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Popular Woodworking

APRIL 2019 | #245



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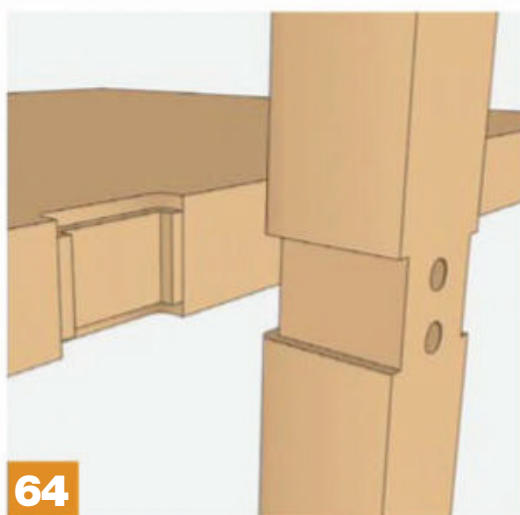
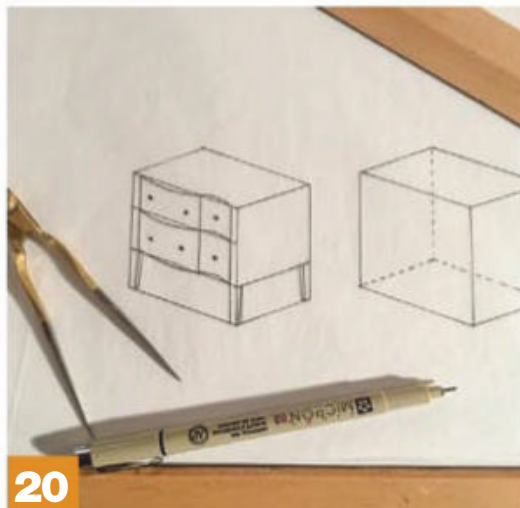


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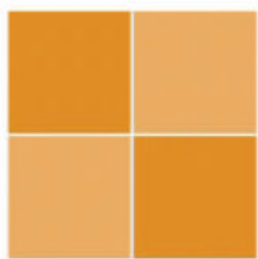
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Connect

FROM THE EDITOR

My Favorite Form of Procrastination

By Andrew Zoellner

There's a running joke at our house. I'll spend a day in the shop, punctuated with trips back and forth to the hardware store. Then I come in the house, and my girlfriend asks me, "What're you making?" And I'll say, "Oh, just more stuff for the shop."

Like many woodworkers, I don't have the luxury of unlimited space or an unlimited budget. I'm always puzzling over ways to give myself more room in the shop or better ways to store tools and organize the materials I keep on hand (or ways to convince my better half that parking in the driveway is better than parking in the garage even in the dead of winter). I'll head out to the shop to finally start in on the furniture project I've had in my head for months, but after moving a pile or two of workshop detritus, instead I'll catch myself putting things away and scheming up ways to stay better organized. When things are clean, I can *really* build some stuff. At least that's what I tell myself.

Likewise, bringing a new tool into the space isn't something to be taken lightly. Where does it go? What about the accessories for the tool? Will I need to move something to use it? That's a conundrum shared by our senior editor, David Lyell, so he designed an outfeed table for his table saw that incorporates space for a CNC router (page 40). Plus, it's



This box (a practice piece after I set up a box joint jig) sits by my table saw and is often the most organized part of my shop. It's where I start when it's time to clean and organize after a project, too.

a good size for an assembly table. That kind of versatility is exactly what we look for when choosing and building shop furniture.

There's also something to be said for simplifying your workflow. For instance, perhaps only using one finish in the shop—eliminating choices so you can focus on the task at hand. Perfect the application process and have faith that you'll be able to replicate the results again and again. Learn the ins and outs, the intricacies, and how the finish performs across wood species and application. That's what Austin Heitzman has accomplished with his finish of choice, and he's sharing his process with you (page 50).

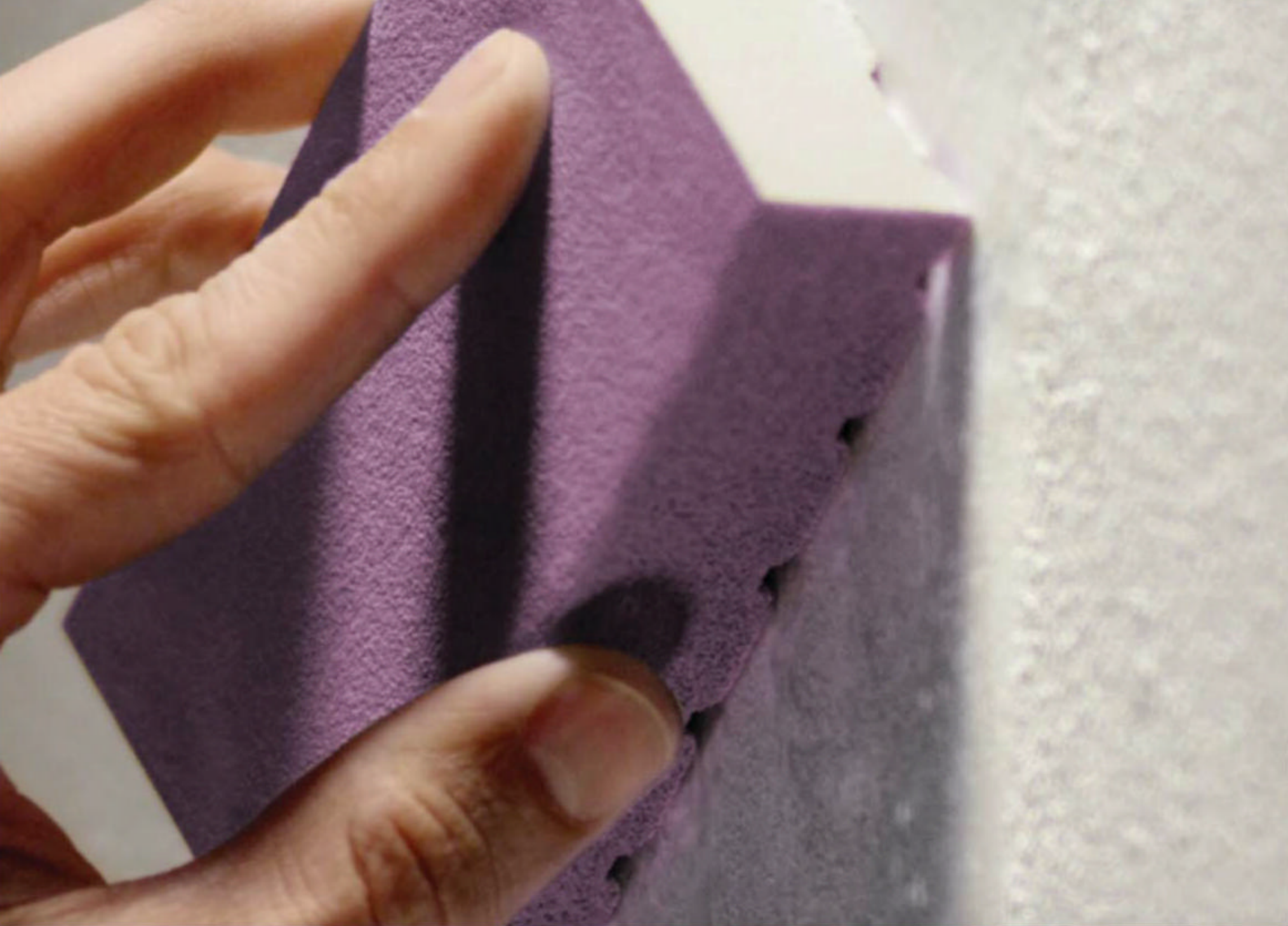
Of course, even simple things can make life better. The steplad-

der Will Myers made for this issue (based on precise measurements from one at the Hancock Shaker Village) is equally at home in the shop or in the house (page 33). The same goes for Zachary Dillinger's Art Deco clock (page 28). He designed a clock that can be wall mounted or set on a surface. It tells time, and it's a beautiful form (built completely with hand tools, to boot).

While you're dragging your feet on getting started on that next project (as I often do), use the time to think about the ways you can use woodworking to make your shop and your life simpler, easier and better.

Andrew Zoellner

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INBOX

Setting Up Shop

I'm in the process of converting a 360 square foot boat storage shed into a workshop and have two issues—among other things—that need to be addressed. Those are lighting and heating for my 18' x 20' shop space.

1. Lighting: I'd like to put in LED lighting right off the bat. When looking for lighting how many lumens should I ideally be looking for? What about the Kelvin temperature? Are there any other considerations that I should be aware of?

2. Heating: My shop is located 20 minutes from the base of Mt. Hood in Oregon. I need to find a cost-effective and efficient heating solution that I can hang off the ceiling or the wall, as I don't want to take up viable floor space. The heater can only be operated using electricity or propane; we don't have natural gas in our area. I'll be applying spray foam insulation to the inside of the shop next year.

Stanley Pearse, Oregon

I've worked through the lighting options in my home shop that I recently built out. With a shop that's nearly square like yours, I'd recommend four 4' LED fixtures to start. When purchasing these fixtures, keep an eye on a couple of numbers. I've seen 4' LED shop lights as low as 2,000 lumens and as high as 5,000 lumens. I'd shoot for something that's at least 4,000 lumens. Second, you'll need to make a personal decision about color temperature. I prefer something on the warmer side of the spectrum, around 4,000K. But some woodworkers swear by their daylight fixtures, 5,000K and up. The warmer temperatures are gentler on my eyes since I do most of my woodworking late into the night. Finally, watch out for the Color Rendering Index (CRI), as this'll dictate the quality of the light produced. LED shop light fixtures can be inexpensive and that's because they sacrifice CRI for sheer lumens. Find a quality fixture that's UL listed and has a CRI rating of at least 90. One final thought, look for a fixture that doesn't have an aggressive reflector, so the light is evenly distributed and bounces off the ceiling and walls to give an even cast.

As far as shop heat, I don't have as thorough of an answer. I have a 220V resistance fan heater in my shop and the bump in my energy bill was more than I would've guessed. But then again, insulating with spray foam and a good air seal may make it a more viable option for you.

David Lyell, Senior Editor



A Good Broad Hatchet

Regarding Peter Follansbee's comment (Issue 243, "How a Woodworker Uses a Hatchet") that he knows of no good single-bevel hatchets currently being made, we're all in luck. I know of a good one. My most used hatchet is the Vaughan SB2. It's the right size and weight, made in the USA, and widely available for about \$30.

Michael Springer, Colorado

Magnetic Tool Storage

This past summer my wife and I moved to a new home. My new workshop is somewhat of a blank slate, so I've been paying more attention to how others configure their workspaces. Of the many small tool storage options, I'm curious about magnetic tool strips.

Will magnetic tool strips adversely affect my tools? A magnetized screwdriver is helpful to keep a screw from getting away but a chisel that attracts swarf when being sharpened or wants to "stick to" another tool when you pick it up seems like a significant drawback.

Scott James, Ohio

Magnetizing a chisel or saw won't have any adverse effects in and of itself, but the ancillary effects could be frustrating (if you're able to actually magnetize the tool enough). I did a little bit of experimenting with a couple chisels of my own and magnets, and found that I was able to get a little bit of a magnetic charge on the chisels (moving them back and forth across a strong magnet). Then I went to sharpen (diamond stone and water), and swarf sticking wasn't an issue (some was attracted to the chisel, but it was miniscule and came right off in my process of drying off the chisel throughout sharpening). Likewise, I was able to attract some screws when I set it down near them on the bench, but again, they didn't stick enough to cause too much concern.

The biggest drawback, in my mind, is the metal on metal contact you'd have between a quality chisel and a magnetic tool strip. At least in my hands, there's a better chance that I'd knick an edge or dull a few saw teeth in the process of putting my tools back on a magnetic tool strip, which is why I stick with simple shop-made wooden tool holders. The French tool rack (*Popular Woodworking* #187) is a good compromise between safe storage and having your tools within arm's reach.

Andrew Zoellner, Editor in Chief

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WORKSHOP TIPS

Vacuum-Hose Dust Control

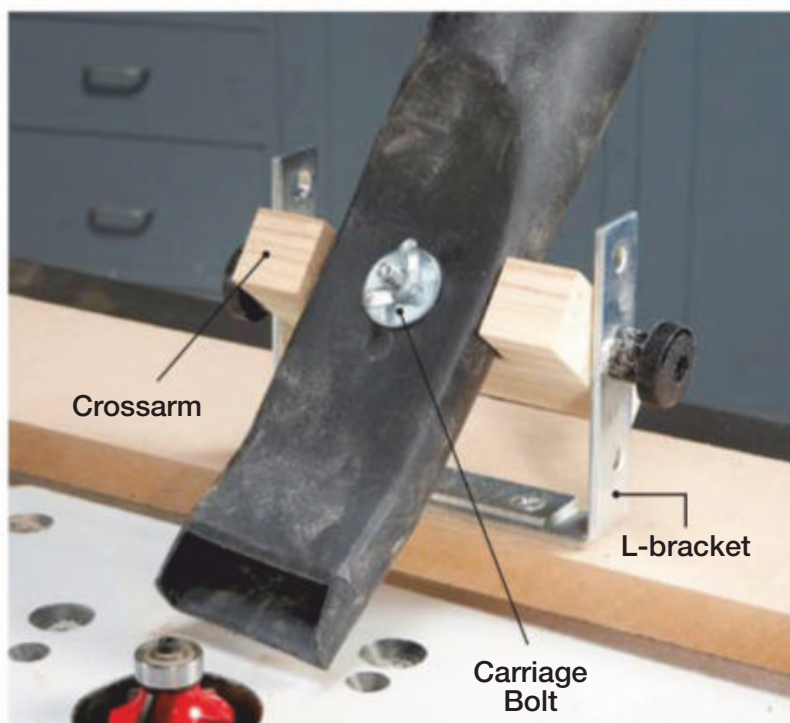
Dust is a real problem when you can't use a router table's fence and its dustport. If you're routing curved parts with a bearing-guided bit, for example, you don't use a fence, but you do make a lot of dust. I've devised a way to suck up that dust with my shop vacuum's nozzle. The nozzle is attached by a bolt to an adjustable stand that allows me to aim the nozzle directly at the bit.

All you need to make the stand is some common hardware and a board that's as long as your router table. The fixture that holds the nozzle is made from two L-brackets. To build the stand, overlap the brackets so they form a U shape and line up their holes. Center the brackets on the board and attach them with screws. Cut a wooden crossarm to fit inside the U. Cut a notch in the crossarm wide enough for your vacuum's nozzle. Drill a hole for a carriage bolt through the notch. Drill the same size hole through the nozzle. Drill a pilot hole in each end of the crossarm for a hanger bolt.

Slip the carriage bolt through the crossarm and nozzle, then add a washer and wing nut. Hold the crossarm between the L-brackets and install the hanger bolts through one of each bracket's screw holes. Use jig knobs to secure the crossarm at the desired angle.—*Len Urban*

Supplies List

No.	Item	No.	Item
2	6" L brackets	2	1/4"-20 female jig knobs
2	1/4"-20 x 1 1/2" hanger bolts	1	1/4"-20 wing nut
1	1/4"-20 x 3" carriage bolt	1	1/4" fender washer



One More Drawer

There's never enough storage space in a shop, is there? When I recycled some old kitchen cabinets to use in my shop, I added one more drawer to each one—in the toe-kick space.—*Mitch Palmer*



Hanging Glue-Up Rack

I mounted this towel-bar style rack on my shop wall for the times when I need to clamp up a small panel. It takes up very little shop space.

To make the rack, you'll need two 1/2" floor flanges, two 2" x 1/2" pipe nipples, two 1/2" 90° elbows, a 36" x 1/2" pipe, and as many 3/4" tees as you like. My rack is 36" long, but you can make it any length. The mounting pipe is 1/2" dia. The tees are 3/4" dia. so they'll slide to wherever they're needed. If you're using more than two clamps, you'll have to do a little adjusting to get their heads to line up perfectly.—*Ray Pruett*

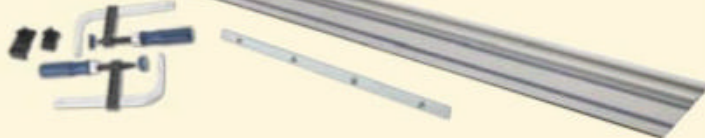
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TRACK SAW MASTER PACK

- Motor: 120V, 1.1kW, 5500 RPM, 9A
- Blade rim speed: 9070 FPM
- Max. cutting depth at 45°:
without rail 1⁵/₈", w/ rail 1⁷/₁₆"
- Max. cutting depth at 90°:
without rail 2⁵/₃₂", w/ rail 1³¹/₃₂"
- Includes saw blade:
160mm x 20mm x 48T
- Dust port dia.: 1¹/₂"
- Saw weight: 11 lbs.

W1835 Track Saw

Includes:
Accessory Pack
& 55" Guide Rail



W1832 Track Saw Master Pack

7" 2 HP PLANER MOULDER W/ STAND

- Motor: 2 HP, 240V, single-phase, 10.8A
- Cutterhead speed: 7000 RPM • CPM: 14,000 • CPI: 64-300
- Feed rate: 0-18 FPM • Max. profile: 6³/₄"W x 3³/₄"D
- Planing width: 7" • Min. stock length: 9"
- Min. stock thickness: 1¹/₄" • Max. stock thickness: 7¹/₂"
- Overall dimensions: 36¹/₄"L x 22"W x 34¹/₂"H
- Approx. shipping weight: 324 lbs.



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D3393 Elliptical Jig for W1812

10" TABLE SAW WITH RIVING KNIFE

- 3 HP, 230V, single-phase
- Blade tilt: Left, 0°-45°
- Table height from floor: 34"
- Cast iron table size:
27" x 40¹/₄"
- Table size with extension:
27" x 53⁵/₈"
- Arbor speed: 4300 RPM
- Arbor size: 5⁸/₈"
- Max. dado width: 1³/₁₆"
- Max depth of cut
@ 90°: 3¹/₈",
@ 45°: 23¹/₁₆"
- Max. rip capacity: 29¹/₂"
- Overall dimensions:
62"L x 41"W x 40"H
- Approx. shipping
weight: 527 lbs.

Includes 10"
Carbide-Tipped
Blade



W1819 10" 3 HP Table Saw with Riving Knife

13" 3/4 HP, BENCH-TOP OSCILLATING DRILL PRESS

- Motor: 3/4 HP, 110V, 1725 RPM
- Overall height: 38"
- Spindle travel: 3¹/₄"
- Swing: 13¹/₄"
- Drill chuck: 5⁸/₈"
- Speeds: 12, 250-3050 RPM
- Table: 12³/₈" dia.
- Table swing: 360°
- Table tilt: 45° left & 45° right
- Approx. shipping
weight: 123 lbs.



W1668 13" 3/4 HP, Bench-Top Drill Press

12" X 15" VARIABLE SPEED BENCH-TOP WOOD LATHE

- Motor: 3/4 HP, 110V, single-phase, universal motor
- 12" swing over bed • 15" between centers
- Two spindle speed ranges: 500-1800 RPM &
1000-3800 RPM
- 1" x 8 TPI RH thread spindle size
- Spindle indexing in 15° increments
- Heavy-duty cast-iron
construction
- Approx. shipping
weight: 87 lbs.



W1836 Bench-Top Wood Lathe

KNIFE BELT SANDER/BUFFER

- Motor: 1 HP, 110V, 14A, 1725 RPM
- Belt size: 2" x 72"-76" range
- Belt speed: 4500 FPM
- Left arbor: 1" x 8¹/₂" extension
with 5⁸/₈" arbor
- Height with belt arm horizontal: 11¹/₂"
- Height with belt arm vertical: 37"
- Overall width: 29¹/₂"
- Cast iron body
- All ball bearing construction
- Approx. shipping weight:
113 lbs.

New



W1843 Knife Belt Sander/Buffer

14" SUPER-DUTY RESAW BANDSAW

- Motor: 2 HP, 110V/220V (prewired 110V),
1720 RPM, 15A at 110V, 7.5A at 220V
- Table size: 21³/₄"L x 16¹/₂"W
- Table tilt: 5°, 45°
- Floor to table height: 37"
- Max cutting height: 14"
- Max throat capacity: 13¹/₂"
- Max cutting width with fence: 12"
- Overall size: 29"W x 32¹/₂"D x 76"H
- Dual 4" dust ports
- Footprint: 23"L x 18"W
- Approx. shipping weight: 388 lb.

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W1849 14" Super-Duty Resaw Bandsaw

WALL-MOUNT DUST COLLECTOR

- Motor: 1 HP, 120V/240V
(prewired 120V), 7A/3.5A
- Air suction capacity: 537 CFM
- Static pressure: 7.2"
- Filter rating 1 micron
- Bag capacity: 1.5 cubic feet
- Intake hole size: 4"
- Impeller: 10" balanced
cast aluminum radial fin
- Canister filter size (dia. x
length): 15" x 16³/₁₆"
- Height with bag
inflated: 46"
- Sound level: 77-79 dB
- Approx. shipping
weight: 62 lbs.



W1844 Wall-Mount Dust Collector
with Canister Filter

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Cam-Style Bench Feet

A mobile workbench is handy in a small shop—until you want it to stand still! After outfitting my bench with casters, I found that their locks didn't prevent the bench from wiggling.

My solution is to add levers to each leg. They work like a cam. With the lever in the horizontal position, the bench rests on the casters. In the vertical position, the casters are raised off the floor about $\frac{1}{4}$ ", so the bench stays put, sitting on wide, flat feet.

Each cam is made from two pieces of $\frac{3}{4}$ " plywood—the second piece is a spacer behind the lever for hand clearance. Cut the spacer's shape to match the cam's foot, to give the foot a larger area of contact with the floor. Attach each assembly with a bolt and lock nut.—*Mark Thiel*



Plywood Caddy

Carrying plywood by yourself is a pain. Here's a helper that allows you to roll it around instead. Just clamp this caddy to the board's edge, tip the sheet down onto the wheels and off you go.

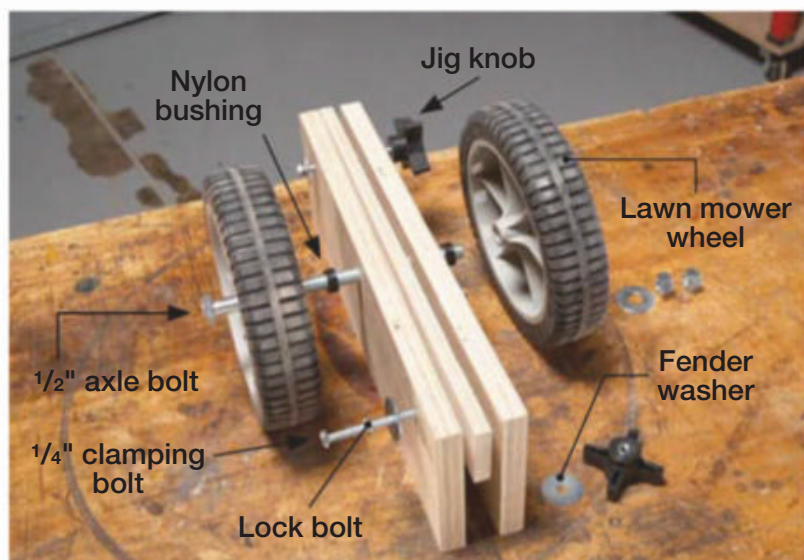
The caddy will fit plywood that's $\frac{1}{2}$ " to $\frac{3}{4}$ " thick. Its sides aren't glued together—they just slide on bolts. I put 7" lawn mower wheels on my caddy so I can roll it over an uneven driveway or my yard when I'm unloading plywood from my truck. Large wheels are ideal for a shop floor, too, because they roll easier than small wheels. Of course, you can use wheels of almost any size.

To make the caddy, temporarily nail together its three parts, flush at the bottom. Drill a $\frac{1}{2}$ " hole for the axle through all three pieces, 1" up from the bottom and centered between



the ends. Drill two $\frac{5}{16}$ " holes for the $\frac{1}{4}$ " clamping bolts. Position the holes 2" from the bottom and 2" from each end. Disassemble the parts.

To assemble the caddy, slip a washer onto the axle bolt and slide the bolt through one wheel. Slip on a nylon bushing, then slide the bolt through the axle hole. Slip on the other nylon bushing, the other wheel, washer and two nuts. Lock the nuts together, leaving about $\frac{1}{4}$ " on either side of the spacer. On the $\frac{1}{4}$ " bolts, slip on a lock washer and a fender washer, then slide them through the $\frac{5}{16}$ " holes. Slip on the other fender washers and thread on the jig knobs.—*Ken Bailey*



Cut List

No.	Item	Dimensions (inches)		
		T	W	L
2	Plywood sides	$\frac{3}{4}$ "	5"	16"
1	Plywood middle	$\frac{1}{2}$ "	2 $\frac{1}{2}$ "	16"

Supplies List

No.	Item	No.	Item
2	7" lawn mower wheels	2	$\frac{1}{4}$ -20 female jig knobs
2	$\frac{1}{2}$ " x $\frac{3}{8}$ " nylon bushings	4	$\frac{1}{4}$ " fender washers
1	$\frac{1}{2}$ " x 8" bolt	2	$\frac{1}{4}$ " lock washers
2	$\frac{1}{2}$ " nuts	2	$\frac{1}{2}$ " washers
2	$\frac{1}{4}$ " x 3" bolts		

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TOOLS

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dreading sanding quite as much. The paper cuts fast and doesn't clog up like some other abrasives we've used. With proper dust collection on the sander, I found no issue

with dust left behind. I did notice that the backing didn't hold on to the Mirka sander after dropping it in a pile of saw dust—that sheet had plenty of abrasive left but I couldn't get it to stick again. I also found that the writing on the back of the paper faded quickly, leaving me a little disoriented after working through the grits. Overall, I was delighted with how efficiently the paper cut. —David Lyell

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Veritas Shooting Board

Shooting boards are typically purposefully primitive – a fence set upon a board to hold your workpiece while planning the perpendicular face. A well equipped bench will have several variations nearby depending on the work that is being done (the vast majority of my work is accomplished with a single 90° board). However, there are plenty of times when I have wanted a few more boards, but haven't taken the time to set them up. This is where the Veritas Shooting Board shines.

For \$199, you are purchasing time and accuracy for your bench work. In typical Lee Valley fashion, the product is thoughtfully engineered, but don't skip the 4 page owners manual, you'll find critical information for setting up the board. The fence swings on top of a plate that anchors the whole mechanism to the board. You'll find 8 stops for the most common fixed angles. Once you swing in to one of the detents you must pay attention to where the indicator lies. There are seven marks that allow you to fine tune the angle by a $\frac{1}{4}^\circ$, the center mark representing dead-on.

The sacrificial fence is held in place by a couple of thumbscrews that allow you to slide it quickly while adjusting the angle of the board.

Perhaps my only trouble was with the shooting track. There is plenty of opportunity for shavings to interrupt the ride of the shooting plane within the track. Frequent clearing gave me the best performance.

The unit can be purchased prebuilt as a right or left hand shooting board. Or you can purchase just the adjustable fence that you can mount in a right or left hand configuration.—*David Lyell*

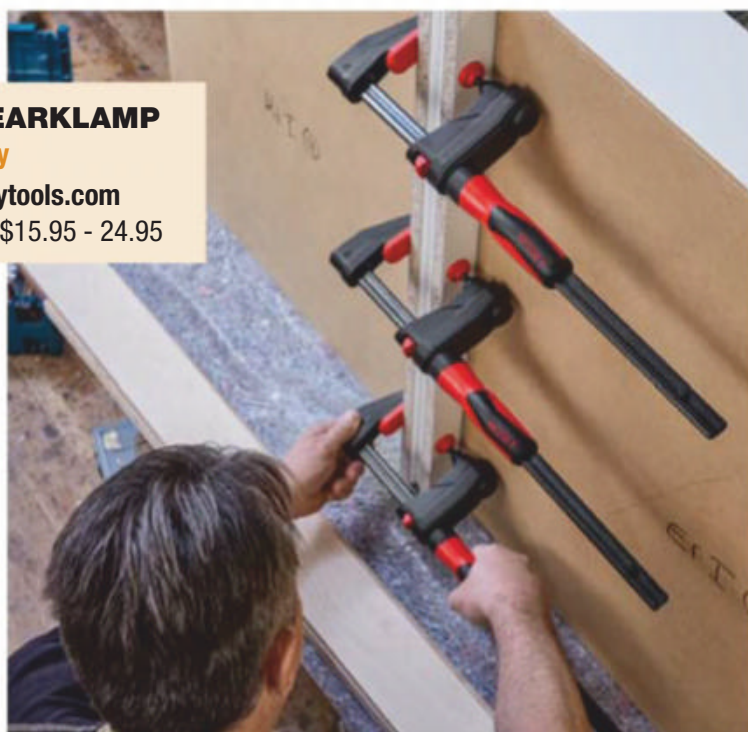


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Bessey GearKlamp

My knuckles scars are proof of trying to tighten f-clamps in weird places like where the handle is against the wall of a cabinet and other confined spaces. The folks at Bessey seem to have experienced the same frustration because the GearKlamp is designed to reach into places that just weren't possible with your average bar clamp or f-clamp. The bar slides through the handle allowing the jaws to reach into the clamping space without compromising the ability to use the handle. The clamping pressure is rated at 450 pounds, and the gearing is made of plastic, so I wouldn't recommend these for panel glue ups, but for cabinet assembly they're very handy. Keep in mind there's only an inch of screw travel—this felt odd after using clamps that have more than 3" of screw travel. —*David Lyell*

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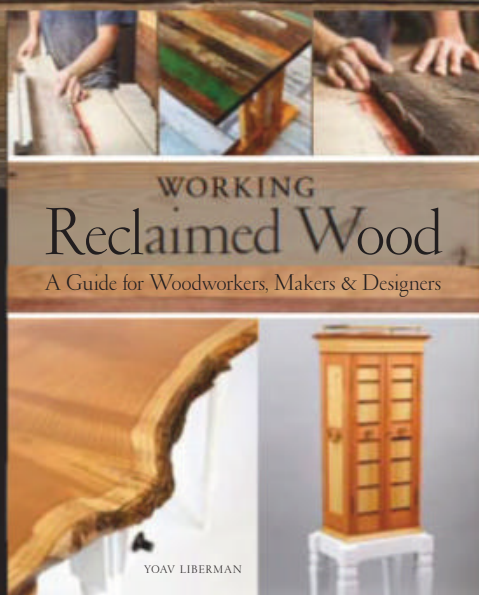
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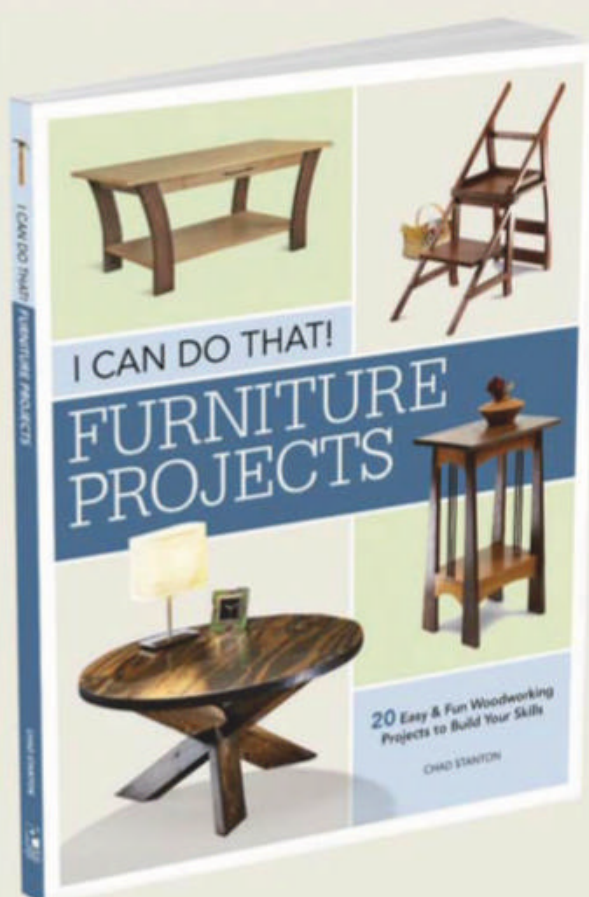
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The Power of Frame & Panel Joinery

Master these skills and you can build anything.

By Peter Follansbee

My first how-to woodworking forays in the late 1970s were badly aimed. Starting out by reading about cabinetmaking, I was in way over my head. Wood selection, grain orientation, bookmatching; so much of what I was reading was aimed at advanced woodworkers. But I was a beginner. I backed up somehow and started learning about cutting the joints. The dovetail ruled supreme at the time. It was as if it was a marker for quality.

Life often throws us curveballs, mine was the onslaught of “green woodworking” books by Drew Langsner, Jennie Alexander and Roy Underhill. These books (and people) saved my woodworking career. I segued into chairmaking and other pursuits based on stock riven or split from freshly felled logs. Along the way, I learned the all-important and versatile mortise-and-tenon joint. And with it, the composition that allows me to build most anything



This partially assembled door shows its tell-tale components: the mortise-and-tenon joints, with a panel groove running along the stile.



I might want or need—the frame and panel. Five pieces of wood, the rectangular frame has two vertical “stiles” and two horizontal “rails” joined at the corners by mortise-and-tenon joints. The inner edges of this frame are grooved to receive the beveled edge of the panel. With this format, I’ve built chests and boxes, cupboards (and the doors for them), cradles, chests of drawers, chairs, and my shop (I skipped the panels there, but Old World timber frames often have panels in the form of plastering, brickwork, etc.). I’ve

1. This plain cupboard shows off the frame-and-panel format. No need for wide boards; you can fill your spaces with more framing and more panels.



2. The plow plane's adjustable fence guides it along the framing parts to cut accurately aligned grooves for the panels.

3. Some panels are raised. I use beveled panels. Trim their rear faces to a long, sloping bevel to feather the edge to fit the grooves.

4. Test-fit three sides of the frame together, then slip the beveled panel into place. Check the fit and make any necessary adjustments.

not done it, but you could outfit the interior of a church with frame-and-panel work—the pews and pulpits in historic English churches were made by local joiners.

Mine are almost always oak that I've riven, hewed and planed from green wood. You don't have to start there, but it's more fun if you do. Once you have the stock prepared, lay out the joinery. I use an awl, a square and a mortise gauge.

My stock is usually about an inch thick. I set the mortise gauge according to the width of my mortise chisel, usually $\frac{5}{16}$ ". I line my mortise chisel flush at the edge of the stile. I lean on it to make a mark then move the chisel over one chisel-width. This time I lean more heavily, making a clear impression on the wood. This is the mark to use for setting the mortise gauge; no ruler needed. Line up the pins of the gauge with this chisel-strike and mark the limits of both the mortises and tenons with this setting.

There are lots of approaches to chopping mortises. Try one repeatedly and stick with it for several dozen

mortises. Then experiment with others. Repetition is really the key. I chop a V-notch right in the middle of the mortise's length, and keep extending that both deeper and longer. Check that your chisel is parallel to the outer face of the stile. It's easiest if that means plumb, rather than having the stock tilted on the bench. For a cupboard door, the mortises don't extend to the top and bottom ends, but are stepped in a bit so there's no exposed joint when you cut the stiles to their final length.

I cut tenon shoulders with a backsaw, and split the cheeks off with a chisel. This is easy because I know my stock will split reliably. Sawn stock might require that you saw all the parts of your tenon. I angle the front shoulder a bit, undercutting it so it snugs up nice and tight to the mortised piece when I assemble.

The panel fits in grooves cut into the frame's inner edges. I use a plow plane to make these grooves. If you don't have a plow, you could cut the grooves with a narrow chisel. In that case, deeply score the groove's position with a marking gauge and then use the chisel bevel down to carefully pare the groove. Patience required.

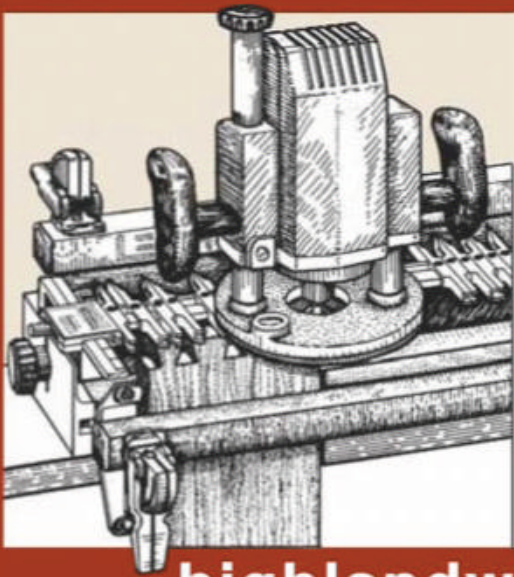
Once you have a plow plane, your life will get simpler. The plow plane features a fence to guide it along its

path. The fence is adjustable, some by wooden screws, some by captured wedges. The iron I use is only $\frac{3}{16}$ " wide. I line this groove up in the midst of the $\frac{5}{16}$ " joints I cut. I start this plane at the far end of my stock and work backwards as I work forwards. Light shavings and sharp irons are key. I make the groove about $\frac{1}{2}$ " deep. I extend it beyond the mortises so it reaches full depth throughout.

Beveling the panel is easy. This isn't raised-panel territory. The inside face is beveled and the outer face is flat (mine are usually carved). I use a hatchet to rough out the long shallow bevel. You can substitute a scrub plane and/or a drawknife if hewing is too daunting. I follow the hatchet with a smooth plane. My bevels fair down almost to nothing to fit the narrow grooves.

A test assembly is imperative; adjustments are made. Once the frame will close up around the panel, pin the joints. In my world, mortise-and-tenon joints must be drawbored. Once you can make the frame and panel, nothing can stop you. Go. **PW**

.....
Peter Follansbee has been involved in traditional craft since 1980. Read more from him on green woodworking, period tools and other topics at pfollansbee.wordpress.com.



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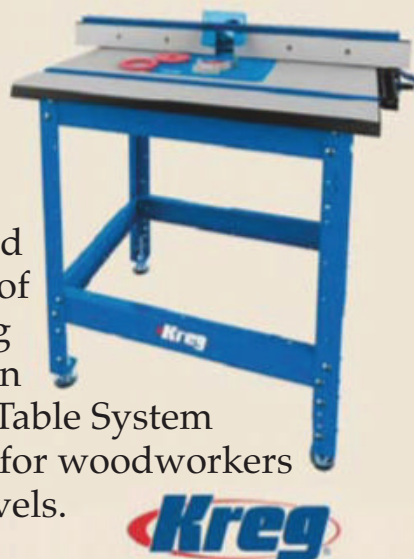
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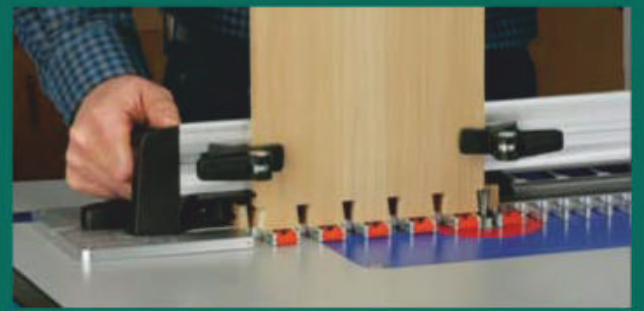


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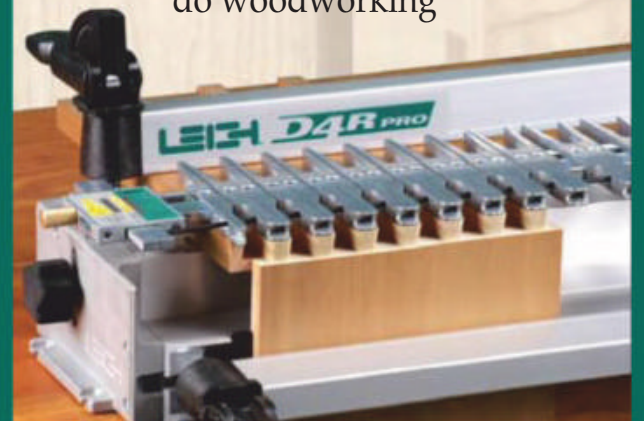
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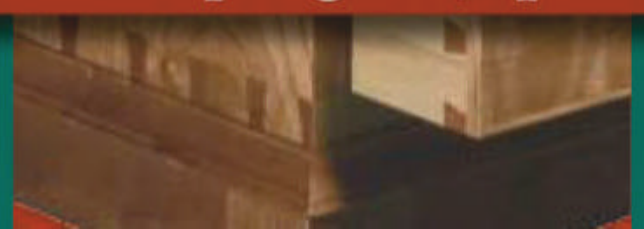


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Chasing a Vision

The design journey isn't a straight line.

By George Walker

I used to work with a guy

whose nickname was the Wiz. He was an exceptional liar and a great storyteller. When the Wiz told a story he'd get all worked up, his arms waving and the veins popping out of his bald head. We used to joke that the reason he got so excited was because he didn't know how the story was going to end either.

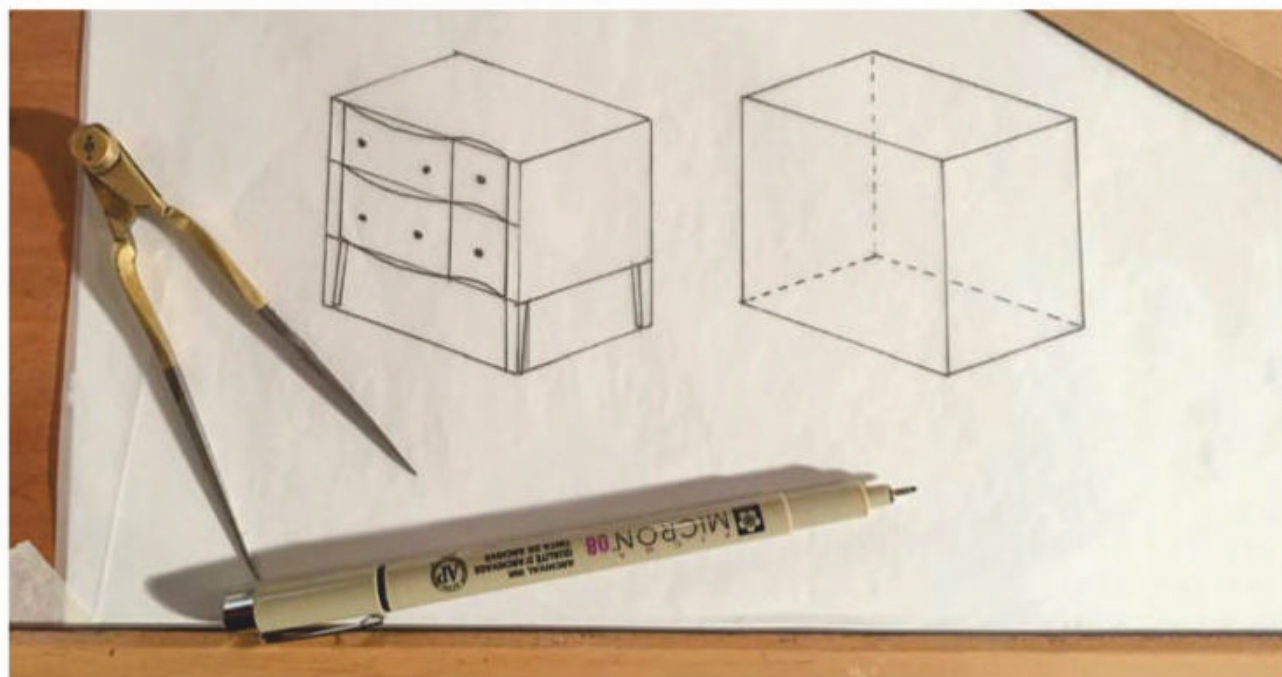
Design is a little bit like that idea that the ending isn't always certain at the beginning. We might have an idea of what we want to build, how big it should be, or what sort of wood we might use. But the project starts out as just some sort of vision off in the distance that's blurred and not quite in focus.

The whole idea of design is to take steps toward a vision and bring the elements into sharper detail until it's all clear. The many steps along the design path are each meant to bring us closer to the vision. In practice, the design journey isn't a straight line, but more like a series of zigzags that move us to our goal.

I divide the design journey into three broad stages—Define, Explore,



1. Each step moves us toward the destination, and ideally that zigzag line gets tighter as we hone in on the finished design.



Refine. Each stage has a goal and all the steps within that stage are aimed squarely at reaching the goal.

Define

The define stage is when we establish the overall concept and requirements of our design. We're getting answers to specific questions like size or function. Let's say we want to design a sideboard: How big is the space it'll occupy? Do we want shelves or drawers? What do we want to store in it? We're starting from a vague idea, for example, that we need more storage in the dining room, and working toward a specific solution like building a cabinet tucked against the wall that faces the bay window. Our goal is to define all the major functional and site issues that our design must satisfy then establish overall size parameters to fit the space it's intended to fill. It can help to draw a rough floor plan to get an idea of traffic and explore some different footprint options for a design.

Much of the define stage is about listing the requirements our design needs to fulfill. Yet there are helpful

tricks we can use to sharpen our vision. Something as simple as mocking up the upper case on a sideboard out of cardboard and propping it up on a card table in the place it'll reside can go a long way toward defining our design.

In the define stage we also clarify the vibe we hope to achieve. Are we after a sleek contemporary look, rustic, arts and craft, something architectural or organic? The define stage, when complete, gives us an envelope to work with so that we can move on to the next phase.

Explore

The explore stage is about playing with the many possibilities that might fit inside the envelope we've defined. Our goal is to take our basic concept and come up with a composition or structure that we can build upon. I like to draw a series of rectangles that mimic the proportions in the overall size parameters we've defined and do a series of rough sketches inside those rectangles.

This allows me to explore different case configurations, the

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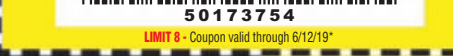
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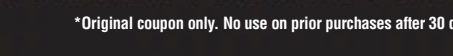


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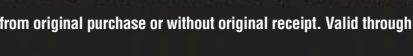


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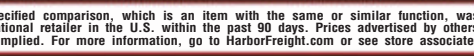


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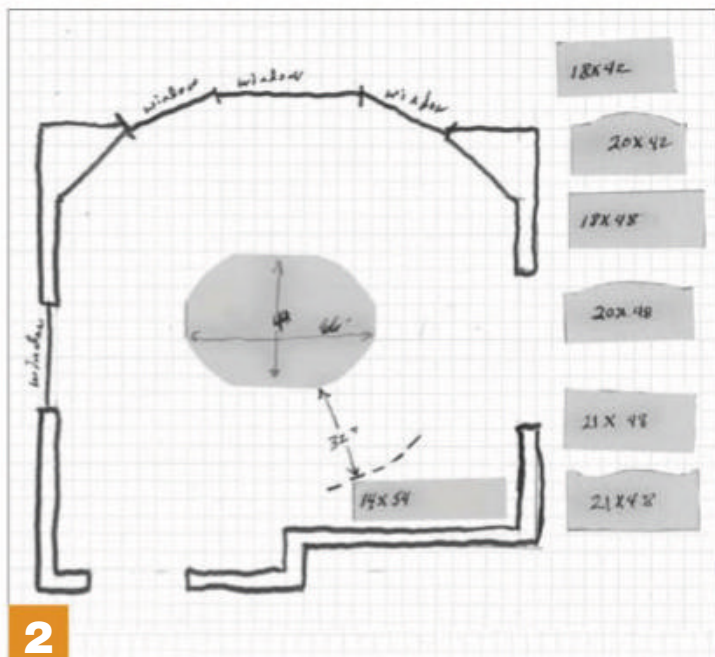


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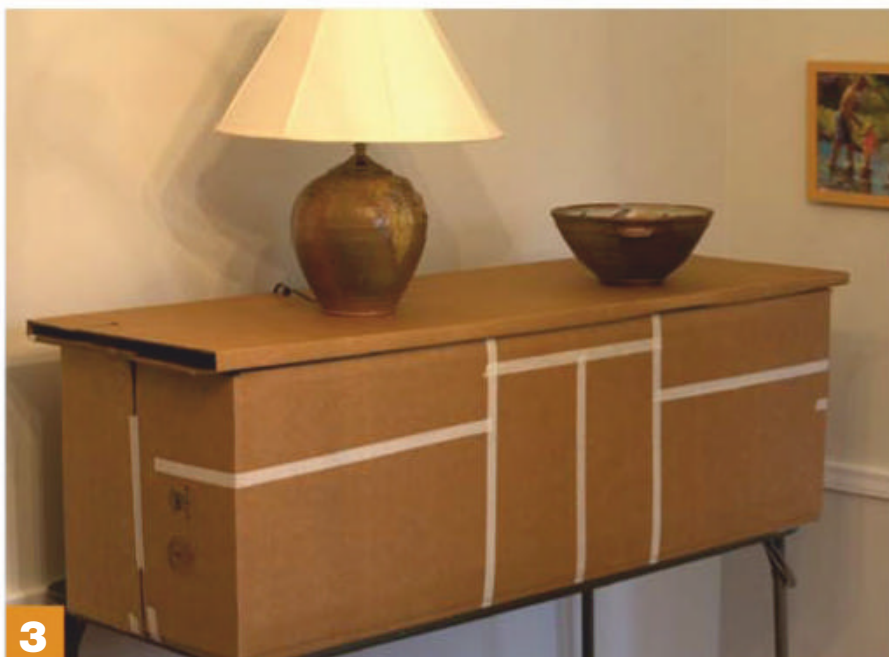


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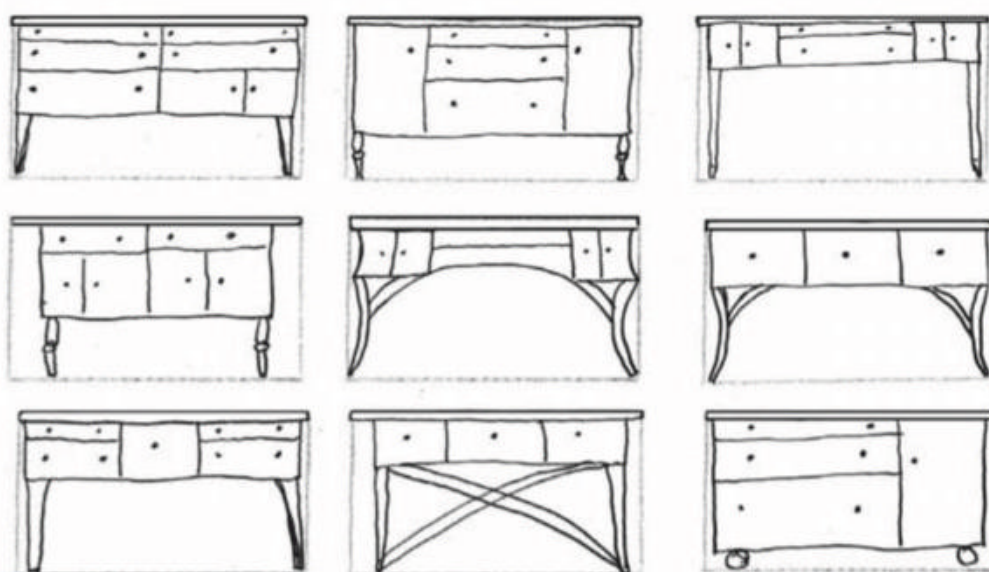
2. A floor plan with a few footprint templates helps to see how our project works—or doesn't work—in foot traffic.

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4. Quick sketches will free your imagination. One of these ideas will rise to the top.



3



4

size and placement of legs, doors and drawers. It helps to do these rough sketches quick and dirty to imagine different possibilities. It's not unusual for me to do 20 to 30 quick sketches during this phase. From these, one composition will float to the top. Armed with this I move on to the refine stage.

Refine

Refining a design is taking our composition and making it sing. Here we take the results of our exploration and play with the size of the different parts to create a pleasing harmony. In this stage I work up proportional drawings and gauge how each part relates to the one next to it, as well as the whole. In short, I push the sizes of adjacent parts up or down and compare how they play off each other visually. This is where we play with the thickness of legs or tabletops.

We can also begin to explore curves and try to get a handle on how bold or restrained we want to curve one part with another.

There's lots of trial and error in this stage. You may bump a part one way or another looking for that sweet spot or the place where you know you've gone too far. Usually you'll find that sweet spot or at least a range where it seems to work. When I'm happy with the small sketch, I might scale it up to a larger half- or full-scale drawing. Moving up to a larger scale will often help the eye make further refinements and see areas to adjust. Often what looks good in small drawings will look jarring at full scale.

Not a Recipe

This process is more like a map than a recipe. You may take a different route than me. Heck, I vary this approach a great deal depending on the customer and the complexity of the project. The important point is that each of these steps helps to focus our vision. To see this process in action, watch my video at byhandandeye.com. You'll look over my shoulder while I design a work table for an artist's painting studio. **PW**

George is the co-author of three design books and writer of the By Hand & Eye blog (with Jim Tolpin). See more at byhandandeye.com.

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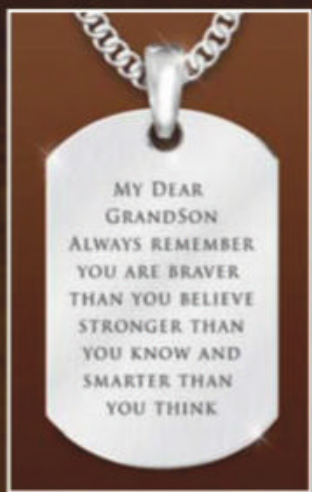
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With just a few offcuts and store-bought clock parts, you can build this elegant design.

By Zachary Dillinger

A Timeless Art Deco Timepiece

At the International Exhibition of Modern Decorative and Industrial Arts, Paris (1925), the world was introduced to the Art Deco movement. Repeating geometric patterns, parallel angles, bold colors and superb craftsmanship in expensive and exotic materials define the style. Art Deco proved popular, and pervasive, in all areas of design—from clothing to furniture and architecture to automobiles. As an automotive enthusiast, it's the latter, the Art Deco automobiles of the pre-WWII era that first drew me in.

This clock is loosely patterned

on a much smaller enameled metal and gold Cartier clock, circa 1935. The design works as both a mantel or wall clock without any modification needed. The material choices—walnut, padauk and curly maple—are directly inspired by my 1939 Packard, which has ivory plastic knobs, a grained walnut dash and red accents to match the color of the body paint. The clock calls for a small amount of wood and uses off-the-shelf components, including a high-quality Seiko high-torque quartz movement with a sweep second hand.



1

1. The view that started it all: the dashboard of my 1939 Packard 120.

PHOTOS BY THE AUTHOR



2. Two dowels in each of the two bottom corners; just one in the top.

3. The frame glued up and ready for final sanding.



The Frame

Building the clock begins with the central walnut frame. All the other parts are fitted to this frame. This piece requires accuracy in stock preparation and joinery; there's no room to hide mistakes or to fudge anything. Each piece must be square, straight and true. Luckily it calls for minimal material so stock preparation, even by hand, is quick and easy. Mill a 40" length of walnut to 1 1/2" square.

By crosscutting this longer piece into the four you need to make the frame, you ensure consistent coloration and grain patterns on the face of the clock. Once milled, crosscut the piece in half.

Cut a 1/2" deep by 1 1/8" wide rabbet along one face. The rabbeted face will ultimately house the glass, with the pane being trapped between the tongue and glued-in bushing strips around the face.

Crosscut the rabbeted blank and then, using a shooting board, produce a piece that's precisely 7" long with perfectly square ends. Using this piece, mark out and plane the second piece to match.

Take the remaining piece of the 1 1/2"-long blank and cut two, precisely 10" pieces following the same procedure outlined above. Due to

the nature of the design, the glazing rabbet in these longer pieces cannot extend the full length of the pieces. They must stop at each end. When working with hand tools, this requires some additional work, namely the use of a center bit or other auger to remove the waste wood. First, clamp the four frame pieces into a square. Mark out both ends of each rabbet by running a pencil along two side pieces using the bottom of the glazing rabbet in the top and bottom frame pieces as a guide.

Unclamp the frame and then, using the same marking gauge setting used on the top and bottom glazing rabbet, establish the 3/8" wide tongue on the left and right pieces. Next, using a center bit of appropriate width, bore overlapping holes down to a depth of 1/2", beginning with the two ends of the rabbet. Then use a sharp chisel to remove the remaining waste down to the layout lines.

Pare the corners square to complete the rabbet. Clamp the four pieces together again to check and fine-tune the glazing rabbet, ensuring that it's flat and of a consistent depth. This is also your last chance to ensure that the frame is square, both inside and outside. Any deviations here will be highly noticeable in the finished piece so take your

time now to ensure it's dead-on.

Once you're satisfied with the fit of the frame, it's time to dowel it together. I used 1/4" dowels, two at each of the bottom corners and one at the top due to clearance issues with the angled cuts that'll be done on the top in the next step. I like to use a marking gauge to lay out the drilled holes in each piece. There are dowel center points available commercially, but I personally get much better results if I lay out each hole with scribed lines and carefully drill them.

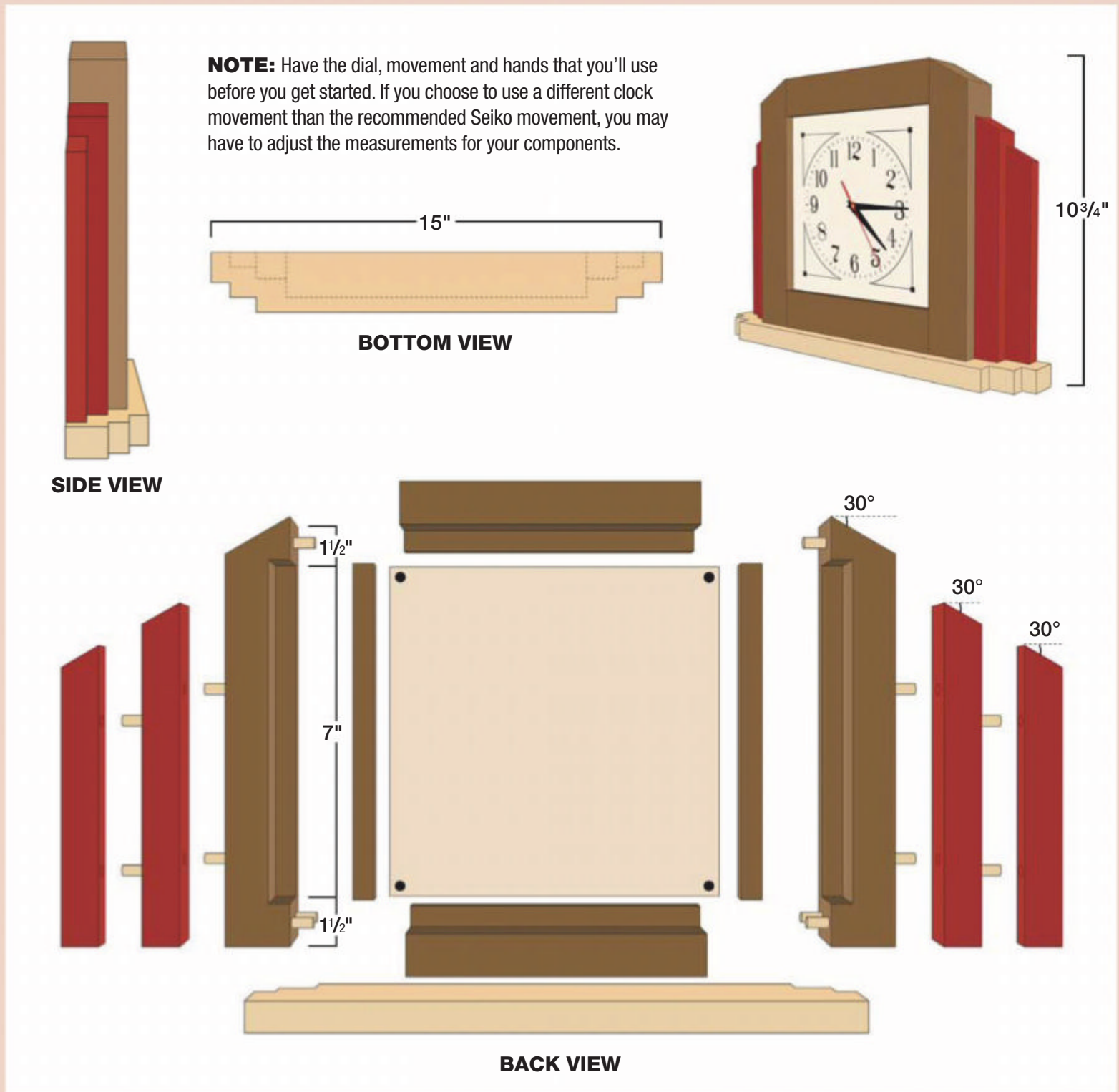
The final step before gluing the frame is to cut opposing 30° angles on the top. You want the angles to begin precisely at the top-most inside corner on each side of the assembled joint. Use a protractor to lay out the line on the dry-fit joint before taking it back apart to saw the angles. I use a finely set crosscut backsaw.

With those cuts made and cleaned up as needed, it's time to glue up the frame. Put glue into each dowel hole and lightly coat the dowels themselves with glue. Clamp the frame and set it aside to dry. Once the glue has cured, plane and sand the frame so that each corner is level, smooth and ready for finish.

Decorative Sides

With the frame completed, it's time

■ Art Deco Clock



Cut List

No.	Item	Dimensions (inches)			Material
		T	W	L	
2	Frame (top & bottom)	1 1/2	1 1/2	7	Walnut
2	Frame (sides)	1 1/2	1 1/2	10	Walnut
2	Long sides	7/8	1	8	Padauk
2	Short sides	7/8	1/2	7	Padauk
14	Dowel	1/4	1/4	1	
1	Base	3/4	15	2	Curly Maple
2	Bushing strips	1/2	1/2	8	Walnut
1	Backing board	1/4	8	8	Hickory Plywood

Supplies

No.	Item
4	1/2" long brass screws
1	7 7/8" square glass
1	7 7/8" paper clock dial
1	Seiko High-Torque Quartz Movement with Sweep Second Hand

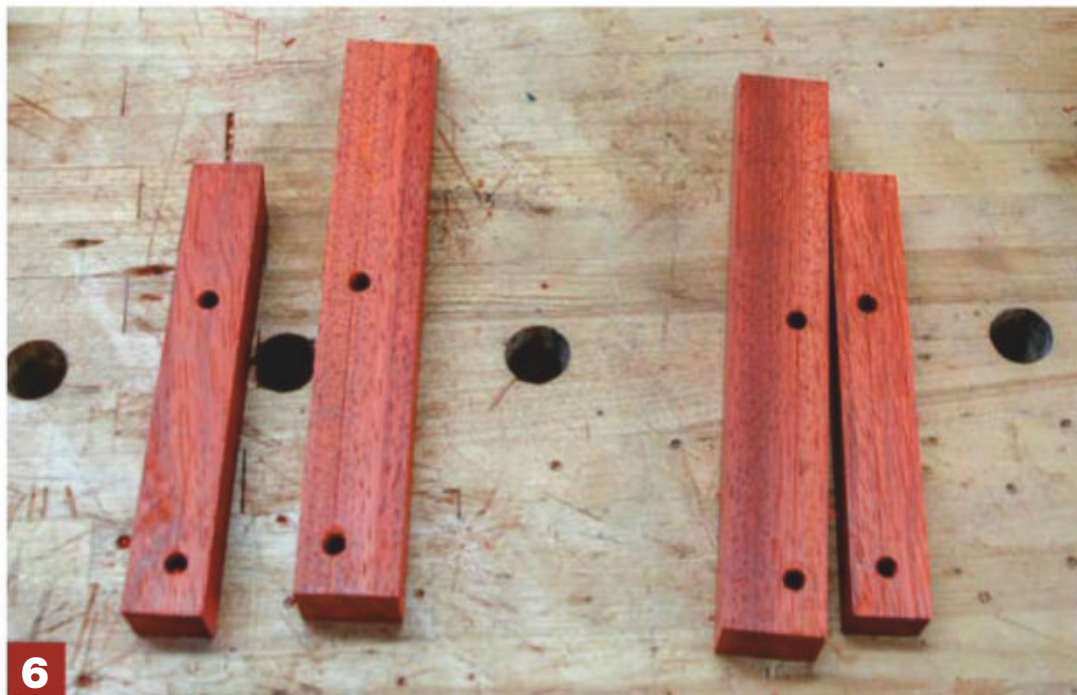
to turn the padauk. Mill the blank to $\frac{7}{8}$ " thick, finishing with a finely set smooth plane. Square up one end of the padauk board on a shooting board.

Using a marking gauge, mark out a strip that's twice the width of the larger side pieces plus a little extra, as much as $\frac{1}{8}$ " depending on your confidence in your sawing ability. Rip the strip from the larger board, then crosscut the strip into two pieces. Rip the strip down the middle and plane to the finished width. Crosscut each piece to the finished length (per the cut list) and then, follow the same procedure used on the frame, trimming the top ends to opposing 30° angles. Repeat these steps on the smaller decorative pieces, which are both narrower and shorter than the larger pieces. When trimmed, dowel and glue them together with their back faces aligned so that there's a decorative ledge in each.

Once the glue has dried, remove them from the clamps and align the angled top edges, then trim the ends so that they're uniform and square. To complete the main frame, dowel and glue the side pieces onto the walnut frame, ensuring that the back faces of each piece are flush with each other. With this completed, the main frame is finished and ready to install the glass, dial and movement.

Install the Clock Dial

I purchased a pre-printed clock dial for this project. It measures $7\frac{7}{8}$ " square and requires a solid backing board so that the movement can be mounted. I used an 8" square of $\frac{1}{4}$ " thick hickory plywood. I glued the dial down to the backing board



4. A shooting board is a vital fixture for precision work.

5. Lay out a cross cut with a square.

6. The position of the dowel holes in the side decorative pieces.

7. Two pieces on each side are made; they're dowelled and glued together first.



8. Aim for a good fit here, but any deviation will later be covered by the bushing strips.

9. The full-length bushing strips along the sides. Cut the top and bottom strips to butt neatly into the side strips.

10. The layout of the decorative notches in the corner. Offset by $\frac{3}{8}$ " as described in the text.



using 3M Super 77 spray adhesive. Check the fit of the dial board in the glazing rabbet and make any necessary adjustments with a sharp block plane.

With the dial affixed, I then drilled the movement mounting hole in the board using the hole in the dial as a guide. I then installed the movement and clock hands per the movement manufacturer's instructions.

I then placed a $7\frac{7}{8}$ " square of glass into the glazing rabbet. Simply glue the bushing strips in using cyanoacrylate (CA) glue.

With the glue cured and the glass solidly mounted, lay the movement and dial board into the clock. After you're satisfied that the dial is centered, pre-drill through the backboard into the bushing strips at each corner and install $\frac{1}{2}$ "-long brass screws to secure the board into the clock.

The Base

I chose highly figured curly maple for the base of the clock. I ripped a larger board down to 2" wide, which will provide a $\frac{1}{2}$ " overhang on the front edge of the clock. This makes a stable base if the clock is to sit on its own and is unobtrusive should the clock be hung on a wall.

To add visual interest to an otherwise plain base, notch the two front corners so that they approximate the stepped shape of the clock frame. To do this, extend the lines of the clock frame toward the front and then offset each front face by $\frac{3}{8}$ " of an inch, as shown in image 10. Then, carefully saw them out.

The base is simply doweled onto the clock frame using three $\frac{1}{4}$ " dowels. Before drilling, make sure that the bottom of the clock frame is perfectly flat and square to the front of the frame. This will prevent ugly gaps between the frame and the

base. Next, you may want to consider applying a coat of shellac to the maple base before assembly. The alcohol in the shellac can leach color out of both the padauk and walnut and pull it onto the surface of the maple, making an ugly smear on the pristine whiteness of the base.

Finishing the Project

I used three coats of blonde Zinsser shellac on the whole piece, thinned with alcohol to about a one pound cut. I then rubbed out the finish with paste wax to slightly reduce the shine of the shellac.

This project would lend itself well to a high-gloss all-black finish over the whole clock frame and base. If that interests you, simply build the piece in maple, sand to a very high grit, and paint using gloss enamel. This will yield a surface that closely approximates the original, which was enameled metal finished in black and red with real gold accents. While you probably won't fetch the same price of the original clock this was based on (it recently sold for more than \$38,000), you'll continue to hone your hand, eye and tool skills, and in my world, that's priceless. **PW**

Zachary Dillinger is the author of With Saw, Plane and Chisel: How to Build Historic American Furniture with Hand Tools.

Shaker Stepladder

This functional form is an ideal intro to the Shaker Style.

By Will Myers



PROJECT #1906

Skill Level:

Intermediate

Time: 2 Days

Cost: \$100

PHOTOS BY THE AUTHOR

I've traveled to Hancock Shaker Village in Pittsfield, Massachusetts, for the past four years, measuring and documenting pieces in their collection. I usually have a list of pieces to examine that's more than I can ever accomplish in the time I have there. My trip this year was a little different. My pre-selected list was shorter and I stayed a little longer. So, for the first time, I had time to wander around and pick a few random pieces to check out.

The collection at Hancock Shaker Village is vast, consisting of more than 22,000 objects housed in 20 original Shaker buildings at a historic Shaker site. This tends to cause me grief; it makes focusing on a selected few items difficult. In the process of documenting pieces, you inevitably run across more items of interest. It's a vicious cycle to say the least.

The small stepladder described here caught my eye on my very first visit to Hancock, a passing glance was all that was possible on that visit. Last year I measured another

piece in the same room with the stepladder, but was running short on time so had to pass over it again. On this last trip I finally was able to measure and photograph the ladder in detail. Except for a couple of details that I'll explain as we go along, the stepladder I'm building here is pretty much a spot-on copy.

Materials

Wood selection for this project is very important. Get it wrong, and you could break your neck! The original ladder was made with white pine legs and butternut treads. For this ladder, I'm using the same, paying special attention to grain. However, neither of these species are what most folks would think of today as woods for ladder making. The Shakers had one major advantage in material: using slow-grown virgin timber. Slow-grown white pine in particular is much stronger and more dense than what we have available now. Butternut would be similarly affected by growth speed. At that time, these

two species would've been plenty strong and would help to keep the ladder lightweight and easy to carry. Most modern, fast-grown white pine is especially soft and weak; totally inadequate for this project. A good substitute would be any fairly strong, clear and straight-grained stock that's available to you. Southern yellow pine is an excellent choice if it's available in your area.

Front Legs & Dado Layout

Mill the front legs to size, making them a bit longer than needed and leaving the ends square. Decide which sides you want to be the faces and front edges, and mark them.

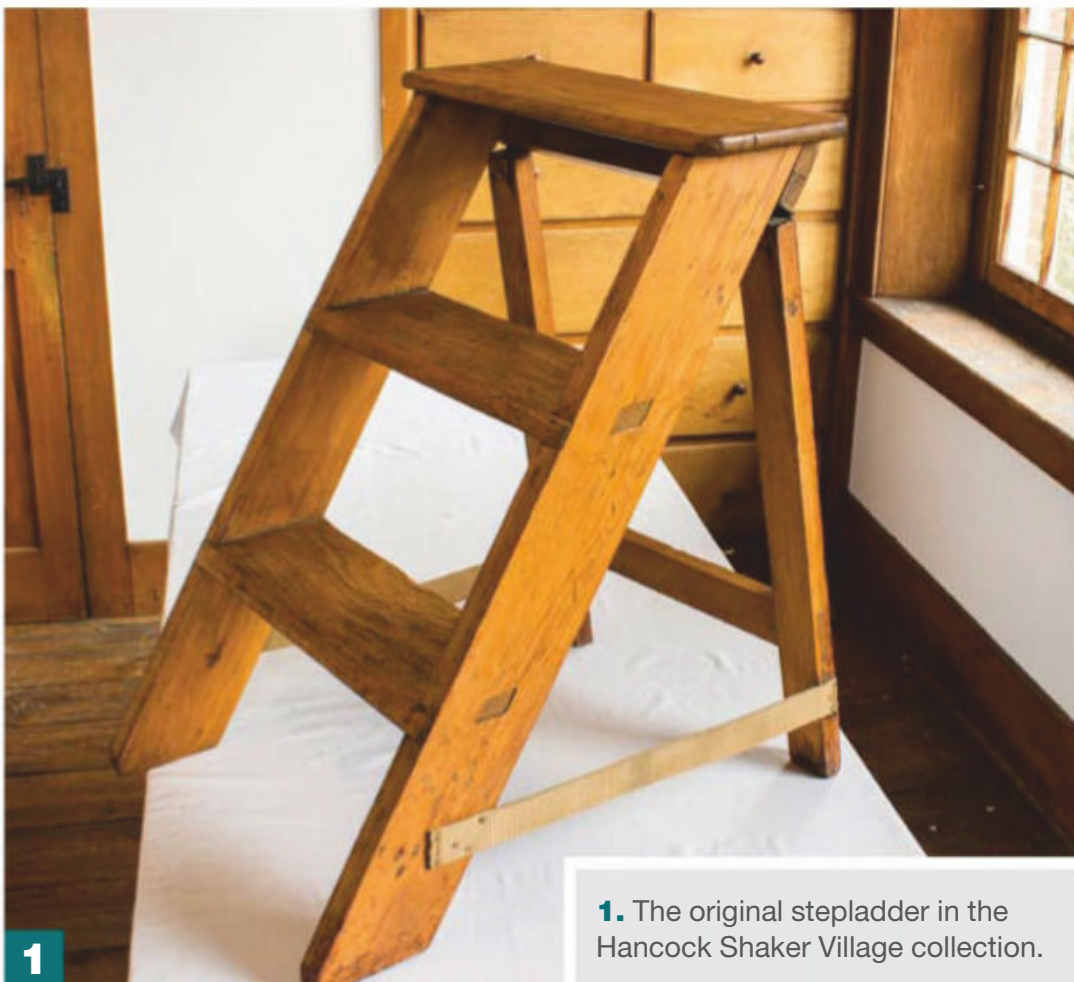
Square and knife a line a $\frac{1}{4}$ " or so from the bottom end of the legs. Measure up from this line $9\frac{13}{16}$ ", knife a line across the pair of legs for the first tread location. Next, measure $9\frac{13}{16}$ " from that line and knife another line for the second tread location. Last, measure up from the second tread mark $9\frac{1}{8}$ " and make a line for the top of the legs.

There are two $\frac{5}{16}$ "-deep dados on the inside of each leg to support the treads. To lay these out, set a bevel to 32° and line it up to the marks on the front edge of the leg by catching your marking knife in the knife line on the front edge. Be sure your line angles from the front edge toward the top of the legs, and knife a line across the inside face of the legs at each dado location.

Line up the tread on the lower side of the knife line and make a tick mark with a pencil on the opposite side. Remove the tread, align your bevel with the tick mark and knife line across. Last, use a marking gauge set to $\frac{5}{16}$ " and make a depth mark between either end of the knife line so you'll know where to stop.

Dadoes & Mortises

There are several ways you could cut the tread dadoes, but in a situation like this, the quickest way is just a saw and chisel.



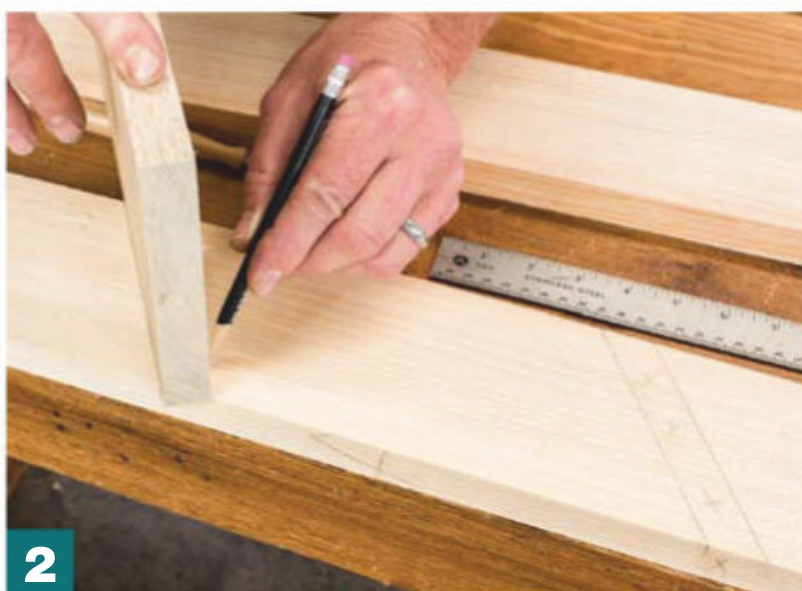
1. The original stepladder in the Hancock Shaker Village collection.

2. Clamp the legs together and do the layout as a pair to ensure perfect alignment of the joints. The best way to lay out the width of the dados is a direct transfer from the treads themselves.

3. Use a sharp chisel on the waste side of the knife lines and make a relief cut to help start your saw.

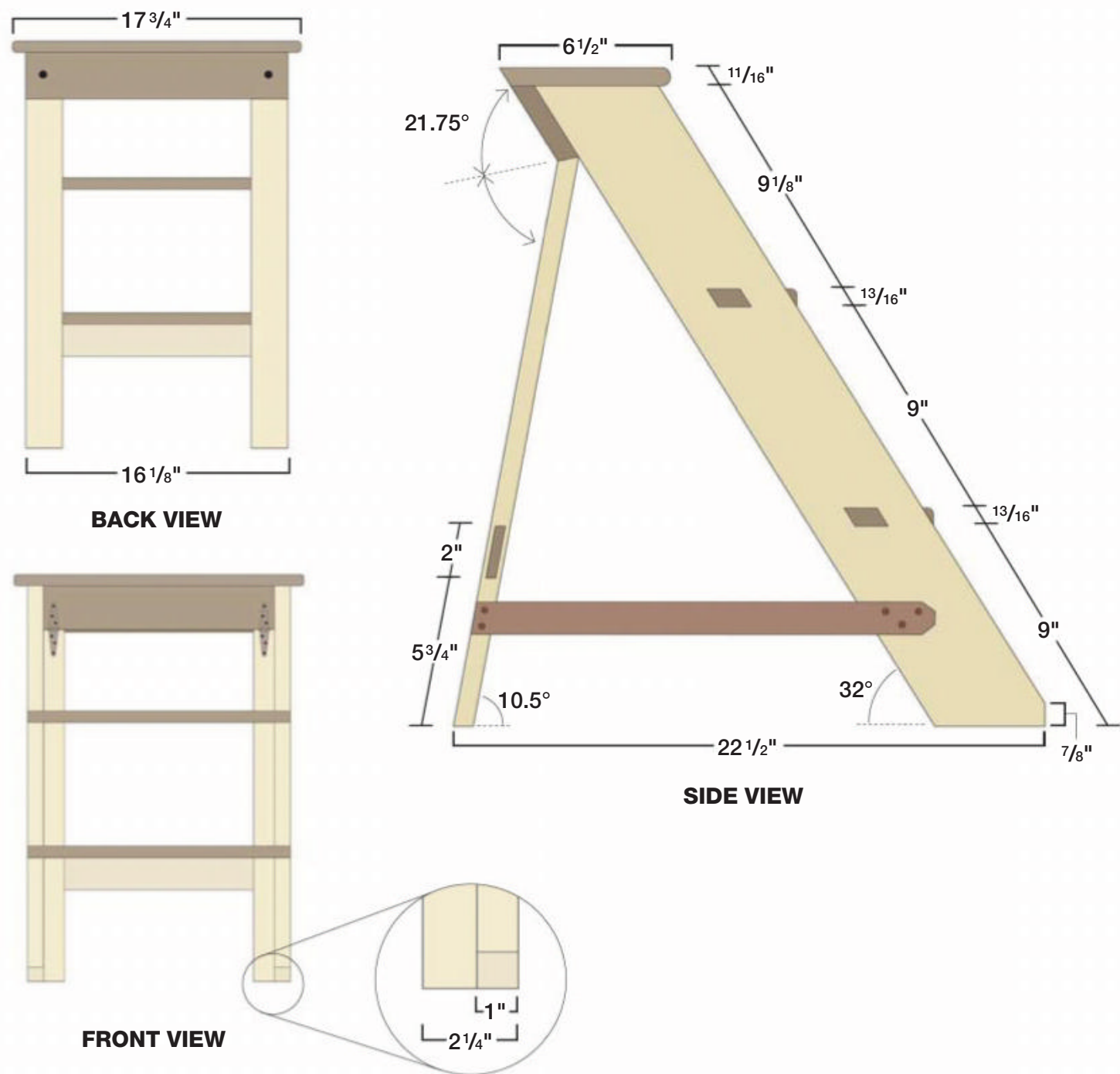
4. Using a crosscut saw, saw down to the depth marks on either end of the dado.

5. To finish, use a sharp chisel to chop and pare the waste from between the saw cuts. The last pass can be done with a router plane to get a nice, flat-bottomed dado.



6. To layout the width of the mortises use a double-tooth marking gauge set to $1\frac{3}{16}$ " between the points and roughly center the teeth to the width of the legs. Remove the waste from the mortises by first boring a couple of auger holes and finish by paring up to the layout lines with a chisel.

Shaker Stepladder



Cut List

No.	Item	Dimensions (inches)			Material
		T	W	L	
1	Top	1 1/16	6 1/2	17 3/4	butternut
2	Legs	1	4	32	white pine
2	Treads	1 1/16	5 1/8	16 1/8	butternut
1	Top Support	3/4	3 3/8	16 1/8	butternut
2	Back legs	3/4	2 1/4	24	white pine
1	Back stretcher	3/4	2	16 1/8	white pine
2	Leather Strips	-	1 1/4	18	

*The leather strips are attached with 3/4" copper tracks.

Wood Selection

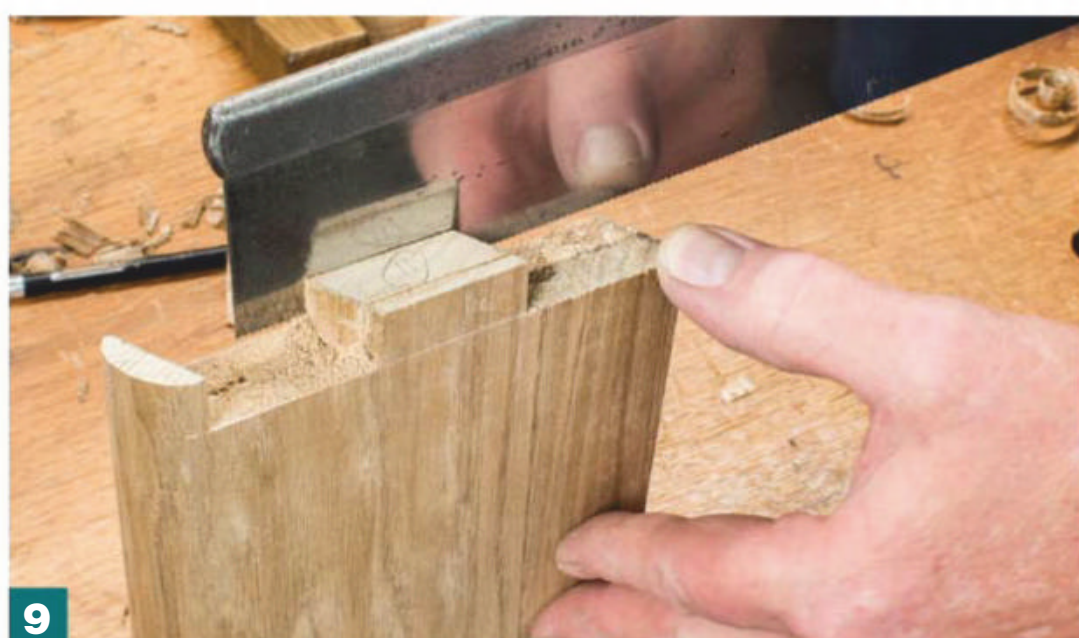
The original ladder was made with white pine legs and butternut treads. I'm using the same, paying particular attention to grain. A good substitute would be any fairly strong, clear and straight-grained stock that's available to you. Southern yellow pine is an excellent choice if it's available in your area.



7. Transferring the mortise width directly to the tenons is the best layout method.

8. Use a coping saw to cut close to the baseline and finish by paring away the remaining waste with a sharp chisel, working halfway from either side to the baseline.

9. Two shallow kerfs are cut in each tenon for the wedges.



The skewed mortises that attach the treads to the legs look like they'd be difficult to execute but they are simple to layout and cut.

Begin by using your bevel and knife to run shallow layout lines across the face side of the legs for the height of the mortises, opposite each dado location in the same manner we did for the dado layout.

I used a scrap of wood inserted in the dado and clamped in the vise to support the work which helped prevent a blowout on the inside of the legs.

Tread Tenons

The tenon layout is done by direct transfer from the mortises. Assemble the treads and legs with the back edges of the treads extending beyond the back of the legs just

enough that they can be planed flush to the legs later.

With a pencil or knife trace the mortise location and the front edge of the legs onto the ends of the treads. It's also a good idea to number each mortise to its corresponding tenon for quick reference later.

Use a cutting gauge set to $\frac{11}{16}$ " and cut a baseline around the ends of both treads. Square down from the marks on the end of the tread down to the baseline. Saw to the waste sides of the tenon and the front, stopping at the baseline.

Test fit the tenons. Once they fit nicely, saw two slots about $\frac{3}{16}$ " from the faces of each tenon to receive wedges. Also, before disassembling, trace from the back edge of the legs onto the ends treads.

The front edges of the treads are

rounded. The round portion extends about $\frac{3}{16}$ " in front of the legs. Again, this can be knocked out quickly with a jack and jointer.

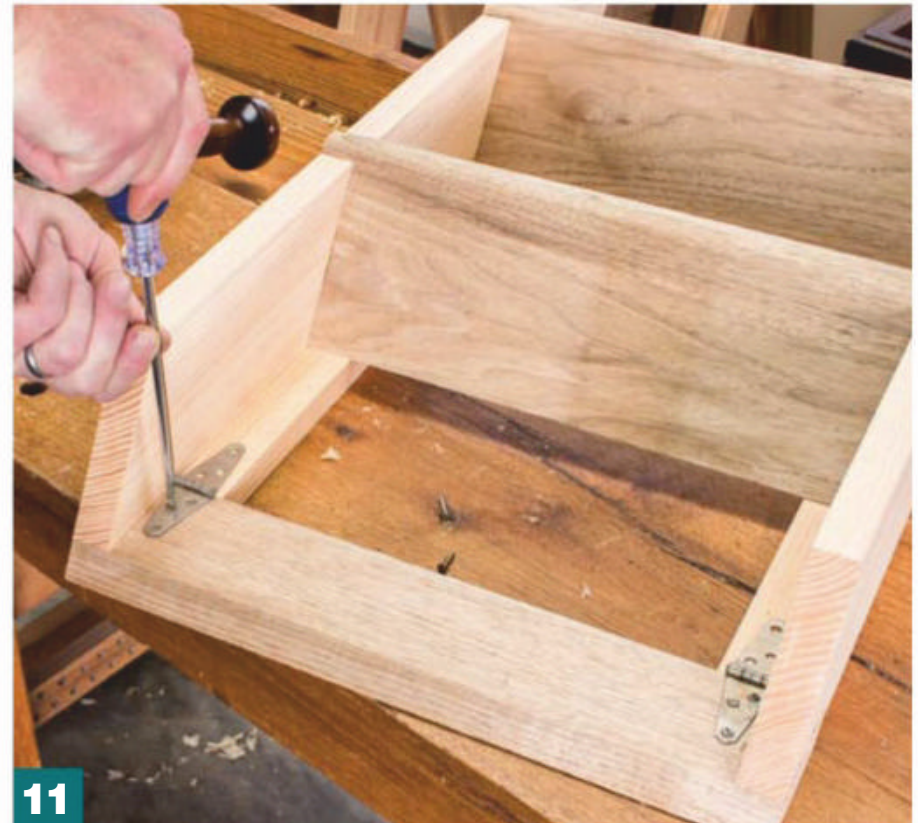
With the joinery finished, cut the angles on the top and bottom of the legs that we laid out earlier. The front of the legs on the bottom also have a $\frac{7}{8}$ " flat cut into them. Last, apply a coat of glue to the dados, tenons, mortises and assemble. Carefully tap the wedges into the tenons. Even though the wedges are oriented to put pressure along the grain, the skew of the tenon also puts pressure across the grain.

Top Support & Back Legs

The upper edge of the top support has the same angle as the legs. The lower edge is cut to 21.75° where the back legs meet.



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The hinges on the original were mounted to the back face of the top support and legs. These weren't the original hinges, and from the number of empty screw holes present, it'd been repaired in this area more than once.

There's not much to making the framework for the back legs. The tops of the legs are cut at the same 21.75° angle as the lower edge of the top support, the bottoms are cut at 32°.

Lay out these mortises with a mortise gauge set to $\frac{3}{8}$ " and use a $\frac{3}{8}$ " mortise chisel. Chop halfway from both sides, meeting in the middle. The tenons are laid out with the same gauge setting. Use a tenon saw cutting cheeks first, then the shoulders.



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14. To mount the rear leg assembly, lay the front leg assembly on its side and place the rear assembly in its position. Move it until the angle at the top of the legs is flat against the angle on the top support. Fold the hinges against the legs and mark the screw locations. Remove and bore pilot holes for the screws and install them.



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10. The top support is attached to the legs with cut nails and glue.

11. I attached the hinges to the inside of the top support so when the legs are open weight is applied from the top support directly to the top of the legs and not the hinges themselves.

12. The two legs are joined by a single $\frac{3}{8}$ " mortise and tenon on either end of the stretcher.

13. The tenons are glued and wedged to hold everything tight.

Top & Finish

The top board is a piece of $\frac{11}{16}$ " stock attached to the top of the legs. The back edge is angled to follow the leg angle on the back. The front edge and ends are simply rounded over. The top attaches with glue, four 2" #10 wood screws and 2 cut nails driven into the top support.

The original stepladder had been painted chrome yellow (there were traces of paint on the undersides of the treads and top). The paint was stripped at some point and replaced with a clear varnish. For this reproduction, I did my favorite finish of 50/50 Danish oil/poly mix. Just wipe it on, wait 15 minutes or so and wipe off the excess. After drying for three days I scuffed it and applied a second coat in the same manner.

The stepladder at Hancock had nylon strapping that'd been added at some point. What the original material was I don't know, but from the number of empty nails holes in this area of the legs, the leg straps had been replaced more than once. Instead of nylon, I used 8-9oz. leather straps $1\frac{1}{4}$ " wide. The straps are attached to the legs using $\frac{3}{4}$ " copper tacks $3\frac{1}{2}$ " from the bottom of the legs. **PW**



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15. Once the finish is cured, install the leg straps.

Will Myers is a woodworker who makes his home in North Carolina.



PROJECT #1907

Skill Level:

Beginner

Time: 2 Days

Cost: \$250

Optimize your shop space with this multi-function outfeed table that gives your CNC router a convenient home.

By David Lyell

CNC Outfeed Table

LEAD IMAGES BY AL PARISH,
ALL OTHER PHOTOS BY THE AUTHOR



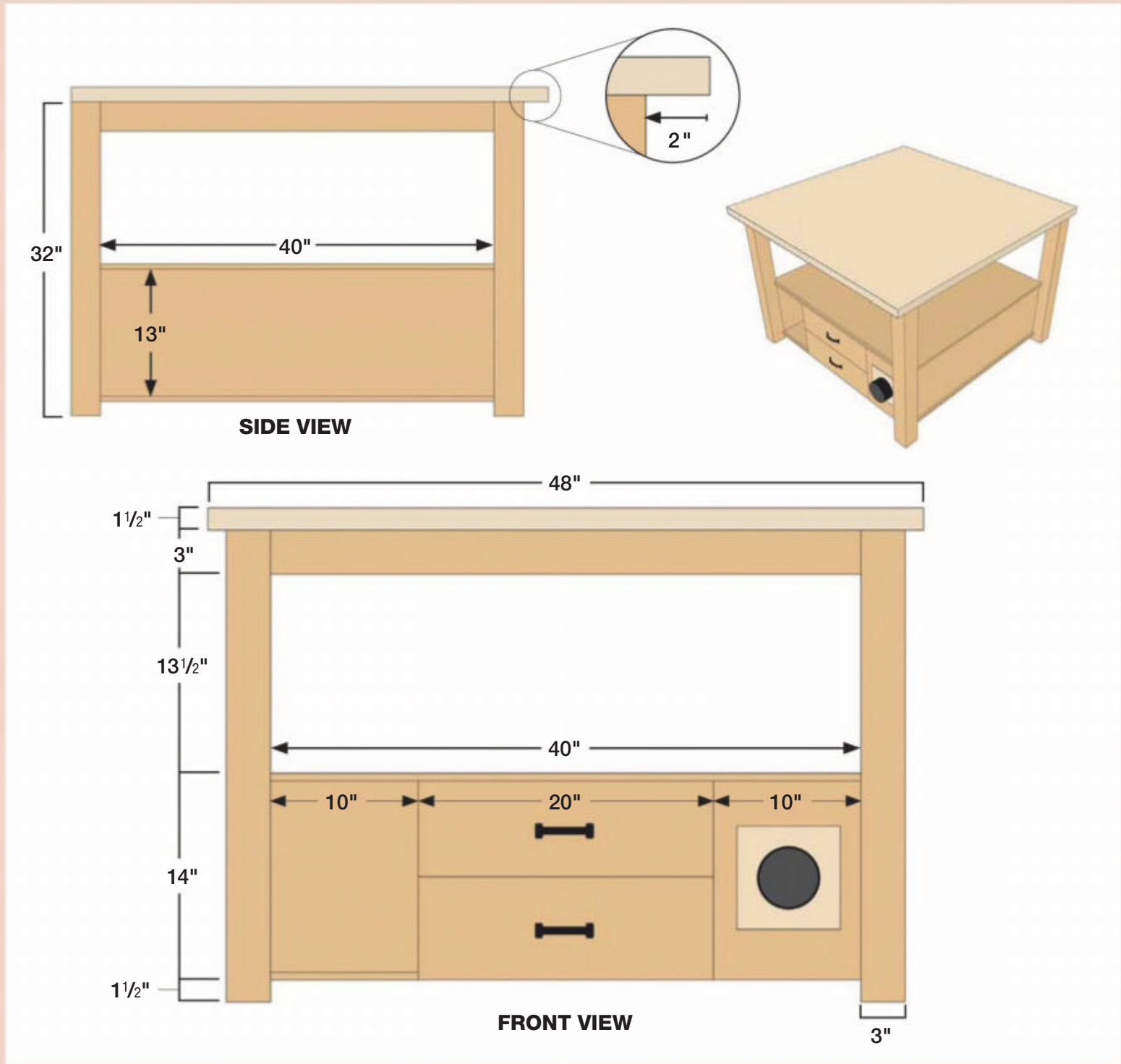
My one-car-garage-turned-shop doesn't have room for a 4'x4' CNC router. I just couldn't imagine finding the space and dedicating it to a machine that while useful, won't see everyday use. So after racking my brain for a few weeks, I came up with a design that would not only allow me to bring a CNC into my shop, but provide me with some much needed outfeed and assembly area.

The key to this project is the hinged top, it provides plenty of room for the CNC in a discrete location and provides plenty of access to the work area. Bonus, I can start a cycle on the CNC, close the top and continue to use my table saw. Watching the router routine doesn't eat up my precious shop time.

Design by Constraint

The form of this table was dictated by a few constraints. First, the lower shelf had to fit my 1,000mm-1,000mm X-Carve®, I rounded this to 40"x40". The second constraint was the top of the table. I wanted to stick with 4'x8' plywood from the home center and decided that a 48"x48" top would be ideal with the size of the base. With the top

CNC Outfeed Table



Cut List

No.	Item	Dimensions (inches)		
		T	W	L
CABINET				
2	Top/bottom	1/2"	42"	40"
3	Sides	1/2"	13"	41"
1	Center divider	1/2"	13"	40"
2	Front dividers	1/2"	13"	19 3/4"
LEGS				
4	Legs	3"	3"	32"
1	Back stretcher	1 1/2"	3"	46"
2	Side stretchers	1 1/2"	3"	40"

No.	Item	Dimensions (inches)		
		T	W	L
DRAWERS				
4	Side	1/2"	5"	18"
2	Bottom	1/2"	20"	40"
4	Front/back	1/2"	5"	17"
2	Face	1/2"	6 1/2"	20"
1	Dust panel	1/2"	10"	13 1/4"
TOP				
2	Top	3/4"	48"	48"
1	Prop	3/4"	-	36"

Supplies

No.	Item
1	Piano hinge (36")
2	Drawer pulls
1	Desk grommet (3")
2	Toggle latch
	Anndason Toggle Latch Clamp 4001
1	Rockler Dust Right Combo Port
	Item#: 28666
4	T-nut leg leveler

and the shelf determined, I was able to draft some designs. I settled on an open-shelf concept. The legs are dimensional Southern yellow pine (SYP) milled up to 3"x3" and the cabinet structure holding it all together is 1/2" Sande plywood.

The third constraint was access to the CNC. I had to eliminate the apron at the front of the table so that I could have unimpeded access to the CNC when the top was flipped up. In practice, I'm really happy with the design; I have access to the entire bed of the CNC.

The fourth constraint I contended with was dust collection on my table saw. In my home shop I use a quick-connect fitting with my dust collector. It's really handy for shops like mine where the dust collector follows you to the tool instead of hard plumbing everything. However, crouching down to the bottom center of the table saw was never an enjoyable activity. So, I had the idea to plumb through the outfeed table to the center of the shop. This started to dictate the orientation of the drawers and structure of the bottom.

Cabinet First

The cabinet at the bottom of the table serves as a platform for the CNC, a housing for the drawers and torsion box to keep the whole assembly table from racking. Start by cutting the top and bottom of the cabinet to 40" x 42". Then rip the 13" parts for the sides and dividers of the cabinet. Cut all of these pieces at once so that they're perfectly consistent.

Start with the top of the cabinet upside on your workbench and work up (or down depending on how you think about it) from there. All of the components attach to the top with pocket holes to keep the top surface of the cabinet clean and smooth. I started with the long side that overhangs the top shelf by 1/2" on each side. Then I attached the middle divider to give myself a steady structure to attach the drawer dividers, the support behind the drawers and



1. Start assembling the cabinet with the top shelf bottom up. Align the long side of the cabinet to the outside edge, paying attention to the 1/2" overhang on both sides.
2. Pocket holes made for a clean top shelf and a quick assembly.
3. While laying out the slides, remember the cabinet is still upside down. Mark your slide location appropriately.

CNC Outfeed Table

the other side panel. Double-check every joint for square as you move along. And, save yourself some frustration later by adding the drawer slides in the front of the case before you secure the top.

I allowed all these pieces to dry before attaching the bottom of the cabinet. I simply predrilled with a countersink bit and made sure I didn't interfere with the $\frac{1}{2}$ " overhang of the side panels and glued and screwed the bottom on. The bottom cabinet is done for now.

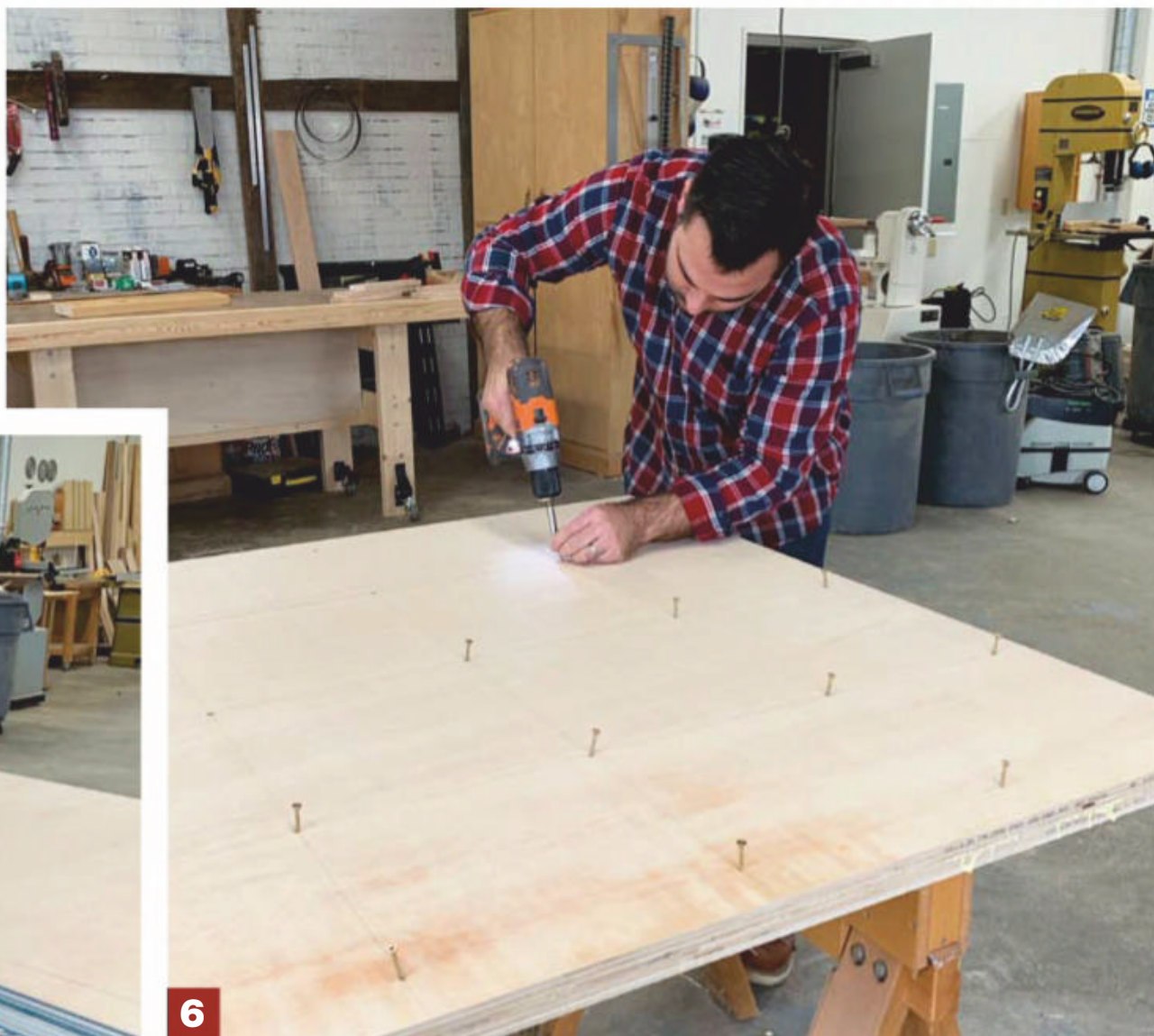
Plywood Top

The top of the outfeed table is doubled up $\frac{3}{4}$ " plywood. I cut one 4'x8' sheet in half and glued it up. A grid work of $1\frac{1}{4}$ " screws 8" apart provided all the necessary clamping action. Remove the screws after letting the top dry for 24 hrs.

4. I used a complete bottom sheet of plywood instead of strips for stability. The cabinet is designed to prevent the table from racking in both directions.

5. At this point, I can't imagine living without a track saw. Cut the 4'x8' sheet in half.

6. I used a grid work of screws to clamp the two pieces together. Take the time to predrill so that you can place screws into their respective holes before glue up.



Make the Legs

Southern yellow pine is used for the legs and aprons, milled from 2"x10" dimensional lumber. I found straight grain for the legs and aprons by avoiding the center of the boards, creating a little waste, but even so, SYP is a great material for shop projects. The 3"x3" legs are glued up and cut to their 31" length. The aprons will be cut after attaching the legs to the cabinet base.

Once the legs are out of the clamps, make note of their orientation relative to the front and sides of the project. I elected to present straight grain to the front of the project with the seam to the sides of the table.

Next, you'll need to rout the stopped rabbet where the cabinet will set into the legs. These are $\frac{1}{2}$ " x $\frac{1}{2}$ " and completed on the router table. I made the cut as a single pass using lines that I carried up to the top of the workpiece.

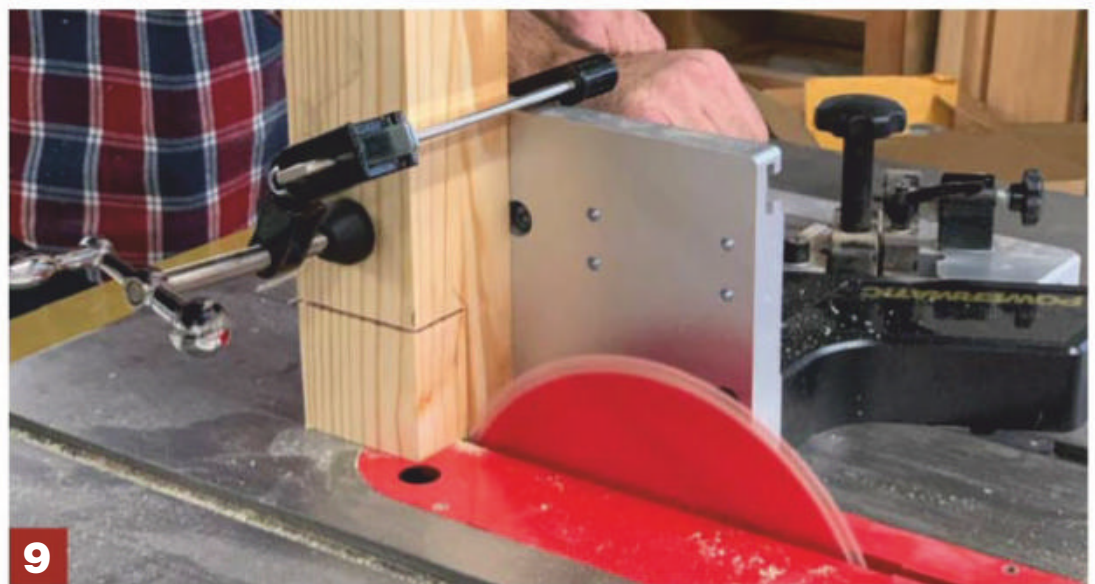
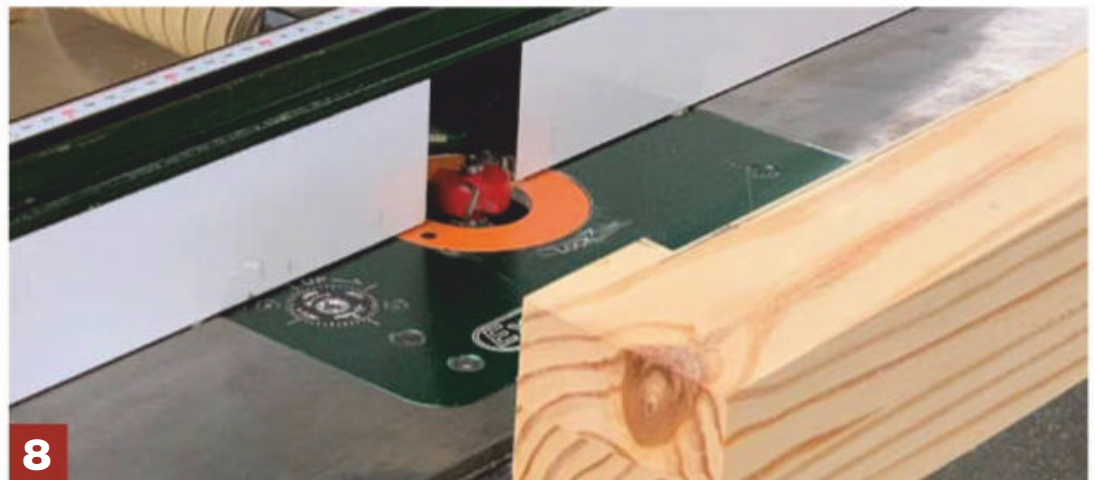
Finally, you'll need to create the lap joint for the back apron. I completed this on the table saw with a tenoning jig. Size it to fit the stock you had milled up earlier. I ended up with a lap joint that was $1\frac{1}{4}$ " deep.

7. Glue and clamp the legs. Because this is shop furniture, I clamped all four legs as a batch.

8. With the first leg, I used a stop block, on the next three I ditched the block and just used the lines I had carried up from layout. Square up the rabbet with a chisel.

9. Make the crosscut, then the rip cut on the lap joint.

10. The lap joints on the back leg are vital to the strength of the table because the front of the table doesn't have an apron. Make sure the surfaces mate together without any gaps.





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Add the Legs

The cabinet is just over 40"x40" at this point, so it should span pretty much any workbench. With the cabinet upside down, attach your legs upside down. The sides of your cabinet should be $\frac{1}{2}$ " longer than the top and bottom shelf. This allows them to sit in the stopped rabbets. I sank three $1\frac{1}{2}$ " screws through the plywood into the legs. Then, add the adjustable feet while the table is still upside down on the bench.

Aprons and Hinges

Measure between the legs on the left and right side and cut some of your previously milled SYP to length. Because the legs are fixed to the cabinet, your cut needs to be perfect—sneak up on the size. I used three pocket holes on each end of the aprons. For this material thickness, I used $2\frac{1}{2}$ " screws.

A piano hinge secures the top. I had a 30" hinge on hand, so that's what I used. Rout a rabbet in the back apron. This is why I lapped the



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11. Glue and screw the legs on in the proper orientation. After double-checking, I found that I had swapped my left and right legs. Thankfully, I was still within the open time of the Titebond III I was using.

12. Drill a hole that fits the insert and is deeper than the entire length of the leveling bolt.

13. The assembly as it stands. Find a friend and flip the assembly onto its feet.



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back apron on the outside of the legs—it provides a long back edge where the hinge can sit.

Don't use the screws that come with the piano hinge. Use your own 1 1/4" screws. The top is heavy and will put quite a bit of stress on the hinge while propped open.

At this point, you can secure the top to the table. I found this to be a tough operation on my own. I laid the tabletop upside down on my table saw and brought the table base up to top, allowing me to screw the top easily. The table is functional now!

Trim Out the Details

The drawer box construction is simple: butt joints and brads. You may choose to use a different type of joinery for your drawers, but I have found this simple construction more than adequate for my shop furniture.

The dust collection for my table saw is routed through the side of the cabinet. In my home shop, I have my table saw against a wall and my dust collector on the far



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14. I elected to use pocket holes for ease and speed, but you could use dowels, floating tenons or regular mortise and tenon to attach the skirts.

15. Use a spiral bit and edge guide to create the rabbet for the hinge to rest in.

16. Square up the rabbet with a chisel and make sure the hinge sits flush.



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17. With the drawer boxes so low, you'll be happy you installed the slides before assembly. Attaching the drawers was enough fun for me.

18. The Dust Right system uses 4" hose. I simply traced around the inside of the flange and made the cut with the jigsaw.

19. The dust collection board will need strips on the side of the compartment to attach to. I used four screws to attach the board to the strips for future repairs or modifications.



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side of the shop. I use a quick release fitting to bring the dust collection hose to each power tool that I'm using as needed. While it's a convenient fitting for this application, reaching under the table saw is never fun. Having the fitting on the outside of this cabinet will save me a bit of twisting and stretching to swap dust collection.

Once I sized the board to the opening to the right of the drawers, it was time to cut the hole to accept the Dust Right fitting and the flange on the back of the board. You need both so that the hose coming from the back of the saw can terminate to the flange and the Dust Right hose can couple with the outside fitting.

Use a 3" cable grommet to route the cables for the X-Carve through the top shelf. The grommet will be partially covered by the CNC, so recess it into the shelf with bearing guided rabbeting bit. With it perfectly flush, the wires are able to pass through with ease. The X-Carve control box will mount to the side of the cabinet directly under here. The cables aren't overly long, so you may find yourself creatively completing the wiring.

One of the last steps is to add the stick that'll prop your table top up. I didn't over engineer this step, though I was tempted to. I simply used a 3/4" dowel attached with a lag screw. The dowel rests in a 1" hole that's 1/2" deep; drill with a Forstner bit.

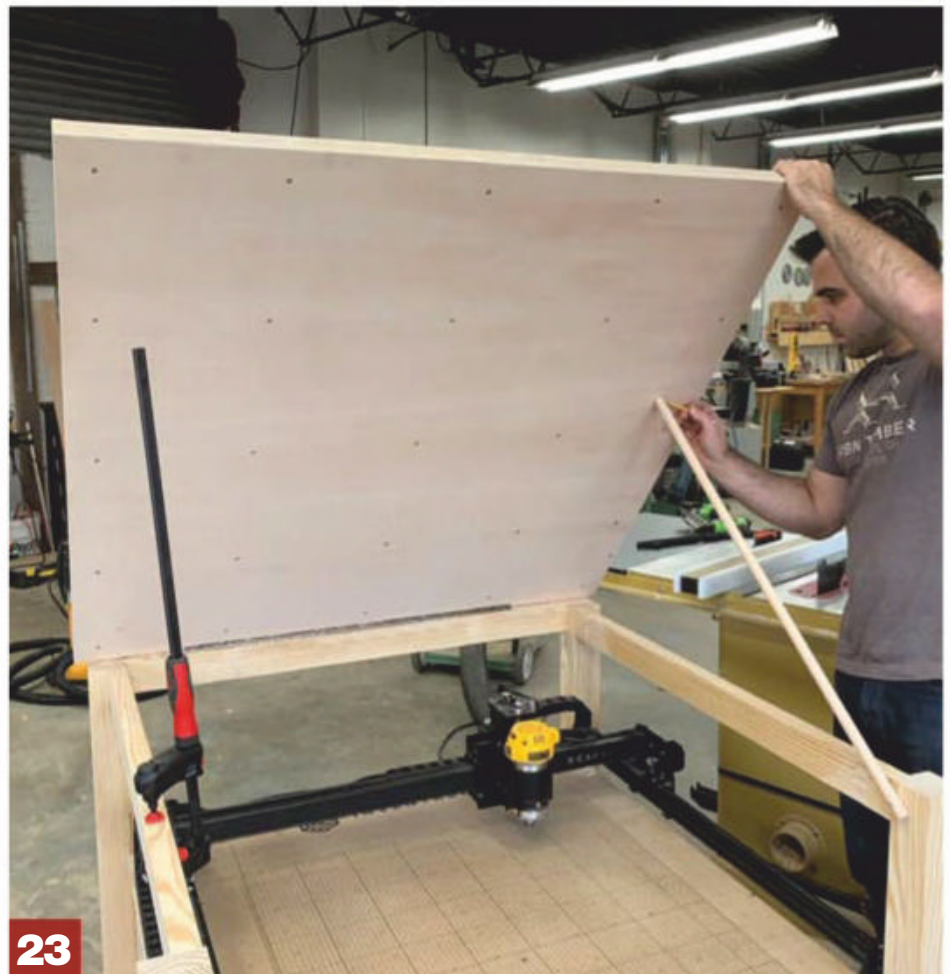
Finishing

I sanded everything to #180 grit and applied two coats of wipe-on satin polyurethane. You'll need to route miter slots that accommodate your particular table saw and adjust the height of the legs until they're perfectly aligned with your table saw top.

After stepping back and looking the table over, I decided to add



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20. I was tempted to use the cabinet cavity to channel the dust, but I had extra hose on hand, so I opted to simplify the airflow.

21. A hole saw and rabbeting bit in a palm router make quick work of adding a nice recessed grommet.

22. Toggle latches attached to angle iron allow me to lock the top to the front two legs.

23. It's tempting to over-engineer this lid prop, but I figured if it's good enough for my Toyota, it's good enough for my outfeed table.



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some maple edge banding and a sheet of laminate to the top to improve the durability of the top. Had this table lived in the secret of my home shop, I would've left this step for that mystical day when my kids are grown and I have hours to spend edge banding everything. Otherwise, this table is ready to serve you as a graciously sized outfeed table, an appropriately sized assembly table and a really convenient CNC station. **PW**

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David Lyell is Popular Woodworking's senior editor and one-car-garage-shop guinea pig.

A man with blonde hair, wearing a red long-sleeved shirt, a black headlamp, and a blue respirator mask with two filters, is applying a dark, glossy finish to a wooden table. He is wearing black gloves and using a cloth. The table is partially finished, showing a deep, dark brown color. In the background, there is a wooden chair with a circular base and several legs. A small jar of Waterlox finish and a brush are on the table next to him.

■ Flawless Finishing with Waterlox

Follow these steps to get a deep glow, a buttery-smooth surface and unmatched protection.

By Austin Heitzman

Years ago, while working at the Philadelphia Museum of Art, I visited the furniture conservation department to ask for some help finishing one of my own pieces. I got a one-word reply: “Waterlox.” After more than a decade as a professional furniture maker, I consider Waterlox my mainstay, too. The reasons are many. Waterlox Original Sealer/Finish has a tung-oil base modified with resins, giving it the luster and vibrancy of pure oil with the quick build and durable protection of a lacquer. Its unique formula also lets you brush it on thick or wipe it on thin. My approach takes advantage of both qualities: I brush on coats first, which saturates the wood and provides a foundation for a series of thin, smooth coats, padded on with a folded rag. I only need to level the surface twice—once after each stage—and I do it with steel wool, which follows every contour and leaves a smoother surface than sandpaper. The whole process couldn’t be simpler, easier and more foolproof, delivering a deeply lustrous semi-gloss that’s also lovely to touch.

This versatile finish will work for almost everything you build. You can apply it thinner for a more natural look or build it up for a deeper luster and more protection. I usually apply five coats, building the finish to a medium film that has durability and depth while letting the wood’s beauty shine through. I’ve found that water beads up on the surface of Waterlox and I’ve never experienced any discolored rings from hot or cold beverages, with or without coasters. At the same time, the film is flexible, so it won’t chip or flake. If there’s damage somehow, Waterlox is easy to repair, letting you blend new finish in with the old and avoid having to strip an entire surface to bare wood.

Get Ready

Prepping the surface for Waterlox is pretty standard. Sand all of the surfaces to #220 grit, and remove the dust with compressed air. The

1. Used correctly, Waterlox will handle most of your finishing needs, delivering deep luster, unmatched protection, and a flawless feel on even the most challenging pieces, like this burl-top table.



2. Surface prep is standard. Sand up to #220 grit. Any less will show sanding scratches, while finer grits could burnish the wood, interfering with its ability to absorb oil.

3. If possible, remove sanding dust with compressed air. A clean brush and rag can also work.



first few coats aren’t particularly sensitive to dust, but, if possible, move the piece to a cleaner area or room for the final padded coats.

Dried glue will resist any oil finish, leaving light areas, so do your best to remove squeeze out. However, if you discover a missed spot after brushing the first coat, Waterlox is forgiving—just let the finish dry, sand the area and reapply. No one will be the wiser.

I break down pieces if I can for finishing, removing tabletops from bases, for example. And I put strips under the workpieces to lift them off

the table when applying Waterlox, so they don’t pick up debris and the finish doesn’t pool around the bottom. I seal these strips with Waterlox so they don’t wick finish from the piece.

Start with Two Coats

I start with two brushed coats of Waterlox, which saturate the wood with finish and establish a foundation for the padded coats that follow. After brushing, I smooth the wet finish with a cotton rag, to remove drips or puddles and leave a wet, even coat.

A large, soft, natural-bristle brush works best, but there's no need to break the bank. I use a 1³/₈" round domed-sash brush by Jack Richeson & Co. It holds a lot of finish and fits nicely into the glass jars I use.

The first step is to get as much finish transferred onto the furniture as possible. Then I use the brush to move the finish around and evenly cover the surface, returning to thirstier areas like end grain or spalted wood to give them more finish. Since Waterlox starts getting tacky after about 15 minutes in a warm shop, it works best to break a big piece into sections, brushing finish onto one section and then wiping down the previous one, and so on.

I remove the excess with clean, lint-free cotton rags. The goal isn't removing every bit of excess but just avoiding pooling and drips. So leave

the piece glossy with wet finish rather than wiping it down to a matte look. If an area is still absorbing a lot of finish at this point, feel free to move more finish there with the rag. That said, the next coat should even out the look. Before leaving the piece to dry, make a last spot check for drips and pools.

After leaving the piece for at least 24 hours, apply a second brushed coat. The wood will absorb less this time, so apply a little less finish to prevent drips. This time, wipe down the surface with the grain, which will make marks less visible. Again, spot-check the piece before you leave it and wait another 24 hours for it to fully cure.

Level the Surface

At this point, it's time to level the surface, removing any debris left in

the finish. I do this with medium-grade steel wool, which seems to scrape rather than scratch and grind the surface (like sandpaper would). This leaves a smoother surface for the thin padded coats that follow. You might be tempted to smooth the surface after the first brushed coat, but my tests show that to be a waste of time. You'll get just as good results smoothing the second coat only. Medium-grade steel wool can get a little prickly and painful, so I protect my hands with latex gloves.

Rub with the grain, as cross-grain scratches can telegraph through to the final finish. Then blow off the surface with compressed air, or brush and wipe off the dust. The surface should feel smooth. Drag your hands over the entire piece, and hit any areas that feel rough with the steel wool again.



4. I brush on Waterlox with a large, round, natural-bristle brush that fits into my jars of finish. I work on one large area at a time. Start by transferring as much finish as possible onto the surface, and then use the brush to spread it evenly.

5. After saturating the surface, wipe off the excess gently with a lint-free cotton rag. You want to even out the sheen while leaving the wood slightly wet so you begin building a film. Let the finish dry for at least 24 hours before brushing on and wiping off another coat as before.

6. Let the second coat cure for another 24 hours, and then buff the surface with medium-grade (#1) steel wool to remove dust and debris and level any rough or bumpy areas. Use your fingers to feel for rough spots as these will telegraph through the thin padded coats that follow.

Last, look at the piece in raking light to spot any drips or heavy areas. In open-grained wood, finish can wick out of the pores during the drying process, leaving a raised rim around each one. Pay special attention to these areas. Any issues left behind will only compound with each thin padded coat that follows.

Pad on Thinner Coats

My padding technique is inspired by French polishing, and lets me build up protection and luster in a series of thin, smooth coats. The process is very forgiving. If you mess up you can just rub the area out, using steel wool for slight mistakes or sandpaper for bigger ones. Then apply extra finish until the area looks similar to its neighbors, and start applying coats to the entire piece again. Once the piece is in service, the same process works for invisible repairs.

To make the pad, simply fold a lint-free cotton rag to make a palm-sized flat area on one side. Any folds on the working side will produce streaks in the finish. It's similar to a pad for French polishing, except that there's no charging cloth wadded inside. Since Waterlox dries slower than shellac, that extra wadding isn't necessary to keep the pad wet.

I use the brush to charge the pad, dipping it in the jar and pressing it into the cloth. The flat side of the pad should be wet but not dripping wet. As you pad on layers the rag will eventually become saturated. Add finish to keep it from getting sticky.

I use the pad to transfer a fair amount of finish onto the surface, and then even it out into a thin, smooth coat. The technique is more like rubbing than wiping. I don't lift the pad from the surface as I go. If you stop short and lift the pad, you'll leave a bump or bubble of finish behind. When you do need to set the pad down on the surface or lift it off, do it in a smooth, gradual motion, like an airplane landing or taking off. I wipe in the direction of the grain, so any marks will be less noticeable.



7. The padding technique depends on a wrinkle-free pad. Fold the corners of a clean cotton rag, and then fold them in again to form a flat pad.

8. Use the brush to charge the pad with finish. A couple of dips should do it.

9. Once again, finish one section at a time. The motion is a gentle back-and-forth, without lifting the pad. When you do need to set it down or lift it, do it like landing a plane to avoid leaving behind a bubble of finish.

The Keys to Success

No finish is perfect, and Waterlox does have a few minor drawbacks. I have developed techniques to eliminate most of those, and the pros vastly outweigh the cons. It isn't cheap, but neither is nice wood or the time you invest in a beautiful piece. In all cases you get what you pay for.

Keep the Shop Warm

One thing people don't realize is how sensitive Waterlox is to temperature. The finish will lay flatter and meld together better in a warmer shop. If applied much below 65 degrees, it tends to clump up and show brush and rag strokes. So turn up the heat in your shop.

If you're heating your shop with a space heater or wood stove, make sure the actual finish and the piece of furniture is up to temperature before you begin padding on coats. If your shop isn't heated regularly in winter, it'd be best to store the finish somewhere that is.

Keep Oxygen Out of Can

Waterlox comes out of the can thin and

ready to use. Unfortunately, as many users have found, it becomes viscous and turns to gel if left in a container with too much air in it. My technique requires thin and watery coats, so I go to great lengths to keep it that way. It's not difficult.

As soon as I get the finish home, I transfer it from its store-bought can into several smaller glass jars with metal screw-on lids (not plastic). I wash and save my old peanut butter, pickle and small, glass condiment jars, in a variety of sizes.

When the finish in the jars gets down to just over half-full, I transfer it into smaller jars, leaving as little air in the new container as possible. If there's even 1" of airspace, I displace the oxygen by blowing into the jar as I put the lid on. I take a deep breath, hold it for a bit so my body uses up most of the oxygen, and then crack the lid and exhale into the contain-

er before screwing down the lid tightly. You can also use an off-the-shelf product called Bloxygen to displace that airspace, or add clean glass marbles to the jar to bring the finish level back to the rim (and thus decreasing the airspace).

If one jar becomes a little more viscous than the others, I use it for the brushed-on coats, as this will not affect the quality of the final finish. And I almost always open a fresh jar for the final padded coat so it lays flat.

Protect Your Lungs & Hands

Waterlox produces a fairly strong odor, so I consider a proper vapor respirator to be a must. I also wear latex gloves to protect my hands and keep them clean.

A. Waterlox cures quickly in the presence of oxygen, and will soon turn to gel in a half-empty can. Your first step should be to empty the can into smaller glass jars with metal lids. Leave them full until use.



Areas that are still absorbing finish will appear dull or pale, so wipe these areas a second time to get more finish into the wood and even out the sheen so it looks evenly glossy and wet. At the same time, you're applying a film here, not a thick coat, so if the finish is dripping, you should apply less to the rag.

You can keep working until you feel a little resistance, but definitely stop when the pad starts to grab, or just before. As the finish tacks, it'll pull fibers from the pad and you'll create stroke marks too, creating problems to fix with steel wool later.

After the finish has cured for 24

hours, pad on a second coat like the first. There's no need to buff the entire piece between coats, but it's worth your time to spot-check for rough spots or drips and knock those down with medium steel wool.

Buff After Second Coat

Once the second coat is dry (24 hours), knock it down with superfine (#0000) steel wool. Rub with the grain where possible, but don't feel bad about rubbing cross-grain to smooth out tight areas where one surface meets another. As before, blow off the entire piece with compressed air and feel for areas you

might've missed. Your hands see far better than your eyes at this juncture.

This is a good time for fine-tuning the finish. If some areas look more matte than others, I just pad on more finish, let it cure and even out the look with more steel wool.

The Most Important Coat

Use a fresh jar of finish for the final coat, so it lays as flat as possible. Pad it on the same way but be extra careful to follow the grain. Once you've wiped a section, check it in raking light. If you see a dull spot, give it another wipe and then do a quick overall wipe of the entire section.

If the temperature is low and you get some bumps and clumps of wet finish, wipe it off as best as you can with a clean rag and let it dry for 24 hours. Then buff it with steel wool to smooth the surface, and pad on another thin coat.

Allow the final coat to dry for an extra day or so to help with the final buffing. If the furniture has areas that'll see heavy use, like a tabletop, or you just want to build up a deeper luster, you can pad on additional layers of finish. Hit the piece lightly with the super-fine steel wool between each additional coat.

The Paper Bag Trick

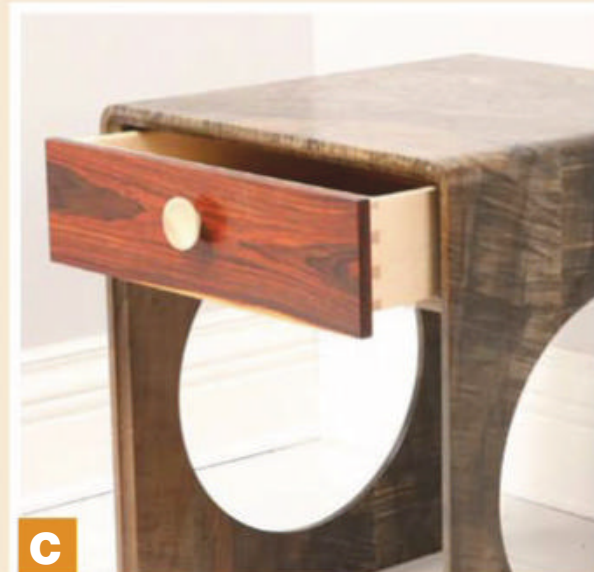
Furniture is made to be touched, so the final coat of any finish needs to be rubbed out. My favorite tool for this is a plain brown paper grocery bag—a mild abrasive that is fool-proof and effective.

The paper grabs small dust particles that have collected in the final coat, leaving a surface that's soft and smooth to the touch. However, it'll not fix significant defects in the finish. Buff those out with steel wool and reapply one or more coats of finish with the rag pad. I cut up clean grocery-store bags, and use only sections that are free of print and seams, folding them into a roughly 4" square. I then buff the wood lightly with the grain, checking the paper often. Any buildup of finish or debris can mar the finish, so switch to fresh paper as needed. If the finish wants to roll up into tiny pills, it's not fully cured, so let it rest another day or two. This step will knock down some of the gloss on the piece, and a few months of curing will knock down the gloss a bit further. That's just one of the many things I love about my go-to finish. **PW**

Austin Heitzman is a professional furniture maker who works with locally salvaged trees in Portland, Oregon. See more of his work (including bonsai displays) at austinheitzmanfurniture.com.

An Alternate Approach for Lighter Woods

Waterlox has a darker hue than some oil finishes, which adds richness to walnut and other medium-to-dark woods, but can make light woods look brownish. That's OK if you're going for an aged look on maple or ash, but if you want to preserve the natural color of any light wood, I recommend polyurethane. If you dilute it half-and-half with mineral spirits, you can use the same brush/pad technique I use for Waterlox to get the same beautiful results, with a similar flexibility of build.



B-C. You can cut polyurethane half-and-half with mineral spirits and use the same brush/pad approach I use for Waterlox. That's what I did on this table, to keep the gray spalted maple closer to its natural color, and the maple drawer parts bright and blonde.



10. After applying two thin padded coats—with 24 hours of drying time between each—it's time to level the surface again. Use 0000 super-fine grade steel wool, working in the direction of the grain and removing the dust afterward.

11. After letting the last coat cure for 24 hours at least, rub out the surface with a common paper grocery bag.

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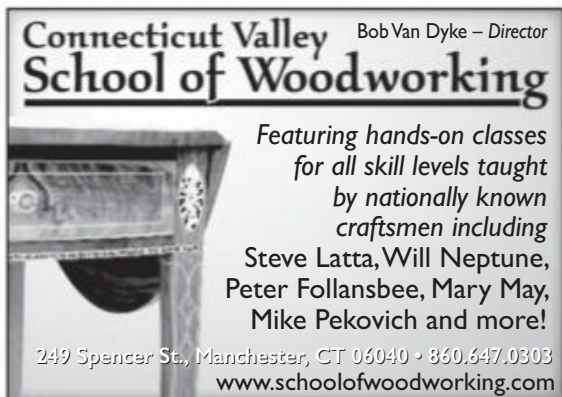


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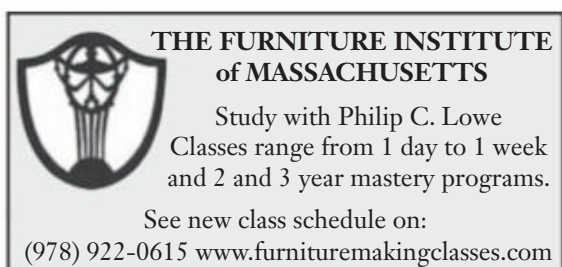
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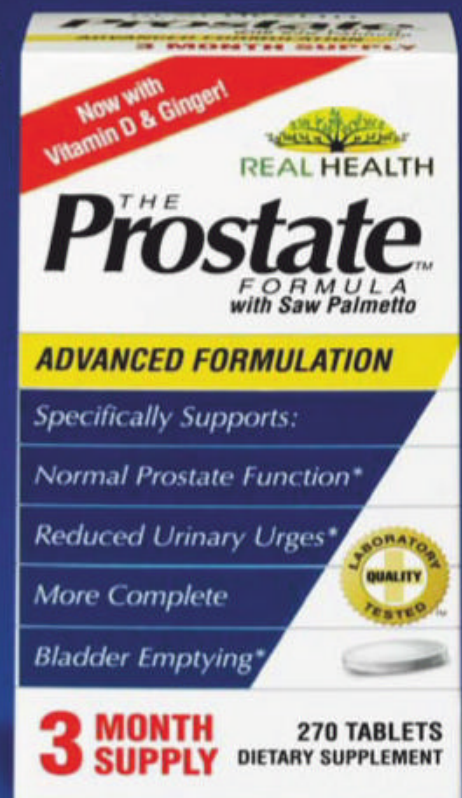
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Leading Acid Reflux Pill Becomes an Anti-Aging Phenomenon

Clinical studies show breakthrough acid reflux treatment also helps maintain vital health and helps protect users from the serious conditions that accompany aging such as fatigue and poor cardiovascular health

by David Waxman
Seattle Washington:

A clinical study on a leading acid reflux pill shows that its key ingredient relieves digestive symptoms while suppressing the inflammation that contributes to premature aging in men and women.

And, if consumer sales are any indication of a product's effectiveness, this 'acid reflux pill turned anti-aging phenomenon' is nothing short of a miracle.

Sold under the brand name AloeCure, it was already backed by clinical data documenting its ability to provide all day and night relief from heartburn, acid reflux, constipation, irritable bowel, gas, bloating, and more.

But soon doctors started reporting some incredible results...

"With AloeCure, my patients started reporting less joint pain, more energy, better sleep, stronger immune systems... even less stress and better skin, hair, and nails" explains Dr. Liza Leal; a leading integrative health specialist and company spokesperson.

AloeCure contains an active ingredient that helps improve digestion by acting as a natural acid-buffer that improves the pH balance of your stomach.

Scientists now believe that this acid imbalance is what contributes to painful inflammation throughout the rest of the body.

The daily allowance of AloeCure has shown to calm this inflammation which is why AloeCure is so effective.

Relieving other stressful symptoms related to GI health like pain, bloating, fatigue, cramping, constipation, diarrhea, heartburn, and nausea.

Now, backed with new clinical studies, AloeCure is being recommended by doctors everywhere to help improve digestion, calm painful inflammation, soothe joint pain, and even reduce the appearance of wrinkles – helping patients to look and feel decades younger.

FIX YOUR GUT & FIGHT INFLAMMATION

Since hitting the market, sales for AloeCure have taken off and there are some very good reasons why.

To start, the clinical studies have been impressive. Participants taking the active ingredient in AloeCure saw a stunning 100% improvement in digestive symptoms, which includes fast and lasting relief from reflux.

Users also experienced higher energy levels and endurance, relief from chronic discomfort and better sleep. Some even reported healthier looking skin, hair, and

nails.

A healthy gut is the key to a reducing swelling and inflammation that can wreak havoc on the human body. Doctors say this is why AloeCure works on so many aspects of your health.

AloeCure's active ingredient is made from the healing compound found in Aloe vera. It is both safe and healthy. There are also no known side effects.

Scientists believe that it helps improve digestive and immune health by acting as a natural acid-buffer that improves the pH balance of your stomach.

Research has shown that this acid imbalance contributes to painful inflammation throughout your entire body and is why AloeCure seems to be so effective.

EXCITING RESULTS FROM

PATIENTS

To date over 5 million bottles of AloeCure have been sold, and the community seeking non-pharma therapy for their GI health continues to grow.

According to Dr. Leal, her patients are absolutely thrilled with their results and are often shocked by how fast it works.

"For the first time in years, they are free from concerns about their digestion and almost every other aspect of their health," says Dr. Leal, "and I recommend it to everyone who wants to improve GI health without resorting to drugs, surgery, or OTC medications."

"I was always in 'indigestion hell.' Doctors put me on all sorts of antacid remedies. Nothing worked. Dr. Leal recommended I try AloeCure. And something remarkable happened... Not only were all the issues I had with my stomach gone - completely gone - but I felt less joint pain and I was able to actually sleep through the night."

With so much positive feedback, it's easy to see why the community of believers is growing and sales for the new pill are soaring.

THE SCIENCE BEHIND ALOECURE

AloeCure is a pill that's taken just once daily. The pill is small. Easy to swallow. There are no harmful side effects and it does not require a prescription.

The active ingredient is a rare Aloe Vera component known as acemannan.

Made from 100% organic Aloe Vera, AloeCure uses a proprietary process that results in the highest quality, most bio-available levels of acemannan known to exist.

According to Dr. Leal and several of her colleagues, improving the pH balance of your stomach and restoring gut health is the key to

revitalizing your entire body.

When your digestive system isn't healthy, it causes unwanted stress on your immune system, which results in inflammation in the rest of the body.

The recommended daily allowance of acemannan in AloeCure has been proven to support digestive health, and calm painful inflammation without side effects or drugs.

This would explain why so many users are experiencing impressive results so quickly.

REVITALIZE YOUR ENTIRE BODY

With daily use, AloeCure helps users look and feel decades younger and defend against some of the painful inflammation that accompanies aging and can make life hard.

By buffering stomach acid and restoring gut health, AloeCure calms painful inflammation and will help improve digestion... soothe aching joints... reduce the appearance of wrinkles and help restore hair and nails ... manage cholesterol and oxidative stress... and improve sleep and brain function... without side effects or expense.

Readers can now reclaim their energy, vitality, and youth regardless of age or current level of health.

One AloeCure Capsule Daily

- Helps End Digestion Nightmares
- Helps Calm Painful Inflammation
- Soothes Stiff & Aching Joints
- Reduces appearance of Wrinkles & Increases Elasticity
- Manages Cholesterol & Oxidative Stress
- Supports Healthy Immune System
- Improves Sleep & Brain Function

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This is the official nationwide release of the new AloeCure pill in the United States. And so, the company is offering our readers up to 3 FREE bottles with their order.

This special give-away is available for the next 48-hours only. All you have to do is call **TOLL-FREE 1-800-748-5760** and provide the operator with the Free Bottle Approval Code: AC100. The company will do the rest.

Important: Due to AloeCure's recent media exposure, phone lines are often busy. If you call and do not immediately get through, please be patient and call back. Those who miss the 48-hour deadline may lose out on this free bottle offer.



Finishing with Just Three Tools

The tools are the most straightforward part of finishing to understand.

By Bob Flexner

Compared to woodworking, finishing is a very simple craft. The objective is no more complicated than transferring a liquid stain or finish from a can or other container to the wood. There are only three tools used to do this: a rag, a brush and a spray gun. (I'm including rollers, paint pads, etc., in the same category with brushes.) Each is easy to use. Even a spray gun is no more complicated than a router.

Because many woodworkers struggle with finishing, despite what I'm saying in this article, I need to include this caveat: Choosing which stain or finish to use and how to use it can be confusing. This is largely due to bad manufacturer labeling, but there's no problem understanding the tools.

There are five key differences among the three tools: cost, speed of transfer, degree of producing a level film, relative amount of waste produced and weather problems with a spray gun.

Cost

Rags cost little to nothing, especially if you make an effort to save old worn-out cotton clothing. In addition, inexpensive paper towels can often be substituted for small jobs. Brushes are also inexpensive, though they cost more than rags. In contrast, even the cheapest spray guns, combined with a source of high-volume or high-pressure air, cost \$200 or more. So, if cost is a factor, you may be limited to using rags and brushes.

The exception is with small objects where you may be able to use aerosols. These are widely available in almost every finish.

Speed

You can apply a stain or finish to a large area faster with a rag or spray



There are only three tools used to apply finishes: a rag, a brush and a spray gun. Think of the almost countless number of hand- and machine-powered tools you use to do quality woodworking and the simplicity of finishing should be evident from this photo.



gun than you can with a brush. Rags are very effective when you intend to wipe off all the excess, as you usually do with stains and oil finishes. Spray guns are effective for applying any stain or finish and either wiping off the excess or leaving a finish to build a film.

In comparison, brushes are inefficient tools, because they can carry only a small amount of the liquid



1. The fastest way to achieve a level finish is by spraying. The downsides to spraying, besides initial expense, are increased waste (compared to brushing or wiping) and the extra expense in cold weather arranging exhaust and warm-air replacement.

2. For smaller objects you can substitute aerosols for spray guns and achieve all the same advantages.

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stain or finish at a time. You have to constantly dip the brush back into the liquid to reload it.

Film Leveling

In cases where you aren't wiping off the excess, finish leveling is very important. You can always sand the finish to remove flaws, such as brush marks and orange peel, and make it level. But this requires extra work, and it always carries with it the risk of cutting through and causing damage that's difficult to repair. The goal in applying any finish is to get it as level as possible from the start. The three tools differ in their ability to produce a level film.

It's nearly impossible to apply a film-building finish with a rag without leaving deep ridges in the film. (The exception is when you use the technique of French polishing, which can only be done with shellac.) Brushes perform better, but they leave brush marks. This is true even with sponge brushes, which leave ridges at the edges of each brush stroke, and with expensive bristle brushes. Spray guns produce the most level surface of the three tools. But even spray guns leave a light pimply texture called "orange peel."

So, it's virtually impossible to apply a perfect finish using any tool unless you wipe off all the excess after each coat. All three tools leave flaws in the finish film. To make a finish perfect, you have to level it using sandpaper, then rub it to the sheen you want using steel wool or rubbing compounds. It usually requires considerably less work to sand a finish level that's been

3. A major flaw that can come with spraying is orange peel. This is an unlevel surface that resembles the peel of an orange. To make a perfect finish, this flaw has to be sanded level.

4. A major flaw that comes with brushing a finish is brush marks. Contrary to what's often said, you can't totally avoid these marks by using a more expensive brush. There'll still be brush marks that have to be sanded level to achieve a perfect finish.

5. Though you can get runs and sags with any of these three tools, the problems are most common when brushing.

applied with a spray gun than one that's been applied with a brush.

Waste

Waste is undesirable because of cost and the amount of pollution it creates. Waste costs more, not only because of the unused finish material, most of which winds up in the atmosphere, on the floor, or on spray-booth filters, but also because of the cost of disposing of used solvents and filters.

Rags and brushes are almost 100 percent efficient. By comparison, spray guns are very inefficient. A large part of the finish material is lost in overspray and bounce-back. HVLP spray guns are more efficient than the old conventional spray guns, and HVLP guns dominate the market because of this.

Weather

If you live in a cold climate and can't finish outdoors for a large part of the year then you'll have problems using a spray gun. Spray guns create a lot of overspray that floats around the room and lands on everything, including your work. You must exhaust this overspray, and this presents two problems: replacing the exhausted

air with warm air, and trapping the overspray before it gets to the fan and builds up on it. In contrast, rags and brushes transfer all the liquid efficiently from the can to the wood. The only leftover is evaporating solvent as the coating dries.

Replacing air with warm air on cold days can be a strain on your heating system. Placing a heater in the room where you're spraying can be a hazard, especially if there's an open flame in the heater. Never spray in a room where there's an open flame as it can cause an explosion.

To trap overspray, arrange a bank of filters between you and the exhaust fan. Don't allow finish or paint to build up on the fan. In addition, don't allow solvents from a solvent-based paint or finish to be drawn across a motor that's not explosion proof.

Though spray guns are easy to use and they produce good results, few hobbyists rely on them because of these problems. The most common tools used by hobbyists are rags and brushes. **PW**

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Bob Flexner is the author of Flexner on Finishing, Wood Finishing 101 and Understanding Wood Finishing.



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The Maloof Chair Joint

As Sam Maloof's chair designs evolved, so did their construction.

By Andrew Zoellner

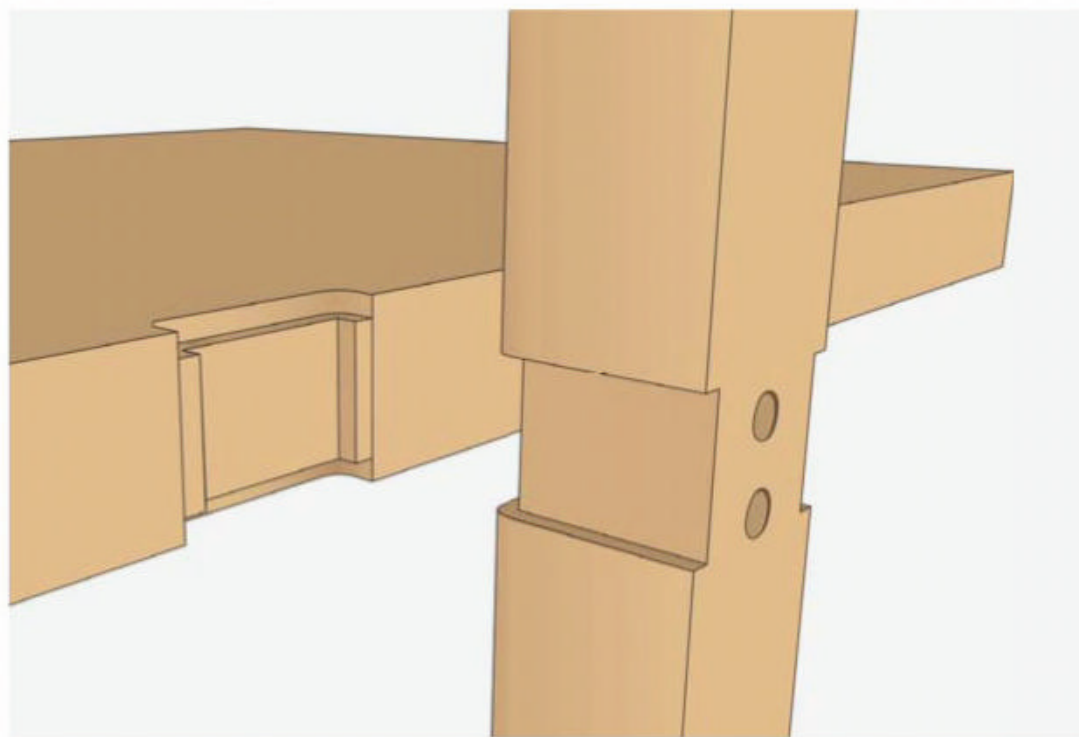
Sam Maloof's sculpted rocking chairs are iconic, so much so that his name is synonymous with that furniture style. The timeless design is striking—light, strong, curvaceous and quite comfortable—made with a combination of machine and hand-work. Beyond his furniture, there's much inspiration in Maloof's way of life and reasons for doing the work he did. I return to this passage from his autobiography (*Sam Maloof: Woodworker*) time and again, reflecting on the 1957 Craftsmen Today conference.

"There I first met Walker Weed, Wharton Esherick, Art Carpenter, John Kapell and Tage Frid. Bob Stocksdales I had met previously, but this meeting cemented our friendship," Maloof writes. "What we all had in common was that we were doing what we wanted to do. None of us was a conformist. None of us wanted to be tied up or bound. I believe all of us were seeking spiritual well-being in what we were doing. We were not using our work as a means of avoiding responsibility in a material sense."

I reached out to Mike Johnson, who worked side-by-side with Maloof for more than three decades and continues to build his designs, to learn more about the Maloof chair joint.

"Sam's early chairs from the 1950s and 60s used a very simple joint that was made by taking the side seat rails and clamping them outside edge to outside edge, then boring a hole centered so that when the rails were unclamped it left a half round socket where a lathe turned leg would then be made to match," Johnson says.

"Just shortly after the wood seat was introduced in 1970—prior to that all seating pieces were upholstered—Sam started experi-



The Maloof chair joint is cut in five steps. First, cut a 2"-wide, 1/4"-deep dado in the side of the chair seat. Then, use a rabbeting bit to cut 1/4" recesses at the top and bottom of the joint. Mill the mating leg 2 1/2" wide (the width of the joint), round over the inside corners of the leg (to match the round left by the rabbets), then cut a 1 1/2"-wide, 1/4"-deep dado on the three mating faces of the leg to match the opening. Once the pieces are fitted, the leg joint is blended and shaped by hand.

menting with the leg to seat joints. Ultimately he settled on using 1/4" rabbeting bits to cut shoulders that the front and rear legs could interlock and be supported with."

After the chair is glued up, the handwork begins, blending the machine-cut joints into the form with rasps and files.

"With as much gluing surface and interlocking quality of the joint, it is arguable as to whether or not the screws used to reinforce the joint are necessary. But Sam would use them anyway, because he wanted to build pieces that would stand the test of time," Johnson adds. "Early Maloof pieces had their screw holes plugged with the same wood the chair was built from. Sometime in the late 1970s Sam started using

contrasting wood—mostly ebony—as a design element."

After all, as Maloof said, "Why go to all that trouble of making a beautiful joint only to hide it?" **PW**

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Mike Johnson and his wife, Joanne own and operate Sam Maloof Woodworker, Inc. Their son, Stephen is Mike's shop assistant, while Joanne serves as business manager. Mike, now in his 38th year with the Maloof organization, has been granted the exclusive licensing agreement to produce Sam Maloof furniture. Mike and Stephen work in Sam's original workshop, building furniture and accessories as well as doing restorations on Sam's early work. See more at sammaloofwoodworker.com
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Andrew Zoellner is Popular Woodworking's editor in chief.

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