead-on accurate and cost as little as $5 each for a 6" version. If you want a sled with extra capacity, 12" rafter squares can be had for $10 each.

To build your own jig, simply top the long edges of the squares with a piece of plywood cut with parallel kerfs to accept the thickness of the squares. Add a work stop mounted parallel to the front/back edges of the work support. Secure that assembly to a T-slot in the sled using a kerf-cut length of solid wood, held down with a bolt and threaded knob. Before cutting your first workpiece, run the jig through the tablesaw to cut the lower edge of the jig and its stop.

—Mike Stuart, Prineville, Ore.

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Because we try to publish original tips, please send yours only to *WOOD*® magazine.

For sending this issue's Top Shop Tip, Mike receives a Rikon 12" variable-speed midi-lathe (no. 70-220VSR) worth $650.

continued on page 16

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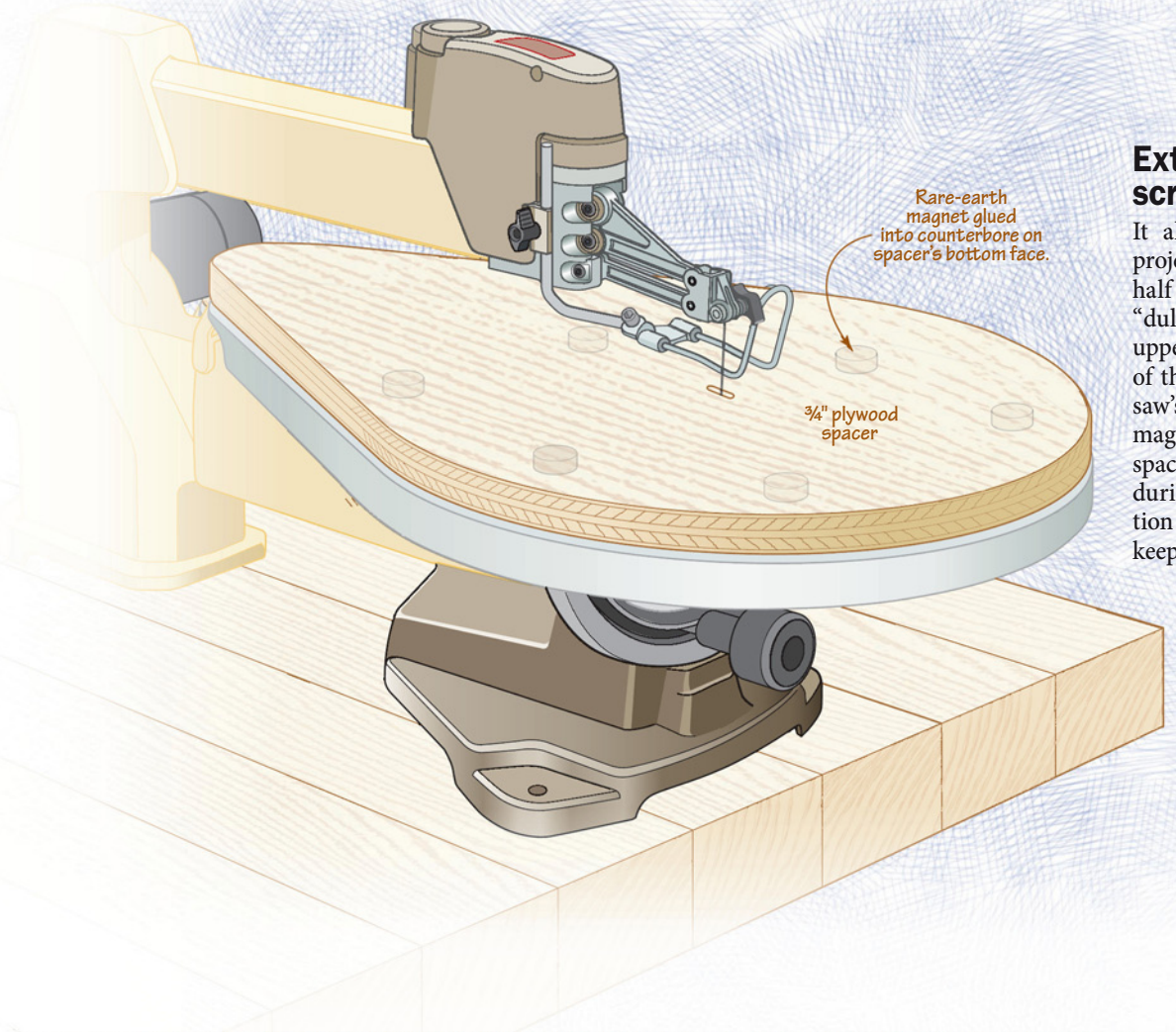
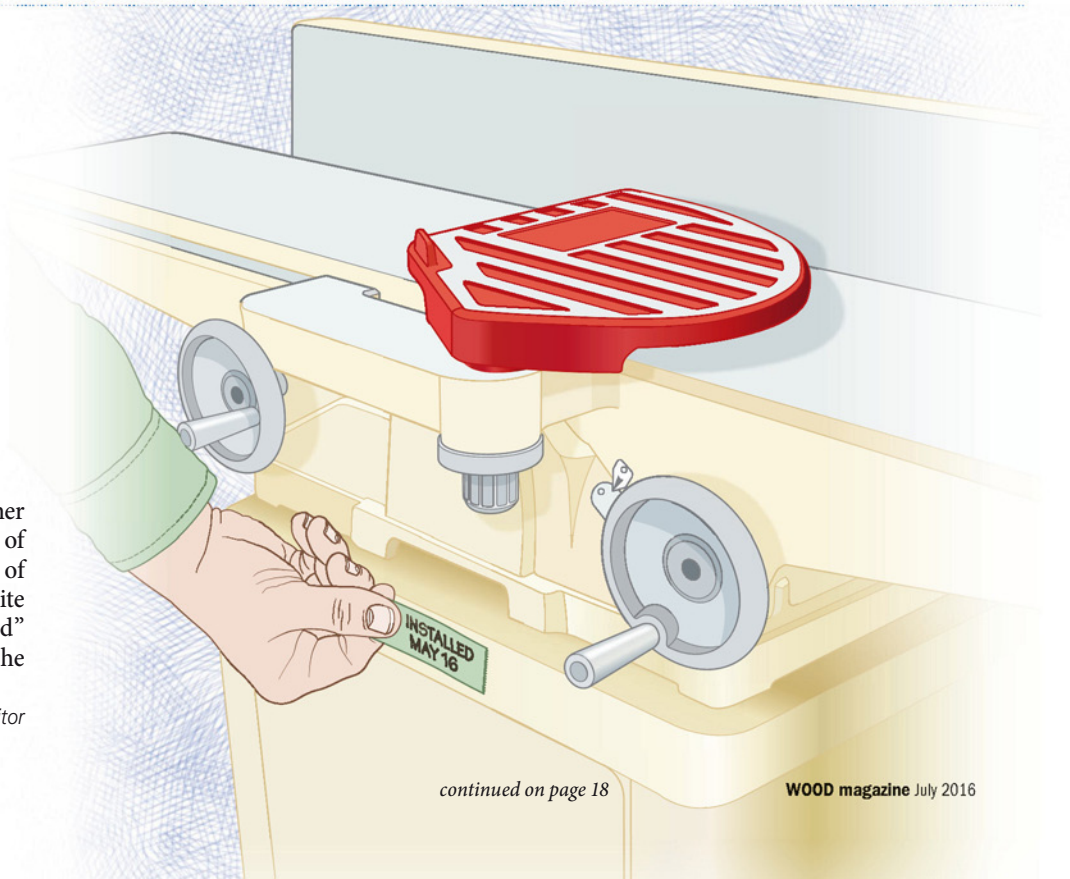


Extend the life of scrollsaw blades

It always bothered me that most projects require using only the lower half of a scrollsaw blade, meaning "dull" blades get tossed with their upper teeth still sharp. To make use of those teeth, I add a spacer to my saw's cast-iron top. Six ½" rare-earth magnets mounted flush with the spacer's bottom face hold it securely during cuts. An occasional application of wax to the top of the spacer keeps workpieces moving freely.

—Dave McGuffin, Louisville, Ky.



Know when knives were last sharpened

To remind me how long jointer or planer knives have been in use, I write the date of their last maintenance on a short length of painter's tape stuck to the machine. I write "installed" for new knives, and "rotated" after flipping double-edged knives to the second edge.

—Craig Ruegsegger, Deputy Editor

continued on page 18

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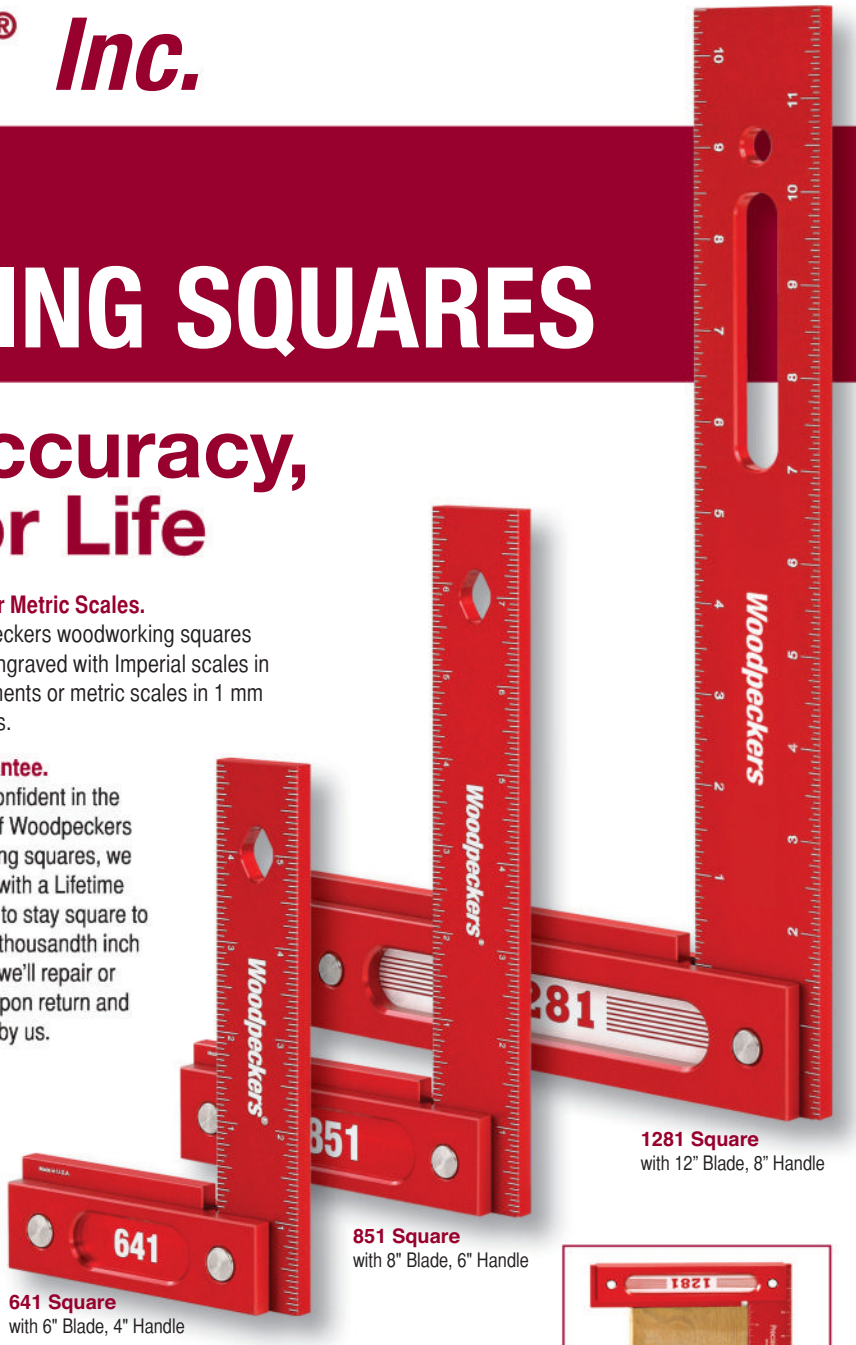
Our Guarantee. We're so confident in the accuracy of Woodpeckers woodworking squares, we offer them with a Lifetime Guarantee to stay square to within one-thousandth inch per foot or we'll repair or replace it upon return and inspection by us.



1281 Square
with 12" Blade, 8" Handle

851 Square
with 8" Blade, 6" Handle

641 Square
with 6" Blade, 4" Handle

All our woodworking squares feature a notch on the inside corner of the handle so you can mark your pencil line all the way to the edge of your stock.

The 641 Square, like its big brother 1281, also sports a 3/4" thick handle allowing it to stand on edge. You can check machine setups with both hands free to make adjustments. This handy little square is small enough to tuck into your shop apron pocket.

Our squares' handle design includes a lip so they can rest on the work unaided. The cheeks register against the stock for precisely square layout work.

The 3/4" thick handle easily stands on edge so you can check and adjust assemblies hands-free. The 1281 Square features handy finger holes for a firm grip when checking stock.

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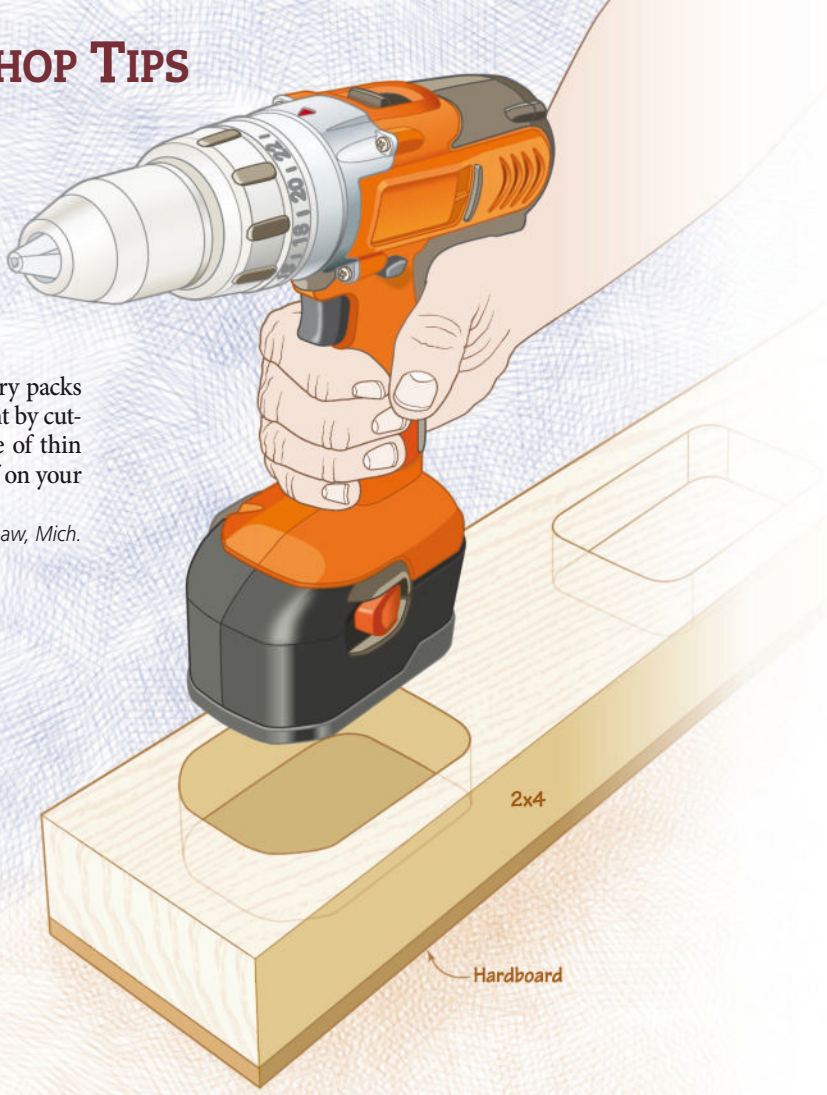
Simple solution for no-tip drill storage

Even cordless drills designed to stand upright on their battery packs will easily tip over. Make a quick shelf that holds them upright by cutting a battery-pack-shaped hole in a 2×4. Then, glue a piece of thin plywood or hardboard to the bottom of the 2×4. Set the shelf on your bench or mount it to the side of the bench or to a wall.

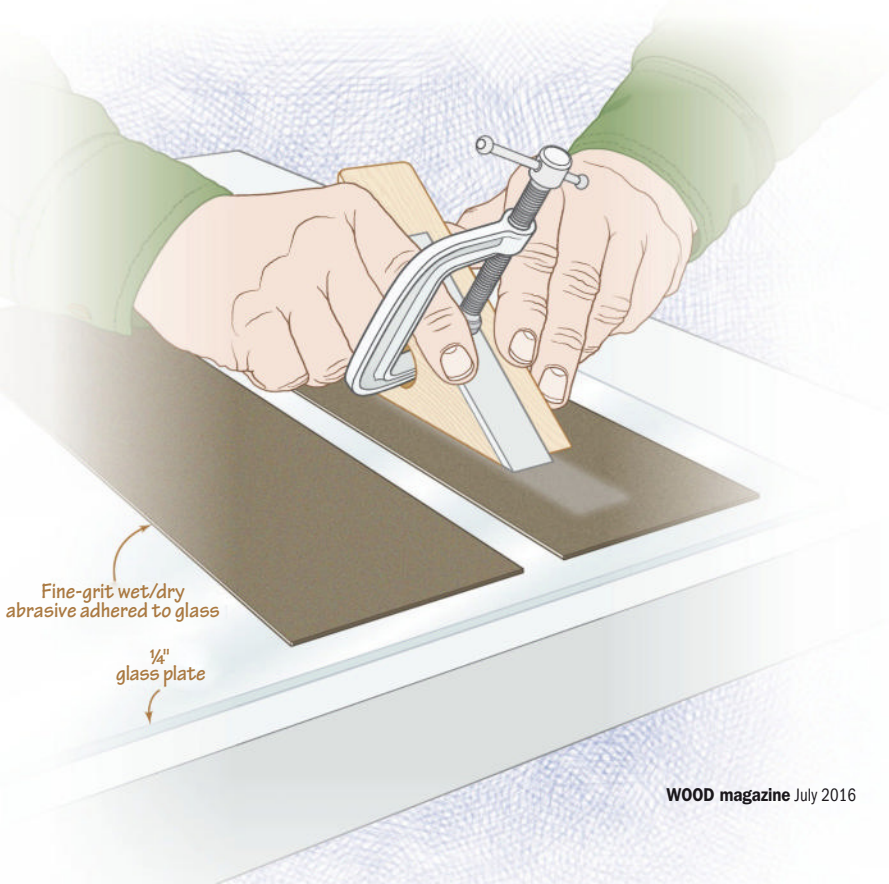
—Les Beeckman, Saginaw, Mich.



Firmly hold small plane blades when honing

Itty-bitty blades, like those on plow planes or small shoulder planes, can be hard to hold steady while sharpening. This little jig precisely secures the tiniest blade. Simply cut a triangular block of wood at an angle matching the blade's bevel. Into this piece bore a hole large enough to accommodate the jaw of a small C-clamp. Use the clamp to secure the blade as shown while stroking the blade edge on a flat abrasive surface.

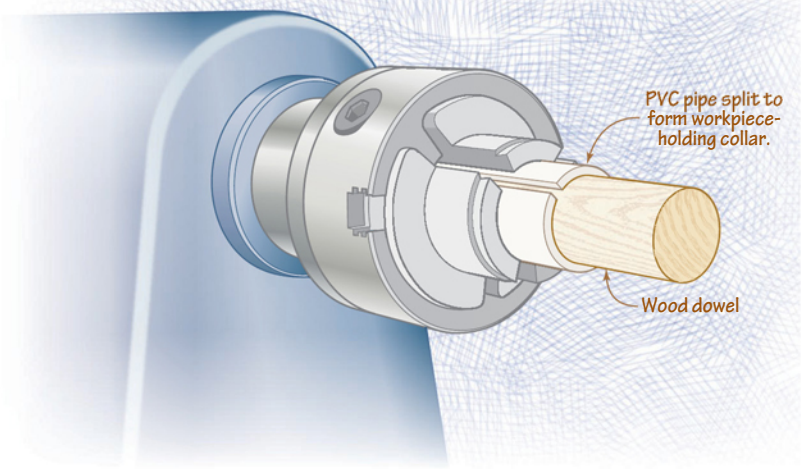
—Charles Mak, Calgary, Alta.



Protect tiny turnings with PVC

Tasked with making a quantity of small turnings from ¾" dowel, I initially considered mounting them directly in my lathe's four-jaw chuck, but realized doing that would mar the dowels. So instead, I placed them in a short length of ¾" PVC pipe. I cut a slot the length of the pipe, enabling it to compress snugly around each dowel as I tightened the chuck's jaws.

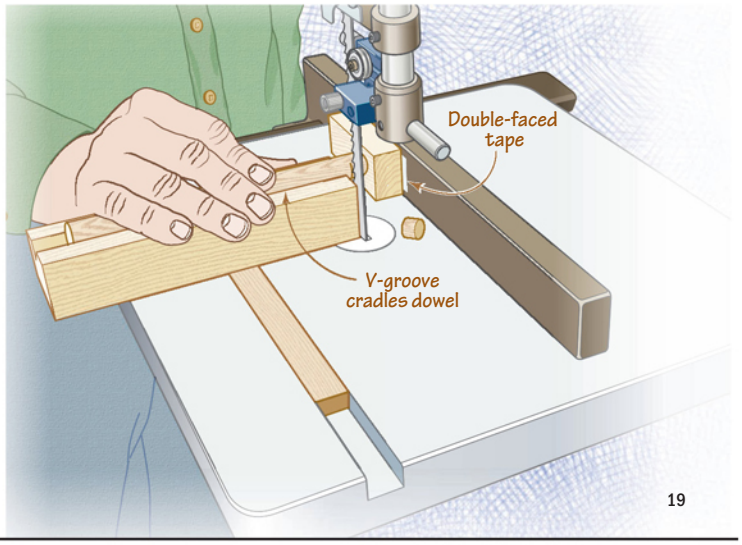
—Arthur Hoff, Lakeland, Fla.



Use this bandsaw jig to avoid small-cutoff projectiles

Crosscutting small pieces, such as buttons or plugs, on a mitersaw or tablesaw can be a dicey proposition. The cutoffs can drift into the blade and fire back at you. To keep such crosscuts safe and manageable, do the job at your bandsaw using this jig. Rest the workpiece in the V-cut edge of a length of wood screwed perpendicular to another length of wood sized to ride in the saw's miter channel. Use a block of wood secured to the saw's fence as a stop for repeatable-length cuts.

—Tony Rush, Springfield, Ore.



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Gun Metal	#PKCP8020	$12.95	$12.05	$11.15	$10.25
24kt Gold	#PKCP8000	$14.95	$13.95	$12.95	$11.95
Antique Brass	#PKCP8040	$14.95	$13.95	$12.95	$11.95

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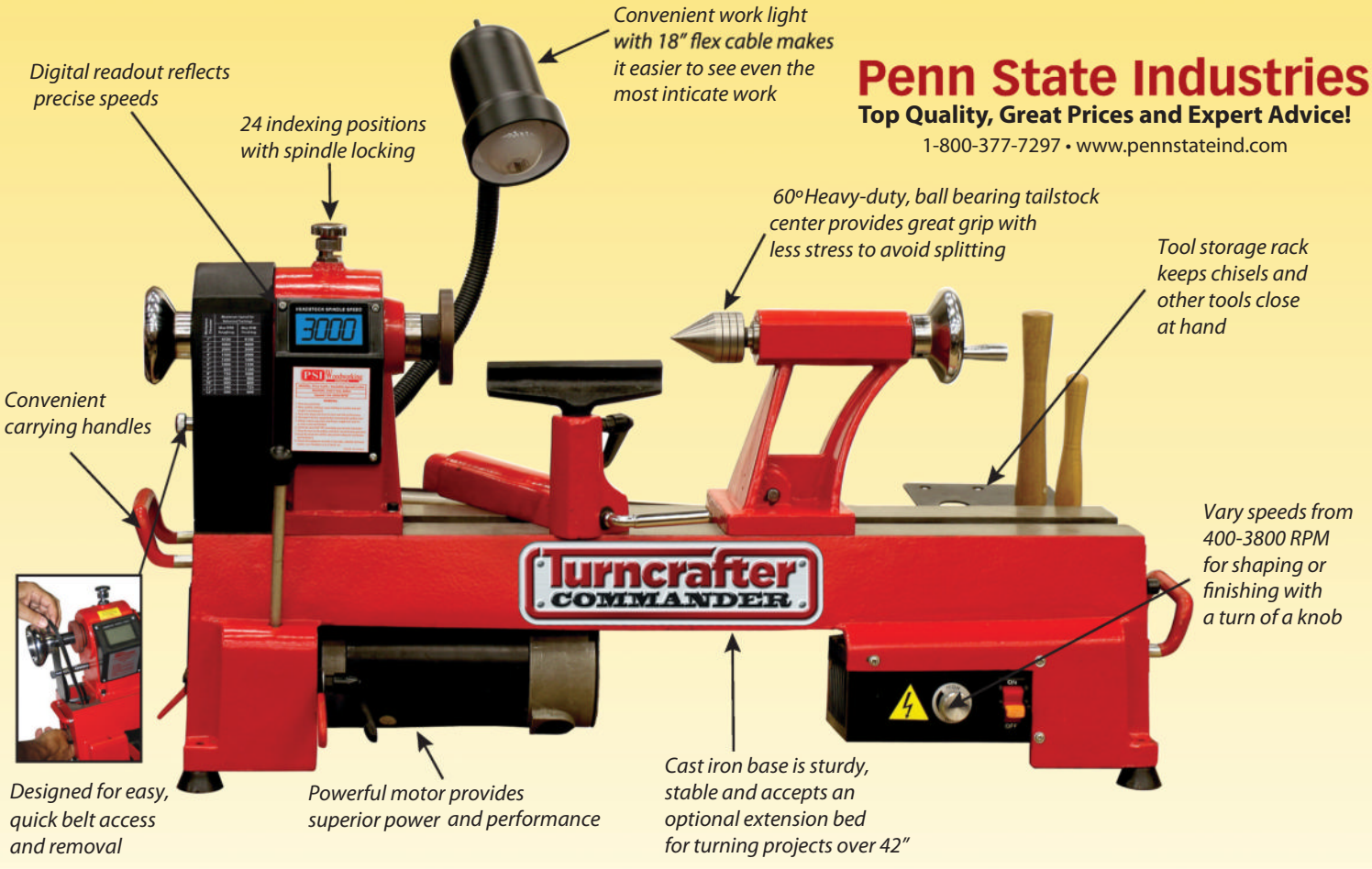
	Item #	1-4	5-24	25-49	50+
Antique Brass	#PKCP8DHAB	$16.95	$15.95	$14.95	$13.95
Antique Pewter	#PKCP8DHAP	$16.95	$15.95	$14.95	$13.95



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Our Pen Making Starter Sets make it easy to start making pens!

QUICK SPECIFICATIONS

Model	10" Swing Variable Speed	12" Swing Variable Speed
Belt Positions	2 positions	2 positions
Speeds	Variable 400-1400 1000-3800 RPM	Variable 400-1400 1000-3800 RPM
Headstock	1" x 8tpi, #2MT	1" x 8tpi, #2MT
Between Centers	18"	18"
Weight	82 lbs.	106 lbs.
Footprint	31" x 7-1/4"	31" x 9-1/2"

INCLUDED WITH LATHE PURCHASE		
Toolrest(s)	6" toolrest	6" & 12" toolrests
Faceplate	3" faceplate	3" faceplate
#2 Spur Center	included	included
Heavy-duty Tailstock Center	included	included

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	Lathe Only $349.95	Basic Starter Set $399.65	Advanced Starter Set $649.85	Lathe Only $449.95	Basic Starter Set $511.65	Advanced Starter Set $737.85
UPS Shipping Cost	$50	$58	$60	$55	$65	$65
Item #	TCLC10VS	TCLC10VS-B	TCLC10VS-A	TCLC12VS	TCLC12VS-B	TCLC12VS-A
Lathe	√	√	√	√	√	√
Slimline Pen Kits		5 (24 kt Gold)	20 (Variety)		5 (24kt Gold)	20 (variety)
Slimline Pencil Kits		5 (24 kt Gold)	20 (Variety)		5 (24kt Gold)	20 (variety)
Pen Mandrel		√	√		√	√
Mandrel Wrench			√			√
3pc Carbon Steel Chisels		√			√	
Mini Pen Blank Mix		√ (Makes 10 kits)	√ (Makes 40 kits)		√ (Makes 10 kits)	√ (Makes 40 kits)
Mid Cure Epoxy Glue		√	√		√	√
7mm Barrel Trimmer		√	√		√	√
Tube Insertion Tool			√			√
Shellawax Creame		√ (30ML)	√ (250ML)		√ (30ML)	√ (250ML)
Pen Assembly Press			√			√
Pen Making DVD		√	√		√	√

Delightfully Downsized

A pared-down workshop returns the focus to the joy of woodworking.

by Anne Briggs Bohnett

At some point in his or her woodworking career, every woodworker dreams about a giant shop space, with ample lighting and fancy machinery. Our farm has a 1,000-square-foot outbuilding that I originally outfitted as my shop. However, as a hand-tool-focused woodworker, after a few projects under the leaky roof of that large space, I decided it was time to downsize instead. So I converted the 8×10' laundry room in our house into my new shop.

I love my new postage-stamp-size space. It is heated, which, during the winter months in Seattle, is a huge plus. The sink makes sharpening with waterstones a lot less messy. And a large window right over the bench lets in lots of natural light while giving me a great view of my chickens, goats, and alpacas playing in the field outside. If I end up building bigger-than-my-normal projects, I will probably annex the porch.

Designing a small workshop took a lot of careful thought to make it work right. I wanted to maximize the natural light from the window. But I still needed walking room between the bench and the window (I am 5'4" and have a fairly short wingspan), so I could work from both sides of the bench. Also, I left just enough space between the bench and the wall for me to rip long stock on my stacking saw benches.

Designing a small workshop took a lot of careful thought to make it work right.

A hanging tool chest, *above*, keeps my most-used tools within easy reach of the main bench. I put my assembly bench against the wall at 90° to the bench. A shelf beneath it holds all of my bench hooks,

Even with space at a premium, a dedicated sharpening station has proven to be worth its square footage. With the hassle taken out of sharpening, I more readily maintain my tools.

shooting boards, battens, holdfasts, and benchdogs within easy reach of both benches.

Everything in the shop is never more than a few steps away, so not only am I walking less in the middle of a project, I also spend a heck of a lot less time wandering around looking for the tool I set down three projects ago. I've trained myself to put tools away as soon as I'm finished using them, and there simply isn't space to allow the mess of multiple projects to build up. Everything in the shop has "its place," and that makes it easy to put tools away and to find them again when needed.

The efficiencies of being in a small space abound. For one, it forces me to think through every stage of a project before I begin. This lets me execute quicker and with more confidence.

The efficiencies of being in a small space abound. For one, it forces me to think through every stage of the project before I begin.

Moving into a smaller shop space had another advantage I hadn't predicted—space became so precious that it wasn't hard to part with some of the tools I'd been hanging on to for far too long. Paring down my tool collection brought in extra money to upgrade some of my vintage tools to a few modern Lie-Nielsen counterparts. I ended up having fewer tools to maintain and sharpen. I can now spend more time woodworking than fighting the constant battle between Seattle's humidity and the iron in a whole fleet of tools.

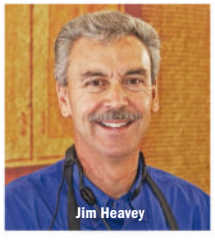
Bench-dog-mounted lighting travels to wherever it is most needed, eliminating the need for an expensive electrical overhaul in the farmhouse.

Someday, when I've got an extra $15,000 to replace the roof, insulate, plumb, and heat my 1,000-square-foot outbuilding, I may turn it back into a woodworking shop. But for now, I couldn't be happier with my little postage stamp in the laundry room.

▶Anne Briggs Bohnett manages the wood studio at Pratt Fine Arts Center, writes for *Furniture & Cabinetmaking* magazine, and manages the popular Instagram account @anneofalltrades.

6 Profiles
From One Router Bit

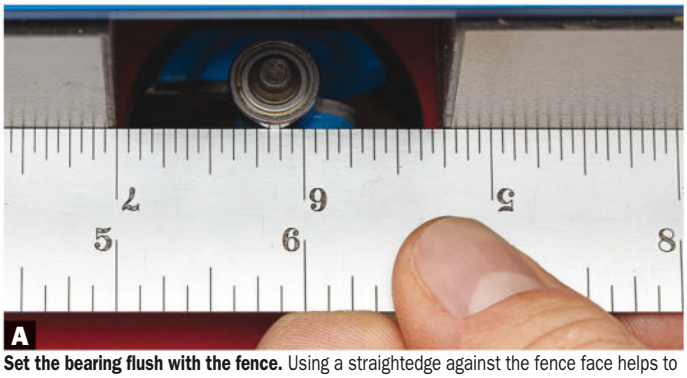
By Jim Heavey



▶ Find ogee bits in a number of different styles and sizes from Bosch, Freud, Whiteside, and others. I've found that price is generally commensurate with quality.

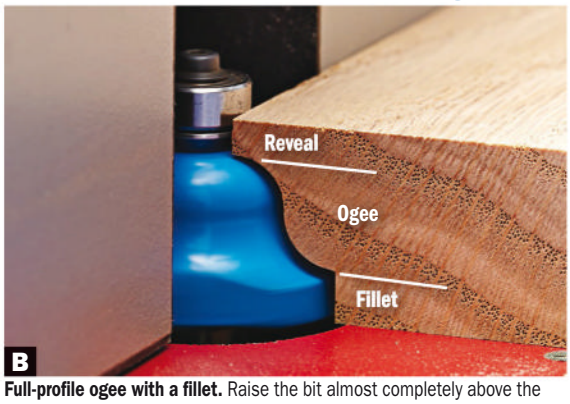
An interesting edge can be the perfect highlight on a prized project. The problem is, quality router bits can be expensive—as much as $50 apiece. Who wants to spend that much on a one-trick pony? Here's the thing: Most router bits can produce at least a couple of different profiles. In this article, I'll show you how you can use an ogee with a fillet to create six different profiles. The one I own runs about $40. Its durable and extremely sharp carbide cutting surfaces contribute to the cost of this near lifetime-lasting bit.

Start by mounting the bit in your table-mounted router, and set your router's speed according to the bit manufacturer's specifications. (I set my router to 18,000 rpm.) The first three profiles are made with the face of the bit's bearing set flush with the table fence [**Photo A**]. By adjusting the bit's depth of cut,



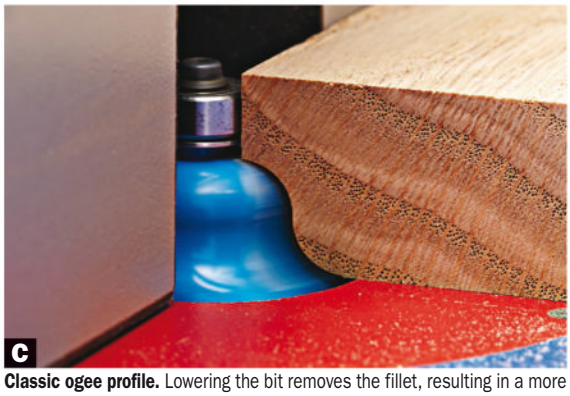
Set the bearing flush with the fence. Using a straightedge against the fence face helps to locate the bearing correctly. The bearing should just "kiss" the straightedge.

Flush the Bearing

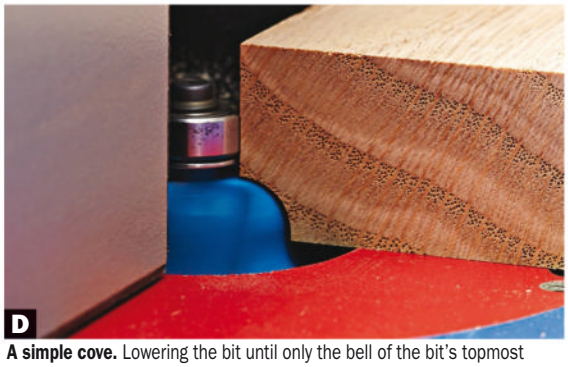


Full-profile ogee with a fillet. Raise the bit almost completely above the tabletop. This will create a fillet (step), the ogee shape, and a small bottom reveal. This produces a very ornate profile.

▶How fast should you go? Learn how to adjust router bit speeds for better cut quality. woodmagazine.com/routerbitspeed

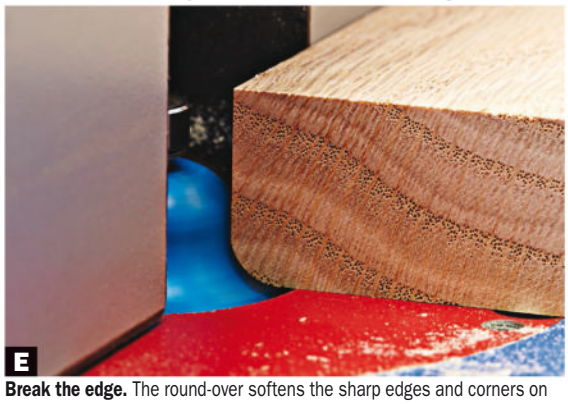


Classic ogee profile. Lowering the bit removes the fillet, resulting in a more classic-looking ogee profile. This second profile has less ornamentation than the first but provides a smooth transition from a flat surface.

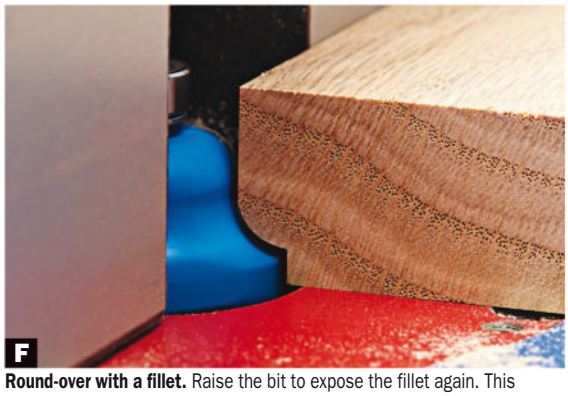


A simple cove. Lowering the bit until only the bell of the bit's topmost cutters is exposed produces a subtle decorative cut. The radius of this cove is ¼".

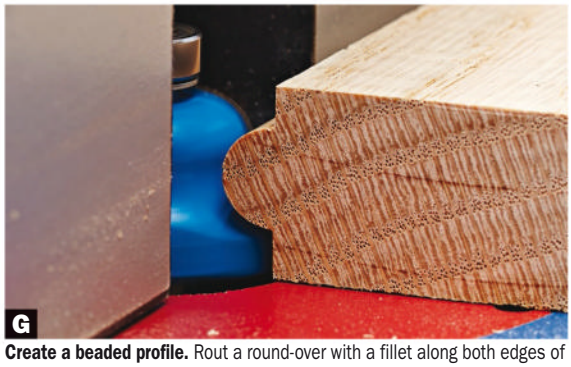
Bury the Bearing



Break the edge. The round-over softens the sharp edges and corners on projects made with splinter-prone woods such as oak or cedar. The radius of this round-over is ¼".



Round-over with a fillet. Raise the bit to expose the fillet again. This round-over with a fillet provides a decorative "shadow line" that nicely sets off the top edge of a project from its side.



Create a beaded profile. Rout a round-over with a fillet along both edges of your board. Test-cut a piece of scrap, adjusting the bit height until the two round-overs meet at the center, forming a perfectly round bead.

▶For additional profiles, try the same bit setups with the *face* of the board against the fence. If variety is the spice of life, this is the entire spice cabinet.

you can isolate sections of the bit's profile [**Photos B, C,** and **D**].

To make the next three profiles, you'll need to slide the router fence forward [**Photos E, F,** and **G**].

Because my memory occasionally lasts only as long as the exercise, I created a storyboard with each of the profiles on the edge [**Photo H**]. Of course, if your shop is anything like mine, finding that storyboard when it's needed may be another story.

To instantly recall how you made a profile, keep a storyboard like this one. Mark the bit type and any pertinent details (cutting depth, bit height, etc.) beside each profile.

Body Mechanics
Proper Plane Form

▶These instructions show a right-handed woodworker. Lefties, just reverse right and left and work in the opposite direction.

With a sharp blade and by moving your arms and legs in unison, shavings will flow from your hand plane with minimal effort. Follow these simple steps to improve your results.

Start with the grip

Wrap three fingers of your dominant hand around the back handle (called the *tote*) and rest your extended index finger behind or against the edge of the blade, *right*. Wrap your other hand around the front knob.

continued on page 29

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Set your body

Stand to the rear of the workpiece, feet set shoulder-width apart, left foot in front, and most of your weight on the right foot. Bend your elbows slightly. Plant the nose of the plane on the workpiece with the blade off the end. Place primary pressure down and forward on the knob and moderate forward pressure on the tote.

▶Record yourself with your phone or video camera and analyze your form. Compare it to our slow-motion examples. woodmagazine.com/planeform

Put the plane in motion

Most of the power comes from your legs, so begin by lifting your front foot slightly and driving off your rear foot. (Sort of like a baseball pitcher.) Rock forward, let your elbows bend until your upper arms contact your body and, as the plane moves, begin transferring weight to your front foot, as shown in the photo on *page 26*. Continue driving forward with your rear leg. Extend your arms to increase the length of the stroke.

For long boards, increase your range by stepping forward, *above*. As the nose of the plane reaches the end of the board, reduce downward pressure on the knob. (Release it, if you like.) Keep pushing on the tote until the blade clears the end of the board. Remove shavings from the plane with your free hand, then conserve effort by dragging the plane along the board back to the starting position for the next stroke.

▶Watch two free videos on sharpening. woodmagazine.com/sharpenvid woodmagazine.com/sharpenvid2

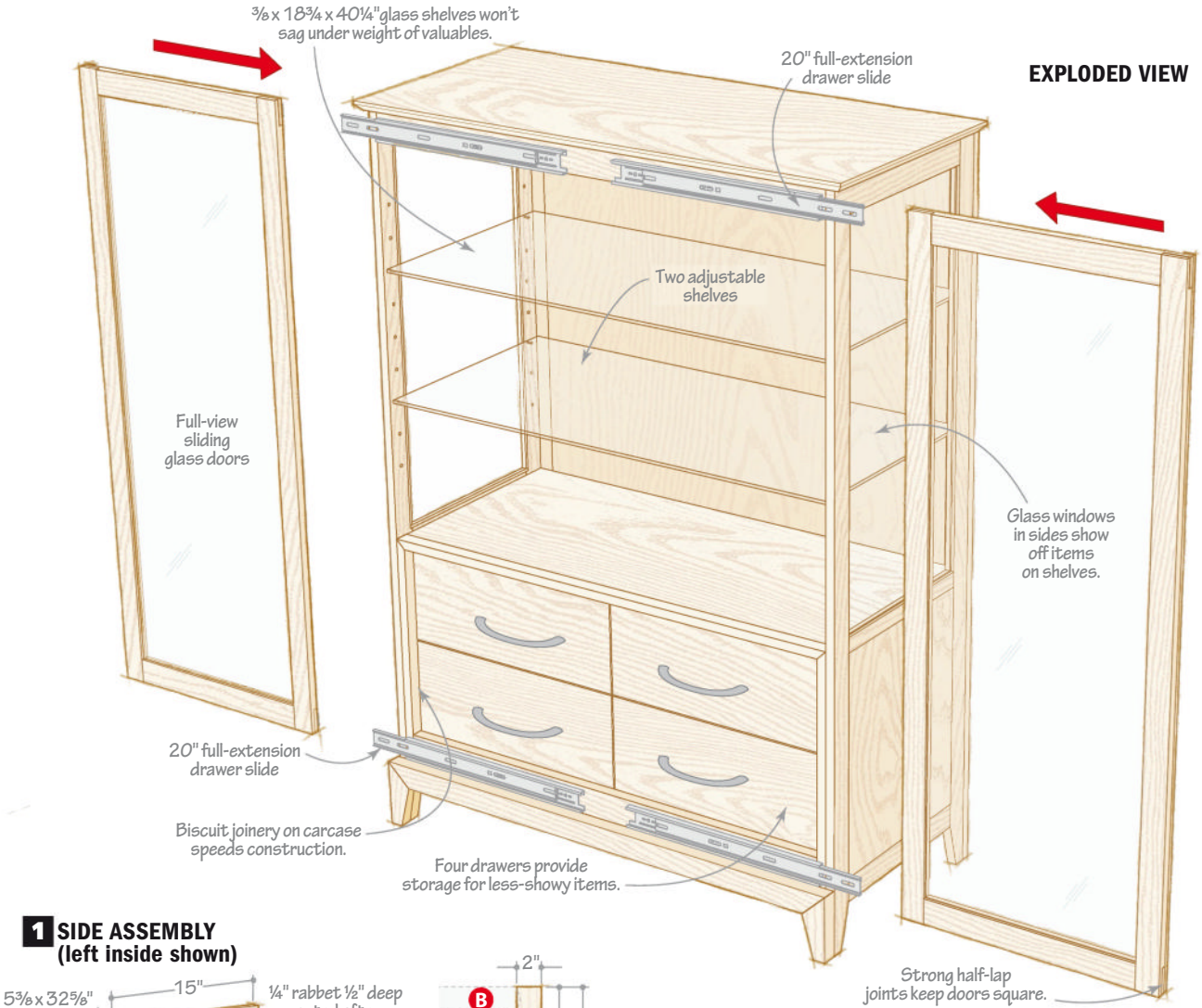
Sliding-door Curio Cabinet

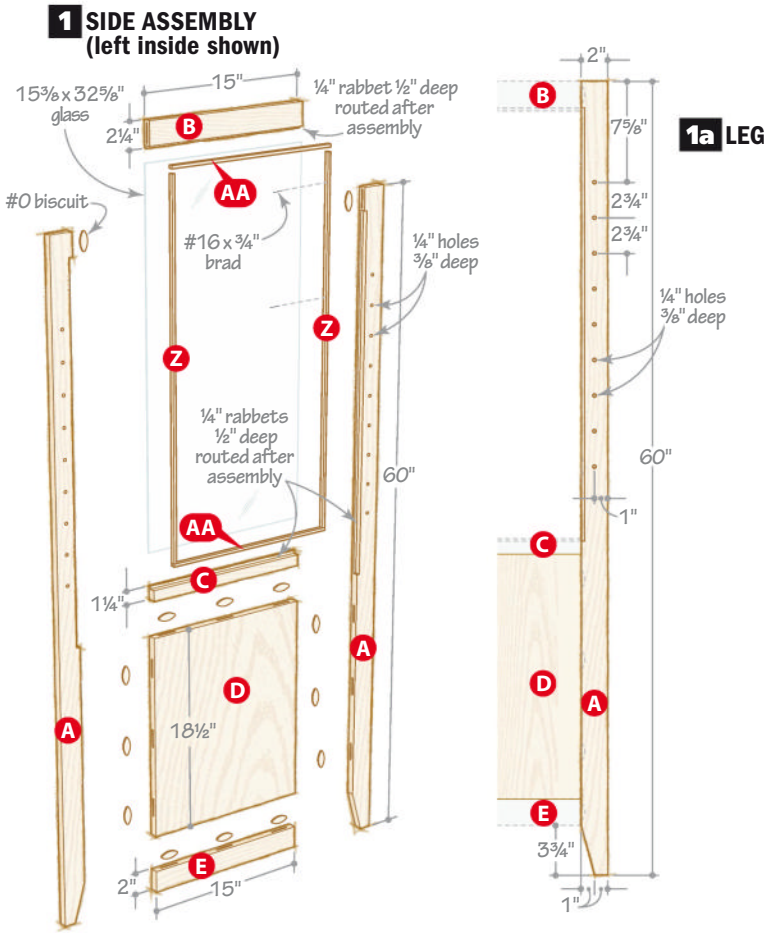
Show off your woodworking skills with this stylish showcase for china, glassware, or collectibles.

DIMENSIONS
60¾"H × 22½"D × 44"L

Approximate materials cost:
$675

4.8 cu. ft. of storage in **4** drawers





Biscuit joinery for the carcase and simple, tablesaw-cut joints for the doors and drawers make this impressive cabinet much easier to build than it first appears. The doors glide open and closed on standard drawer slides, combining smooth action with ease of installation.

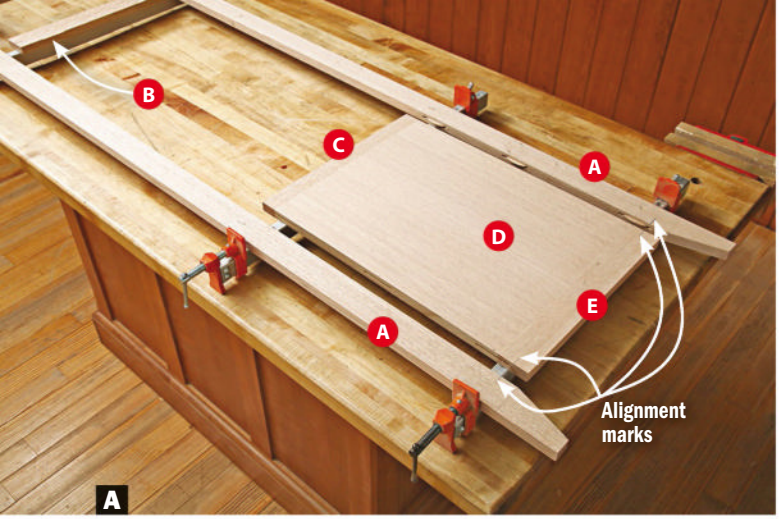
▶Brush up on biscuit joinery. woodmagazine.com/biscuitbasics

Start at the sides

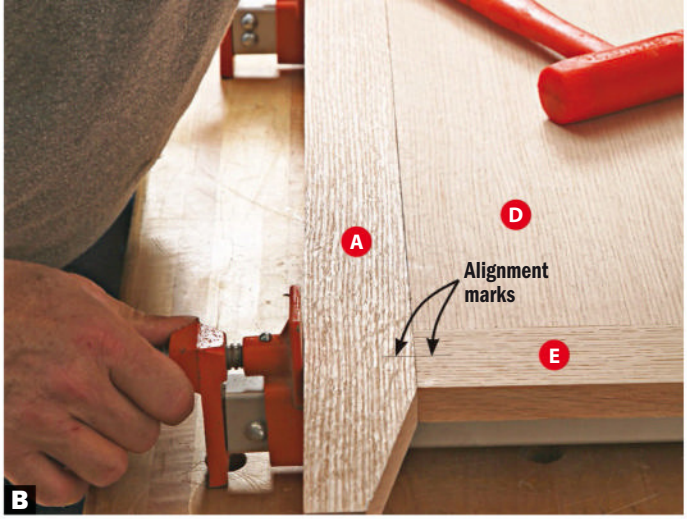
1 Cut parts A–E to size [**Materials List**, *page 37*, **Drawing 1**]. Taper the leg (A) feet [**Drawing 1a**]. Set two legs aside for the back assembly.

2 Biscuit and glue a center rail (C) and bottom rail (E) to each panel (D), keeping the outside faces flush [**Drawing 1**].

Note: *Several joints require #0 biscuits to prevent visible biscuit slots, so we used that size throughout.*



Dry-fit to ensure square side assemblies. Draw alignment marks on the top and bottom rails (B, E) and legs (A). Then, disassemble, apply glue, and clamp.



Align the marks as you draw the clamps tight, and keep both surfaces flush. Then, measure the diagonals to check square again.

3 Cut biscuit slots in the legs (A), top rails (B), and panel assembly (C/D/E) [**Drawing 1**]. Glue and clamp the side assemblies [**Photos A** and **B**].

4 Rabbet the inner face of each side (A–E) for glass [**Drawing 1, Photo C**]. Leave the router set up to rout the doors later.

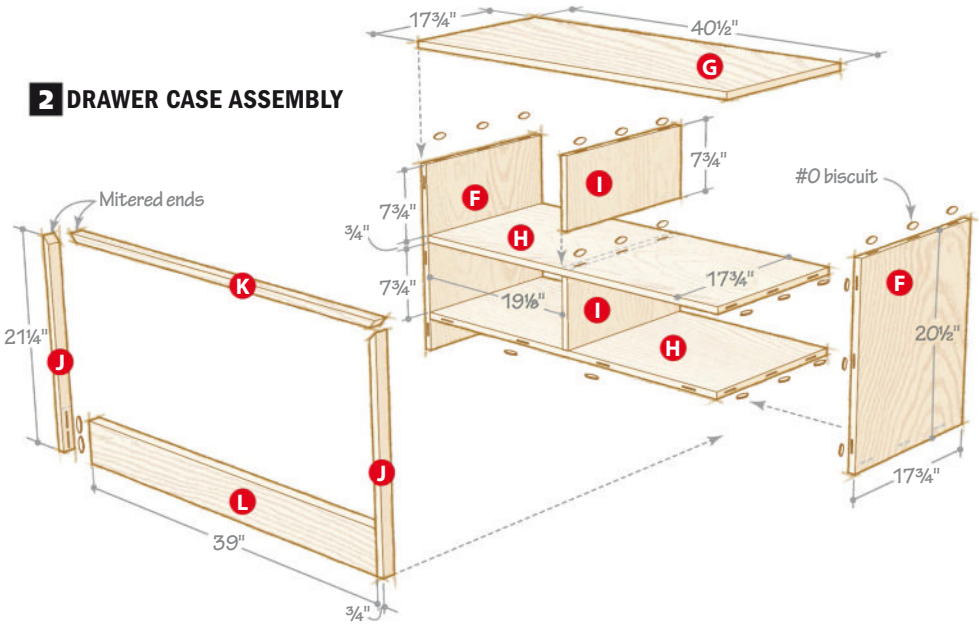
5 Drill shelf-pin holes in the legs assemblies [**Drawing 1a**].

▶Watch a free video about drilling shelf-pin holes accurately.
woodmagazine.com/shelfpin

Build the drawer case

1 Cut drawer-case parts F–I to size [**Drawing 2**]. Mark all of the biscuit locations, and identify mating edges and faces to facilitate assembly [**Photo D**].

2 DRAWER CASE ASSEMBLY



SKILL BUILDER

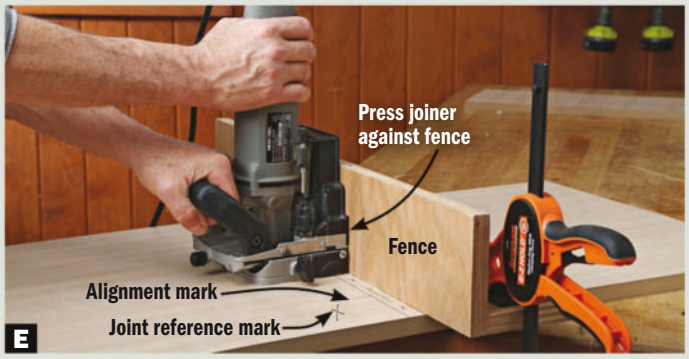
Keep faces straight for biscuiting success

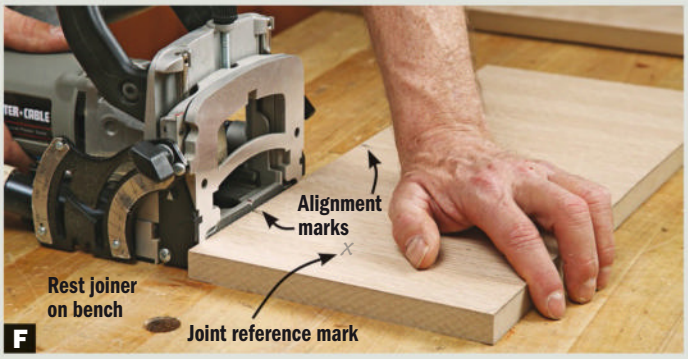
Biscuit-joining edges to faces offers a challenge: precisely centering slots on an edge and between pairs of lines drawn on the ends, top, and shelves. When you cut slots for edge-to-edge biscuiting, the biscuit joiner fence accurately positions the slot on both parts, but the fence can't help in this situation.

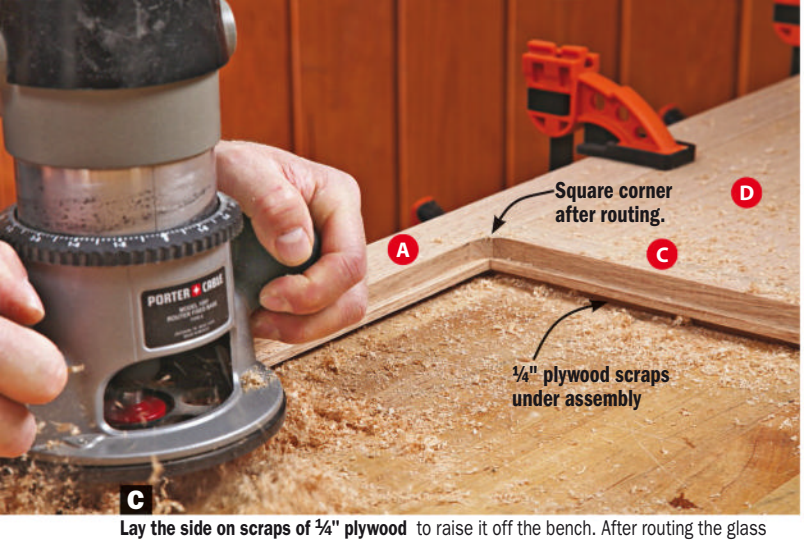
The answer is to pay careful attention to the joint alignment marks when you cut the slots.

So, remove the joiner's fence and construct a plywood or MDF fence like the one shown *below, left*.

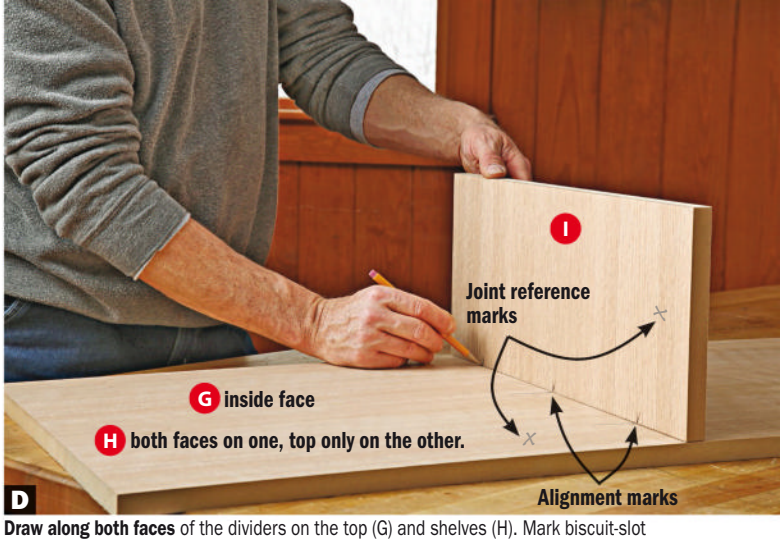
When you cut slots in the face of a part, such as a shelf (H), clamp the wooden fence along the line on the unmarked side of the joint [**Photo E**]. To edge-slot the mating part, lay it on the benchtop with the marked face up [**Photo F**]. When you join the parts, match the marks.



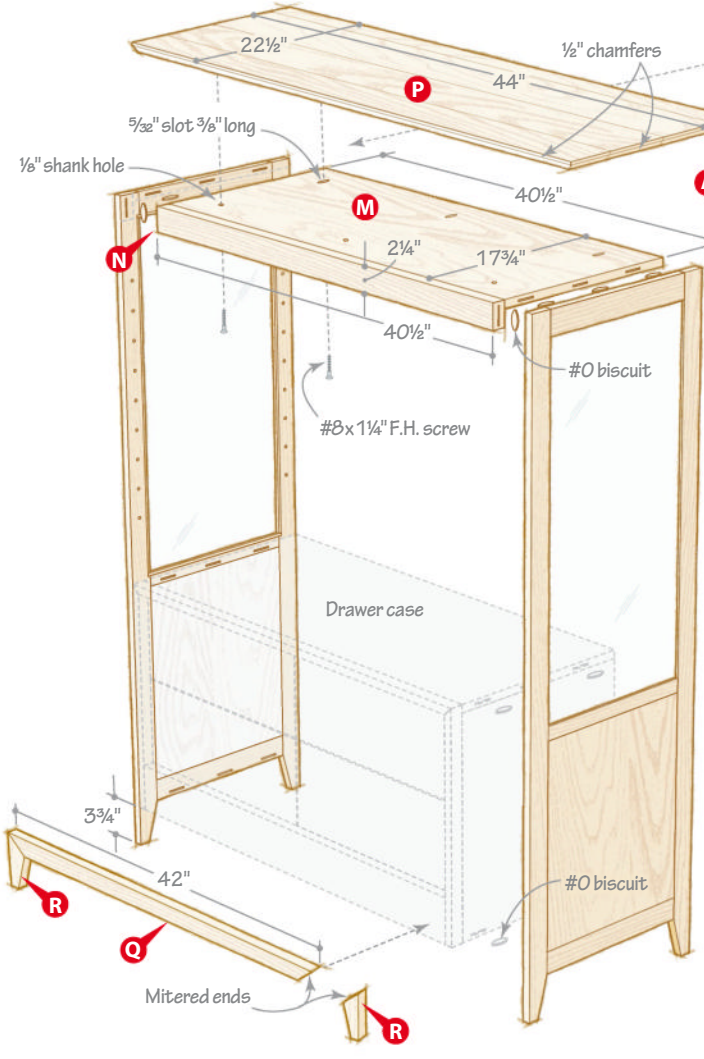


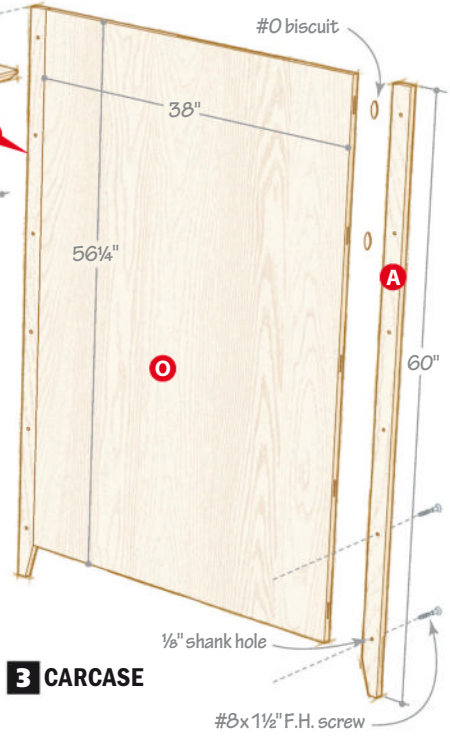


Lay the side on scraps of ¼" plywood to raise it off the bench. After routing the glass opening, square the corners with a chisel.

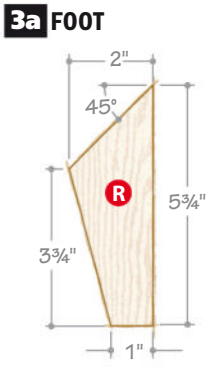


Draw along both faces of the dividers on the top (G) and shelves (H). Mark biscuit-slot centers and joint reference marks on faces of both parts.





3 CARCASE



Miter-cut the ends of parts J and K; then, assemble the frame with glue and biscuits. Biscuit and glue the frame to the case.

Construct the carcase

1 Cut parts M–O to size, and edge-glue stock for the top (P). After the glue dries, cut the top to size and chamfer the ends and edges [**Drawing 3**].

2 Drill screw holes and slots through the case top (M) [**Drawing 3**]. Attach the top rail (N) to the case top with biscuits and glue. Glue and biscuit the two legs (A) you set aside to the back (O).

3 Cut the drawer frame (J, K, and L) [**Drawing 2**] to fit the front of the drawer case.

2 Cut the biscuit slots [**Skill Builder**, *previous page*]. Insert biscuits into the slots without glue and dry-assemble the drawer case [**Drawing 2**], checking for flush edges and squareness. Glue and clamp the assembly.

▶ Glue up a top that stays flat.
woodmagazine.com/flattop

Tip! *To form the slots in the case top, drill two adjacent 5/32" holes and cut, file, or sand away the web between them. The slots allow the top to freely expand and contract with seasonal changes in humidity.*

3 Join the drawer case (F–L) and case top/rail assembly (M/N) to one side (A–E) with glue and biscuits [**Drawing 3**, **Photo G**]. Then, attach the other side assembly.

4 Position the back assembly (A/O) on the rear of the carcase and drill countersunk screw pilot holes in the back legs [**Drawing 3**]. Then, glue and screw the back to the carcase.

5 Fasten the top (P) to the case top (M) as shown in **Drawing 3**. Center the screws in the slots at the rear.

6 Cut the base rail (Q) to size, miter-cut the ends, and cut the feet (R) to shape [**Drawing 3a**]. Glue the miters together. Then, glue the base rail/feet assembly to the front of the carcase [**Drawing 3**].

7 Finish-sand the carcase assembly (A–R) with progressively finer grits through 220.

Now, you need four drawers

1 Cut drawer parts S–V to size. Set the false fronts (V) aside for now.

2 Saw or rout grooves in the drawer sides (S) and fronts/backs (T), and dadoes in the sides [**Drawing 4**]. Rabbet the fronts and backs (T).

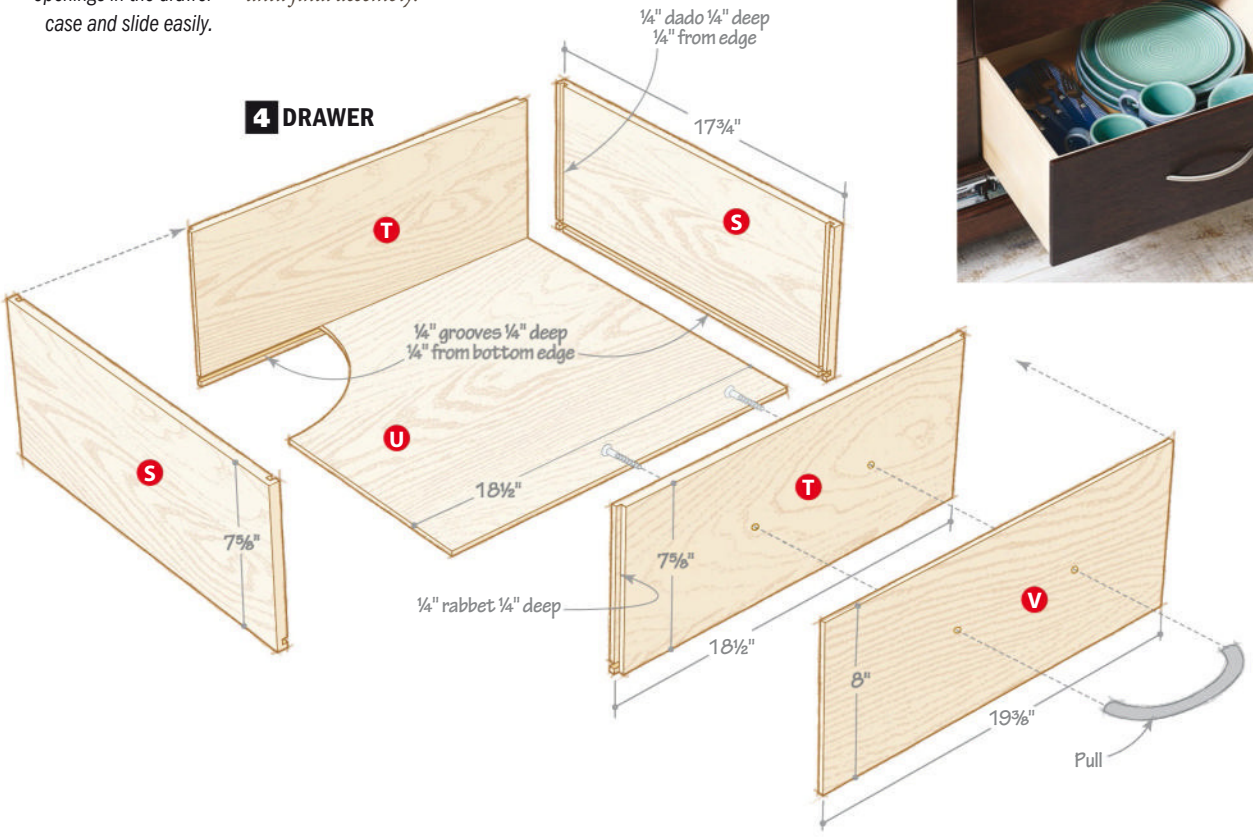
3 Finish-sand the parts, including the false fronts. Then, assemble the fronts/backs, sides, and bottoms.

▶ Watch a free video about cutting this drawer joint. woodmagazine.com/simpledrawers

Tip! *Dry-assemble the drawers before gluing to make sure they fit the openings in the drawer case and slide easily.*

Note: *The drawer boxes (S–U) will not be stained. You can clear-finish them now and set them aside until final assembly.*

Align the drawer case side (F) with the bottom edge of the side bottom rail (E). Bring the front of the case flush with the front edge of the leg (A).



The doors come next

Tip! Cut some extra pieces the width and thickness of the stiles and rails (W, X) to test your setup for cutting the half-laps.

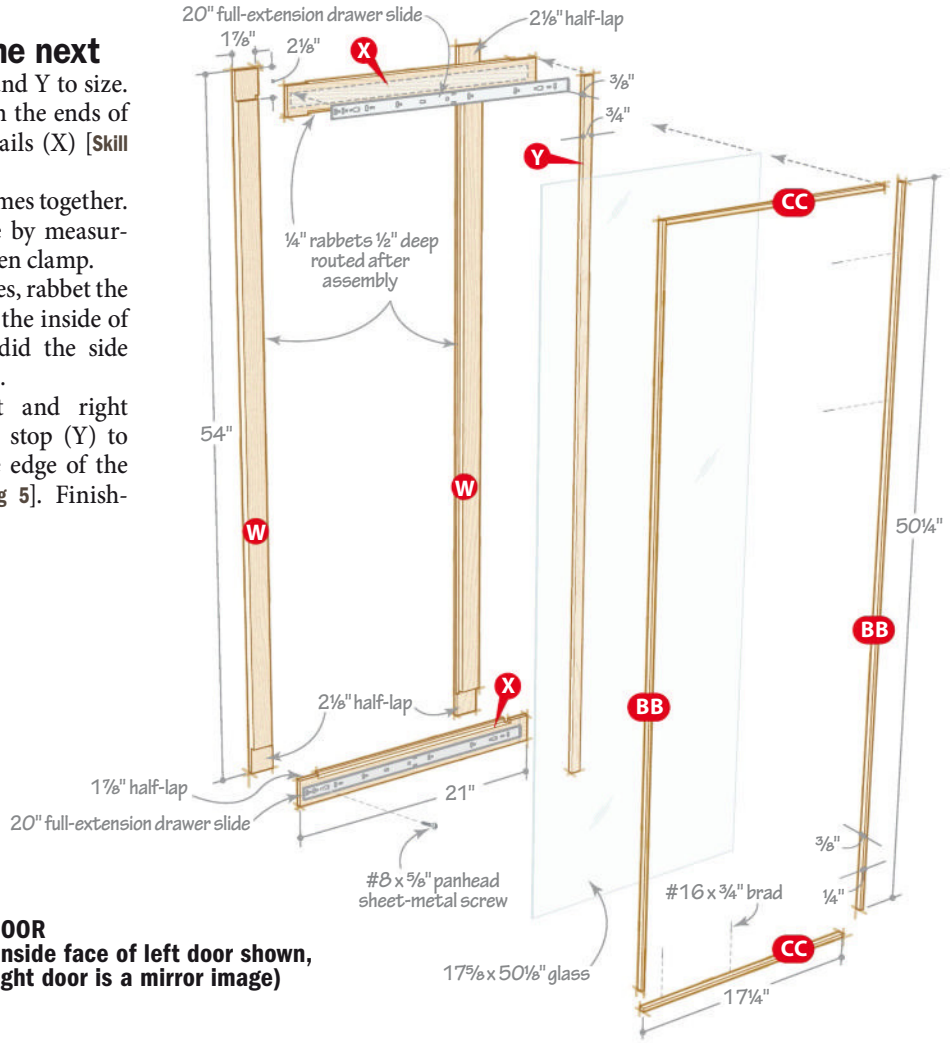
▶ Find out more about half-lap joints. woodmagazine.com/halflap

1 Cut parts W, X, and Y to size. Form half-laps on the ends of the stiles (W) and rails (X) [**Skill Builder, Drawing 5**].

2 Glue the door frames together. Check for square by measuring the diagonals, then clamp.

3 After the glue dries, rabbet the glass opening on the inside of each door, as you did the side assemblies [**Drawing 5**].

4 Designate a left and right door, and glue a stop (Y) to each, flush with the edge of the outside stile [**Drawing 5**]. Finish-sand the doors.



5 DOOR
(inside face of left door shown, right door is a mirror image)

SKILL BUILDER

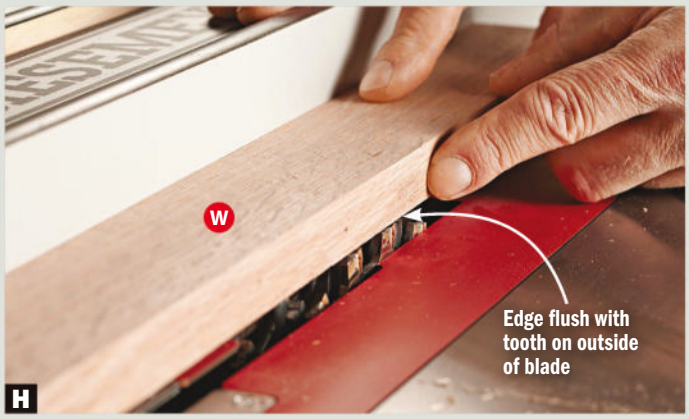
Gauge width with parts to ensure precise half-laps

Strong, attractive half-laps require careful measuring and cutting. Always cut test joints to check setups and sneak up on your final settings for success.

To cut the joints, install a ¾" stacked dado set in your tablesaw. Set the cutting depth to one-half the thickness of your stiles and rails.

Then, for the half-laps on the ends of the rails, set the distance from the outside of the dado set to the tablesaw fence at the width of a stile (W). For highest accuracy, gauge the distance with the stile itself [**Photo H**]. Make test cuts. Then, cut the half-laps on the rails (X) [**Photo I**]. Make each cut in several passes, butting the end against the saw fence for the final pass. An auxiliary miter-gauge fence prevents splintering the workpiece.

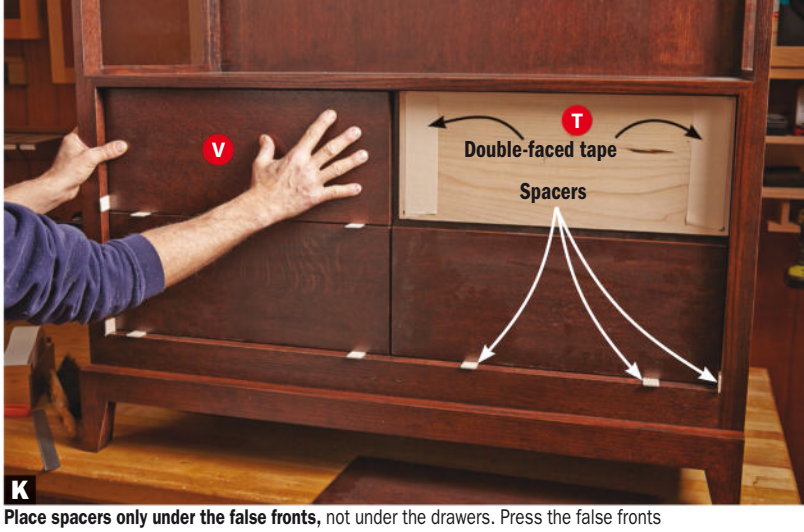
Adjust the fence to the width of a rail (X), and similarly cut the half-laps on the ends of the stiles (W).



H

I

Equalize the spaces between the drawer fronts by dividing the total gap by three. Cut eight spacers to that thickness. Similarly, measure the side-to-side gap, divide that by three, and cut four spacers to that thickness.



Place spacers only under the false fronts, not under the drawers. Press the false fronts firmly onto the double-faced tape.

Note: *For safety and best appearance, ask your glass dealer to grind the shelf edges. Several edge profiles usually are available.*

Tip! *As you cut and fit the stops, mark them on the back for position so you can reinstall them easily after finishing.*

Note: *Instead of glass shelves, you could make ¾" wood shelves and finish them to match the cabinet.*

Assemble the cabinet

1 Measure the side and door openings and have ⅛" glass cut to fit. Buy ⅜" glass for the two shelves at the same time. Mill stock for the glass stops (Z–CC) and cut stops to fit each opening.

2 Touch up the finish-sanding on the carcase, drawer false fronts, doors, and glass stops as necessary. Stain as desired and apply a clear finish. (We used General Finishes Java gel stain with several topcoats of lacquer sprayed on.)

3 Slide the drawers into the case and stack false fronts (V) in front of two drawers. Measure the gap between the fronts and the case top [**Photo J**].

4 Apply strips of double-faced tape to the drawer fronts (T), position spacers at the bottom and sides of the opening, and press the bottom false fronts (V) into place. Put the remaining spacers in place, and attach the other two false fronts [**Photo K**]. The tape, along with the screws for the pulls [**Step 8**] will hold the fronts permanently.

5 Install the glass in the cabinet sides and doors. Secure the stops with brads or a pneumatic pinner.

6 Attach the drawer-mounted components of 20" full-extension, side-mount drawer slides to the top and bottom door rails (X) [**Photo L**]. Orient the slides so that the end that would be at the front when installed in a cabinet faces the outside of the carcase.

7 Separate the slide parts, and attach the cabinet-mounted components to the carcase bottom rail (L) and top rail (N) ⅛" from the top and bottom [**Photo M**].

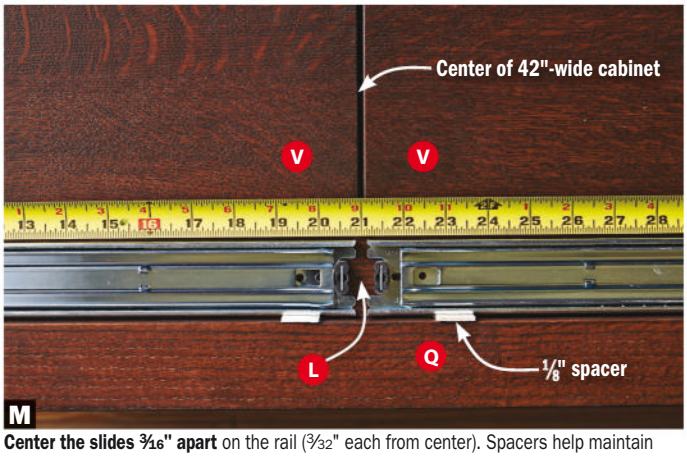
8 Remove the drawers and install pulls [**Source**], which shouldn't extend more than 1" from the drawer fronts to clear the doors. Replace the drawers.

9 Slide the doors into place. Adjust the hang and parting gap as necessary with the slide-mounting screws. Install the shelves. Then, move the cabinet into a prominent position suitable for a showpiece.

Tip! *Thick double-faced tape, such as carpet tape, works best for attaching the drawer fronts.*

Produced by **Larry Johnston** with **John Olson** and **Brian Bergstrom**
Project design: **John Olson**
Illustrations: **Lorna Johnson**

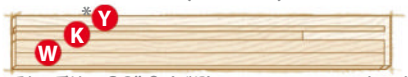
Position the fully assembled drawer slides flush at the top and bottom of the door and the inside edges. Center the screws in the slotted holes for adjustability.



Center the slides 3/16" apart on the rail (3/32" each from center). Spacers help maintain slide position while you drive the screws into the rails.

¾ x 7¼ x 96" Oak (2 needed)

¾ x 7¼ x 96" Oak (2 needed)

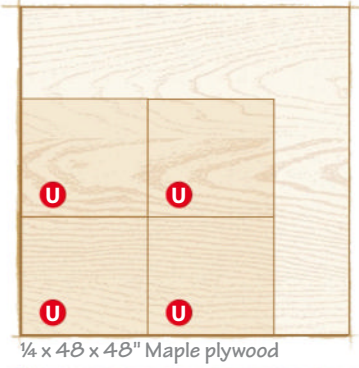


¾ x 7¼ x 60" Oak *Plane or resaw to the thicknesses listed in the Materials List.

¾ x 7¼ x 96" Oak

½ x 9¼ x 96" Oak

½ x 3½ x 96" Oak



¼ x 48 x 48" Maple plywood

1¼ x 9¼ x 48" Oak

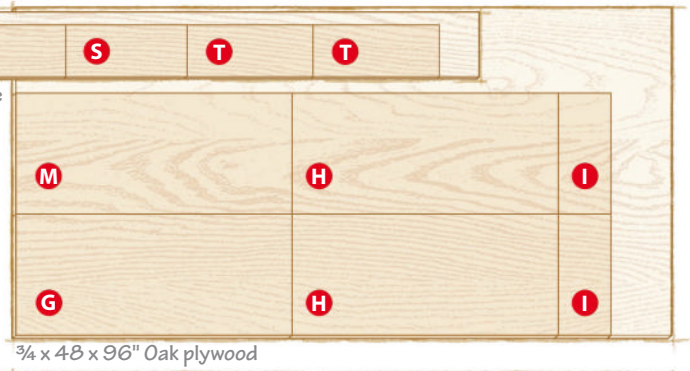
Cutting Diagram

This project requires
38 bd. ft. 4/4 red oak
5 bd. ft. 6/4 red oak
21 bd. ft. 4/4 maple
2 sheets ¾" red oak plywood
half sheet ¼" maple plywood

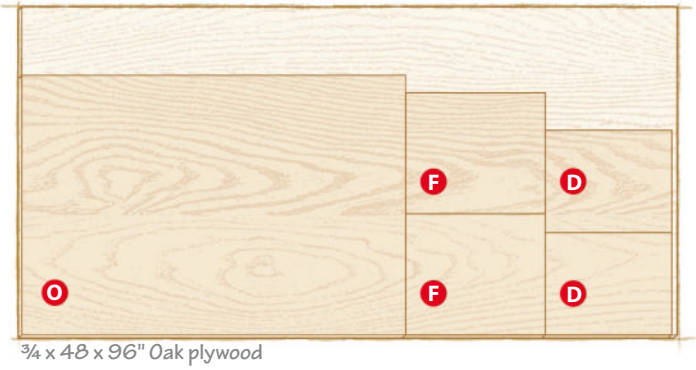
½ x 9¼ x 120" Maple

½ x 9¼ x 96" Maple

½ x 9¼ x 96" Maple



¾ x 48 x 96" Oak plywood



¾ x 48 x 96" Oak plywood

Materials List

Part		FINISHED SIZE T	W	L	Matl.	Qty.
Sides						
A	legs	¾"	2"	60"	O	6
B	top rails	¾"	2¼"	15"	O	2
C	center rails	¾"	1¼"	15"	O	2
D	panels	¾"	15"	18½"	OP	2
E	bottom rails	¾"	2"	15"	O	2
Drawer case						
F	sides	¾"	17¾"	20½"	OP	2
G	top	¾"	17¾"	40½"	OP	1
H	shelves	¾"	17¾"	39"	OP	2
I	dividers	¾"	17¾"	7¾"	OP	2
J*	frame stiles	¾"	1¼"	21¼"	O	2
K*	frame top rail	¾"	1¼"	40½"	O	1
L*	frame bottom rail	1¼"	4¼"	39"	O	1
Carcase						
M	case top	¾"	17¾"	40½"	OP	1
N	top front rail	1¼"	2¼"	40½"	O	1
O	back	¾"	38"	56¼"	OP	1
P*	top	¾"	22½"	44"	O	1
Q	base rail	1¼"	2"	42"	O	1
R*	feet	1¼"	2"	5¾"	O	2
Drawers						
S	sides	½"	7⅝"	17¾"	M	8
T	fronts/backs	½"	7⅝"	18½"	M	8
U	bottoms	¼"	17¼"	18½"	MP	4
V	false fronts	¼"	8"	19⅜"	O	4
Doors						
W	stiles	¾"	1⅞"	54"	O	4
X	rails	¾"	2⅛"	21"	O	4
Y	stops	¾"	⅜"	54"	O	2
Glass stops						
Z*	side vertical	¼"	⅜"	32¼"	O	4
AA*	side horizontal	¼"	⅜"	15½"	O	4
BB*	door vertical	¼"	⅜"	50¼"	O	4
CC*	door horizontal	¼"	⅜"	17¼"	O	4

*Parts initially cut oversize. See the instructions.

Materials key: O–red oak, OP–oak plywood, M–maple, MP–maple plywood.
Supplies: Size #0 biscuits (102); #8×1½" flathead wood screws (12); #8×1¼" flathead wood screws (6); #8×⅝" panhead sheet-metal screws (16); glass, ⅛×17⅝×50⅛" (2), ⅛×15⅜×32⅝" (2), ⅜×18¾×40¼" (2).
Blade and bits: Stack dado set, ¼" rabbet and 45° chamfer router bits.

Source

Drawer slides: Accuride series 3832, 20", no. 32508, $22.99/pair, (2 pairs), Rockler, 800-279-4441, rockler.com.
Drawer pulls: Berenson Alto pull, 7921-2BPN-P, no. 1006115, $4.39 (4), Rockler.
Shelf pins: 16-pack, no. 22773, $4.99, Rockler.

Idea Shop 6:

Step Up to the Saw

Acquire and accessorize your first stationary tool.

By now you should have several hundred dollars squirreled away. With the addition of another paycheck's budgeted amount, you'll have enough to purchase your shop's centerpiece machine. But first, add a set of clamps.

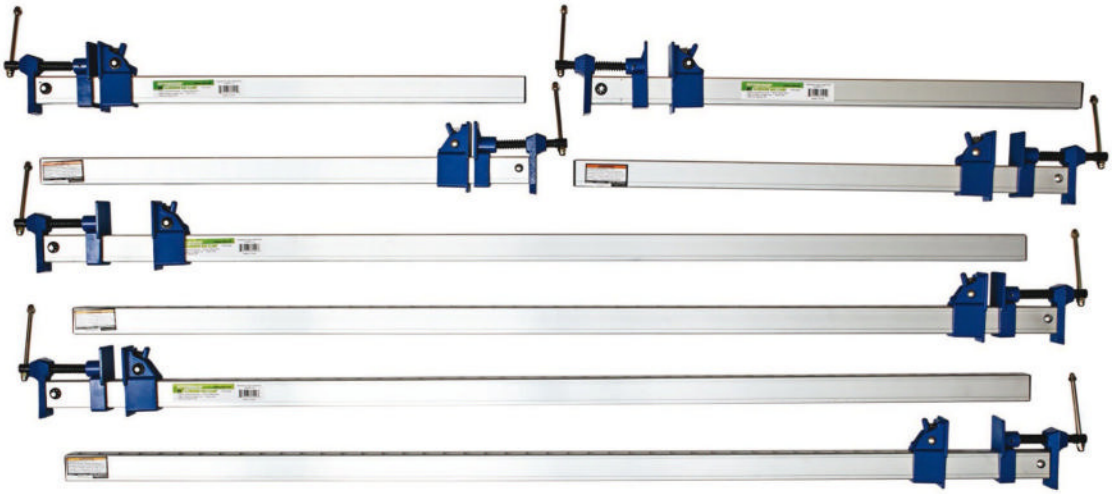
▶Watch a video of the shop growing, updated with each paycheck.
woodmagazine.com/is6progress

Learn through this series of Idea Shop 6 articles how to set up a shop by working within a budget of $150 every two weeks over 26 pay periods. Coinciding with each paycheck, we provide online a collection of related articles, plans, and videos. To get an e-mail reminder of that posting, sign up for our newsletter at woodmagazine.com/newsletter. The first article in this series ran in WOOD® 238 (March 2016). Catch up with the previous installments at woodmagazine.com/ideashop6.

Paycheck 9

Woodworkers joke that you never have too many clamps. As you build projects, you'll see what we mean. So add to your collection four each of 24" and 48" aluminum bar clamps. (We purchased ours at Harbor Freight, harborfreight.com.) Those, and materials for a wall rack to hang them, use all but about $20 of this check, so sock that away in your savings jar.

After building the clamp rack, *bottom*, begin shopping for a tablesaw to fit your budget at reviewatool.com. That purchase comes with the next check, so learn more about what to look for in the free online article at woodmagazine.com/buyatablesaw.



Buying Smart: Aluminum bar clamps work well for panel glue-ups and carcase assembly. Because of their light weight, they make it easy to move or reposition an assembly.

▶Find plans for all the jigs and fixtures shown. woodmagazine.com/ideashop6

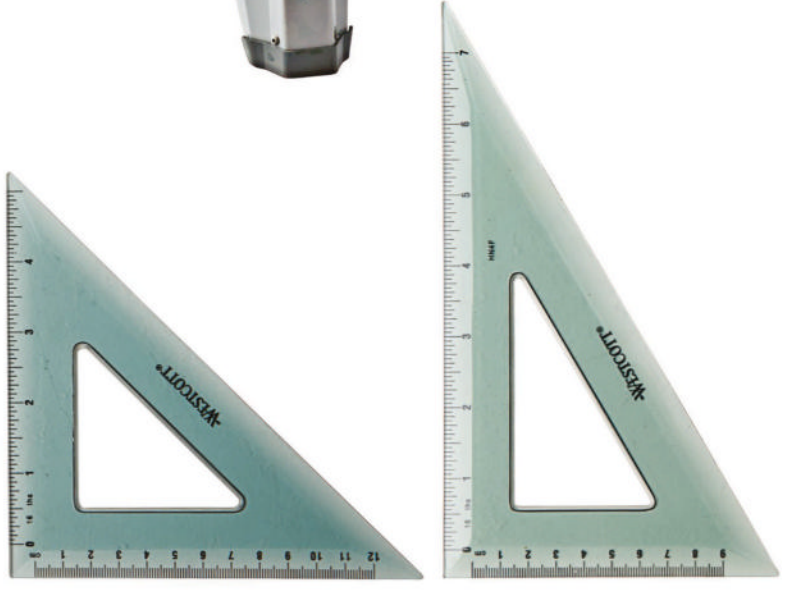
Build a versatile home for clamps. Keep bar clamps, one-handed bar clamps, spring clamps, and future clamp acquisitions organized on a wall-hung rack.

Paycheck 10

With the addition of a tablesaw, the space starts to look like a shop. We chose a Ridgid (homedepot.com) contractor's saw with a built-in mobile base. Find lots of information about setting up your new saw for accuracy and using it safely at woodmagazine.com/ideashop6. After buying the saw, pick up a pair of inexpensive drafting triangles at an office supply store. Use these to set up the tablesaw's blade-tilt and miter-gauge stops.

continued on page 42

A motor inside the tablesaw cabinet spins a 10" blade that raises above the table for cutting stock of various thicknesses, and tilts for bevel cuts. Work is guided past the blade along the rip fence for ripcuts or, for crosscuts and miters, with a miter gauge that slides in slots in the tabletop.



Whether tilting the tablesaw blade or pivoting the head of the miter gauge, set precise angles of 30°, 45°, 60°, and 90° with this pair of drafting triangles. Long edges of 6" and 8" improve precision. Dead-on accurate, and they cost only a few dollars.

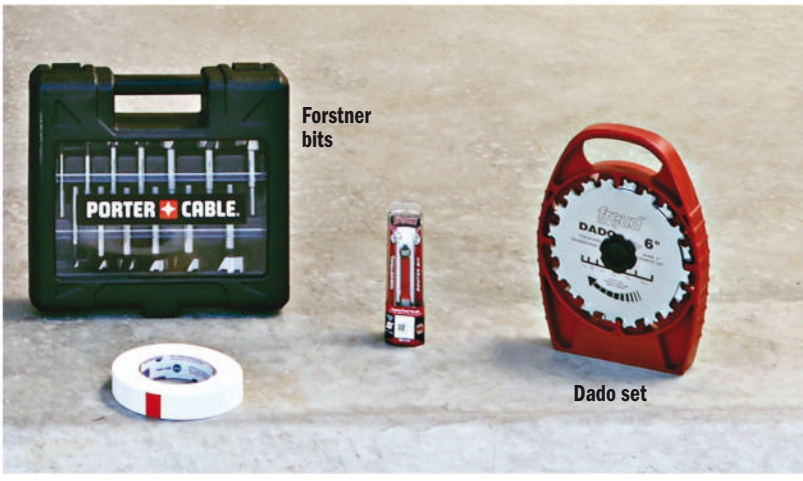
Paycheck 11

Using your jigsaw and drill-powered sanding jig, turn a plywood scrap into a handy pushstick. Use it to move material safely past the tablesaw blade, keeping your fingers out of harm's way. Because pushsticks get cut up with use, make several so you always have a fresh one on hand. Find several designs on the Idea Shop 6 website.

If your saw struggles to cut thick or dense wood, invest in a thin-kerf blade (about $30). Because the thinner blade removes less wood, it requires less power to make a cut. Bank the remaining money.

Although only 1/32" thinner than a regular blade, a thin-kerf blade removes 25 percent less wood, enabling deeper and faster cuts, and wasting less material.

Paycheck 12



All of this check, and some savings from your nest egg, go to purchase a 6" dado set, a flush-trim router bit, a Forstner drill-bit set, and a roll of double-faced tape (amazingly handy stuff to have around, as you'll discover). Use the router bit, Forstner bits, and tape to make zero-clearance inserts for the tablesaw, *below*. Make several of these blanks, as you'll need a new one for different widths of the dado blade and for each time you tilt the blade to a new angle.

More great jigs for the tablesaw in the next issue guarantee perfect crosscuts and miters, and you'll build a versatile workbench and tool rack.

▶A dado set consists of two blades (called outside cutters) that can be stacked around additional blades (chippers) to plow dadoes and grooves from ¼" to 13/16" wide.

▶Forstner bits were named for their inventor, Benjamin Forstner. They cut clean, flat-bottomed holes.

▶Get instruction on making a zero-clearance insert and watch a free video of the process.
woodmagazine.com/zeroclearance
woodmagazine.com/zcivideo

By fitting close around the blade, a zero-clearance insert prevents cutoffs from falling into the saw, and reduces chip-out on workpieces. Relief areas on the underside, cut with a Forstner drill bit, fit around flanges in the throat of the saw.

Produced by **Craig Ruegsegger** with **Lucas Peters**

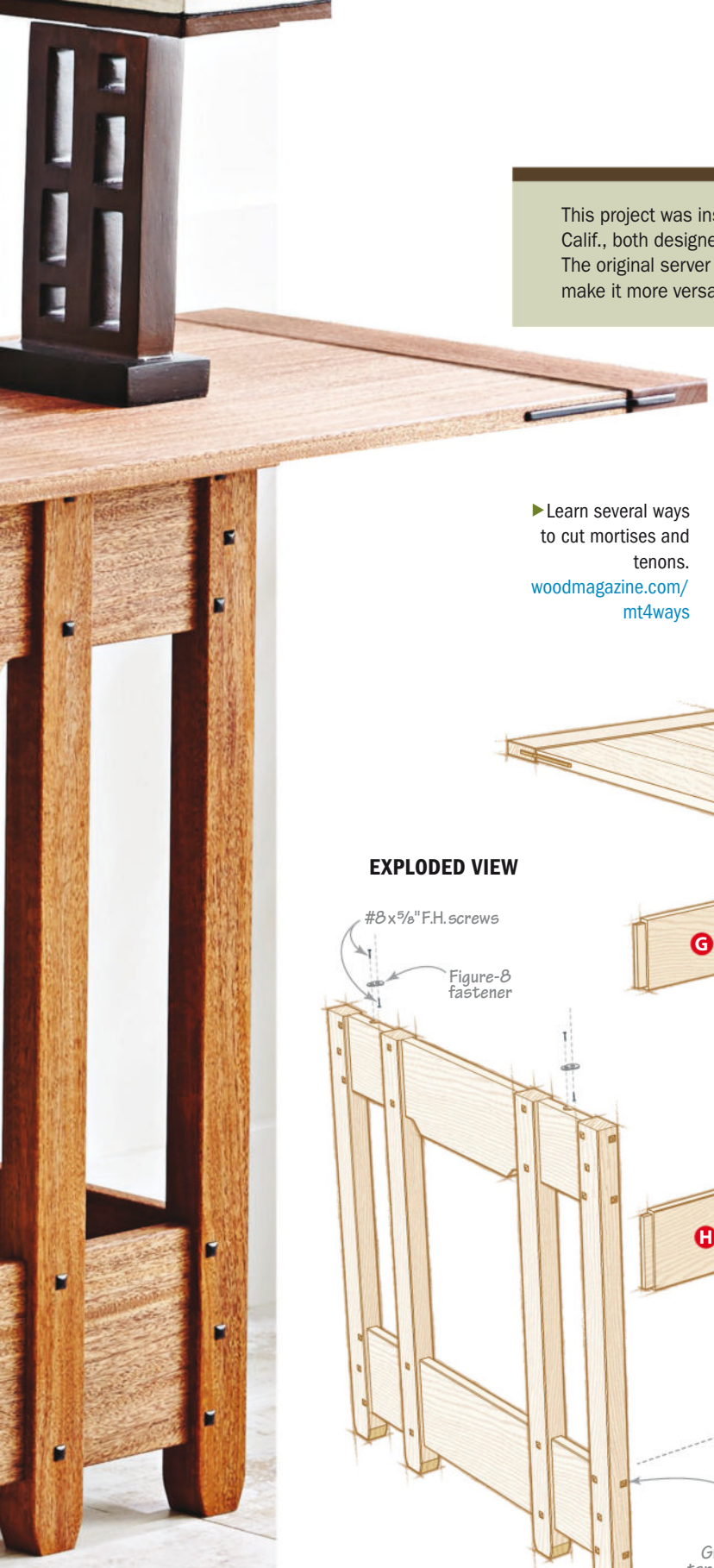
Greene & Greene Server

Whether used as a display stand or serving table, this elegant piece brings a uniquely American style to your home.

DIMENSIONS
60" W × 30" H × 18½" D

Approximate materials cost:
$200

Number of decorative plugs and splines:
48



This project was inspired by a server from the Freeman Ford house in Pasadena, Calif., both designed in the early 20th century by brothers Henry and Charles Greene. The original server measured more than 7' long; we shortened this version to 5' to make it more versatile.

Start with the base

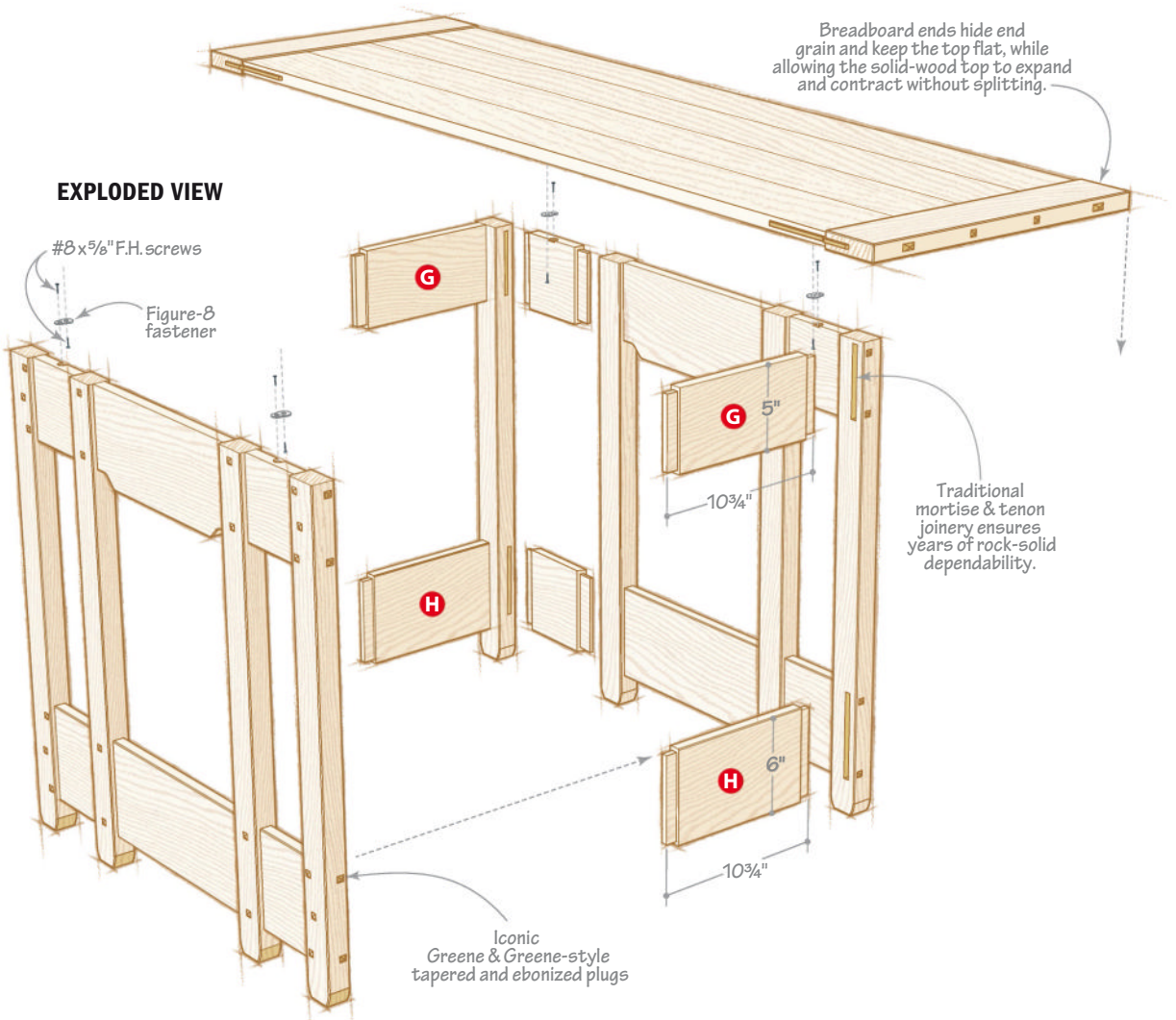
▶ Learn several ways to cut mortises and tenons. woodmagazine.com/mt4ways

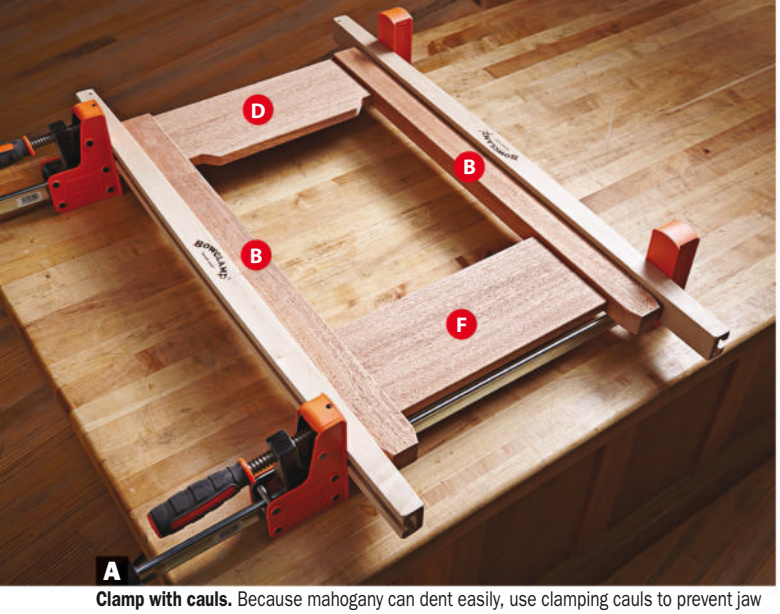
1 Cut the corner (A) and center legs (B) to size [**Materials List**, *page 50*]. Lay out and cut the mortises [**Drawings 1** and **1a**].

2 Cut and sand rounded tapers at the bottom of each leg (A, B) [**Drawing 1**]. Rout ⅛" round-overs along all edges of each leg.

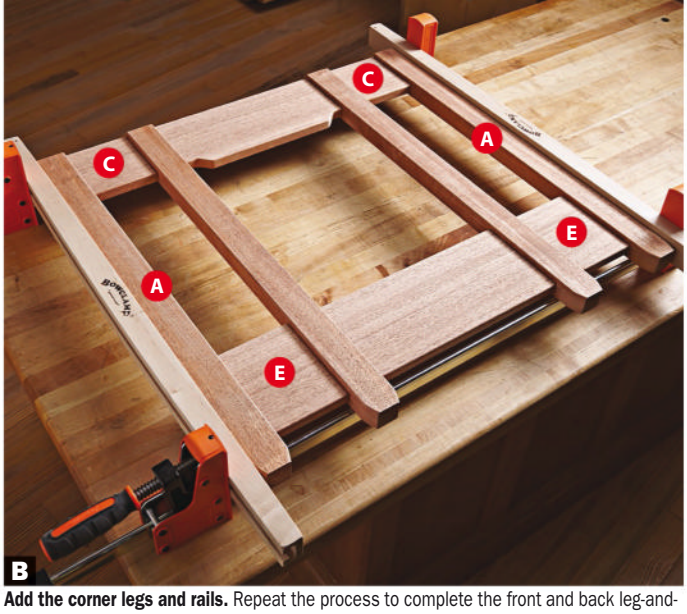
Tip! *Leave the ⅜" chisel in your mortiser after cutting the leg mortises. Use it later to cut the plug mortises on the breadboard ends (J).*

EXPLODED VIEW





Clamp with cauls. Because mahogany can dent easily, use clamping cauls to prevent jaw impressions on the legs.



Add the corner legs and rails. Repeat the process to complete the front and back leg-and-rail assemblies.

3 Cut all rails (C–H) to size [**Materials List, Drawing 2, Exploded View**]. Cut tenons on the ends of each rail [**Drawings 2a** and **2b**]. Dry-fit each tenon into its mating mortise; trim as needed for a snug fit.

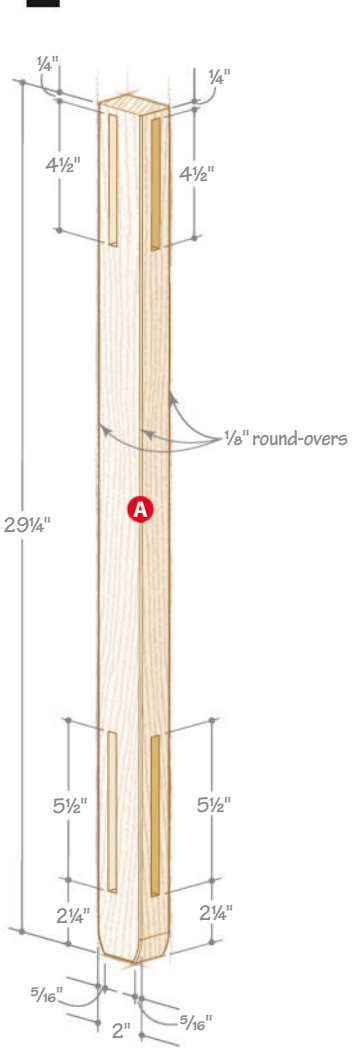
4 To form the cloud-lift profile, lay out a pair of ½" radii on each end of the top center rails (D) [**Drawing 2b**], and then cut and sand them to shape. Round over the top and bottom edges of the bottom rails (E, F, H), and only the bottom edges of the top rails (C, D, G). Sand all rails and legs to 220 grit before assembly; the nonflush surfaces are difficult to sand afterward.

5 Glue and clamp the center rails (D, F) to the center legs (B) [**Photo A**]. After the glue dries, glue and clamp the short rails (C, E) and corner legs (A) to these assemblies [**Photo B**].

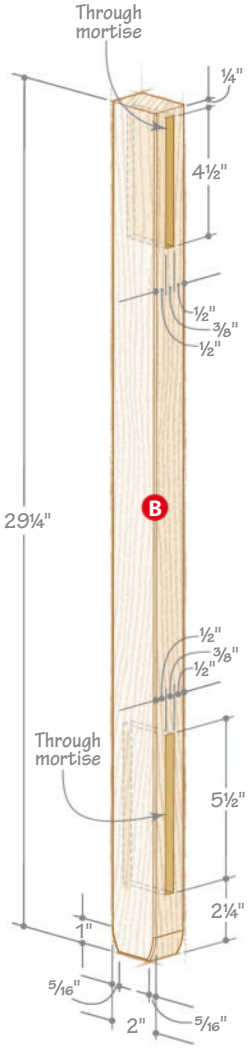
Tip! *Once you fit a specific mortise and tenon joint, mark both parts with corresponding letters or numbers to keep them paired up during assembly.*

Note: *A clamping caul has a subtle arc along one edge so that, when captured between an assembly and clamp jaws, it distributes force along the entire assembly edge. We use Bowclamp cauls here (bowclamp.com), but you can make your own from any stock.*

1 LEGS

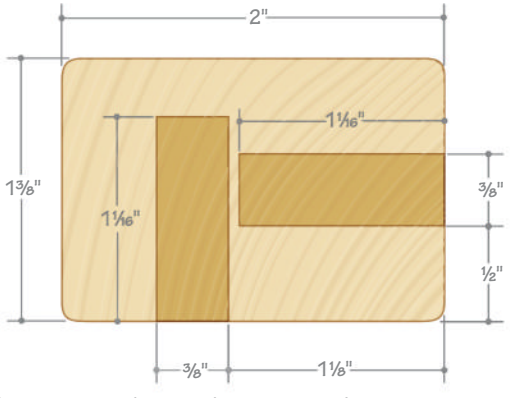


(Left rear/right front corner shown, right rear corner and left front corner are mirror images)



(Center leg)

1a CORNER LEG MORTISE DETAIL



(Left rear corner shown, right rear corner leg is a mirror image)

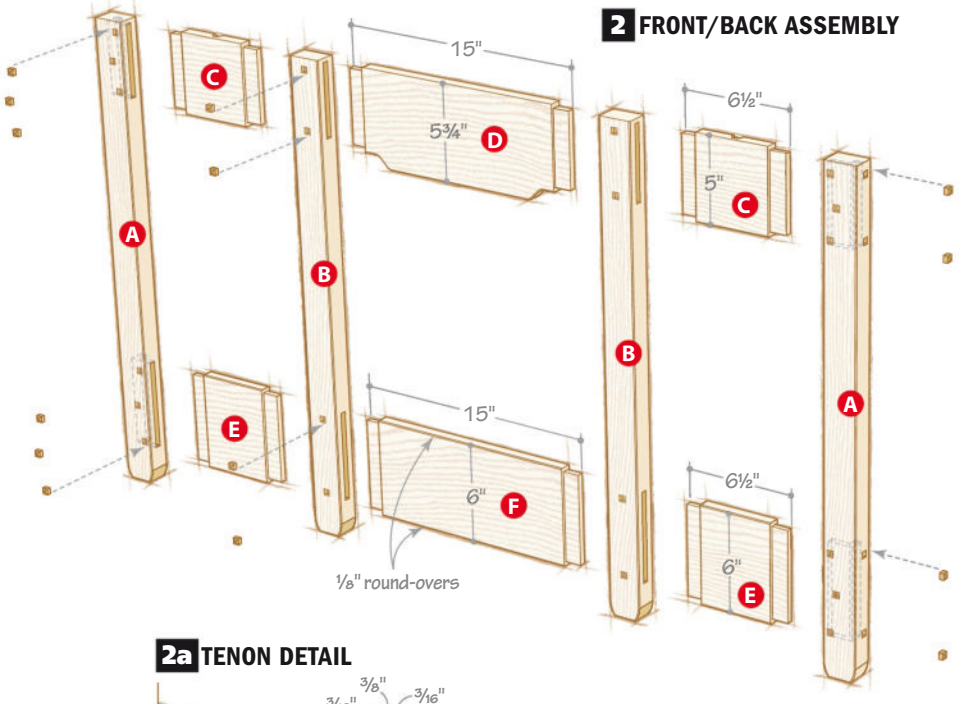
Drill stopped holes for each plug mortise by attaching a stop collar to a 21/64" brad-point drill bit for a 3/8"-deep hole. (You can get by with a 5/16" bit.)

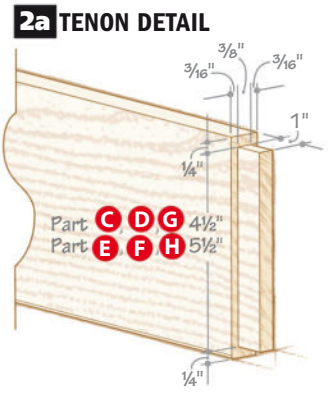
Chisel the mortise corners by removing the bit from your drill, positioning the chisel over the hole, and inserting the bit shank into the hole. Align the corners, remove the bit, and tap to depth with a mallet.

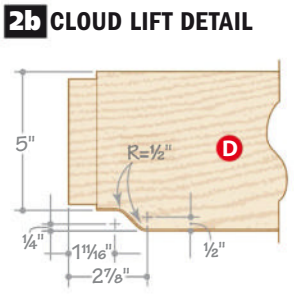
▶To purchase a square-hole punch, see **Sources** on *page 50*.

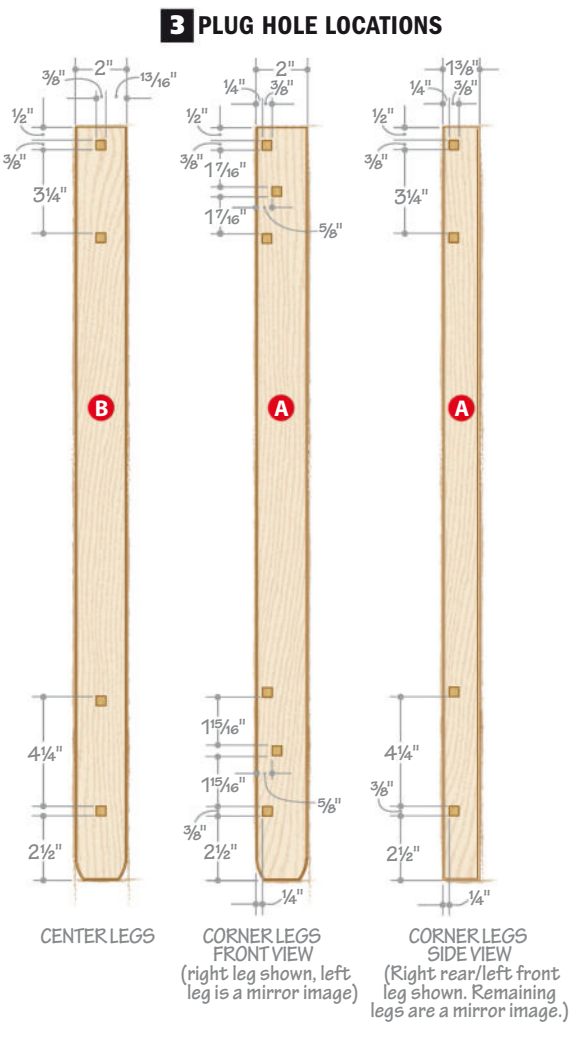
Install the plugs

1 Lay out the locations for the ebonized plugs on the front-facing leg-and-rail assembly (A–F) [**Drawing 3**]. (If your server will sit against a wall—as ours does—you can skip the plugs for the back assembly.) You'll cut the mortises in the ends after gluing the entire base together [**Step 3**, *page 48*]. Doing this in stages prevents damaging the leg surfaces over mortises that do not have tenons glued into them yet. Drill and chisel the front plug mortises [**Photos C** and **D**].







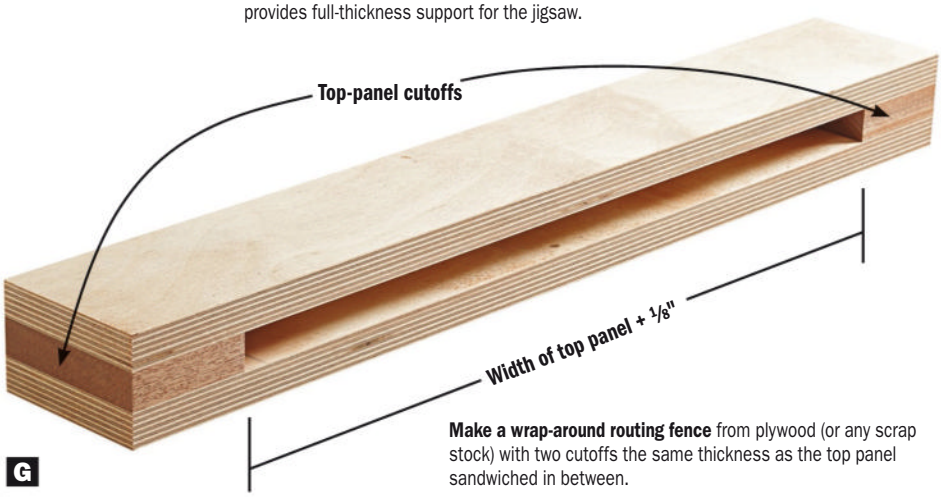


Score the ends of the top panel with a marking gauge to indicate the length of the tenons. (See **Drawing 5**.)

Separate the tenons by cutting along the layout lines with a jigsaw. Doing this now provides full-thickness support for the jigsaw.

2 Shape plugs [**Skill Builder**], then cut them to length so they protrude about 3/16" from the legs. Apply glue and gently tap them in.

3 Glue the end rails (G, H) to the front and back leg assemblies (A–F) [**Exploded View**], and clamp until dry. Cut mortises and install plugs in the end-facing surfaces of the corner legs [**Drawing 3**].



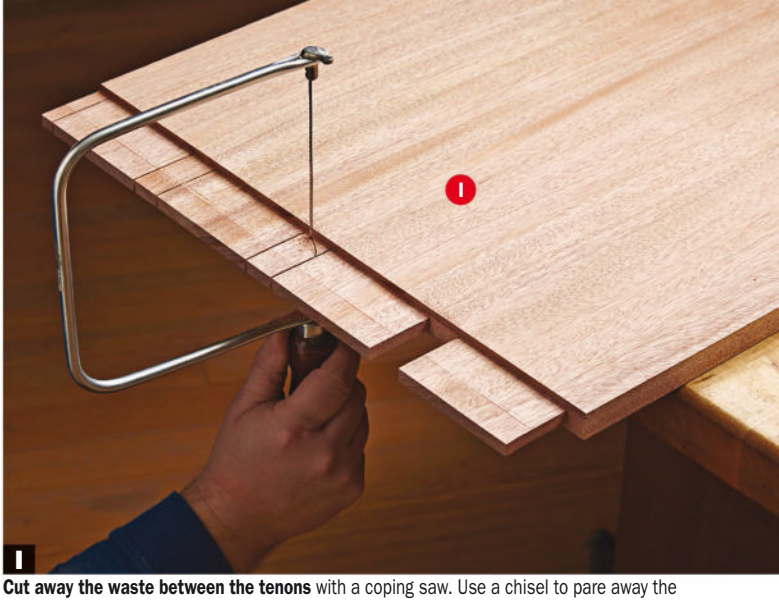
Make a wrap-around routing fence from plywood (or any scrap stock) with two cutoffs the same thickness as the top panel sandwiched in between.

SKILL BUILDER

Fake your own ebony plugs

True African ebony can cost $100 or more per board foot, so we "ebonized" our own plugs from hard maple. To do this, cut eight 3/8"-square strips about a foot long. Sand a rounded pyramid point on each end, and color the tip with a permanent black marker. Dip the tip into a dark stain or dye, such as black walnut or ebony, and allow to soak in. After the colorant dries, spray a coat of shellac to seal the coloring and prevent it from running when applying finish to the project later. When dry, cut off each plug at the bandsaw or with a handsaw and repeat as needed.

Rout the tenons with any flat-bottom bit, making shallow, incremental cuts, and moving the fence inward. Flip the top with each cut so you remove the same amount from each face.



Cut away the waste between the tenons with a coping saw. Use a chisel to pare away the remainder at the shoulders.

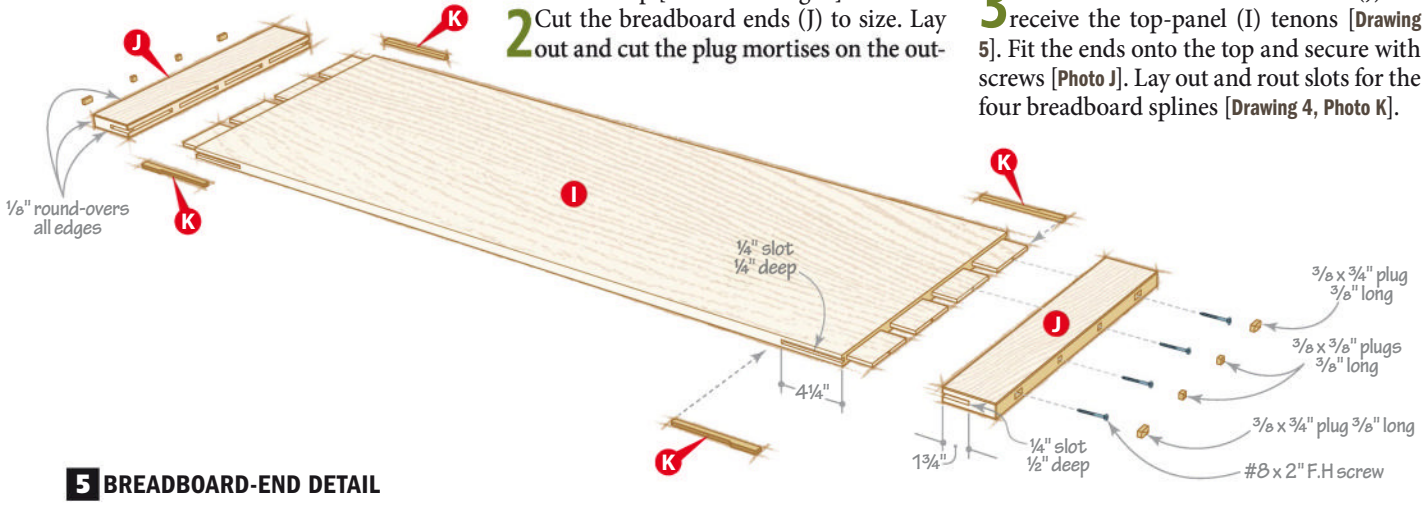
Now for the top

1 Glue up and cut to size the top panel (I) [**Materials List**]. Then, make tenons on both ends of the top [**Photos E** through **I**].

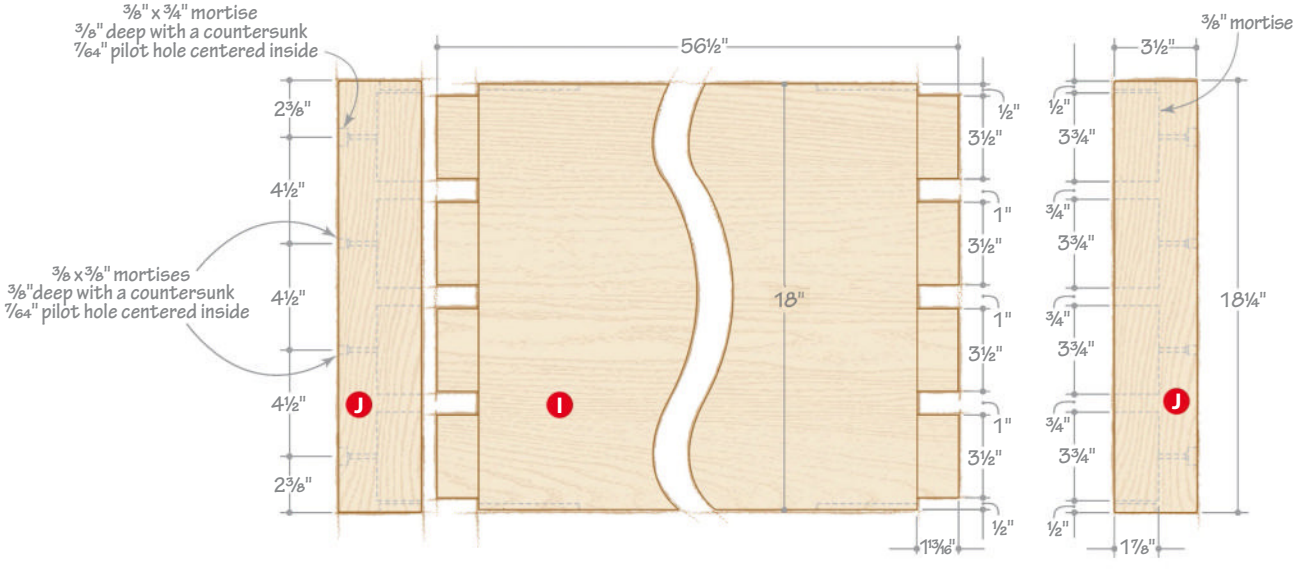
2 Cut the breadboard ends (J) to size. Lay out and cut the plug mortises on the outside edge of each piece [**Drawing 5**]. Do not install the plugs yet; you'll do that after assembling the top and breadboard ends.

3 Mortise the breadboard ends (J) to receive the top-panel (I) tenons [**Drawing 5**]. Fit the ends onto the top and secure with screws [**Photo J**]. Lay out and rout slots for the four breadboard splines [**Drawing 4, Photo K**].

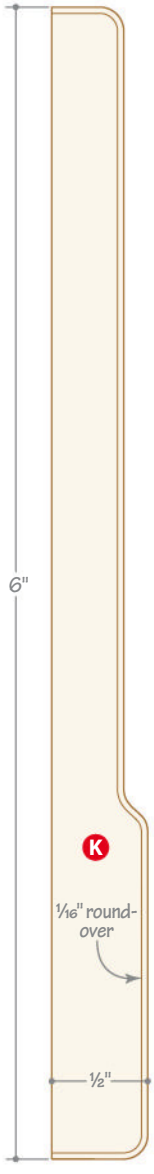
4 TOP

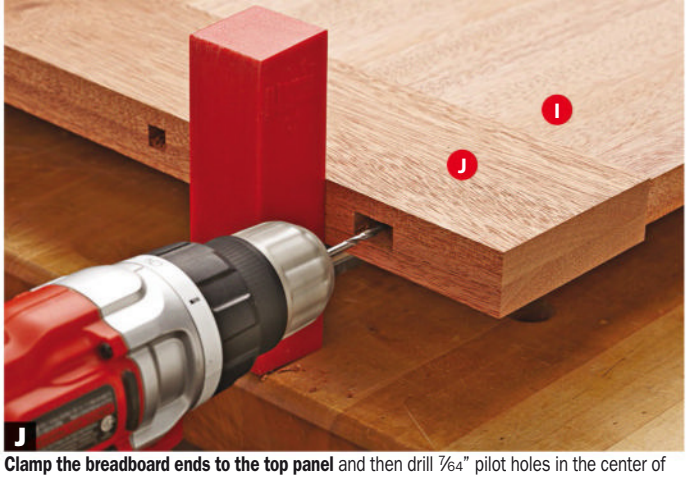


5 BREADBOARD-END DETAIL

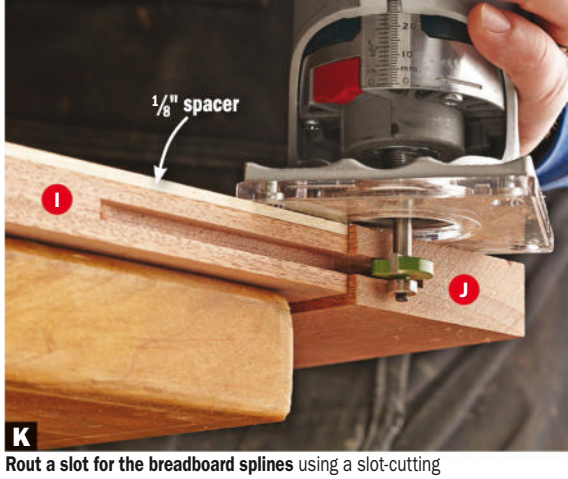


SPLINE FULL-SIZE PATTERN





Clamp the breadboard ends to the top panel and then drill 7/64" pilot holes in the center of each mortise into the corresponding tenon. Secure with screws.



Rout a slot for the breadboard splines using a slot-cutting bit. Square up the rounded ends with a 1/4" chisel.

4 Remove the breadboard ends (J). Using a chisel, cut each spline slot in those pieces 1/4" deeper; leave the grooves in the top panel (I) as is [**Drawing 4**]. This allows for expansion and contraction due to seasonal humidity changes.

5 Round over the edges of the top panel (I) and the outer edges and ends of the breadboard ends (J). Enlarge the pilot holes in the breadboard ends to 11/64" to allow for seasonal movement. Finish-sand the top and ends.

6 Make plugs and splines [**Full-Size Pattern**], and color them black as before. Clamp the breadboard ends to the top panel, and secure with screws—no glue. Next, glue the plugs in the mortises. ***Glue the breadboard splines to the top panel, but not to the breadboard ends.*** This allows for expansion without splitting the splines.

Bring it all together

1 Apply finish to the base and top assemblies. We used three coats of a 50/50 mixture of Watco natural and medium-walnut Danish oil finishes, sanding between coats with 600-grit sandpaper. Topcoat with a water-resistant finish, such as polyurethane or precatalyzed lacquer.

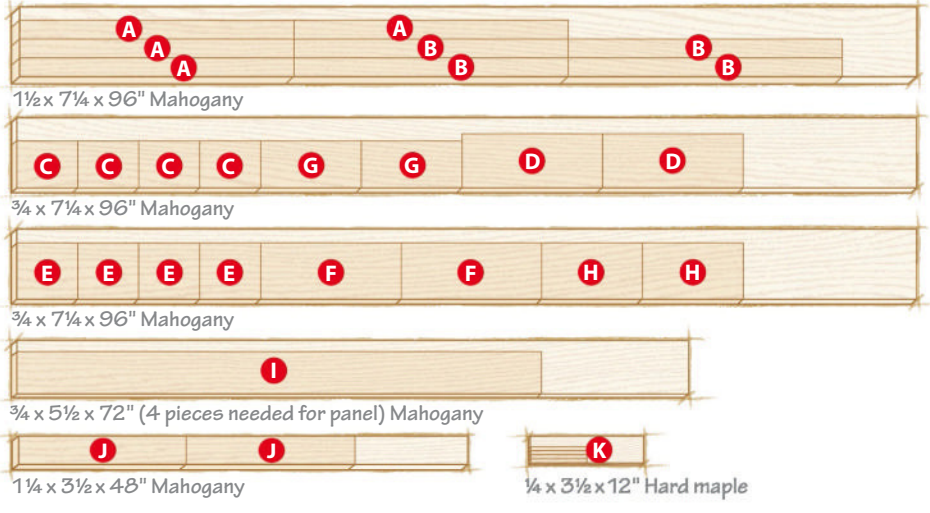
2 Center the top on the base and attach it with figure-8 fasteners. Now show off your server and make your friends "Greene" with envy.

Produced by **Bob Hunter** with **John Olson**
Project design: **Kevin Boyle**
Illustrations: **Roxanne LeMoine, Kurt Schultz**

▶Download this full-size printable pattern.
woodmagazine.com/240patterns

Cutting Diagram

This project requires approximately 30 bd. ft. of 3/4" mahogany, 3 bd. ft. of 1 1/4" mahogany, 20 bd. ft. of 1 1/2" mahogany, and 1 bd. ft. of hard maple.



Materials List

Part		FINISHED SIZE T	W	L	Matl.	Qty.
Base						
A	corner legs	1⅜"	2"	29¼"	M	4
B	center legs	1⅜"	2"	29¼"	M	4
C	top short rails	¾"	5"	6½"	M	4
D	top center rails	¾"	5¾"	15"	M	2
E	bottom short rails	¾"	6"	6½"	M	4
F	bottom center rails	¾"	6"	15"	M	2
G	top end rails	¾"	5"	10¾"	M	2
H	bottom end rails	¾"	6"	10¾"	M	2
Top						
I	top panel	¾"	18"	56½"	M	1
J	breadboard ends	1"	3½"	18¼"	M	2
K	splines	¼"	½"	6"	H	4

Materials key: M–mahogany, H–hard maple.
Bits: 1/8" round-over, 1/4" slot-cutter.
Supplies: #8×5/8" flathead screws, #8×2" flathead screws.

Sources

3/8" square-hole punch: no. 50K59.06, $29.50, Lee Valley, 800-871-8158, leevalley.com.
1/4" deep-cut slot-cutting router bit: no. 16J83.14, $30.80, Lee Valley.
Figure-8 fasteners (20-pack): no. 13K01.50, $3.20 (screws not included), Lee Valley.

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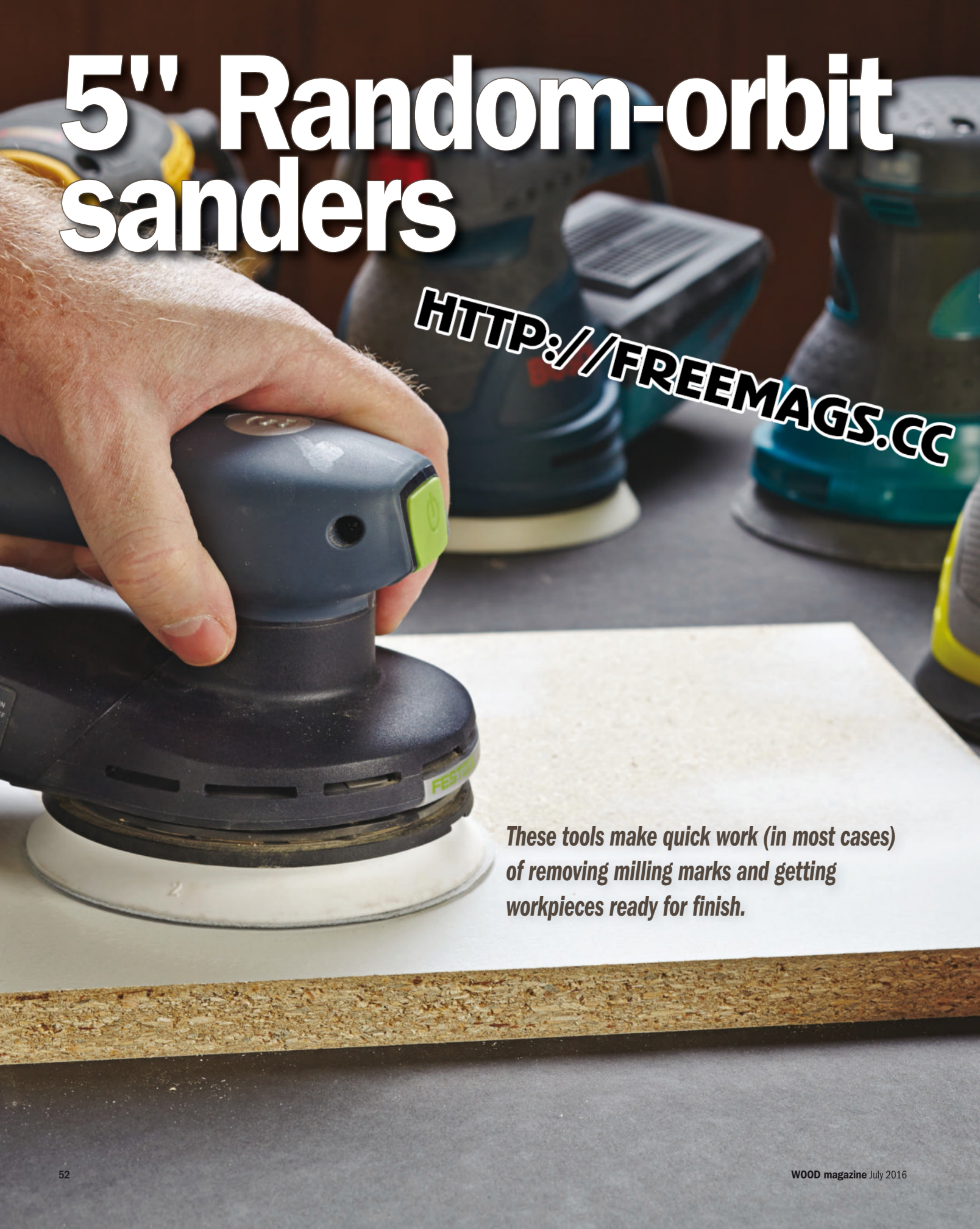
5" Random-orbit sanders



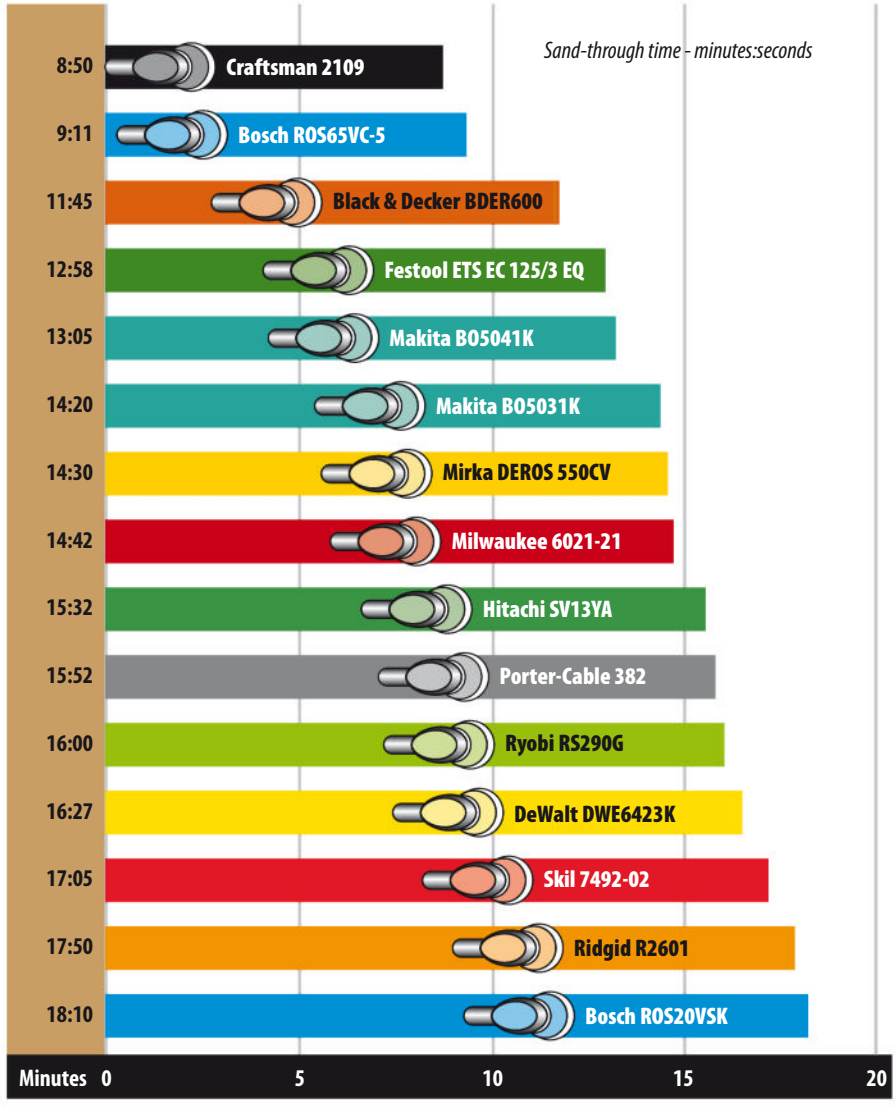
These tools make quick work (in most cases) of removing milling marks and getting workpieces ready for finish.

Fastest to the Finish Line

With each sander, we sanded away the melamine coating from a 12x12" piece of particleboard using a new 80-grit Klingspor's Stearate 100 disc, timing how long it took to remove the melamine. Results shown are the average of multiple tests.

We love every aspect of crafting a beautiful piece of furniture. Check that: everything but sanding. A random-orbit sander, like the ones we tested for this article, doesn't make sanding any less of a chore, but a good one shortens the drudgery while delivering a better finish than you could by hand. To help you find that good one, we tested 15 models with 5" hook-and-loop pads to see which worked the fastest, which netted the best finish, and which best combined both aspects—all while judging how well each one sucked up the dust it created.

To measure aggressiveness, we conducted the test at *right*. The Craftsman 2109 and Bosch ROS65VC-5 worked fastest, each finishing in about nine minutes. By contrast, seven sanders needed more than 15 minutes to do the same job.



▶ Festool produced the first electric random-orbit sander in 1976. It was at least another decade before these tools became popular in the U.S.

Black & Decker BDER600, $35

800-544-6986, blackanddecker.com

This single-speed sander outperformed three higher-priced models overall, and finished third-best for rate of material removal. But dust collection with its onboard container was not good, its paddle power switch and slide-style switch lock proved clumsy to operate, and it wandered and jerked more than most others.

Bosch ROS20VSK, $75

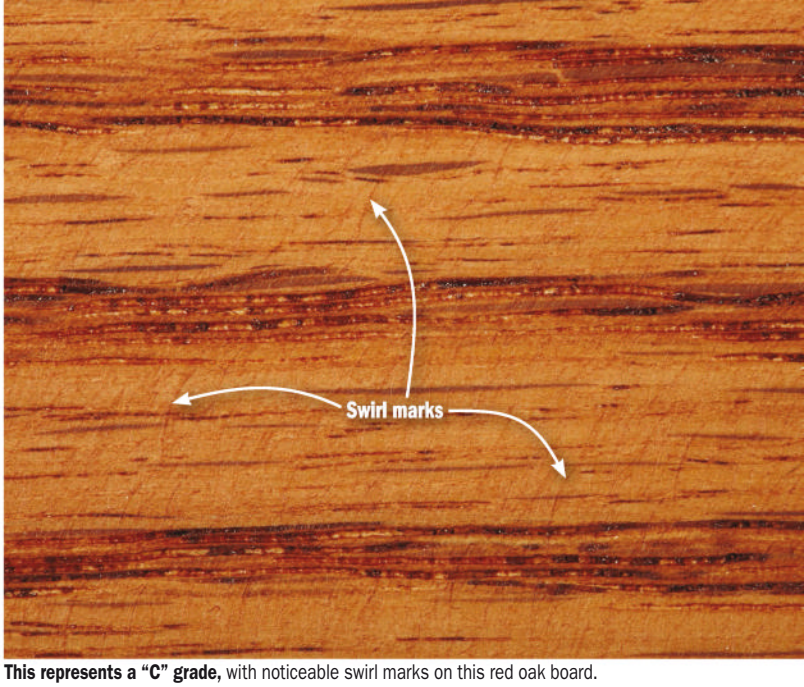
877-267-2499, boschtools.com

Dust collection is excellent with this sander, and it produced little vibration and few control issues. But it finished last in the aggressiveness testing, and its quality of finish—particularly in oak—lagged behind the other sanders.

Bosch ROS65VC-5, $215

Aggressive with great dust collection, it barely vibrates, thanks to a weight about double the lightest sanders. But its size, pistol-grip handle, and tendency to jerk and veer off course demand two-hand use. This sander left more scratches and swirls than we expected for a premium-priced tool.

The absence of swirl marks nets an "A" grade for the sander used on this board.



This represents a "C" grade, with noticeable swirl marks on this red oak board.

Gunning for a fine finish

An aggressive sander may be great for flattening and smoothing, but if it leaves a coarse surface, you'll lose the time you saved refining the surface to ready it for finishing. To do its magic, a random-orbit sander abrades the wood surface by two circular movements: the higher-speed spinning (oscillations, measured in rpm), and the side-stepping cam-action arcs (orbits, from 3/32" to 3/16" among this group). With each successively finer abrasive you use, the sander removes marks left by the previous grit. Ideally, by the time you get to 180- or 220-grit abrasive, you should not see any swirl or scratch marks, even after applying stain.

To judge each sander's quality of finish, we sanded away pencil marks from red oak and pine sample boards using 120-, 150-, 180-, and 220-grit discs in succession. Then we applied an oil-based penetrating stain to reveal any scratches or swirl marks, as shown *above*.

The Craftsman, Festool ETS EC 125/3 EQ, and Mirka DEROS 550CV delivered the best results after sanding to 220, with the Makita BO5041K just slightly behind. However, the Festool was the only sander that produced scratch-free surfaces after sanding to only 180 grit. Most other models needed to sand longer with each grit to blend the scratches, or continue on to 220 grit to get similar results. See how each model performed in the chart on *page 57*.

▶ Eleven of the tested sanders have variable-speed motors, and we tested those at their fastest settings. The rare times to slow down a sander are when the sanding disc loads up with debris when working on sappy, oily, or painted workpieces, or when the high speed makes the tool harder to control.

2016 WOOD Magazine TOP VALUE 5" Random-Orbit Sander

Craftsman 2109, $60

800-349-4358, craftsman.com

Ranking among the leaders in aggressiveness and finish quality, we like a lot about this sander. It's comfortable to hold and operate, but has one shortcoming: poor dust collection with the included canister, which improved significantly with a vacuum. Ignore the two features that add little value: an LED light and a green-yellow-red sensor light to indicate the amount of downforce applied in use.

2016 WOOD Magazine TOP VALUE 5" Random-Orbit Sander

DeWalt DWE6423K, $80

800-433-9258, dewalt.com

This model handles most tasks pretty well, and excels at a few. It's reliable, comfortable to use, good at collecting dust, and capable of producing mostly scratch-free wood surfaces. Plus, it comes with a three-year warranty.

2016 WOOD Magazine TOP TOOL 5" Random-Orbit Sander

Festool ETS EC 125/3 EQ, $385

888-337-8600, festoolusa.com

This sander saves time in many ways: It's reasonably aggressive, delivers a final finish one grit quicker than the others, and its pad stops instantly when powered down. A brushless motor holds the key for this low-vibration sander. It's light, handles like a dream, and has excellent dust collection when hooked to a vacuum, but requires special nine-hole discs.

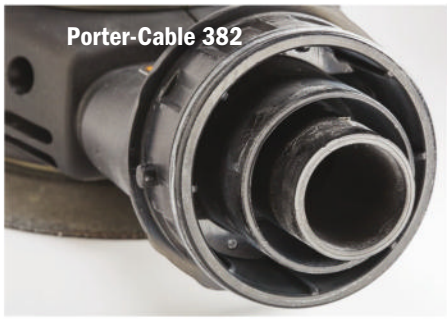
Dodge *all* the dust

Sanders create dust; there's no avoiding it. But that doesn't mean you should put up with airborne dust because the sander can't contain it. We evaluated each model using its onboard dust-collection container (see a post-test photo *below right*) and hooked to a proven high-efficiency vacuum.

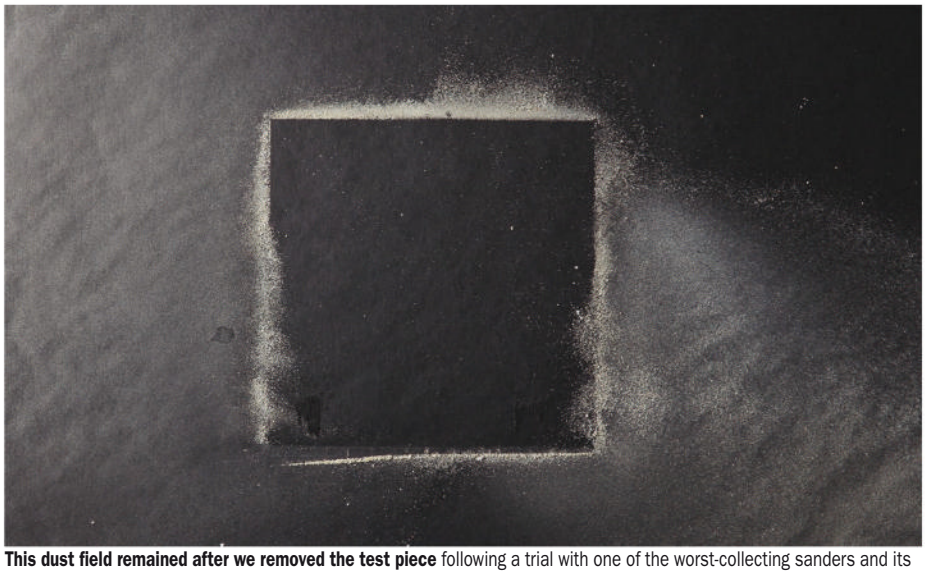
The two Bosch sanders and the Milwaukee 6021-21 fared best using their onboard dust containers, while scoring about the same when tethered to the vacuum. The DeWalt DWE6423K, Festool, Mirka, Porter-Cable 382, and Skil 7492-02 also scored high marks when using the vacuum. (The Festool and Mirka sanders do not include a dust-collection container.)

Connecting many of these sanders to a common 1¼" or 1½" shop-vacuum hose turned into a frustrating venture because of dust ports varying in shapes and sizes (see the photos *above*). Our favorites are the ports on the Bosch and Festool sanders, which hooked up easily to 1¼" hose. We wish the industry would standardize port sizes to make dust collection easier.

▶To get the best results from a random-orbit sander, apply only the weight of your hand with no additional downward pressure. Use the same technique with two-handed sanders.



An array of dust port sizes and shapes that proved difficult to connect to a typical 1¼" or 1½" shop-vacuum hose.



This dust field remained after we removed the test piece following a trial with one of the worst-collecting sanders and its container. The best sanders left virtually no dust behind.

Hitachi SV13YA, $80

800-829-4752, hitachipowertools.com

This sander delivered above-average finishes and comes with a five-year warranty. But it vibrated the most, and we found it difficult to control. It collected little dust, and its oblong dust port (top of page) is nearly impossible to connect to a vacuum hose. The recessed sliding power switch is difficult to operate.

Makita BO5031K, $85

800-462-5482, makitatools.com

This above-average sander turns out a nice finish pretty quickly, shows no control issues, and has only minor vibration. But its included dust bag does only a fair job of dust collection, and its undersized port requires a hose clamp to attach most vacuum hoses.

Makita BO5041K, $100

A pistol-grip rear handle and a front knob give this sander a different look and feel than its sibling, but the core functions are nearly identical. It turned out slightly better surface finishes just a little quicker than the BO5031K—possibly due to the use of two hands.

Go brushless—if you can spare the coin

The Festool and Mirka sanders, equipped with smooth-running brushless motors, greatly outdistanced the other 13 sanders to share our Top Tool award. These two low-profile sanders deliver exceptional finishes and dust collection with little vibration, and each comes with a three-year warranty. In comparing the two, though, we can't find a good reason to pay an extra $210 for the Mirka over the already-pricey Festool.

The Craftsman 2109 and DeWalt DWE6423K share Top Value honors. The Craftsman ($60) proved the most aggressive of this field, yet delivered excellent finishes. But you'll need to tether it to a vacuum for dust collection. The DeWalt delivers good finishes with better dust collection for just $20 more. But if you're really on a tight budget, get the $45 Porter-Cable 382.

Produced by **Bob Hunter** with **Bob Saunders**

Milwaukee 6021-21, $80

800-729-3878, milwaukeetool.com

As were about to go to press with this issue, we learned this model has been discontinued and replaced with an updated model. But if you can still find this older model—maybe at a discounted price—you'll get a sander that delivers slightly above-average results. Dust collection proved its greatest feat, scoring equally well with the included fabric filter bag and a vacuum. It's comfortable to use, the pad stops quickly at shutoff, and it (still) comes with a five-year warranty.

Mirka DEROS 550CV, $595

330-963-6421, mirka.com/en-us/us

Like the Festool, this sander's brushless motor makes it lighter and virtually vibration-free. Even though it does a great job of collecting dust using standard eight-hole discs, it gets even better when using a disc that takes advantage of the pad's 28 holes. The dust port rotates to ward off vacuum-hose tangles, but because it's tucked tightly beneath the handle, some hoses might not fit. Our only knock: The paddle switch can get wearisome to hold down during use.

Porter-Cable 382, $45

800-544-6986, portercable.com

A solid performer despite its low price, this single-speed sander proved a nice surprise. When hooked to a shop vacuum, its dust collection was among the best in our test, and it fared pretty well when using its included bag. Although the finish results were a little below average, it made up for it in the other categories.

Ridgid R2601, $70

866-539-1710, ridgid.com

Average-quality finishes are what you can expect with this sander. But because it's not very aggressive, be prepared to sand longer to get flawless surfaces. Dust collection with the included bag filter was poor, but improved greatly with a vacuum. A noticeable pull and vibration make using this tool a bit of a chore.

Ryobi RS290G, $40

800-525-2579, ryobitools.com

You'll get what you should expect from a $40 single-speed sander: a slow worker that delivers slightly below-average finish quality and dust collection, as well as vibration and control issues. Its slide-style power switch was stiff and needed more effort than we'd expect to operate it.

Skil 7492-02, $40

877-754-5999, skiltools.com

This single-speed sander produces an average sanded surface. Dust collection was above average with its canister filter and exceptional with a vacuum. It has the same downforce sensor as the Craftsman, but we found it of little use. It vibrates and pulls more than we like, and at shutdown its pad takes the longest time (7½ seconds) to stop.

5" Random-Orbit Sanders: Controlled Fury Meets Fine Finish

MODEL	PERFORMANCE RATINGS (1)												SANDING PAD											
	PRIMARY					SECONDARY																		
		ABSENCE OF SCRATCHES (2)		DUST COLLECTION																				
	AGGRESSIVENESS (RATE OF REMOVAL)	RED OAK	PINE	W/ONBOARD ATTACHMENT	W/SHOP VACUUM	EASE OF CONTROL	ABSENCE OF VIBRATION	HANDLE/GRIP COMFORT	EASE OF OPERATING POWER SWITCH	EASE OF OPERATING SPEED CONTROL	SECONDS FOR PAD TO STOP SPINNING AT SHUTDOWN	OSCILLATING SPEED, RPM x 1,000	ORBITING STROKE DIAMETER, INCHES	NUMBER OF DUST-COLLECTION HOLES	TYPE OF ONBOARD DUST CONTAINER (3)	OUTSIDE DIAMETER OF DUST PORT, INCHES	TYPE OF POWER SWITCH (4)	CORD LENGTH	WARRANTY, YEARS (5)	WEIGHT, LBS	COUNTRY OF ASSEMBLY (6)	SELLING PRICE (7)
BLACK & DECKER BDER600	B+	B+	B-	C-	B	C	B	B	C+	N/A	4.6	14	1/8	8	C	1	P	7'	2	2.9	C	$35
BOSCH ROS20VSK	C	C	B	A-	A-	B	B	B	A	B	3.0	7.5–12	3/32	8	CF	1⅛	R	8'4"	1	3.5	M	$75
BOSCH ROS65VC-5	A	C	B-	A	A	C	A-	A	A	A	4.4	5.5–12	5/32	8	CF	1⅛	T	13'	1	5.3	H	$215
CRAFTSMAN 2109	A	A	A	D	B-	B	B	B	B-	A	4.5	5–13	5/32	8	CF	1½	R	8'	1	4.0	C	$60
DEWALT DWE6423K	B-	B+	A-	B	A-	B	B-	B	B	A	2.4	8–12	3/32	8	B	1 11/16	R	6'3"	3	2.9	X	$80
FESTOOL ETS EC 125/3 EQ	B+	A	A	N/A	A	A	A-	A	A	A	0.1	6–10	1/8	9	N	1⅛	R	13'	3	2.6	G	$385
HITACHI SV13YA	B-	B	A-	D	C	C	D+	B-	D	C	5.6	7–12	1/8	8	B	Oblong	S	7'8"	5	3.1	C	$80
MAKITA BO5031K	B	B	A	C	B+	A	B	B	A	A	2.6	4–12	1/8	8	B	⅞	R	6'4"	1	2.9	U	$85
MAKITA BO5041K	B+	A-	A-	C-	B	A	B	A	A	A	3.5	4–12	1/8	8	B	⅞	T	6'4"	1	3.1	U	$100
MILWAUKEE 6021-21	B	B-	B+	A-	A-	B	B	B	B-	B-	2.4	7–12	3/32	8	B	1½	R	7'6"	5	3.3	C	$80
MIRKA DEROS 550CV	B	A	A	N/A	A	A	A	A	A	A	1.1	4–10	3/16	28	N	1	P	13'	2*	2.2	F	$595
PORTER-CABLE 382	B-	B-	C+	B	A	B	B	B-	B-	N/A	2.8	12	1/8	8	B	1, 1½	R	7'8"	3	3.0	X	$45
RIDGID R2601	C	B-	B	D	B+	C-	C+	B-	B-	B-	4.3	7–12	3/32	8	B	1½, 2¼	S	7'8"	3†	3.5	C	$70
RYOBI RS290G	B-	B-	B-	C	B+	C-	B-	B-	B-	N/A	4.1	12.5	3/32	8	B	1¼	S	6'	3	3.5	C	$40
SKIL 7492-02	C+	B	B	B	A	C+	C+	B-	B	N/A	7.5	12.5	3/32	8	CF	1½	R	6'	1	3.2	C	$40

1. A Excellent; B Good; C Fair; D Poor; N/A Not applicable
2. Evaluated after sanding to 220 grit.
3. (B) Fabric bag; (C) Plastic canister without filter inside; (CF) Plastic canister with paper filter inside; (N) No filter attachment
4. (P) Paddle; (R) Rocker; (S) Slide; (T) Trigger
5. (*) A third year is available upon registration after purchase. (†) Lifetime service upon registration after purchase.
6. (C) China; (F) Finland; (G) Germany; (H) Hungary; (M) Malaysia; (U) United States; (X) Mexico
7. Prices current at time of article production and do not include shipping, where applicable.

▶ Read reviews of other portable sanders and add your own reviews.
reviewatool.com/sander

Indoor/Outdoor Storage Bench

DIMENSIONS
33" H × 16¼" D × 44" W

Approximate materials cost:
$100

4 cu. ft.
approx. storage capacity

About red grandis

For this project we sought a wood that looks good, carries a reasonable price tag, and works like a dream. It also would have to stand up to the elements because this bench could find itself on a deck, patio, or porch, as easily as an interior entry hallway. The usual choices for these circumstances, white oak or cedar, would have worked, but then our lumber supplier recommended red grandis, and we're glad he did.

This member of the eucalyptus family meets all of the above-mentioned price and performance criteria. If you choose it, know that it can vary considerably in color—from creamy pink to nearly red—from one batch to the next, so buy all that you will need, and then some, from the same batch before getting started.

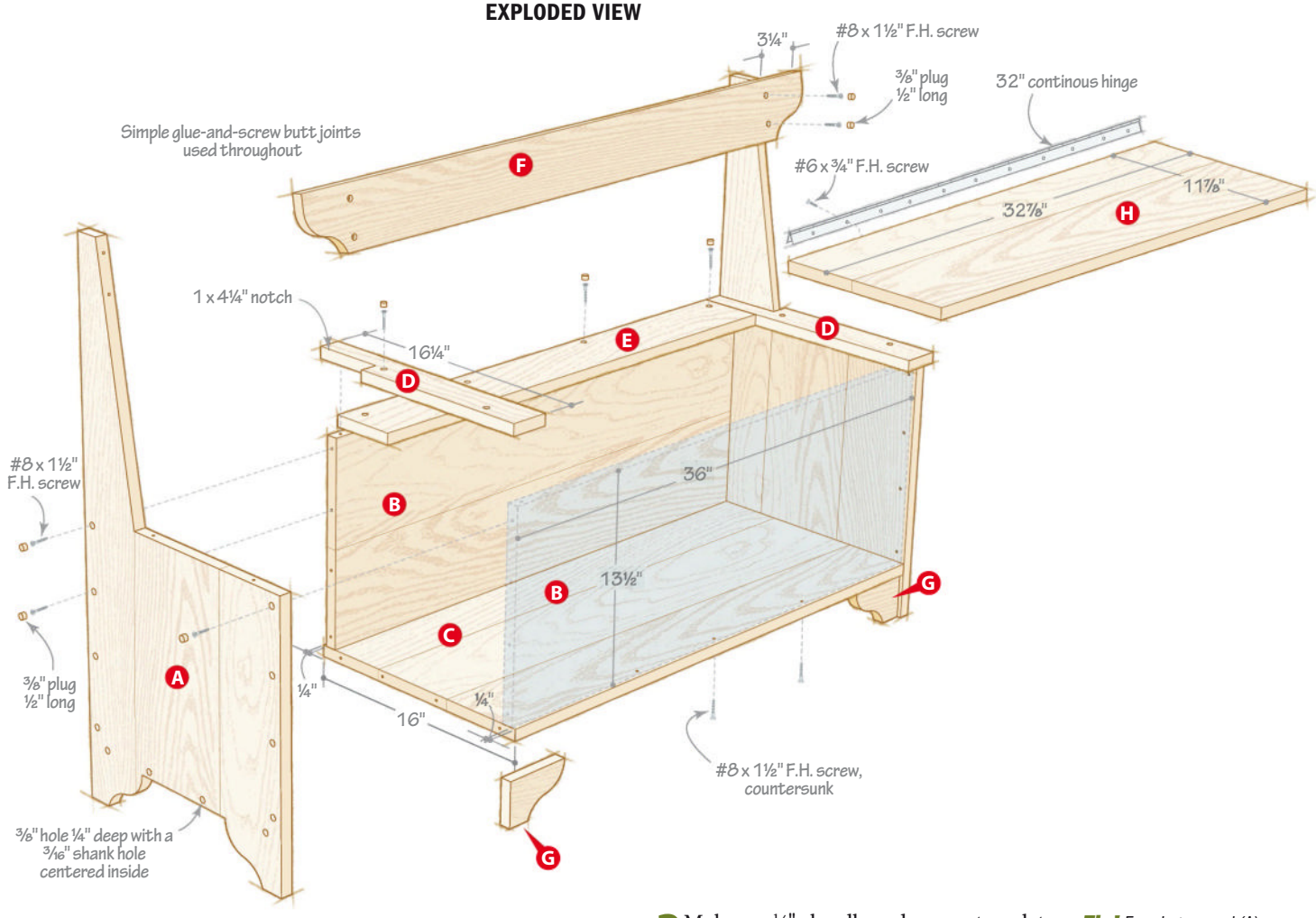
Furniture projects don't have to be complicated to be attractive and eminently functional. Case in point: this comfortable, pleasing-to-the-eye, sturdy, and practical bench with built-in storage. It consists of only 12 parts joined together with just glue and screws. It doesn't get much simpler, or more satisfying, than that.

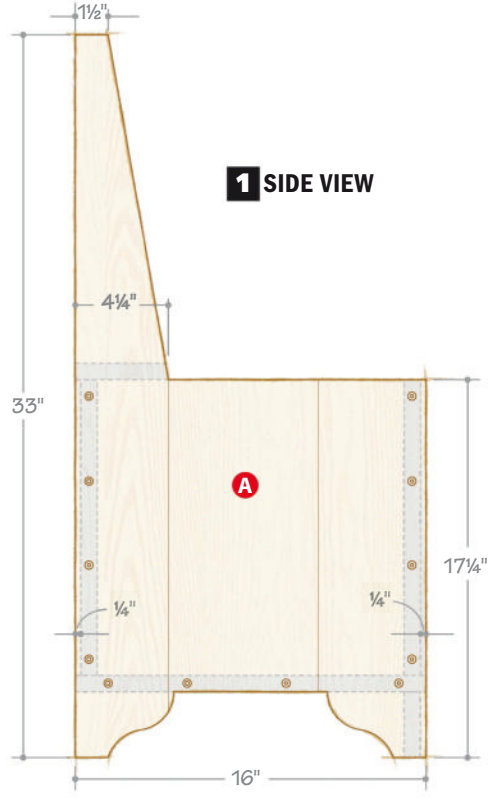
First, build a basic box

1 Cut two ¾×4¼×33" blanks for the back portions of the ends (A). Lay out the taper [**Drawing 1**] and cut the blanks to shape.

2 Now glue up two ¾×11¾×17¼" blanks to serve as the center and front portions of the ends (A). Glue one of those blanks to each of the tapered blanks [**Photo A**].

EXPLODED VIEW





1 SIDE VIEW

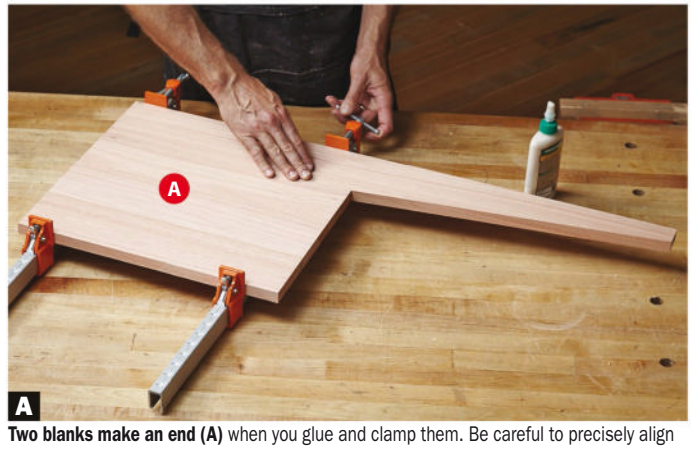
END

3 Make a ¼" hardboard ogee template using the **Full-size Ogee Pattern** on *page 61*. Then use this template to mark the cutout on the bottoms of the ends (A). Jigsaw the cutout on each end, sand to shape, and finish-sand the ends.

4 Glue up the front and back (B) and bottom (C) and cut them to size [**Materials List**]. Finish-sand these panels.

5 Use clamping squares to align the front and back (B) as you glue and clamp them

Tip! *Forming an end (A) with two blanks glued together (instead of clamping boards to make it in one glue-up) allows you to make a straight cut with a tablesaw instead of a jigsaw, ensuring a flat surface where the seat sides (D) will rest later.*

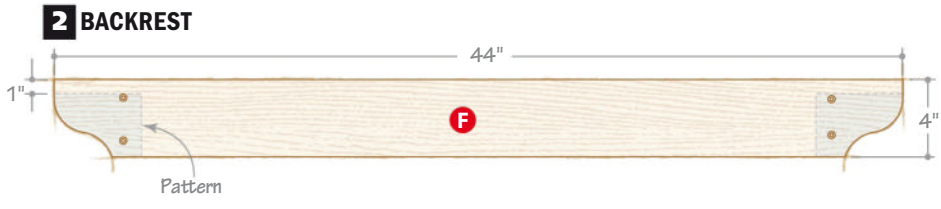


Two blanks make an end (A) when you glue and clamp them. Be careful to precisely align the faces and bottom ends of the two blanks.

Position the front and back (B) with a ¼" setback from the edges of the bottom (C).

Saw the plugs but not the surrounding surface using a flush-cutting handsaw and a piece of cardstock with a hole sized to the plug diameter.

Place masking tape on the countersinking bit to control the counterbore depth. Then drill 3/16" shank holes in the ends (A). Do not glue these joints—oversize shank holes allow for wood movement with seasonal changes in humidity.



to the bottom (C) [**Photo B**]. After the glue dries, reinforce those butt joints with screws [**Exploded View**].

6 Clamp (don't glue) one end (A) to the B/C assembly, flush at the front and back edges of the bottom (C). Secure the end with screws driven through counterbored holes [**Exploded View, Photo C**]. Repeat for the other end.

Now, tackle the seat and back

1 Cut to size the seat sides and back (D, E), then notch the seat sides [**Exploded View**]. Glue and screw the back in place flush with the back edges of the ends (A). Attach the sides using screws only.

2 Cut plugs from scrap matching the color and grain around the counterbored screw holes. Glue the plugs in and saw off excess material [**Photo D**]. Chisel or sand the plugs flush [**Skill Builder**].

3 Use the ogee template to lay out the backrest (F) [**Drawing 2**] and feet (G). Cut and sand the pieces to shape.

4 Glue, screw, and plug the backrest (F) flush with the tops of the ends (A) [**Exploded View**]. Attach the feet with glue only, setting them ¼" back from the front edges of the ends and bottom.

5 Glue up a blank for the seat (H), cut it to size, then sand it smooth. Hacksaw a continuous hinge to 32" long, and screw it to the back edge of the seat, centered. Now center the seat in its opening and screw the hinge to the seat back (E).

6 Apply a finish appropriate to where the bench will be located. Before placing ours in a sunny indoor location we brushed on three coats of satin polyurethane. Now sit back and enjoy!

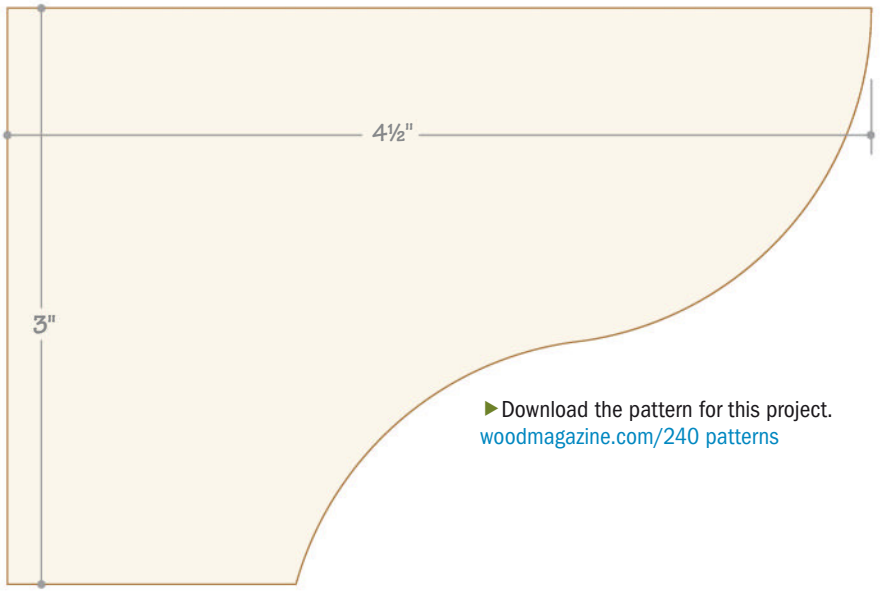
Produced by **Bill Krier** with **Kevin Boyle**
Project design: **Kevin Boyle**
Illustrations: **Roxanne LeMoine; Lorna Johnson**

Skill Builder

Pare plugs perfectly

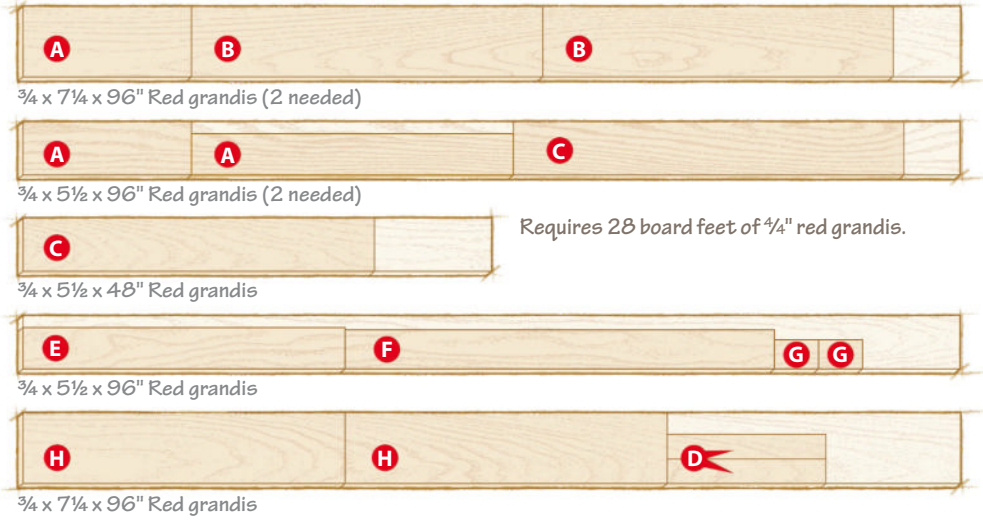
After sawing off hole plugs, you still need to make them flat, smooth, and flush with the surrounding surface. You can do that by sanding them, but that can be slow, and you run the risk of marring the surrounding wood. Instead, use a chisel to pare off the excess plug material. Work the chisel gently around the perimeter of the plug in a sawing-like motion to prevent the plug from breaking off below the surface. Do this right after gluing in the plug—that way, if you accidentally snap off the plug too low, you can extract it before the glue sets.

FULL-SIZE OGEE PATTERN



▶Download the pattern for this project.
woodmagazine.com/240 patterns

Cutting Diagram



Requires 28 board feet of ¼" red grandis.

Materials List

Part		FINISHED SIZE T	W	L	Matl.	Qty.
A*	ends	¾"	16"	33"	R	2
B	front/back	¾"	13½"	36"	R	2
C	bottom	¾"	16"	36"	R	1
D	seat sides	¾"	2½"	16¼"	R	2
E	seat back	¾"	4¼"	33"	R	1
F	backrest	¾"	4"	44"	R	1
G	feet	¾"	3"	4½"	R	2
H	seat	¾"	11⅞"	32⅞"	R	1

*Part assembled from two differently sized blanks. See the instructions.

Material key: R–red grandis.
Supplies: 32" continuous hinge, #6×¾" flathead screws (for hinge if it doesn't come with screws), #8×1½" flathead screws.
Bits: Countersinking bit, ⅜" plug cutter.

The Robots Are Coming!

Why you should consider these cutting-edge high-tech tools

Whether you're an early adopter of technology or a Luddite with a flip-phone, these horizon-expanding tools will add an entirely new dimension to your woodworking. With prices coming down as the technology matures, many of these machines cost about as much as a cabinet saw—or less. If you're intimidated by the idea of a computer-operated woodworking tool, take a deep breath. There's nothing magical about these machines; each one, at its simplest, is just a device that moves a bit, laser, or extruder along three axes to cut, engrave, or build.

CNC: An automated shop assistant

What it does

▶CNC stands for "computerized numerical control," a method of automating the movement of a machine's cutter. The term CNC is also used to refer to the machine as a whole.

No, it won't sweep floors or empty the dust collector for you, but a CNC can cut out multiple identical parts with perfectly shaped edges while you do other things [**Photo A**]. Looking to engrave soft metals, such as brass or aluminum, acrylics, or wood with textures, images, or text that would be next to impossible to create or recreate by hand [**Photo B**]? A CNC has your back, ready to save you loads of time—if you can stop watching it work. (It's mesmerizing!)

What to look for when buying

As with any machine purchase, consider the manufacturer's reputation, warranty, and technical support. You may need a little guidance when getting started, particularly if you have no experience with CNC technology. The Laguna iQ, for example, comes with an offer of two hours of one-on-one training with tech support.

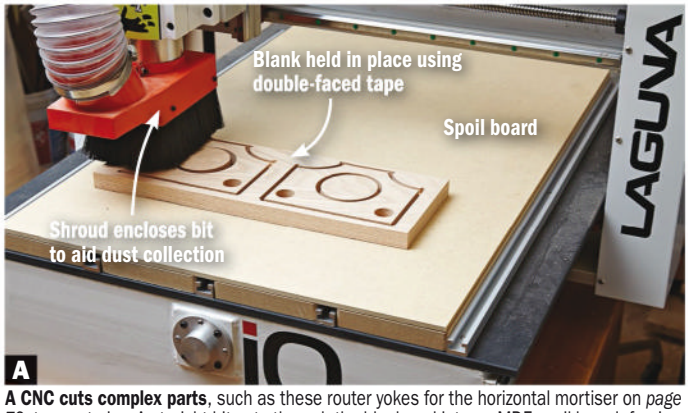
Tip! *If you choose to use a router with your CNC, select a variable-speed model. We found that lowering the router's speed reduced the noise level nearly 15 decibels, and still produced good cut quality.*

Consider also whether you want a CNC machine that drives the router bit using a router or spindle. The latter costs more and typically requires a cooling system, but runs quieter and lasts longer.

Be aware that many of these machines don't come with routers included in the prices, or with the CAM software (see "**Select your software**") required to use the machine.

iQ Laguna, $6,000
220V power supply,
24×36" envelope
lagunatools.com

▶The area where a workpiece rests on a machine is called the "work envelope." This dictates the largest workpiece that fits in or on the machine.



A CNC cuts complex parts, such as these router yokes for the horizontal mortiser on *page 72*, to exact size. A straight bit cuts through the blank and into an MDF spoil board, freeing the workpiece.

Create in CAM. A model or drawing created in CAM software can be re-created on any number of workpieces, and scaled up or down easily.

Select your software

The software available for running CNCs is almost as diverse as the machines. It ranges from simplistic and free-to-download (often without technical support) to advanced programs that can cost thousands. The majority of programs run on Windows operating systems, but you'll also find a few Mac programs.

Although each CNC has different software requirements, the majority work the same way when it comes to programming. First, you design the model, text, or pattern in a computer-aided design (CAD) program such as Adobe Illustrator or SketchUp. That file must then be run through a computer-aided manufacturing (CAM) program, such as Vetric's VCarve. That program takes the model file you created in CAD and renders it compatible with your CNC by outputting what's known as G-code, the most widely used programming language.

Finally, the CNC controller software interprets the G-code and sends signals to the machine to move the cutter in the three axes—up/down, left/right, and forward/back. Sometimes the controller software is built into the machine. Sometimes it's run from a separate computer. Sometimes both.

The etch-anything laser cutter

What it does

Laser cutter/engravers transfer detailed images to wood—burning the likeness of a photo or illustration, for instance [**Photo C**]—and their minuscule kerfs make it possible to create very precise parts from thin material [**Photo D**]. Those who regularly do marquetry, build with small, thin parts, or need to engrave or inscribe would find a laser most useful.

What to look for when buying

First, decide whether you need a CO_2 laser or a diode laser. A CO_2 laser, like the Full Spectrum H-series laser shown *right*, works well for cutting or engraving wood, acrylic, glass, plastics, leather, paper, and even stone. However, reflective metals might damage it. CO_2 lasers cut thicker materials—a 40-watt unit like this one can cut ¼"-thick plastic or wood—and leaves behind a smoother surface finish.

Diode lasers, like the one found on Next Wave Automation's Piranha Fx (see "**Get all three machines in one**," *page 66*), are more compact than their CO_2 counterparts, and require less electricity. They work on reflective metals without risk of damaging the machine. But because they're often of lower wattage, they are mainly used as engravers.

Some lasers, such as those in Epilog's Fusion M2 series, feature both diode and CO_2 lasers in the same units.

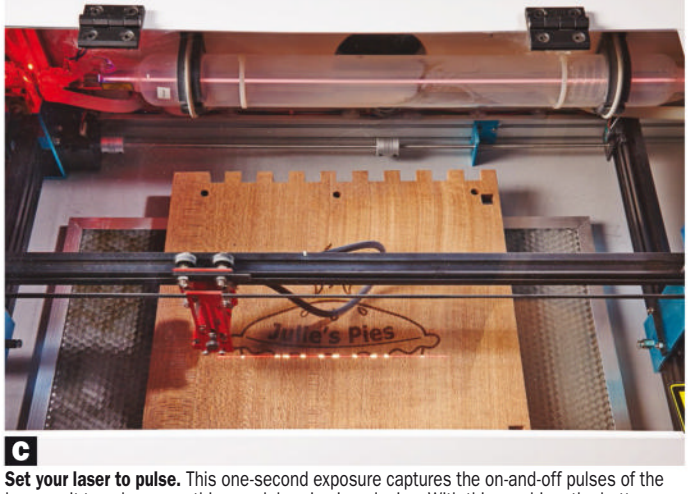
▶Diode lasers require the user to wear special safety glasses to block out harmful rays, whereas CO_2 lasers do not. The polycarbonate or acrylic used in their viewing windows absorbs those rays.

Full Spectrum H-Series 40W Laser, $3,499

110V power supply, 24×36" envelope

fslaser.com

Although many lasers come with a blower fan to exhaust fumes to the outdoors, a self-contained air purifier eliminates the need to run a duct outdoors.



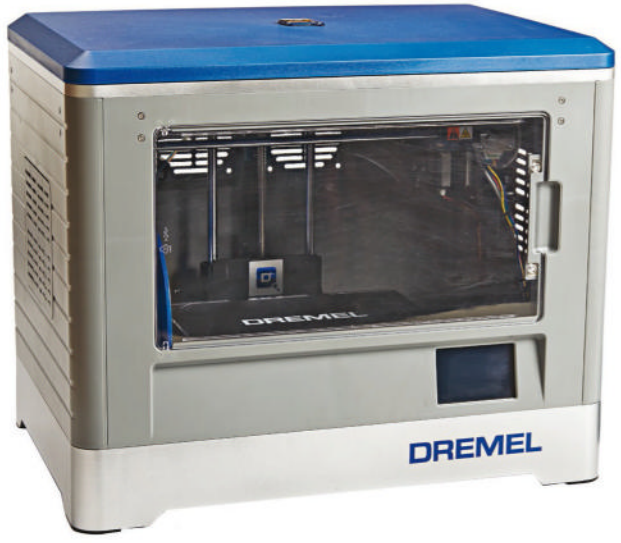
C

Set your laser to pulse. This one-second exposure captures the on-and-off pulses of the laser as it travels across this panel, burning in a design. With this machine, the bottom can be removed, making it possible to engrave or cut pieces too large to fit inside.

D

Cut precise small parts. A laser makes easy work of the interior cuts in this puzzle map of the U.S. Because the laser burns away the wood, the edges of the ¼"-thick pieces have a singed brown color.

Refine design with a 3D printer



Dremel 3D20-01 Printer, $1,000

110V power supply, 9×5.9×5.5" envelope

3dprinter.dremel.com

Most mass-market 3D printers are similar in size and noise level to an ordinary inkjet printer. Most units come with proprietary software, and some require proprietary filament spools to operate.

Tip! *Some online hardware retailers provide CAD files of their parts. Use these files to print an item to check its fit or function when prototyping personal projects. Check their terms of use so you don't run afoul of copyright or patent law.*

▶Sites such as thingiverse.com are excellent resources for free-to-download 3D printer plans.

What it does

You might wonder how a machine that builds in plastic could be used in woodworking. Well, if you've tried to draw out a piece of furniture for a client or spouse only to have them struggle to envision it, imagine how helpful a 3D printer would be for generating precise, scalable prototypes [**Photo E**].

In addition, 3D printers excel at making small parts that complement your wood projects or jigs. Build a chess or checkerboard? Print your own customized game pieces. Have a jig that needs a knob or an odd-size plastic washer? Save yourself a trip to the store and make your own instead. A 3D printer also provides a way to make perfect-fitting reducers/adaptors for every dust-collection port in your shop.

What to look for when buying

3D printers use extruded PLA or ABS plastic. The Dremel 3D20-01 printer, *above*, can only print using PLA plastic, but many models can use both. PLA is biodegradable, has a pleasing smell when melting, releases no harmful fumes, and can be printed on a cold surface. It's less sturdy than ABS and has a lower melting point, though, so don't leave your printed model in a hot car.

ABS, a petroleum product, requires a heated printer bed (to keep the layers from curling as they cool) and outdoor ventilation for the fumes generated as the machine works.

Also consider a machine's maximum build resolution—the thickness of the plastic layers in the model [**Photo F**]. Finer layers make for a more detailed model, though it will take longer for the machine to build it.

▶Alternative filaments blend PLA or ABS plastic with additives such as wood fibers, powdered metals, or elastomers to produce models that look like wood, are magnetic, or are stretchy.

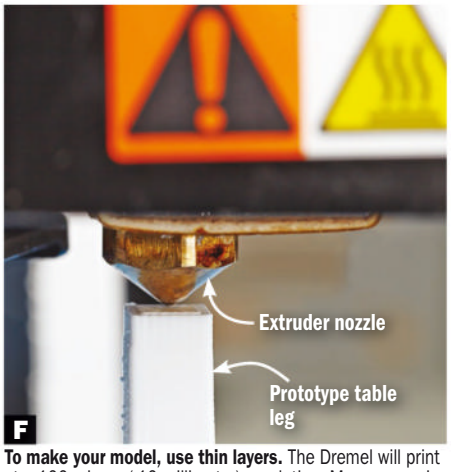
Tip! *An unheated glass bed benefits from having blue painter's tape applied to the surface to improve model adhesion.*

Actual project

3D-printed prototype miniature

E

Start out small. A physical prototype lets you look at a project from all angles, checking its proportions and how light and shadow affect its appearance.



F

To make your model, use thin layers. The Dremel will print at a 100 micron (.10 millimeter) resolution. More expensive models can print in layers as fine as 20 microns thick. They may even offer dual extruders, which allow switching between two different colors without stopping the machine and switching spools.

Next Wave Automation
CNC Piranha Fx, $3,200
(Includes CNC, laser, and 3D printer)
110V power supply
Laser and CNC envelope: 12×13"
3D printer envelope: 12×12×3"
nextwaveautomation.com

Get all three machines in one

If you view yourself as a would-be casual user of this technology, but don't want to invest in three dedicated tools, consider the CNC Piranha Fx. On its own, it's an affordable ($1,600), router-powered benchtop CNC machine. But if you purchase the laser engraver and 3D printer modules, which mount in the chuck of the router used for the CNC function (around $800 each), you can have the functionality of all three machines in one system, for a lower price than the cost of purchasing dedicated units.

The Piranha comes with some limitations. Its 12×18" envelope for CNC work is substantially smaller than many dedicated CNC machines. The 3D printer module, despite having a large 12×12" envelope, is only capable of printing models up to 3" tall. The laser module is very low power—3 watts—so it's limited to light surface engraving and cutting only veneer-thick material.

On the upside, you only have to learn two programs (VCarve for the CNC and laser, Next Wave 3D for the printer) to run three machines. Plus, the Piranha Fx comes equipped with a VCarve software package—an added cost with many other CNC units.

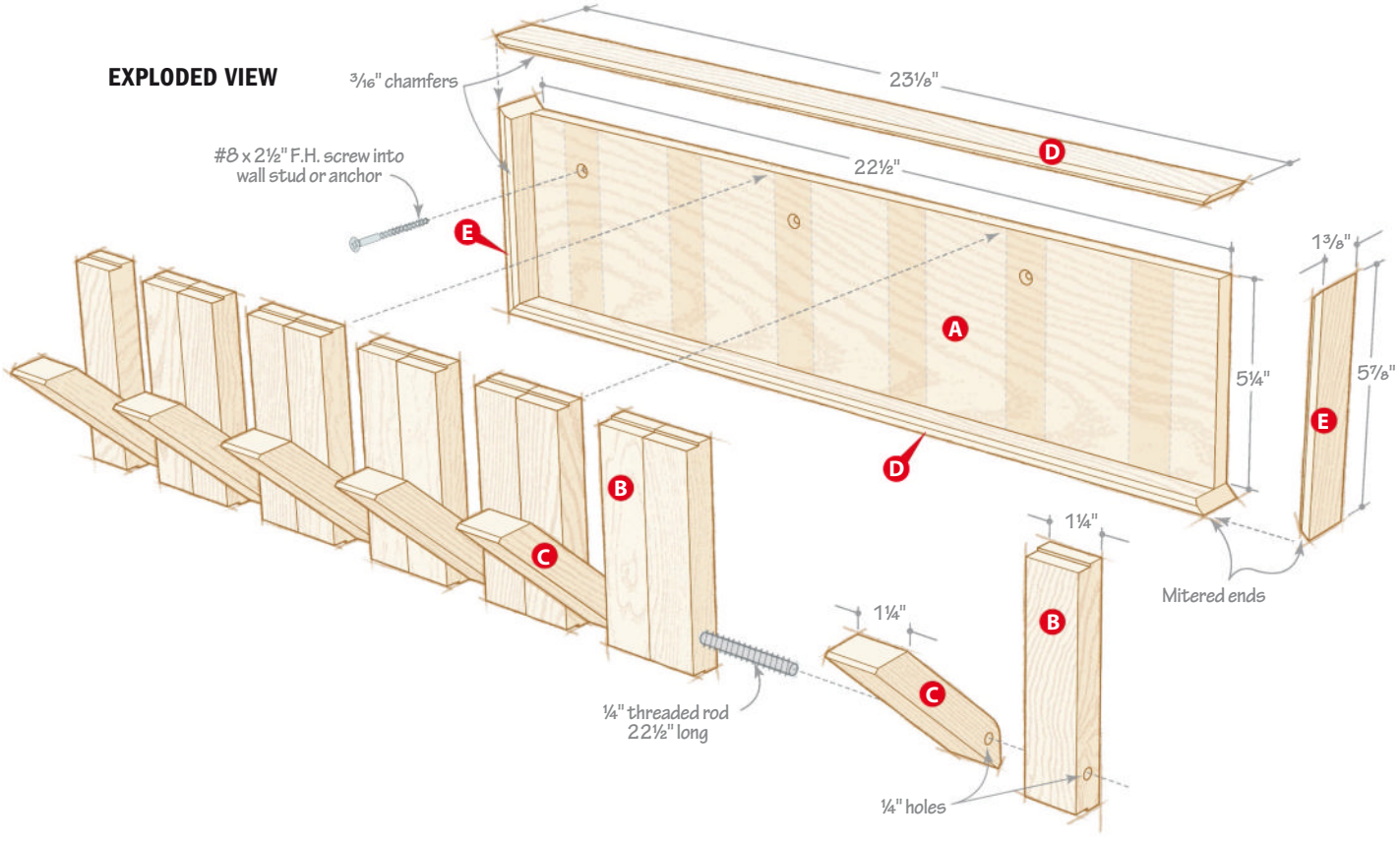
Produced by **Nate Granzow** with **Lucas Peters**

Hidden-Hook Coat Rack

DIMENSIONS: 5⅞" H x 23⅛" W x 1⅜" D (Hooks up)

Approximate materials cost: **$10 per rack**

6 hooks per rack, as built



In just a weekend, you can whip up enough of these to organize every entry and closet in the house. Simply press the bottom end of a hook to drop it down.

▶Need to hang up lots of stuff? Make a rack as long as you like by simply adding more hooks and spacers.

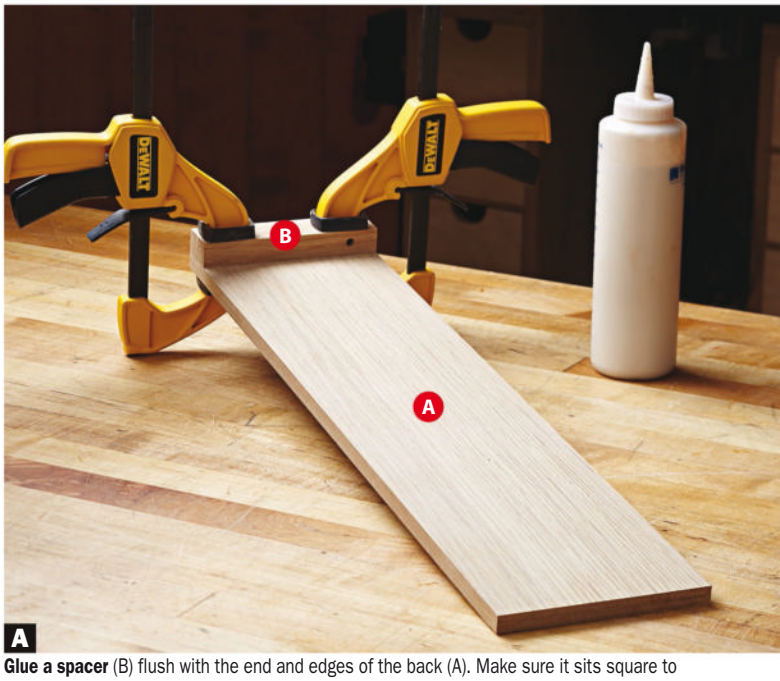
Tip! *We used quartersawn stock to minimize wood movement that might cause the hooks to bind.*

Just five simple parts

1 Cut the back (A) ½" longer than listed, and the spacers (B) and hooks (C) to finished size [**Materials List**]. Set up a stopblock on your drill-press fence and, with the back face of each against the fence, drill holes through the spacers [**Drawing 1**]. Reposition the stopblock and drill through the hooks.

2 Relieve the sharp edges of the spacers by sanding them lightly. (You'll chamfer the hooks later.) Glue five pairs of spacers (B) together edge to edge. While those assemblies dry, glue a single spacer to the back (A) [**Photo A**].

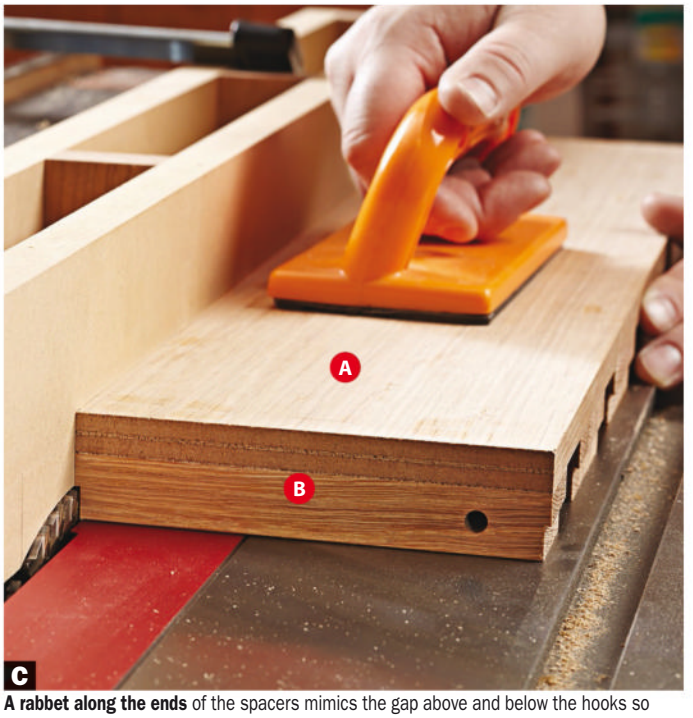
3 Glue the pairs of spacers and the remaining single spacer to the back using hooks to position them [**Photo B**]. Remove the hooks after all the spacers are in place, and cut and sand the hooks to shape [**Drawing 1**].



A

Glue a spacer (B) flush with the end and edges of the back (A). Make sure it sits square to the edges.

Clamp the spacers (B) snug to the hooks (C) before clamping the spacers to the back (A). Elevate the hooks so they don't accidentally get glued in place.



A rabbet along the ends of the spacers mimics the gap above and below the hooks so they all blend together.

4 After the glue dries, trim the back (A) to bring the last spacer flush with the end. Rabbet both ends of the spacers (B) [**Drawing 1**, **Photo C**]. Sand or plane the hooks (C) so they slide smoothly between the spacers, with just a touch of friction. Relieve the edges as you did with the spacers.

5 To accept the screws that secure the rack to the wall, drill countersunk holes between spacers [**Exploded View**]. Apply a finish to the hooks and the edges of the spacers. (We wiped on several coats of Danish oil.)

6 Cut a threaded rod to length [**Exploded View**]. Then, install the hooks, pinning them with the rod.

▶The hooks pivot easier on a threaded rod than on a dowel or smooth rod.

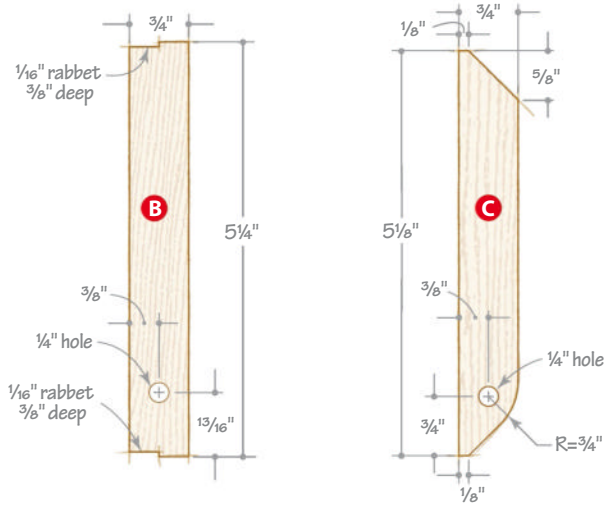
7 Miter-cut the trim (D, E) to fit around the back assembly. Chamfer the front edges of the trim [**Exploded View**] and glue the trim in place.

8 Apply a finish to all pieces. Secure the back to the wall, screwing into studs or using appropriate wall anchors.

▶Each rack requires approximately 1.5 board feet of 4/4 quartersawn oak.

Produced by **Craig Ruegsegger** with **John Olson**
Project design: **John Olson**
Illustrations: **Roxanne LeMoine, Lorna Johnson**

1 SPACER AND HOOK



Materials List

Part		FINISHED SIZE T	W	L	Matl.	Qty.
A*	back	½"	5¼"	22½"	OP	1
B	spacers	¾"	1¼"	5¼"	O	12
C	hooks	¾"	1¼"	5⅛"	O	6
D	top/bottom trim	5/16"	1⅜"	23⅛"	O	2
E	side trim	5/16"	1⅜"	5⅞"	O	2

*Parts initially cut oversize. See the instructions.

Materials key: OP–oak plywood, O–quartersawn oak.
Supplies: ¼×24" threaded rod, #8×2½" flathead screws, hollow wall anchor.

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FREE → 40-CAPACITY DESKTOP HUMIDOR

Shop-made Horizontal Mortiser

DIMENSIONS
8¼" H × 21½" D × 30¼" L

Approximate materials cost:
$175

Makes mortises up to 4" long

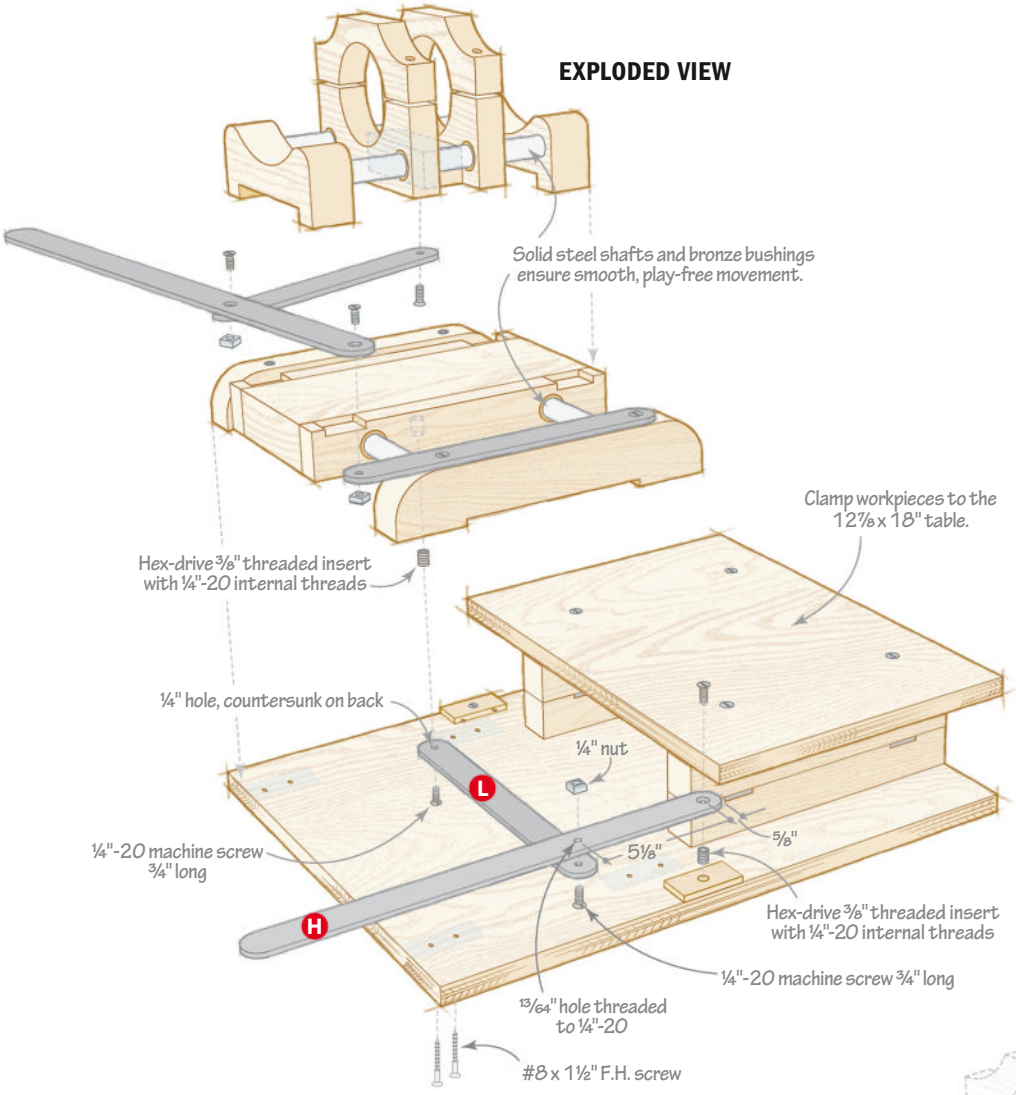
Note: *This fixture is designed around a router motor measuring 3½" diameter—a common size for 1½–1¾ hp routers, including those made by Bosch, Porter-Cable, Craftsman, and DeWalt.*

Cutting mortises by hand takes a fair amount of skill and a lot of time. But here's an affordable, shop-made fixture that works with your router to help you repeatably cut dead-on-accurate mortises in no time flat.

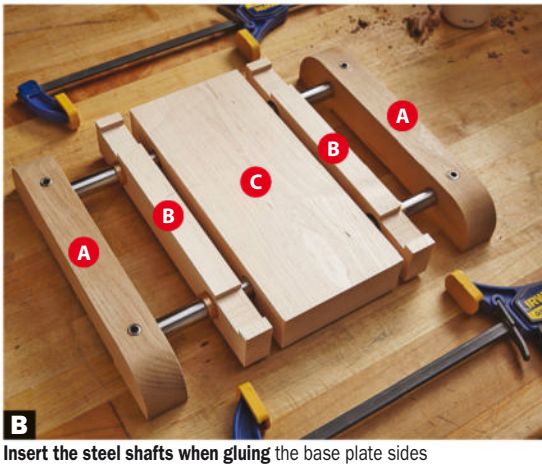
Construct the carriage

1 Begin by cutting parts A–D to size [**Materials List**]. Next, cut two 5½×7" blanks for the yoke tops and bottoms (E, F). Cut the yoke spacer (G) to size.

2 Notch the base feet (A), base plate sides (B), and pillow blocks (D) [**Drawings 1a, 1b,** and **2a**]. In the base feet, drill ¾" holes for the



Prevent tear-out when driving the threaded inserts by clamping a piece of ⅜" scrap with a ⅜" hole onto each foot (A).

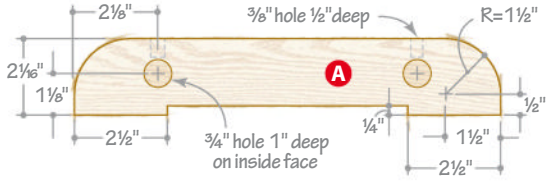


Insert the steel shafts when gluing the base plate sides (B) to the base plate center (C) to ensure proper alignment. Insert the base feet (A) to check their fit with the assembly.

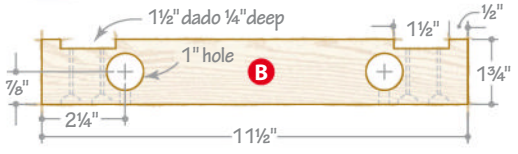
steel shafts and ⅜" holes for threaded inserts where shown. Drive the threaded inserts into place [**Photo A**]. Round the base-feet corners.

3 Drill the holes in the base plate sides and center (B, C) [**Drawing 3**]. Push bronze bushings into the holes of the base plate sides. Glue up the base assembly [**Photo B**].

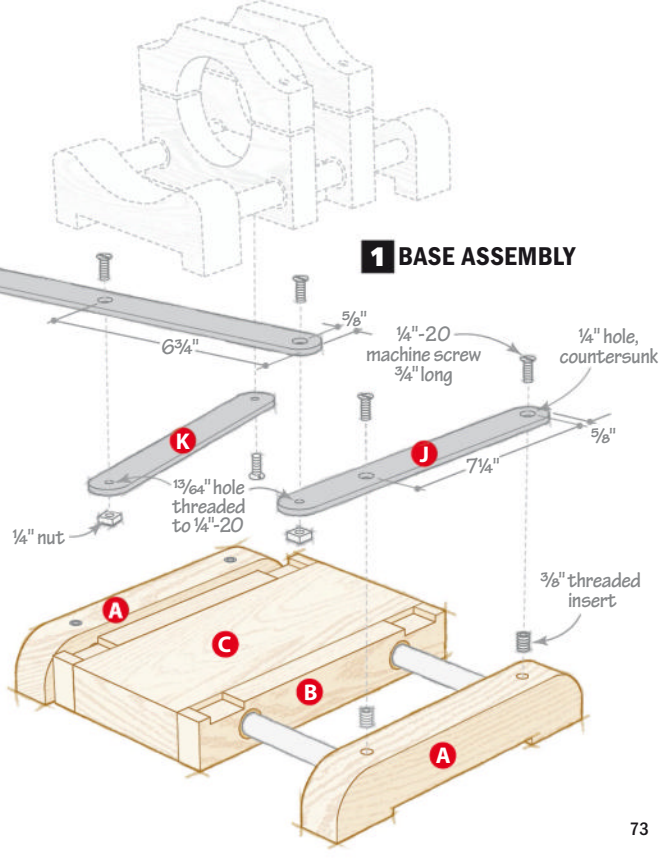
1a BASE FOOT

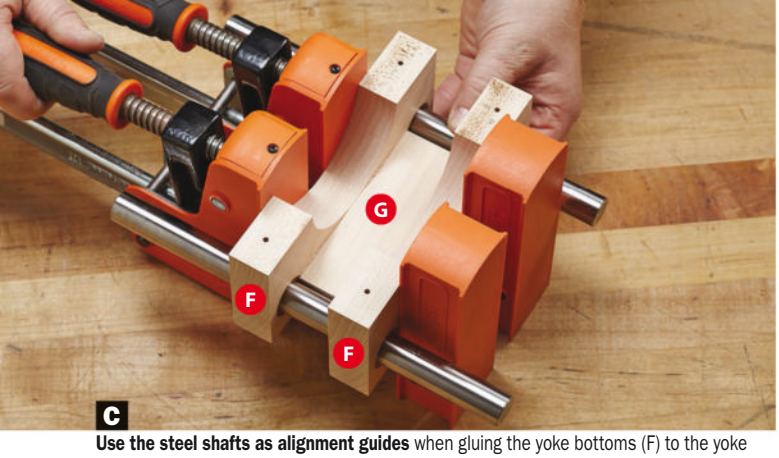


1b BASE PLATE SIDE



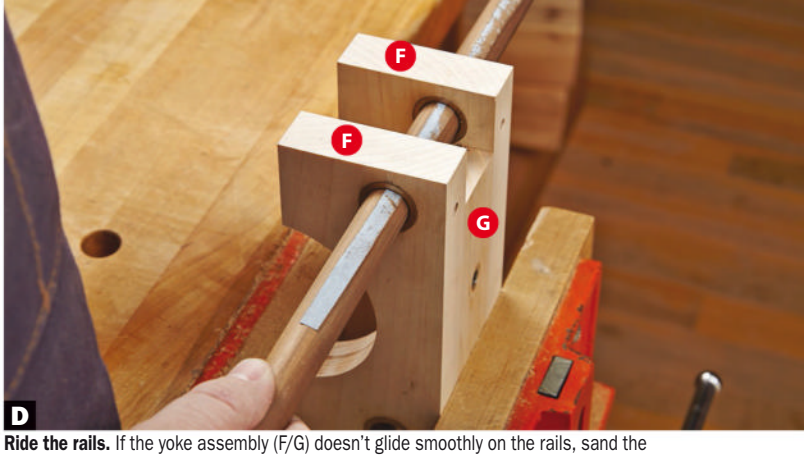
1 BASE ASSEMBLY





C

Use the steel shafts as alignment guides when gluing the yoke bottoms (F) to the yoke spacer (G).



D

Ride the rails. If the yoke assembly (F/G) doesn't glide smoothly on the rails, sand the inside of the bushings lightly using strips of 120-grit sandpaper adhered to a dowel. Twist the dowel to ensure you sand the inside evenly. Do the same to the base assembly (B/C) if necessary.

Note: *Depending on the size of your router, you may have to remove more material from the pillow blocks (D). You'll know when you dry-assemble the yoke assembly later.*

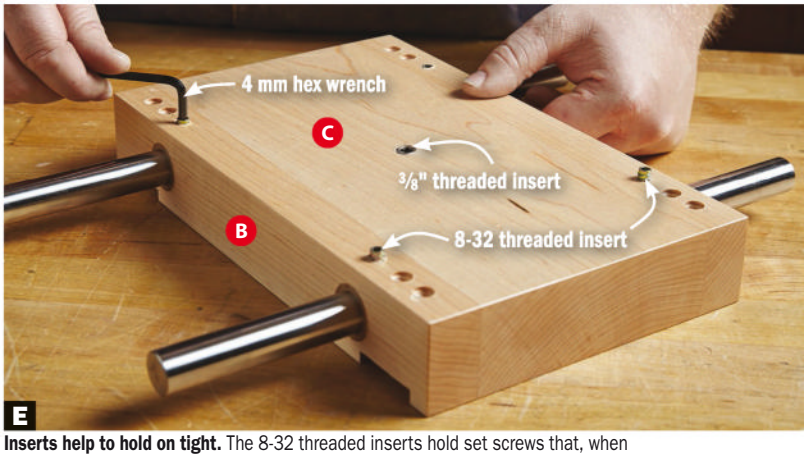
Note: *This mortiser is designed to accommodate the needs of left-handed and right-handed users. To set it up for left-handed use, simply mount the control arms and linkages in the mirror opposite of what's shown.*

4 Stack the pillow blocks (D) together face-to-face with double-faced tape. Mark and cut to shape the tops of the pillow blocks [**Drawing 2a**]. Drill the holes where shown.

5 Likewise, stack the yoke blanks together with double-faced tape, drill the 1" holes, and radius the corners [**Drawing 2b**]. Remove the base from your router and measure the diameter of the motor body. Separate the blanks and bore holes of that diameter in them using a hole saw or circle cutter. Then, drill the shank and pilot holes. Rip the blanks apart at the tablesaw to create the yoke tops (E) and bottoms (F).

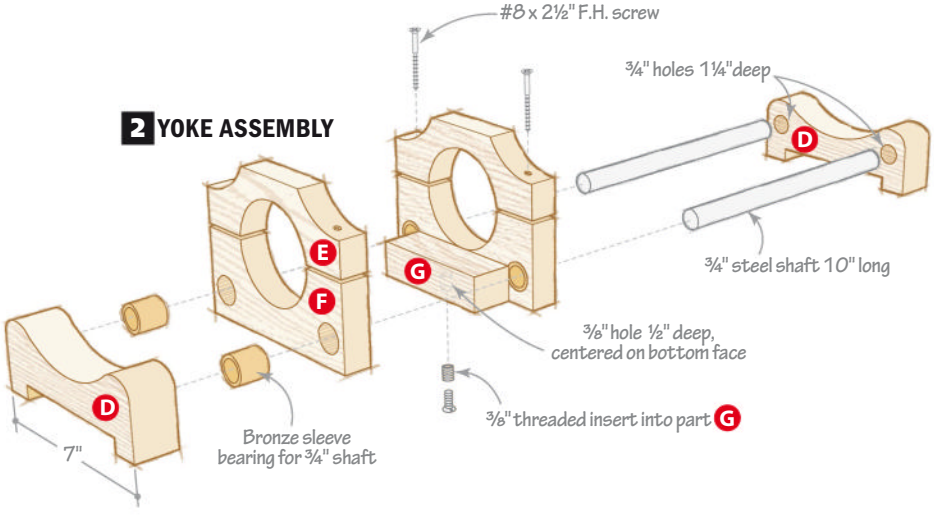
6 Press bronze bushings into the yoke bottoms (F) and glue the yoke spacer (G) in place [**Photo C**]. Adjust the fit of the steel shafts in the bushings if necessary [**Photo D**].

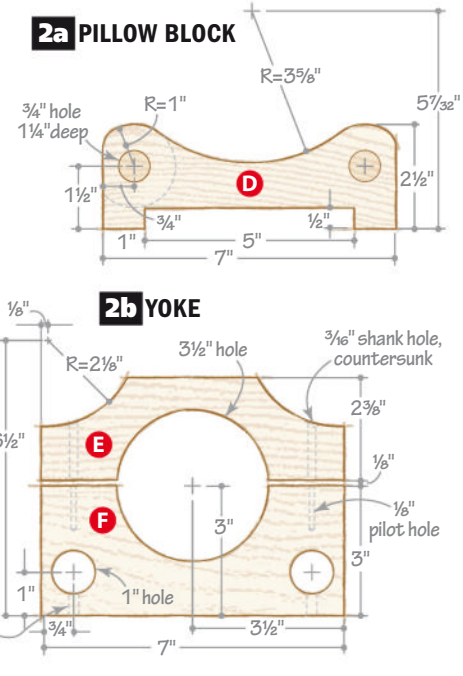
7 Check the fit of the yoke assembly (D–G) on the base assembly (A/B/C). Drill pilot holes for screws through the base plate sides (B) [**Drawing 1b**] into the feet of the pillow blocks (D). Drill ⅜" holes in the center of the base plate center (C) and the yoke spacer (G) for threaded inserts [**Drawings 2** and **3**]. Drill centered 15⁄64" holes beneath every bronze bushing for threaded inserts [**Photo E**].

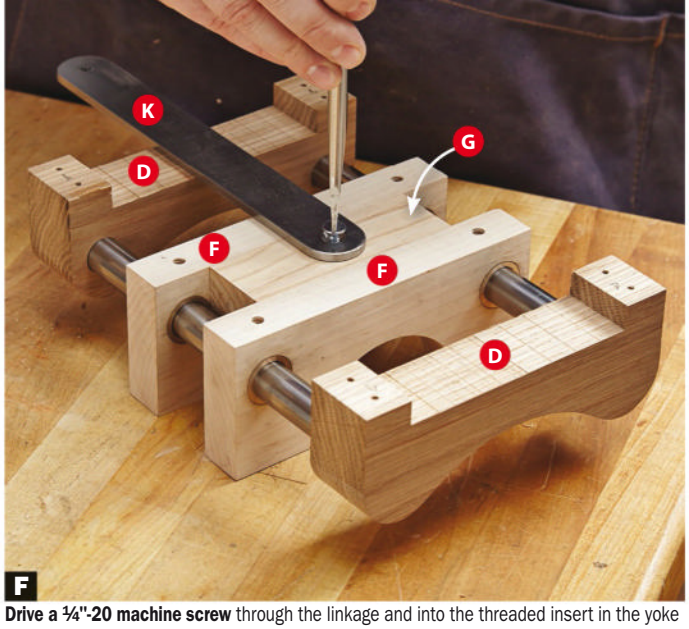


E

Inserts help to hold on tight. The 8-32 threaded inserts hold set screws that, when tightened, ensure the bronze sleeve bearings won't move with use.

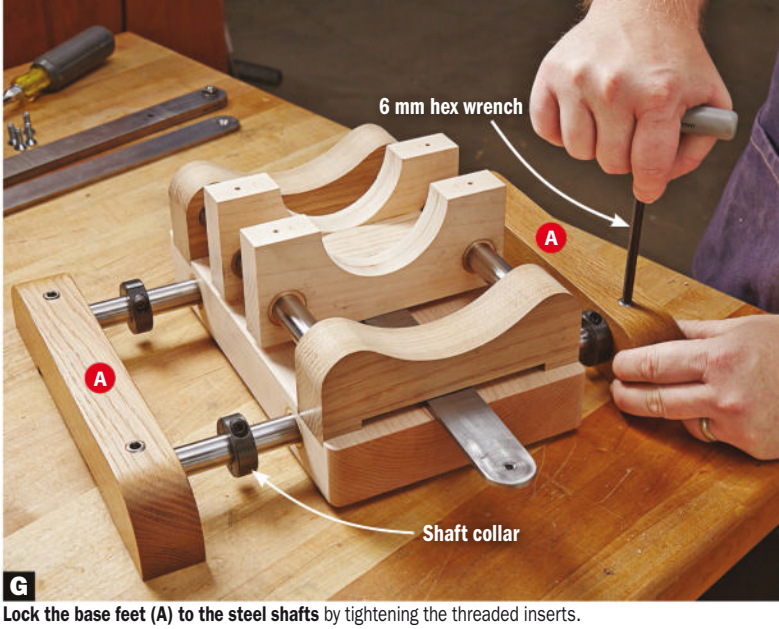






F

Drive a ¼"-20 machine screw through the linkage and into the threaded insert in the yoke assembly. Apply threadlocking adhesive to prevent the screw from backing out.



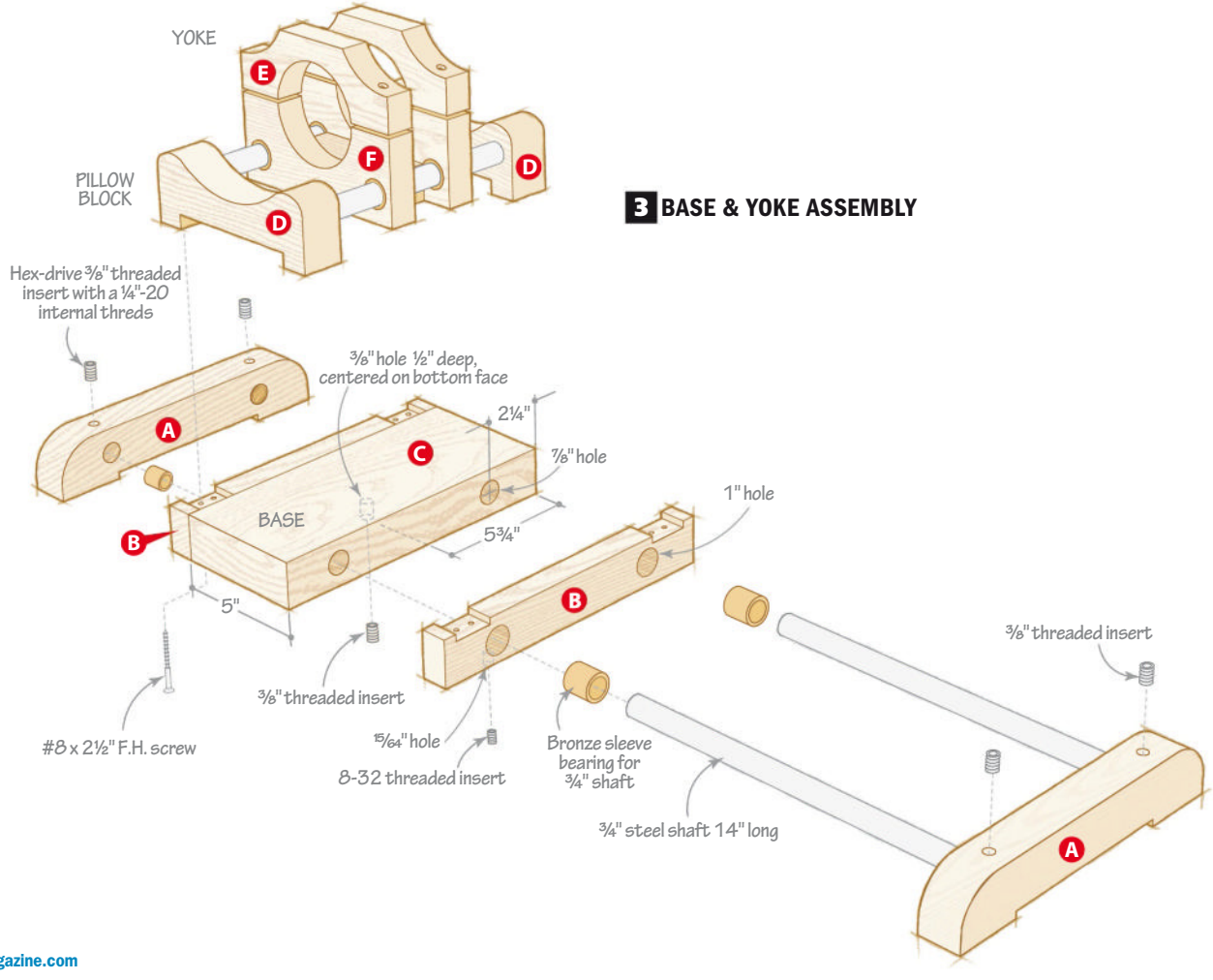
G

Lock the base feet (A) to the steel shafts by tightening the threaded inserts.

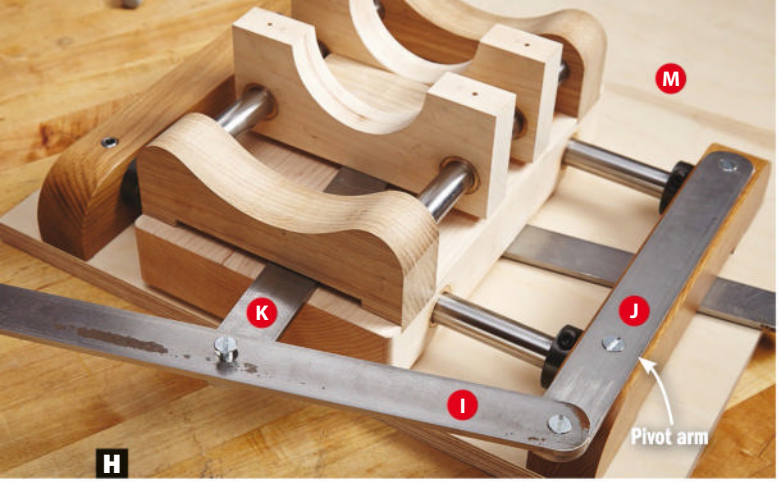
Mill the steel parts

1 From 3/16×1¼" steel, hacksaw the control arms (H, I), pivot arm (J), and linkages (K, L) to length [**Exploded View** and **Drawing 1**]. Round the ends with a grinder. Drill, countersink, and tap the holes to accept ¼"-20 machine screws. Install the short linkage (K) on the yoke assembly [**Photo F**].

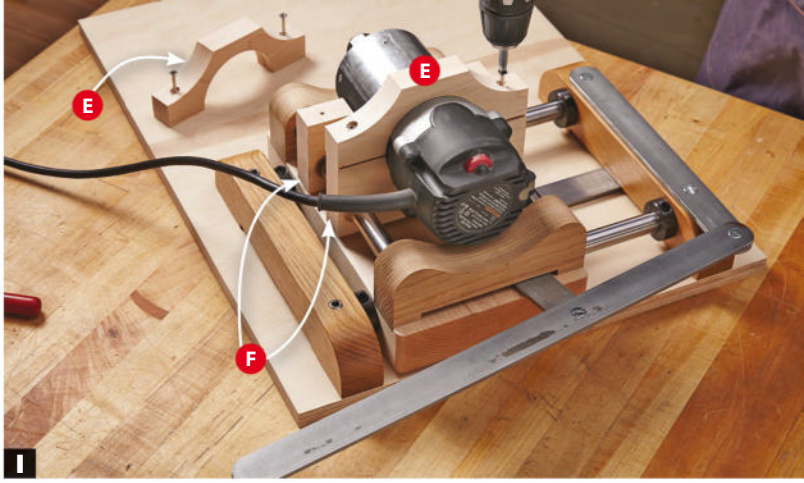
2 Screw the yoke assembly to the base assembly. Slide the steel shafts through the base assembly, bolt on the shaft collars, and attach the base feet (A) [**Photo G**]. Then, mount the long linkage (L) to the base plate center (C).



3 BASE & YOKE ASSEMBLY



Attach the pivot arm (J) to one of the base feet (A). Then attach the front-to-back control arm (I) to the short linkage (K) and pivot arm. Check the assembly for smooth front-to-back travel.



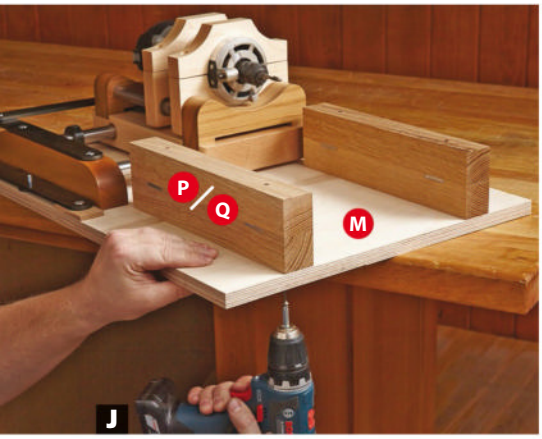
Tighten the yokes (E/F) around the router as high up on the router's motor housing as possible for maximum cutting depth.

Whip up a work table

1 Cut the mounting plate (M) to size [**Drawing 4**]. Screw the base feet (A) of the base/yoke assembly to the mounting plate from below. Install the pivot arm (J) and front-to-back control arm (I) [**Drawing 1, Photo H**]. Mount the router in the yoke [**Photo I**].

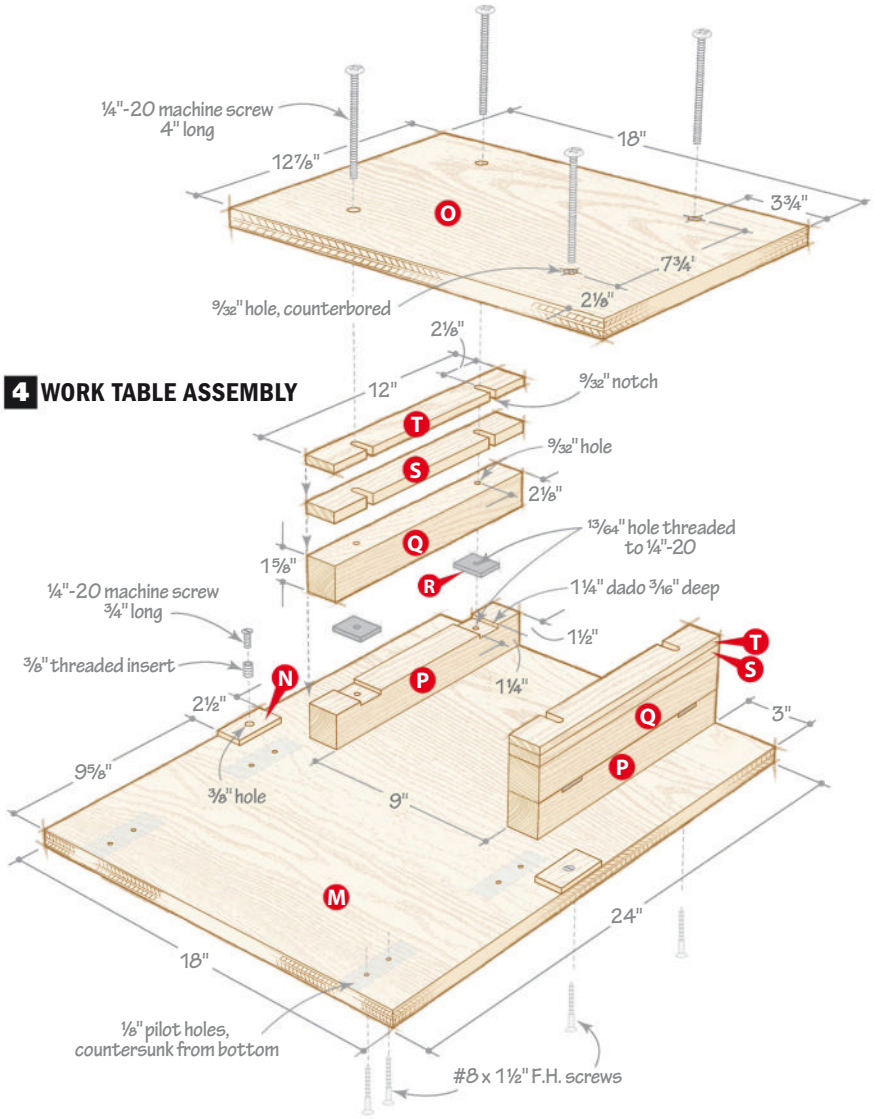
2 Cut to size the control-arm mounting plates (N) and glue them to the mounting plate (M) [**Drawing 4**]. Drill holes and install threaded inserts in the center of the control-arm mounting plates. Then, attach the side-to-side control arm (H) to a mounting plate and the long linkage (L) [**Exploded View**].

3 Cut parts O–R to size. Machine dadoes in the bottom risers (P) [**Drawing 4**]. Then, cut steel plates (R) to fit the dadoes and epoxy them in place. Drill completely through the plates and bottom risers and tap the plates for ¼"-20 machine screws [**Drawing 4**].



Place the mortiser so it overhangs the edge of your bench to simplify attaching the risers (P/Q) to the mounting plate (M).

4 WORK TABLE ASSEMBLY

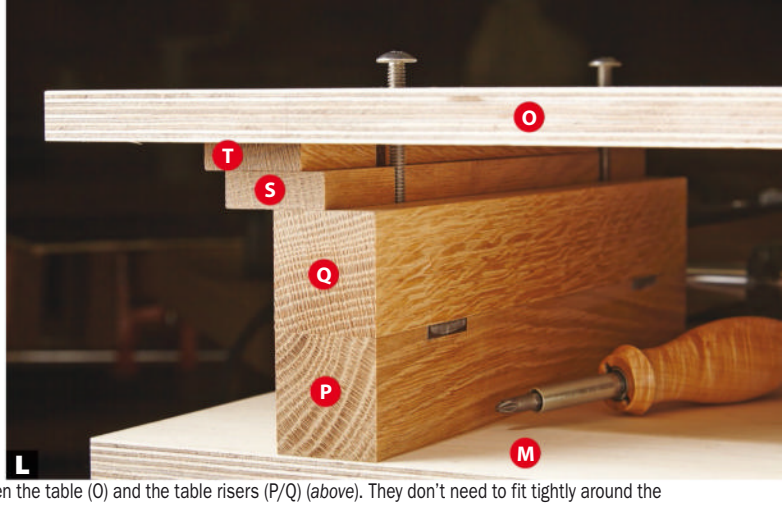


Using your mortiser

Before you set to work knocking out mortises, let's kick the tires. First, **to set the location** of the mortise on your workpiece thickness, adjust the height of the table (O) using the spacers (S, T), removing or adding as necessary. Make additional spacers of different thicknesses if needed to position the mortiser bit on your workpiece thickness.

To set the length of the mortises, use the shaft collars as stops. You can make mortises 4" long with the shaft collars at their limits.

To hold your workpiece in place during operation, clamp it to the table. Working with multiple identical parts? Position each one exactly the same way by clamping scrapwood stops to the table. Mount toggle clamps onto the stops to hold the workpiece flat against the table.



Notch the spacers (S, T) at the tablesaw (*above*). Then, check their fit around the bolts between the table (O) and the table risers (P/Q) (*above*). They don't need to fit tightly around the bolts; the bolts, when tightened, will hold them in place.

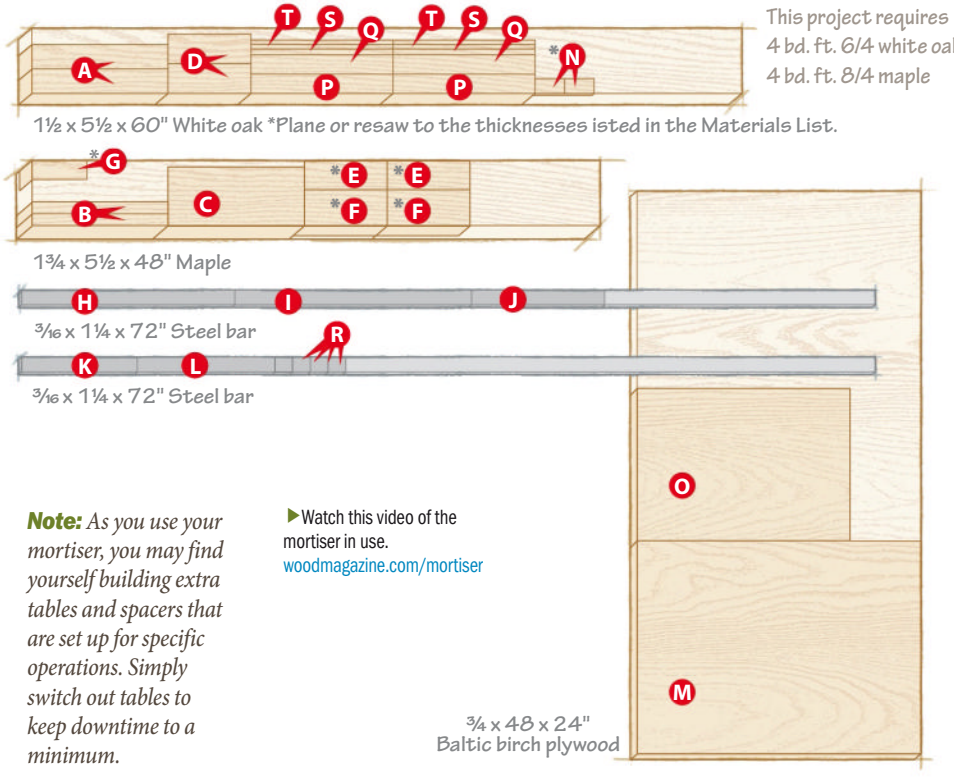
4 Transfer the hole locations on the bottom risers (P) to the tops of the top risers (Q). Drill 9/32" holes through the top risers, then glue the risers together [**Drawing 4**]. After the glue dries, glue and screw these assemblies to the mounting plate (M) [**Photo J**].

5 Cut to size the thick and thin table spacers (S, T). To ensure the holes in the spacers line up, cut one 1½×12" blank from 1" stock for each side. Drill 9/32" holes in them to align with the holes in the risers (P/Q). Then, resaw each blank into the two spacers and cut the notches [**Photos K** and **L**]. Use the spacers as guides to drill the counterbored holes in the table (O) [**Drawing 4**].

Assemble the mortiser. If everything functions as desired, disassemble the mortiser as much as possible. Finish-sand and apply a finish to all parts. We used satin spray lacquer. The steel control arms and linkages were finished with Birchwood Casey Cold Blue [**Sources**]. Reassemble after finishing, pop an upcut spiral bit in your router, and it's ready to go to work.

Produced by **Nate Granzow** with **John Olson**
Project design: **John Olson**
Illustrations: **Lorna Johnson**

Cutting Diagram



This project requires
4 bd. ft. 6/4 white oak
4 bd. ft. 8/4 maple

Note: *As you use your mortiser, you may find yourself building extra tables and spacers that are set up for specific operations. Simply switch out tables to keep downtime to a minimum.*

▶Watch this video of the mortiser in use.
woodmagazine.com/mortiser

Materials List

Part		FINISHED SIZE T	W	L	Matl.	Qty.
Router carriage						
A	base feet	1½"	2 1/16"	11½"	WO	2
B	base plate sides	1¾"	1"	11½"	M	2
C	base plate center	1¾"	5"	11½"	M	1
D	pillow blocks	1½"	2½"	7"	WO	2
E*	yoke tops	1"	2⅜"	7"	M	2
F*	yoke bottoms	1"	3"	7"	M	2
G	yoke spacer	1¼"	1½"	4⅝"	M	1
Work table						
H	side-to-side control arm	3/16"	1¼"	18"	S	1
I	front-to-back control arm	3/16"	1¼"	20"	S	1
J	pivot arm	3/16"	1¼"	11¼"	S	1
K	short linkage	3/16"	1¼"	9¾"	S	1
L	long linkage	3/16"	1¼"	11⅝"	S	1
M	mounting plate	¾"	18"	24"	BP	1
N	control-arm mounting plates	¼"	1¼"	2½"	WO	2
O	table	¾"	12⅞"	18"	BP	1
P	bottom risers	1½"	1⅝"	12"	WO	2
Q	top risers	1½"	1⅝"	12"	WO	2
R	steel plates	3/16"	1¼"	1½"	S	4
S*	thick table spacers	1½"	½"	12"	WO	2
T*	thin table spacers	1½"	⅜"	12"	WO	2

*Parts initially cut oversize. See the instructions.

Materials key: WO–white oak, M–maple, S–steel, BP–Baltic birch plywood.
Supplies: #8×1½", #8×2½" flathead screws; ¼" flathead machine screws, ¾" long (8); ¼"-20×4" machine screws (4); ¼" nuts (3).
Blades and bits: Dado blade; 15/64", 9/32", ⅜" brad-point bits; ⅝", ¾", ⅞", and 1" Forstner bits; 13/64" twist bit; tap driver and ¼-20 tap; countersinking bit.
Sources: This mortiser requires the following specialty parts and hardware to construct: bronze sleeve bearings for ¾" shaft, 1" OD, 1" length (8); ¾" diameter, 10"-long hardened-steel shafts (2); ¾" diameter, 14"-long hardened-steel shafts (2); (⅜" O.D.) ¼"-20×19/32" internal thread hex-drive tapping inserts (8); one-piece clamp-on shaft collars for ¾" shaft (4); hex-drive tapping inserts without flange, 8-32 exterior thread, 25/64" long (8).

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SUPER COUPON

16 OZ. HAMMERS WITH FIBERGLASS HANDLE

PITTSBURGH

CLAW LOT 69006 60715/60714

RIP LOT 47873 shown 69005/61262

SAVE 77%

YOUR CHOICE $3.99 comp at $17.99

20030947

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SUPER COUPON

12" x 33-3/8" WOOD LATHE WITH REVERSIBLE HEAD

CENTRAL MACHINERY

SAVE $118

$229.99

LOT 34706 comp at $347.99

20050785

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SUPER COUPON

POWDER-FREE NITRILE GLOVES PACK OF 100

SAVE 59%

- 5 mil thickness

HARDY

Item 68498 shown

SIZE	LOT
MED	68496/61363
LG	68497/61360
X-LG	68498/61359

YOUR CHOICE $5.99 comp at $14.97

19981895

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SUPER COUPON

350 LB. CAPACITY FOLDING SAW HORSE

CENTRAL MACHINERY

LOT 69446 shown 61979/60710

SAVE 44%

Customer Rating

$9.99 comp at $17.97

19992346

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SUPER COUPON

60 LED SOLAR SECURITY LIGHT

Bunker Hill Security

SAVE 54%

LOT 62534/69643 shown

Includes 6V, 900 mAh NiCd battery pack.

$31.99 comp at $69.99

20019846

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SUPER COUPON

27" ROLLER CABINET

Customer Rating

SAVE $279

LOT 61485 67421 shown

- Welded Steel Joints
- Lockable Drawers

$159.99 comp at $439.97

20036124

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SUPER COUPON

MOVER'S DOLLY

Customer Rating

HaulMaster

LOT 60497/93888 shown 61899/62399/63095/63096 63098/63097

SAVE 59%

- 1000 lb. capacity

$7.99 comp at $19.97

20057359

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SUPER COUPON

2 HP FIXED BASE ROUTER

Customer Rating

drillmaster

LOT 68341

SAVE 34%

$44.99 comp at $69

19982036

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SUPER COUPON

60" 4 DRAWER HARDWOOD WORKBENCH

LOT 69054/93454 62603 shown

Tools sold separately.

WINDSOR DESIGN

SAVE $235

$139.99 comp at $375

19994782

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SUPER COUPON

FREE

WITH ANY PURCHASE

3-1/2" SUPER BRIGHT NINE LED ALUMINUM FLASHLIGHT

LOT 65020/69052 shown
69111/62522/62573

$4.99 VALUE

LIMIT 1 - Cannot be used with other discount, coupon or prior purchase. Coupon good at our stores, HarborFreight.com or by calling 800-423-2567. Offer good while supplies last. Shipping & Handling charges may apply if not picked up in-store. Non-transferable. Original coupon must be presented. Valid through 9/3/16. Limit one FREE GIFT coupon per customer per day.

20104621

SUPER COUPON

CENTRAL MACHINERY

4" x 36" BELT/ 6" DISC SANDER

Customer Rating

SAVE $84

LOT 62502
97181 shown

$59.99

~~$84.99~~ comp at $144.10

20142039

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SUPER COUPON

SUPER QUIET

8750 PEAK/ 7000 RUNNING WATTS 13 HP (420 CC) GAS GENERATORS

PREDATOR GENERATORS

SAVE $459

LOT 68530/63086
63085/69671 shown

LOT 68525/69677
63087/63088
CALIFORNIA ONLY

Customer Rating

• 76 dB Noise Level

$539.99 ~~$599.99~~ comp at $999

20060628

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SUPER COUPON

CENTRAL MACHINERY

2 HP INDUSTRIAL 5 MICRON DUST COLLECTOR

• 70 Gallon capacity

Customer Rating

SAVE $210

LOT 61790/97869 shown

$169.99

comp at $379.99

20080357

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SUPER COUPON

ORBITAL HAND SANDER

Customer Rating

drillmaster

LOT 40070 shown
61311/61509

SAVE 66%

$9.99

comp at $29.97

20107979

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SUPER COUPON

6.5 HP (212 CC) OHV HORIZONTAL SHAFT GAS ENGINES

SAVE $228

PREDATOR ENGINES

LOT 60363
69730/68120

LOT 68121/69727 shown
CALIFORNIA ONLY

$99.99

comp at $328

20126622

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SUPER COUPON

16" VARIABLE SPEED SCROLL SAW

SAVE $59

CENTRAL MACHINERY

LOT 62519/93012 shown

Customer Rating

$59.99

comp at $119

20143720

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SUPER COUPON

PNEUMATIC ADJUSTABLE ROLLER SEAT

PITTSBURGH AUTOMOTIVE

SAVE 50%

• 300 lb. capacity

LOT 46319 shown
61160/61896

$19.99

comp at $39.99

20061039

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SUPER COUPON

CENTRAL MACHINERY

8", 5 SPEED BENCHTOP DRILL PRESS

LOT 62520/62390/60238 shown

SAVE $66

$59.99

comp at $126.47

20091976

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SUPER COUPON

NO. 33 BENCH PLANE

WINDSOR DESIGN

Customer Rating

SAVE 66%

$7.99

LOT 97544 comp at $23.63

20113839

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SUPER COUPON

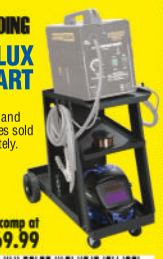
CHICAGO ELECTRIC WELDING

MIG-FLUX WELDING CART

SAVE 50%

Welder and accessories sold separately.

LOT 69340 shown
60790/90305/61316



$34.99

comp at $69.99

20130319

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SUPER COUPON

DOVETAIL JIG

WINDSOR DESIGN

LOT 34102

SAVE 51%

$27.99

comp at $57.98

20134995

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SUPER COUPON

ELECTRIC CHAIN SAW SHARPENER

CHICAGO ELECTRIC POWER TOOLS

Customer Rating

LOT 61613
68221 shown

4-1/4" grinding wheel included.

SAVE 44%

$27.99

comp at $49.99

20072294

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SUPER COUPON

ALUMINUM OXIDE SANDING SPONGES - PACK OF 10

Lifetime CARBIDE

SAVE 78%

YOUR CHOICE $3.99 comp at $18.27

COARSE LOT 46751
MEDIUM LOT 46752
FINE LOT 46753

20100755

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SUPER COUPON

12,000 LB. ELECTRIC WINCH WITH REMOTE CONTROL AND AUTOMATIC BRAKE

LOT 61256/60813
61889/68142 shown

SAVE $433

BADLAND

$319.99

comp at $752.99

20115490

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SUPER COUPON

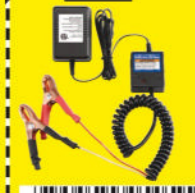
CENTECH

AUTOMATIC BATTERY FLOAT CHARGER

SAVE 82%

Customer Rating

LOT 42292 shown
69594/69955



$5.99

comp at $34.99

20140377

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Hand Tools We Love

Pull this rabbet out of your hat, er, tool chest

Jack Rabbet Plane, PM-V11 steel-alloy blade (05P53.71), $337

Combining the best features of a rabbet plane and a jack plane, this tool is perfect for cleaning up rabbets and tenons because the blade cuts the full width of the body. And the added length and mass helps you power through long rabbets or bevels.

Scoring spurs on each side eliminate tear-out, especially on cross-grain work. Simply adjust them up and out of the cut when not needed. Setscrews eliminate lateral blade movement. The included fence makes it easy to control the cutting width; we added an auxiliary wood face for extra support, helpful when edge-jointing a perfectly square edge.

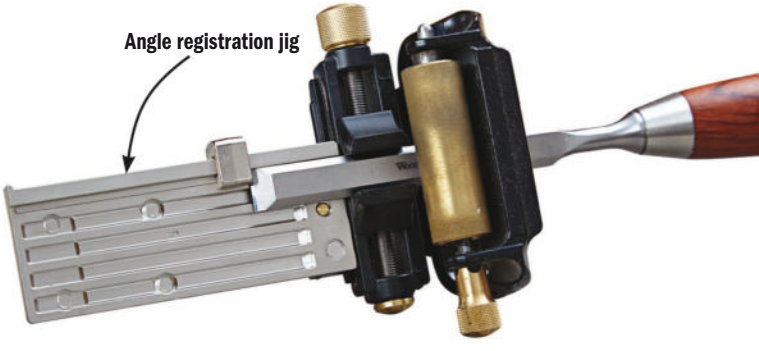
800-871-8158, leevalley.com

Trim your work, not your wallet

WoodRiver cranked-neck chisel plane set (151240), $44

Cranked-neck chisels work great for trimming anything flush with a workpiece's surface, such as dowel plugs or dried glue. This stubby set does that for a bargain price, thanks to four interchangeable blades that make it a cinch to reach any area of need, even tight corners. The short handle gives you access to areas where a long-handled chisel just can't reach.

800-225-1153, woodcraft.com



Sharpen narrow tools with precision

Veritas Mk.II Narrow-Blade Honing Guide (05M09.10), $84.50

We love the Veritas Mk.II honing guide. But it can't control side-to-side deflection on chisels less than ½" wide or those with no flat surface on top between the beveled edges. The self-centering jaws on this new honing guide clamp tools from the sides instead, keeping the cutting edges square to the blade's sides. It works with blades from ⅛" to 1½" wide, and at 15–40° bevel angles.

800-871-8158, leevalley.com

continued on page 82

Back Again for the First Time

Our modern take on a 1929 classic, yours for the unbelievably nostalgic price of ONLY $29!

You have a secret hidden up your sleeve. Strapped to your wrist is a miniature masterpiece, composed of hundreds of tiny moving parts that measure the steady heartbeat of the universe. You love this watch. And you still smile every time you check it, because you remember that you almost didn't buy it. You almost turned the page without a second thought, figuring that the ***Stauer Metropolitan Watch*** **for only $29** was just too good to be true. But now you know how right it feels to be wrong.

Our lowest price EVER for a classic men's dress watch. How can we offer the ***Metropolitan*** for less than $30? The answer is simple. Stauer has sold over one million watches in the last decade and many of our clients buy more than one. Our goal isn't to sell you a single watch, our goal is to help you fall in love with Stauer's entire line of vintage-inspired luxury timepieces and jewelry. And every great relationship has to start somewhere...

Tells today's time with yesterday's style. The Metropolitan is exactly the kind of elegant, must-have accessory that belongs in every gentleman's collection next to his British cufflinks and Italian neckties. Inspired by a rare 1929 Swiss classic found at auction, the ***Metropolitan Watch*** revives a distinctive and debonair retro design for 21st-century men of exceptional taste.

The ***Stauer Metropolitan*** retains all the hallmarks of a well-bred wristwatch including a gold-finished case, antique ivory guilloche face, blued Breguet-style hands, an easy-to-read date window at the 3 o'clock position, and a crown of sapphire blue. It secures with a crocodile-patterned, genuine black leather strap and is water resistant to 3 ATM.

Your satisfaction is 100% guaranteed. We are so sure that you will be stunned by the magnificent ***Stauer Metropolitan Watch*** that we offer a 60-day money back guarantee. If you're not impressed after wearing it for a few weeks, return it for a full refund of the purchase price. But once the first compliments roll in, we're sure that you'll see the value of time well spent!

Stauer Metropolitan Timepiece— ~~$199~~

Offer Code Price **$29** + S&P ***Save $170***

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Luxurious gold-finished case with sapphire-colored crown - Crocodile-embossed leather strap - Band fits wrists 6 ¼"–8 ¾" - Water-resistant to 3 ATM

This router lift also raises the table

Router Lift, $250

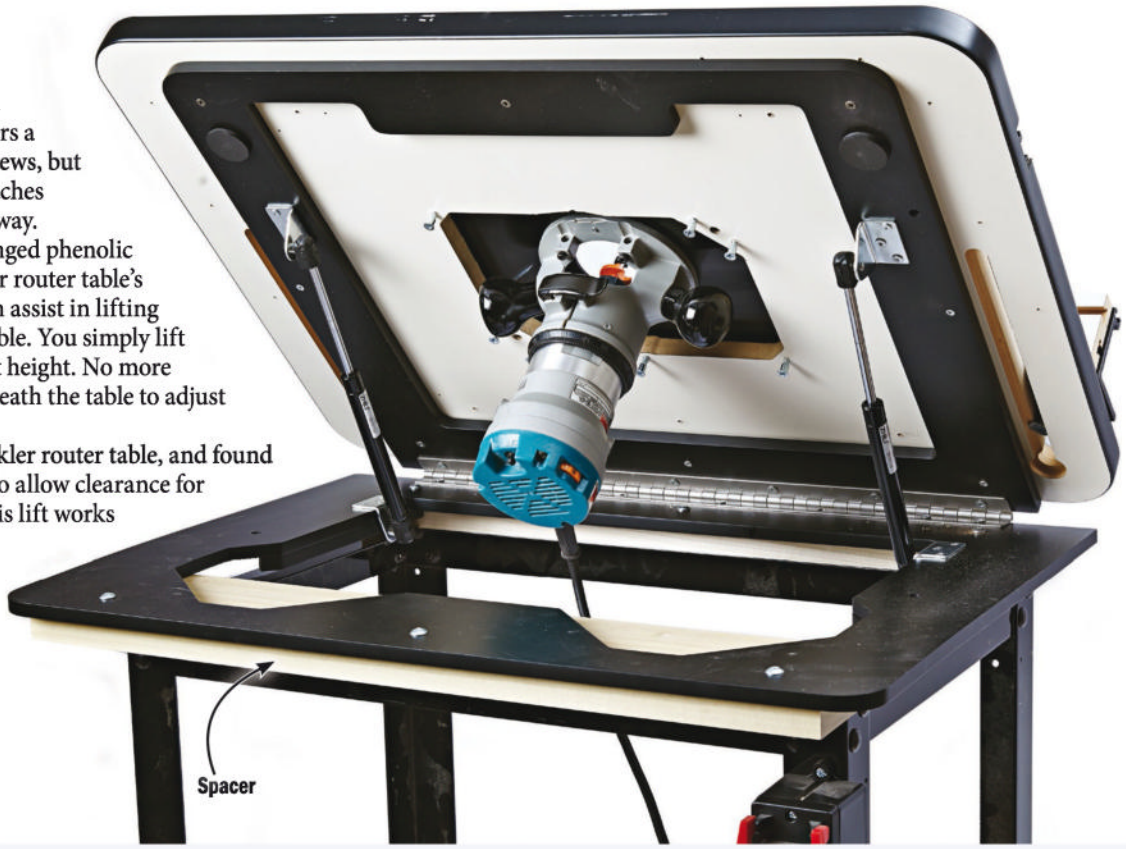
I usually think of a router lift as a mechanism that raises and lowers a router motor via threaded leadscrews, but the Dowelmax Router Lift approaches height adjustments in a different way.

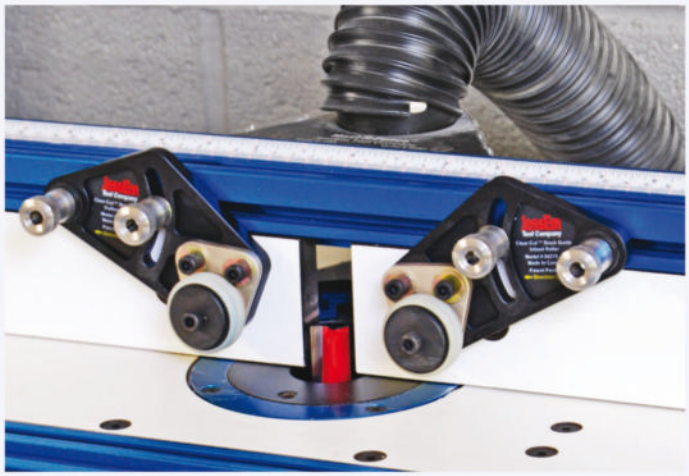
This lift consists of a pair of hinged phenolic plates that sandwich between your router table's stand and top. Two gas struts then assist in lifting and control the lowering of the table. You simply lift the top to change bits or adjust bit height. No more squatting down and reaching beneath the table to adjust the router.

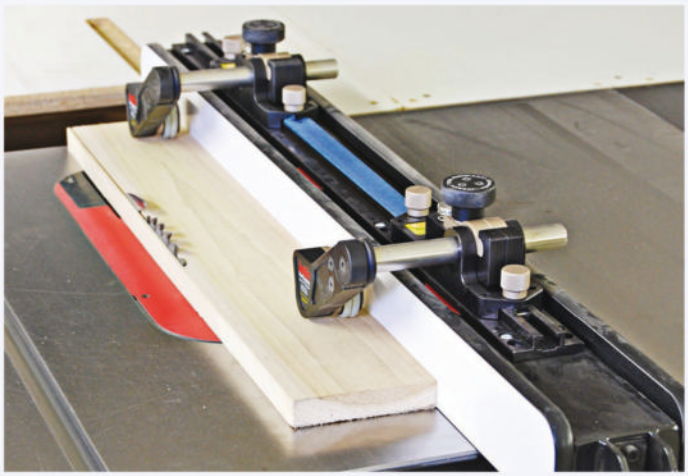
I mounted this system to a Rockler router table, and found that I needed to add two spacers to allow clearance for the strut mounts. No big deal. This lift works well for providing access to the router, but precision is still only as good as your router's adjustments.

—Tested by Bob Hunter, Tools Editor

Dowelmax/OMS Tool Co.
877-986-9400, dowelmax.com







Canted-roller guides keep routing and sawing on point

Clear-Cut Stock Guides, $100 for router table, $250 for tablesaw

Now that I've used JessEm's Clear-Cut Stock Guides, my old featherboards will gather more dust than they help create. The router-table guides mount easily in a T-slot on your fence, and lock in place anywhere along its length. The angled polyurethane guide rollers pull a workpiece toward the fence as you feed it through the bit, while simultaneously applying effective downward pressure. One-way bearings on the rollers prevent kickback.

The tablesaw guides work similarly, and if your saw's fence has a T-slot on top, simply attach the brackets directly. But for a Biesemeyer-style fence, you must first drill holes in its center beam to install the included T-track.

One downside, though: The router-table guides won't work with stock narrower than ¾", and for pieces narrower than 1½", you'll have to lay your pushstick flat to clear the rollers. And the tablesaw guides impede the use of a pushstick on stock narrower than 3½".

—Tested by Matt Seiler

JessEm Tool Co.
866-272-7492; jessem.com

continued on page 84

Health|EXCLUSIVE

Chicago Doctor Invents Affordable Hearing Aid

Outperforms Many Higher Priced Hearing Aids

Reported by J. Page

CHICAGO: A local board-certified Ear, Nose, and Throat (ENT) physician, Dr. S. Cherukuri, has just shaken up the hearing aid industry with the invention of a medical-grade, affordable hearing aid. **This revolutionary hearing aid is designed to help millions of people with hearing loss who cannot afford—or do not wish to pay—the much higher cost of traditional hearing aids.**

"Perhaps the best quality-to-price ratio in the hearing aid industry" — **Dr. Babu, Board-Certified ENT Physician**

Dr. Cherukuri knew that untreated hearing loss could lead to depression, social isolation, anxiety, and symptoms consistent with Alzheimer's disease. **He could not understand why the cost of hearing aids was so high when the prices on so many consumer electronics like TVs, DVD players, cell phones, and digital cameras had fallen.**

Since Medicare and most private insurance plans do not cover the costs of hearing aids, which traditionally run between $2,000-$6,000 for a pair, many of the doctor's patients could not afford the expense. Dr. Cherukuri's goal was to find a reasonable solution that would help with the most common types of hearing loss at an affordable price, similar to the **"one-size-fits-most" reading glasses** available at drug stores.

He evaluated numerous hearing devices and sound amplifiers, including those seen on television. Without fail, almost all of these were found to amplify bass/low frequencies (below 1000 Hz) and were not useful in amplifying the frequencies related to the human voice.

Surprising Source Inspires

The doctor's inspiration to defeat the powers-that-be that kept inexpensive hearing aids out of the hands of the public actually came from a new cell phone he had just purchased. **"I felt that if someone could devise an affordable device like an iPhone® for about $200 that could do all sorts of things, I could create a hearing aid at a similar price."**

- **Designed by a Board-Certified Ear, Nose, & Throat (ENT) Doctor**
- **Doctor-Recommended, Audiologist-Tested**
- **★★★★★Top Rated Hearing Aid Online— Thousands of Satisfied Customers**
- **Batteries Included! Comes Ready To Use**
- **FDA-Registered**
- **Save Up To 90%**
- **Free Shipping Available**
- **100% Money-Back Guarantee**

Affordable Hearing Aid with Superb Performance

The high cost of hearing aids is a result of layers of middlemen and expensive unnecessary features. Dr. Cherukuri concluded that it would be possible to develop a medical-grade hearing aid without sacrificing the quality of components. The result is the **MDHearingAid PRO**, under $200 each when buying a pair. **It has been declared to be the best low-cost hearing aid that amplifies the range of sounds associated with the human voice without overly amplifying background noise.**

Tested by Leading Doctors and Audiologists

The **MDHearingAid PRO** has been rigorously tested by leading ENT physicians and audiologists who have unanimously agreed that the **sound quality and output in many cases exceeds more expensive hearing aids.**

MDHearingAid® PRO

Proudly Assembled in the USA from Domestic & Imported Components.

100% Money-Back Guarantee 45-DAY RISK-FREE TRIAL

BBB A+ RATING ACCREDITED BUSINESS

Doctors and patients agree:

"BEST QUALITY SOUND"
"LOWEST AFFORDABLE PRICE"

"I have been wearing hearing aids for over 25 years and these are the best behind-the-ear aids I have tried. ***Their sound quality rivals that of my $3,500 custom pair of Phonak® Xtra digital ITE."***
—Gerald L.

"I have a $2,000 ReSound® Live hearing aid in my left ear and the MDHearingAid *PRO in the right ear.* ***I am not able to notice a significant difference in sound quality between the two hearing aids."***
—Dr. May, ENT Physician

"They work so great, my mother says she hasn't heard this well in years, even with her $2,000 digital! ***It was so great to see the joy on her face.*** *She is 90 years young again."*
—Al P.

For the Lowest Price Call Today

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Phone Lines Open 24 Hours EVERY DAY

Use Offer Code: CQ66 to get FREE Batteries for a Full Year!

FREE Shipping Available

MDHearingAid.com

Jet launches cyclone dust collectors

1½-hp cyclone collector (no. 717515) $1,050
2-hp cyclone collector (no. 717520) $1,400
3-hp cyclone collector (no. 717530K) $1,760

By shortening the link between the fan and filter on its new line of cyclone dust collectors, Jet claims more efficient airflow. The pleated canister filter is rated to trap dust as fine as 1 micron. Each machine comes with a remote-control starter, multi-port inlet, steel support frame, and steel collection drum.

800-274-6848, jettools.com

▶Read reviews of woodworking tools and add your own.

WOOD MAGAZINE'S REVIEWATOOL.COM

Skilsaw debuts worm-drive tablesaw

SPT70WT-22 10" tablesaw, $379

The Skilsaw worm-drive portable circular saw was invented in 1924, and nearly a century later, Skilsaw has adapted that technology to a job-site/benchtop tablesaw. The SPT70WT-22's worm-drive gearing delivers greater torque and runs cooler than traditional belt-driven saws, according to Skilsaw. This model has a maximum 25" rip capacity, and comes with a 30-tooth Freud Diablo rip blade.

877-754-5999, skilsaw.com

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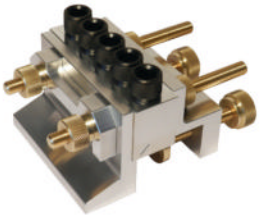
PRECISION ENGINEERED JOINING SYSTEM

GOLD MEDAL WINNER AT THE TOMORROW'S WORLD SCIENCE FAIR, LONDON, ENGLAND

Revolutionary New Router Table Lift

Reduced set up time and improved access vs. crank handle lifts.



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Guaranteed stronger than mortise and tenon and others.

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or log on to

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What's Ahead

A GLIMPSE INSIDE THE SEPTEMBER ISSUE (ON SALE JULY 5)

Stylish, simple bookcase
Who says pine can't look refined? This tome-toting beauty will look right at home in your den or study.

Krenov-inspired cabinet
Despite its high-style lineage, this slender beauty goes together with surprisingly simple joinery.

Cupcake tree
This project—as sweet to turn as the treats it holds—comes apart for easy storage.

Rock me, rock you
This nanny rocker lets you lull baby to sleep while multitasking with a book, phone, or tablet.

Benchtop drill presses
We test eight models in search of the best bit-spinner for your shop.

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