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- Floor-to-table height: 37"
- Max cutting width: 13½"
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- Table tilt: 5° left, 45° right
- Floor-to-table height: 37½"
- Blade speeds: 1700 and 3500 FPM
- Overall size: 32" W x 32" D x 73" H
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- Table size: 23½" W x 17¼" L x 1½" H
- Table tilt: 5° left, 45° right
- Floor-to-table height: 37½"
- Blade size: 131½" long
- Blade speeds: 1700 and 3500 FPM
- Overall size: 32" W x 32" D x 73" H
- Footprint: 27" L x 17¾" W
- Approx. shipping weight: 446 lbs.



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14" HEAVY-DUTY BANDSAW

- Motor: 1½ HP, 110V/220V (prewired 110V) single-phase, 1725 RPM, 15A/7.5A
- Precision-ground cast-iron table size: 20½" x 14" x 1½"
- Table tilt: 15° left, 45° right
- Floor-to-table height: 44"
- Cutting capacity/throat: 13½"
- Max. cutting height: 6"
- Blade size: 92½" to 93½" (⅛" to ¾")
- Overall size: 30" W x 26" D x 67¼" H
- Approx. shipping weight: 259 lbs.



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17" HEAVY-DUTY BANDSAW

- Motor: 2 HP, 110V/220V, single-phase, TEFC, (prewired 220V), 1725 RPM, 60 Hz, 20A/10A
- Precision-ground cast-iron table size: 17" x 17" x 1½"
- Table tilt: 10° left, 45° right
- Floor-to-table height: 37½"
- Cutting capacity/throat: 16¼" left of blade
- Max. cutting height: 12½"
- Blade size: 131½"
- Blade widths available: ⅛"–1"
- Blade speeds: 1700 & 3500 FPM
- Approx. shipping weight: 342 lbs.



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G0513ANV ONLY \$925⁰⁰



17" HEAVY-DUTY BANDSAW W/ FOOT BRAKE

- Motor: 2 HP, 110V/220V, 20A/10A, or 220V, single-phase, 8.7A, TEFC capacitor start induction, 60 Hz, prewired 220V, 1725 RPM
- Power transfer: Belt drive
- Precision-ground cast-iron table
- Table size: 23½" W x 17¼" L x 1½" H
- Table tilt: 5° left, 45° right
- Floor-to-table height: 37½"
- Blade size: 131½" long
- Blade speeds: 1700 and 3500 FPM
- Overall size: 32" W x 32" D x 73" H
- Footprint: 27" L x 17¾" W
- Approx. shipping weight: 446 lbs.



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G0852 ONLY \$950⁰⁰

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1 1/2 HP PORTABLE CYCLONE DUST COLLECTOR

- Motor: 1 1/2 HP, 110V, 3450 RPM, 15A
- Intake hole size: 6"
- Impeller: 12 3/4" welded steel
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- Suction capacity: 868 CFM @ 2.6" SP
- Max. airflow: 868 CFM
- Max. static pressure: 9.7"
- Approx. shipping weight: 375 lbs.



G0860 ONLY \$725⁰⁰

\$119 shipping

2 HP PORTABLE CYCLONE DUST COLLECTOR

- Motor: 2 HP, 220V, 3450 RPM, 9A
- Intake hole size: 7"
- Impeller: 13" welded steel
- Collection drum size: 35 gallons, max. capacity: 20 gallons
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- Max. static pressure: 11.0"
- Approx. shipping weight: 419 lbs.



G0862 ONLY \$1295⁰⁰

\$115 shipping

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- Motor: 3 HP, 220 V, single phase
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- Max. cutting height: 6 1/8"
- Max. cutting depth: 1/8"
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- Knife size: 20" x 1" x 1/8" (G0454)
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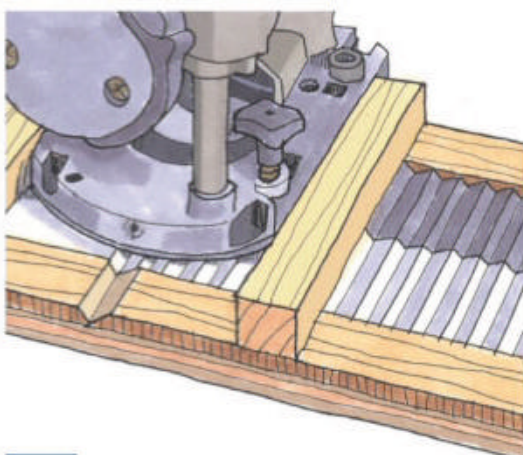
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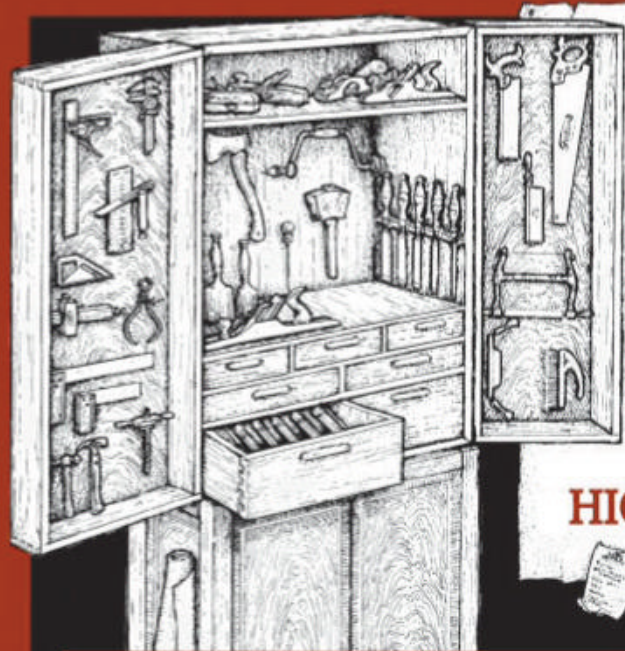
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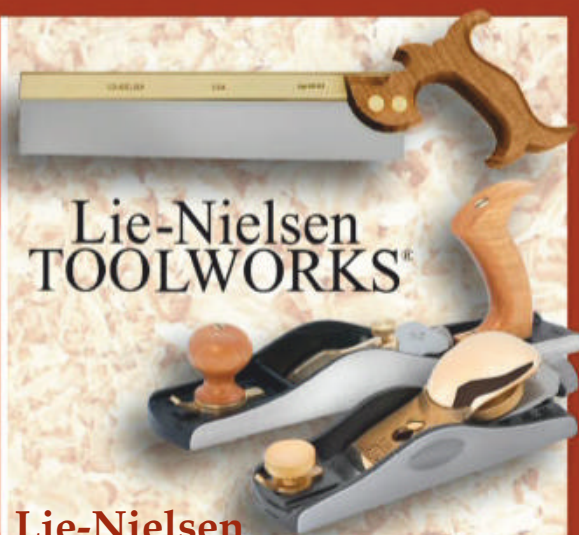
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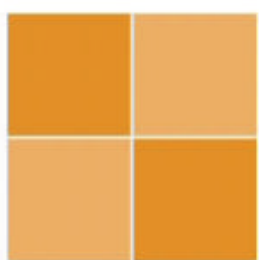


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Connect

FROM THE EDITOR

The Upside of a Small Shop

By Andrew Zoellner

As this first issue of 2019 goes to press, I'm thinking a lot about my workshop. A few years ago, during the height of the KonMari craze, my girlfriend and I took everything in our apartment out of our closets, bookcases, dressers, drawers and cabinets, held each item in our hands, and decided whether or not to include it in our lives. Though it seemed a little hokey, we felt a sense of relief as we sold, donated and gave away the items that didn't bring us joy. The result was more space for the items we *did* want in our lives, and a reduced sense of guilt when getting rid of things that didn't make the cut. Except, I didn't go through the process with my tools and shop space.

We were saving to buy a house, and without knowing what future shop space I'd have to work with, I didn't want to part with any tools and eliminate any possibilities that a future shop might need. In our new house, I dedicated a 20' x 14' part of my garage to a workshop (as well as the 20' x 10' section that's supposed to be where we park a car during the cold months), and I've come to the realization that my shop is TOO full. As I worked on the credenza I built for this issue (page 44), the first non-home improvement project I tackled in this space, things started to become clear.

It really drove home how much I value good, versatile tools, especially a router and a router table. This



one tool can cut joinery for drawers, miters, dados, grooves, rabbets and edge profiles. With a little jiggling, it can joint edges and flatten big surfaces. And it barely takes up any floor space when not in use. The same goes for my track saw. It excels at breaking down sheet goods, but that's just the start. It's way easier to get a straight, square edge on a long piece of stock using a track saw than my puny 6" jointer. I don't think I'd trade a track saw for a table saw, but that might be a comfort thing.

Then there are the tools I purchased with good intentions that I don't use (and which take up space). And, it hurts to talk about the tools and fasteners and hardware I've purchased because I couldn't locate the ones I had already (because there's too much stuff in my shop).

Space limitations seem to creep up no matter the size of the shop. Even in the Pop Wood shop, with bigger machinery, more benches and more space, we have to be diligent about keeping things organized and maximizing the space. It seems we

fill the space we have, no matter the size. That's what appealed so much to me about the knockdown shave horse project designed by Amy Pate (page 28). Disassembled, it can be tucked away without too much hassle and be moved to new locations without much trouble (when you need space, go find it!).

And it reinforces a gut feeling I keep having, about the joy of a box full of hand tools, a workbench and time to focus on building furniture and not maintaining a shop. That's how James McConnell prefers to work, and his gorgeous bar stools showcase the level of craftsmanship you can achieve with careful work and a carefully chosen tool kit (page 36).

In 2019, let's do more with what we have, and be ruthless in removing the tools (and wood and fasteners and hardware) that get in the way.

Andrew Zoellner

PHOTO BY THE AUTHOR

The hottest trend in
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INBOX

Topcoat Questions

Bob, I am having trouble with Minwax satin oil-based polyurethane. Here's the story, I stained a table and it came out really nice. I wiped it down with mineral spirits to make sure I didn't leave any stain behind.

The first coat of poly went on well with a natural bristle brush. During the second coat, I made a mistake while brushing and had a spot run. So, I sanded with #320 grit to get the run out. I applied a third coat and got all the runs out but was unhappy I could see brush marks.

I went back to the paint store and they suggested that I use wipe-on poly to eliminate brush marks. I made my own by mixing the oil-based polyurethane with mineral spirits, 50/50. The application went great, but when it dried I was able to see alternating lines in natural light from a low angle that look grayish.

I'm worried that I have so many coats on the top, the table will cup because I haven't applied finish to the bottom yet. Finally, I called Minwax and a rep suggested that I left stain on the table and to start over.

Andrew K.
Denver, PA

1. There's no need to finish both sides of tabletops. This is a myth, probably resulting from the warping that can occur from veneering only one side using a water-based glue. The glue causes the veneer to swell, so that when it dries, it shrinks and causes the substrate to cup. So woodworkers, most of whom use water-based glues, learned that they needed to veneer both sides. Then this procedure morphed into the thinking that you need to also finish both sides.

For proof of what I'm saying look at old furniture, from about the 1920s and earlier. The undersides of the tops are not finished. Around the 1930s, factories began finishing the undersides, especially from the rails outward, (still rarely between the rails) to make the wood feel better when people touched it and to also look better if people crawled underneath.

By the way, there's no cupping with contact cement on just one side, though I don't like using this adhesive for veneering.

2. The issue of how thick you make the finish is based primarily on how it looks. The thicker it gets, the more plastic looking it gets. You're always weighing this against improved water resistance. The thicker the finish the better it is against liquids penetrating, but if you get it too thick, it won't look good. Two coats, which you were aiming for, is pretty thin in my opinion. I guess it depends on how thickly you apply each coat.

3. Wiping the stain with mineral spirits bothers me some because you might be removing some of the stain. I've never done this. I've just wiped well with a clean cloth. But apparently, you didn't have a problem.

4. In my experience, Minwax poly is one of the worst for bubbles. The best way to eliminate bubbles in the finish is to add 5 percent or 10 percent mineral spirits (paint thinner) to the finish. This slows the drying so the bubbles have more time to pop out on their own. Of course, this also allows more time for dust to settle. You need to be sure the air is as clean as possible, but it's usually impossible to avoid dust nibs entirely.

So a trick to get rid of them after the finish has fully dried is to rub the finish with a folded brown paper bag (like from a supermarket). As long as the dust nibs are not really bad or really big, this usually flattens them without marring the finish.

5. You can usually eliminate the brush marks with the same thinning. When a finish is thinner, it levels better.

6. So now the most difficult issue, the "alternating lines" you mention after applying the satin poly thinned half. I don't really understand your terminology. I'm assuming you mean what I would call streaks.

My experience is that it's impossible to apply a satin wiping varnish without these streaks. There's no problem with gloss wiping varnish. (Notice that this 10 percent thinning is much less than the half-and-half to make the wiping varnish. I don't know why the satin wiping varnish is so difficult, but I believe Minwax is the only company that makes it, and I've never found that their "technicians" have a clue about anything.)

7. At this point I think you have two choices, maybe three. One is to sand the finish level and brush a coat of 10 percent thinned satin poly.

A second is to apply several coats of gloss wiping varnish and then rub out with #0000 steel wool. Then apply wax or furniture polish to prevent light scratches showing up when an object is moved across the abrasive scratches. (It flattens the ridges).

And a third might be to sand the finish level, then rub it with the #0000 steel wool and apply wax or furniture polish to protect it. You may have to work up through several grits of sandpaper to #400 grit or #600 grit to be successful with the steel wool.

Bob Flexner
contributing editor

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WORKSHOP TIPS

Table Saw Tray

A storage tray is a useful addition to any stationary tool. After adding this one to my table saw, I don't know how I ever did without it. I made the tray about 3" deep—just deep enough to store the essentials lower than the surface of my saw, but shallow enough to keep items from getting buried. As a bonus, I found all the parts I needed to build it in my scrap bin.

I bolted the tray to the saw using the factory-drilled holes for adding extension tables. The tray's top edge is about 1/8" below the level of the saw, so it doesn't interfere with the fence. —*Dana Atwood*



Two-Sided Table Saw Insert

I needed a 1/4" zero-clearance throat plate for cutting dados the other day, but my throat plate only had a 3/4" slot in it. I didn't want to interrupt my project to make or buy a new throat plate, so I turned the old one 180° and cut a new slot in it. Why hadn't I thought of that before? Now, whenever I make a new throat plate, I make it two-sided right off the bat. —*Dean O. Travis*



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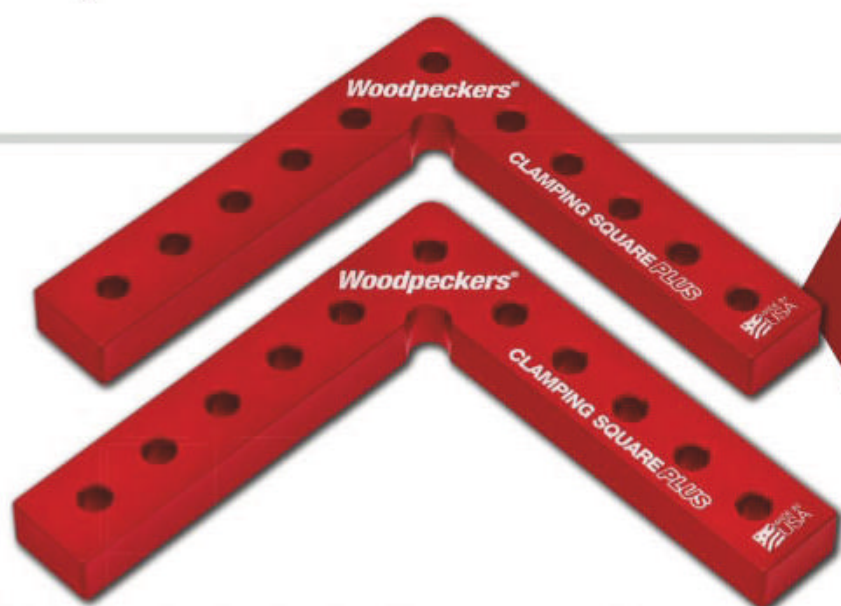
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NEW TOOLS

Rockler Convertible Benchtop Router Table

Ever since I decided to commit to a one-car workshop, I've been extremely selective about the tools that I bring into the shop. A stand-alone router table hasn't proven itself worthy of the square footage in my shop. But this Rockler convertible benchtop router table got my gears turning. What if I could fold up my router table and tuck it away? This router table is supported by folding legs that have two configurations, benchtop and wall-mount. In the benchtop mode, there is ample space on the feet to clamp the table to your workbench. In the wall-mount mode, the table is very sturdy, but keep in mind you'll need room on your wall for infeed and outfeed. Mounting this to the side of an assembly table in the middle of your shop might make more sense.

CONVERTIBLE BENCHTOP ROUTER TABLE

Rockler Woodworking and Hardware

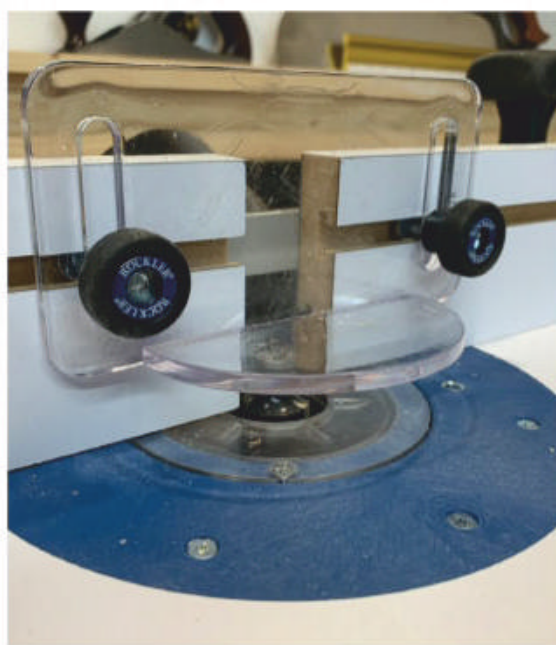
rockler.com

Price: \$199

The router mounts to a plastic plate that has tons of configuration options for different brands of routers. The Porter Cable router I used in the table was not listed on the compatibility list, but fit perfectly on the mid-size plate (they have a different plate for compact routers). This was a router I didn't

use much, so I will probably leave the plate on, which means that I can set up this router table quickly in the future. However, the plate functions as a pretty good base and is easily removable if you're a one router shop.

If you are accustomed to a full-size router table, you'll have to keep in mind that this fence is shorter than what you're likely used to. —David Lyell



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Festool Domino 500 Series Connectors

Every woodworker loves joints that are tight, strong and secure. Dovetail joints and mortise and tenons will get you there, but if you need a knockdown joint, good options are limited. That's where Festool's connector sets come in. With the connectors, you can create furniture or cabinetry and disassemble, move and reassemble it with only a hex wrench. Festool introduced a 14mm connector

system for the Domino DF 700 last year, and this year they added the 8mm connector system for the DF 500. This is the set I tested.

The set includes components for straight and corner connections and for integrating it with Festool's LR 32 cabinetry system. Components can be

purchased individually, but the full set includes a 15mm drill bit and clever drill guide that makes it easy to accurately locate the cross anchors that draw joints together.

First, use the 8mm bit to cut mortises for both dominos and connectors. On one side, insert a split anchor and notched bolt. On the other side, drill a hole from the top for the cross anchor with the drill guide. Once you slide them together, a hex wrench and screw pulls the joint tight. Loosen the screws and the joints are quickly disassembled.

■ DOMINO 500 SERIES CONNECTORS

Festool
festool.com
Price: \$375



I found the system works quite well as long as you include a number of regular wood dominos for joint rigidity. The connectors are for drawing the joints together, not as a replacement for good joints. Overall it's a good solution for knockdown furniture, especially if you already have a Domino joiner at your disposal.

—Tim Celeski

DeWalt DCW210 Sander

The DCW210 5-inch random orbit sander is the latest woodworking tool in DeWalt's 20-volt MAX cordless line. I'm sure I don't have to try very hard to interest woodworkers in the freedom afforded by a battery-powered sander. Not just the freedom from a power cord, but also the freedom to grab your work and take it outside to keep accumulated sawdust and cloudy air out of the workshop altogether.

■ DCW210 5" SANDER

DeWalt
dewalt.com
Price: \$199 with battery,
\$119 for bare tool.



This sander features a powerful brushless motor, dust-sealed switch, 8,000-12,000 rpm speed dial, and a cloth dust collection bag that snaps onto its positive-locking dust port tube. The switch and dial operate effortlessly with the sander held in one hand, but the dust port is not so easy to use. I tried to fit the port to 10 other dust collection vac hoses in my collection with no luck—the sander is only designed to clip onto a specific DeWalt hose end.

Fitted with a compact 2.0 amp-hour (AH) battery pack (combined weight 2.9 lbs.), the sander ran for 16½ minutes. The tool also feels light and lively enough (3.5 lbs.) with a 4.0 AH pack, but DeWalt's larger 6.0 and 9.0 AH Flexvolt packs are heavy enough to tip the sander over and are too clumsy to consider.

While using the sander for surfacing glue-lam workbench slabs with #60-grit disks, I could really lean on it with both hands without stalling or overheating the tool. And in tests on hard maple with #100 grit discs, the DCW210 removed 4.9 grams of sawdust in three minutes. And its dust bag collected 61 percent of the dust created—both metrics on par with other cordless sanders I've tested. —Michael Springer



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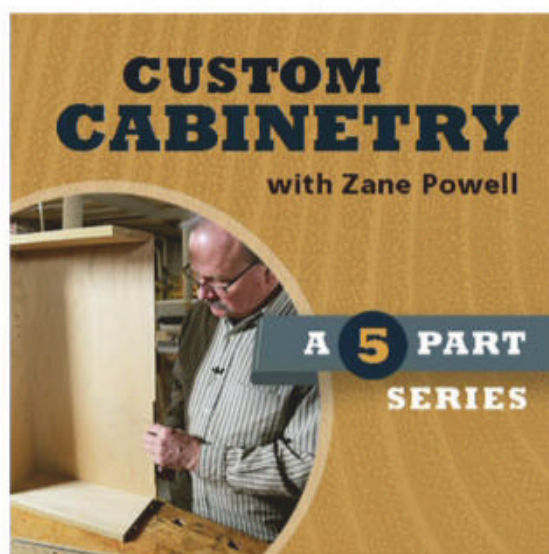


Stickley Poppy Table Project [PDF Download](#)

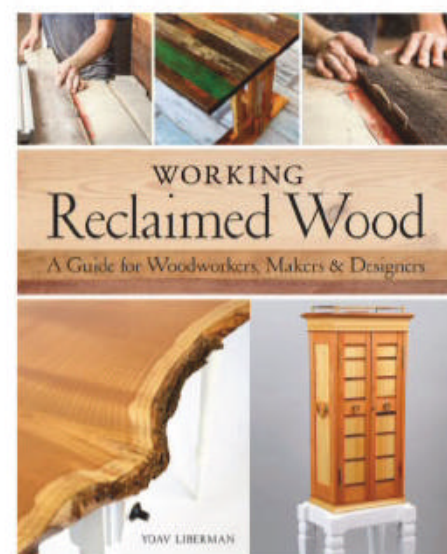
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Router Bit Storage Case

Keep your bits visible and ready to go with this simple storage solution.

By David Lyell

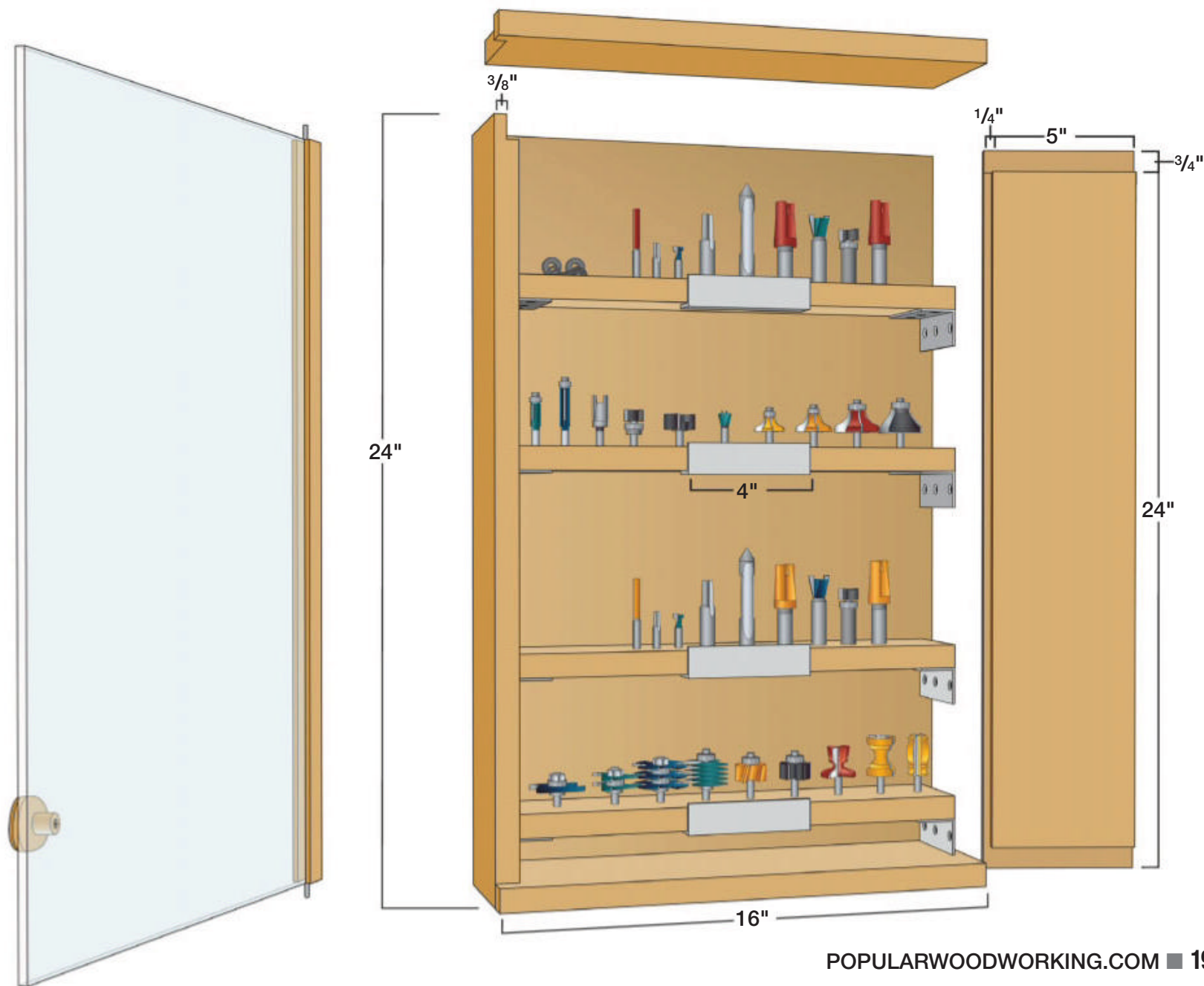
Like all of our I Can Do That! projects, this case is designed to be useful, easy to build and made from inexpensive materials. The carcass is made from red oak with a plywood back. It features four removable shelves (held in place by simple metal brackets) that provide easy access to your 1/4" and 1/2" shank router bits. The frameless door is made from a polycarbonate sheet and the unique hinge design uses aluminum dowels. This case can be built in a day and will quickly enhance the workflow of your workshop. It can easily be scaled up or down, to accommodate a wide variety of router bits (or drill bits) to keep your shop organized. **PW**

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		T	W	L
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1	Side	3/4	4 1/4	24
2	Top & bottom	3/4	5	16
4	Shelves	3/4	3	14 1/2
1	Hinge rail	3/4	5/8	22
1	Back	1/4	15 1/4	24
1	Door	3/16	14 3/4	22
1	Knob	3/4	3/4	-
2	Hinge rods	1/8	1/8	2
8	Shelf supports	3/4	3/4	2 1/2



10 Router Tips for Furniture Makers

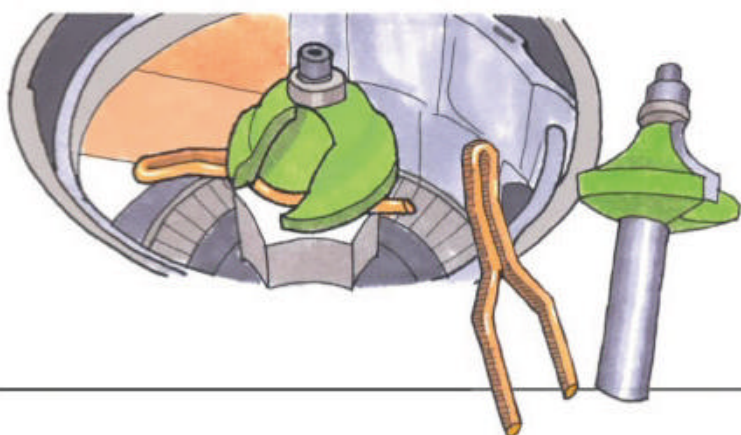
Get to know one of the most useful tools in your shop.

By the Editors

Too many of us have our routers set up as dedicated roundover tools. There's so much more to the router. We've pulled together some unique tips that will help you build incredible furniture. From face jointing small boards to best practices when approaching the bit without a fence, you'll find a tip that helps you find yet another use for the router in the workshop.

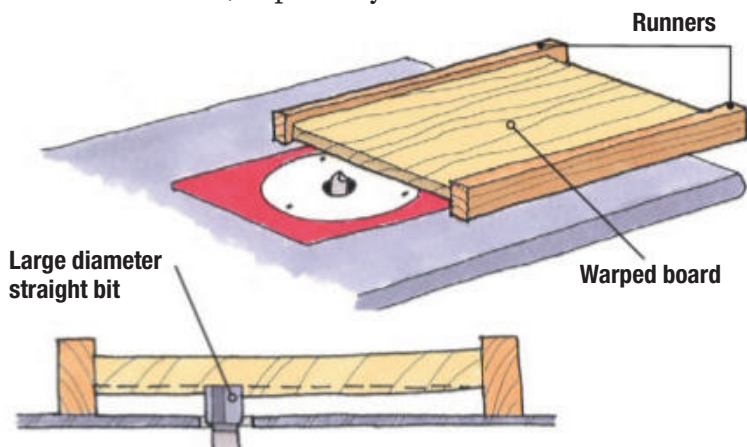
1 SIMPLE BIT SPACER

Manipulating two wrenches can be frustrating enough. Grab a piece of copper or something else bendable and make a bit spacer to avoid bottoming out your router bit in the collet. It's as simple as it sounds. You can even make it long enough to rest on your router base if you align the height correctly.



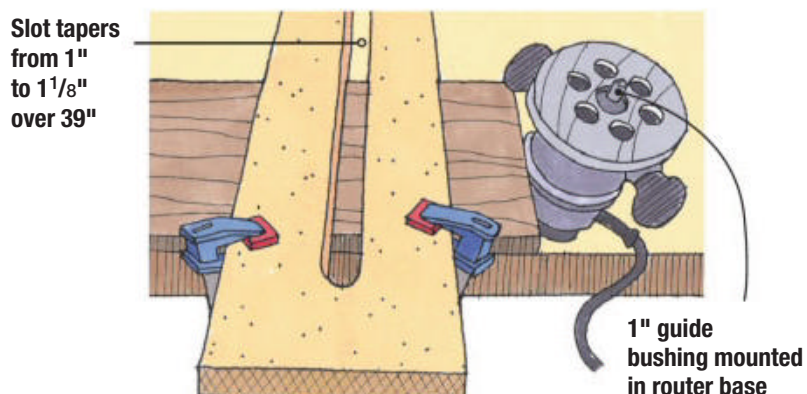
2 FLATTENING A WIDE BOARD

If your jointer isn't wide enough and your lumber isn't cooperating under a handplane, try the router table. Attach runners to both sides of the board and run it across a straight bit. You'll be shocked at how well this works, especially for smaller stock.



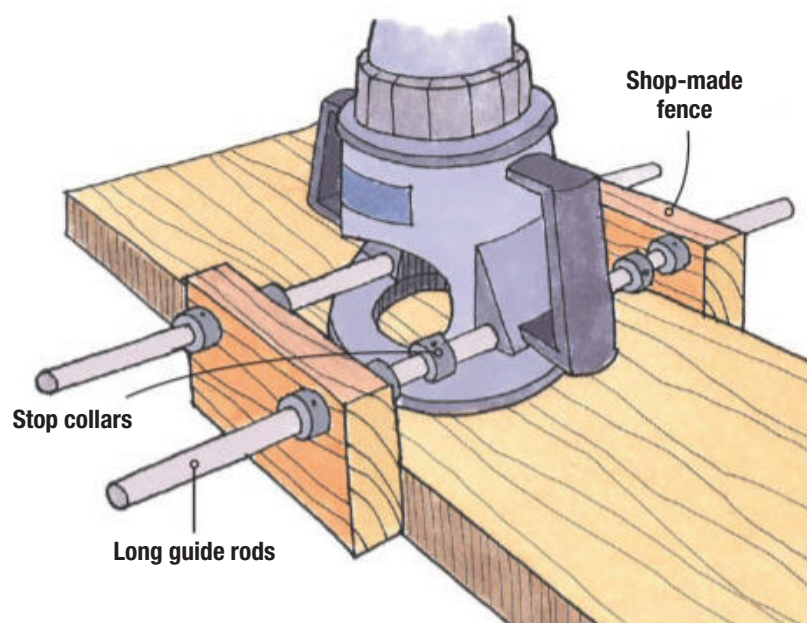
3 SLIDING DOVETAIL JIG

With a single piece of MDF or Baltic birch, you can create a jig that'll guarantee a perfect sliding dovetail. It starts with two holes that determine the taper of the slot. At one end of your jig, drill a 1" hole and on the other end of the jig, drill a 1 1/8" hole. Place a straight edge between the tangents of each hole and use a flush trim bit to make a perfect line between them. Use a 1" guide bushing with the jig, and you'll be able to use any size dovetail bit.



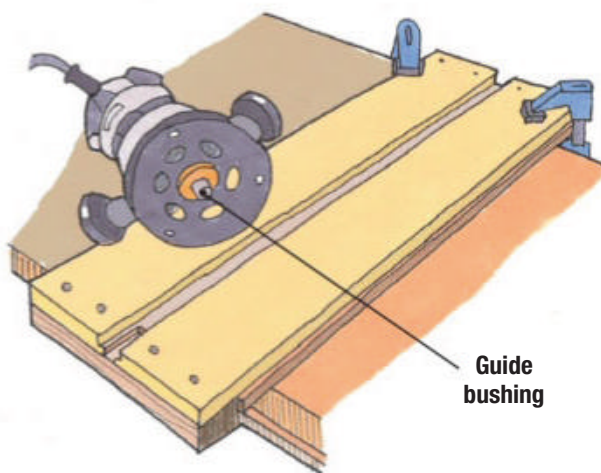
4 ADJUSTABLE ROUTED MORTISES

Huge mortises can be made with a clever adjustable fence. Use long guide rods that can span your workpiece and stop collars to control the travel. Most router bases accept these guide rods, so determine the spacing based on your router model. Accurate holes in the shop-made fence will prevent the assembly from racking as you slide it along the workpiece, and a bit of wax will keep things running smoothly.

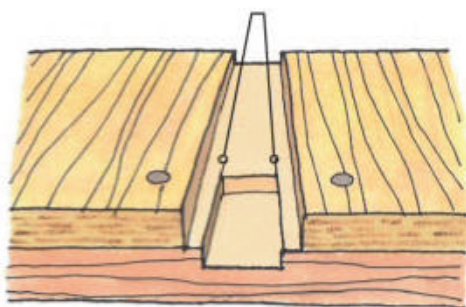


5 DADO JIG

Straight and accurate dados are easy to make using this simple jig. It's composed of two pieces of melamine shelving, cut 4" wide, and a couple of crossbars screwed underneath. The space between the melamine pieces is 1"—exactly fitting the 1" o.d. guide bushing in my router. The router can't wobble as you cut the dado. To prepare the jig, precut a dado in one of the crossbars. Line up this dado with a pair of layout marks on the workpiece, clamp the jig in place, and have at it.

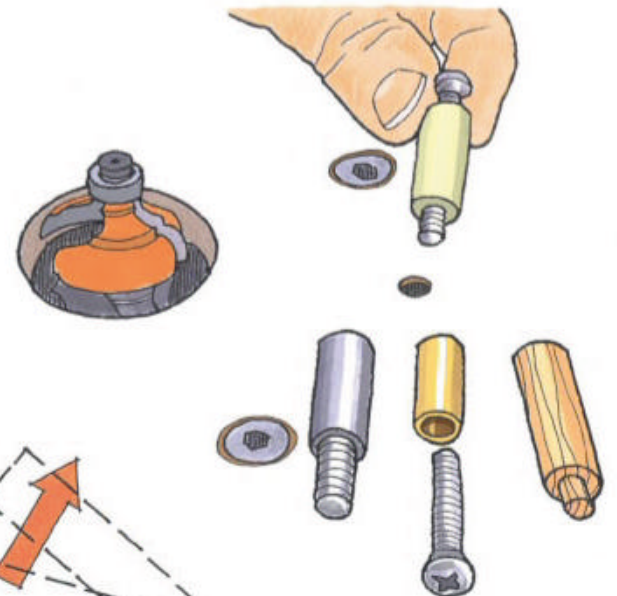


Layout lines

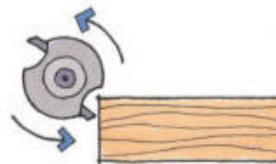


6 USE A STARTING PIN

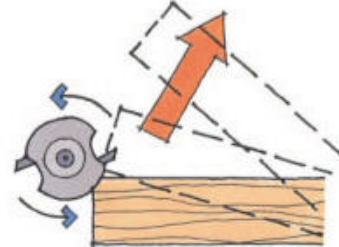
It seems that few people take advantage of the starting pin on their router table. The pin acts as a fulcrum so that you can enter a fence-less, pilot-bearing led cut without risking the workpiece kicking away as it catches the endgrain.



WITHOUT A STARTING PIN

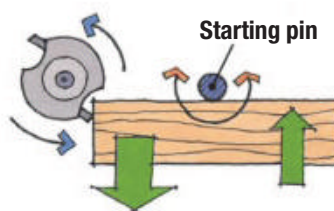


Workpiece is caught by the cutting tip of the spinning bit before it reaches the pilot bearing.

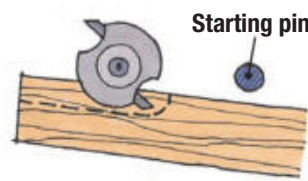


In a nanosecond, the bit's rotation throws the work aside!

WITH A STARTING PIN



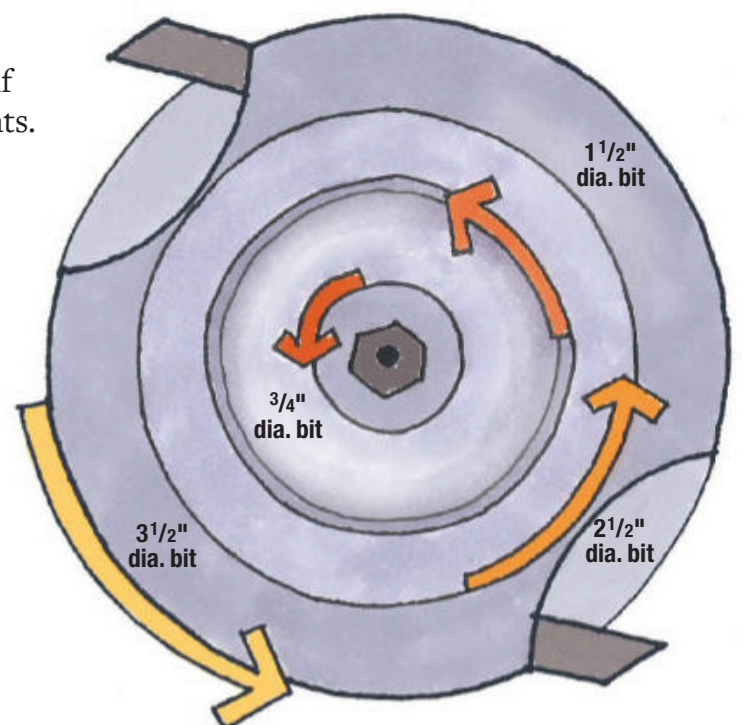
The starting pin gives leverage to counter the rotational force of the bit's bearing.



Maintaining contact with the starting pin isn't necessary once the work contacts the pilot bearing.

7 PACE THE CUT

It can be tempting to set your router speed and forget it. But there are very tangible consequences to using router bits of different diameters. At 22,000 rpm, $\frac{3}{4}$ " bit has a tip speed of 49mph. A $1\frac{1}{2}$ " bit at the same rpm has a tip speed of 98mpg. That's twice the speed! So, you'll need to feed slower or turn your speed down (proper cutting is always a relationship between speed and feed). Bits will come with recommended speeds, and you should always use those speeds as a starting point. Listen to the router as it cuts. You'll hear if you need to make adjustments.

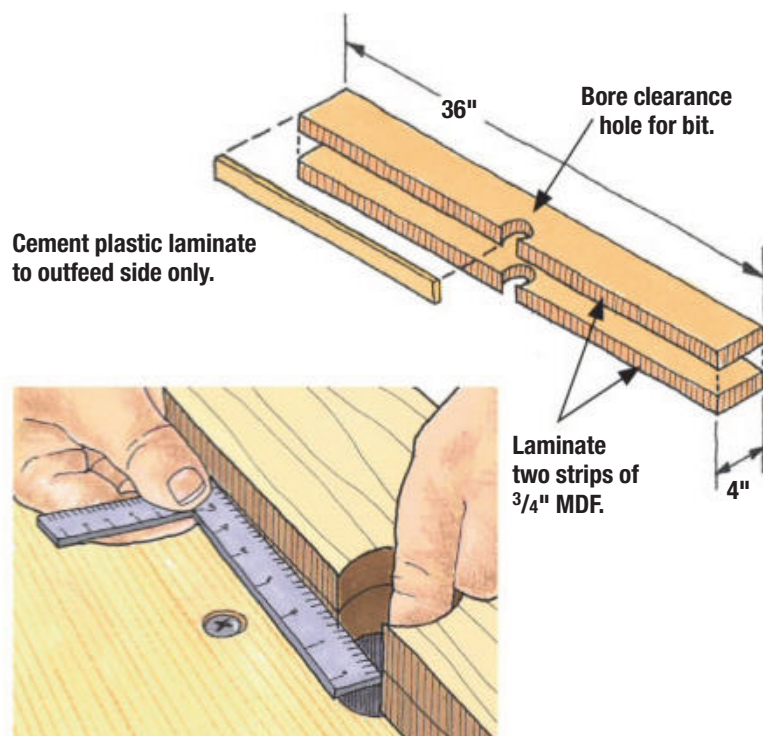


Bit Dia.	RPM	MPH	Bit Dia.	RPM	MPH
$\frac{3}{4}$ "	22,000	49	$3\frac{1}{2}$ "	22,000	228*
$1\frac{1}{2}$ "	22,000	98	$3\frac{1}{2}$ "	12,500	130
$2\frac{1}{2}$ "	22,000	164*	$3\frac{1}{2}$ "	10,000	104
$2\frac{1}{2}$ "	12,500	130			
$2\frac{1}{2}$ "	10,000	104			

**Maximum safe
speed = 130mph**

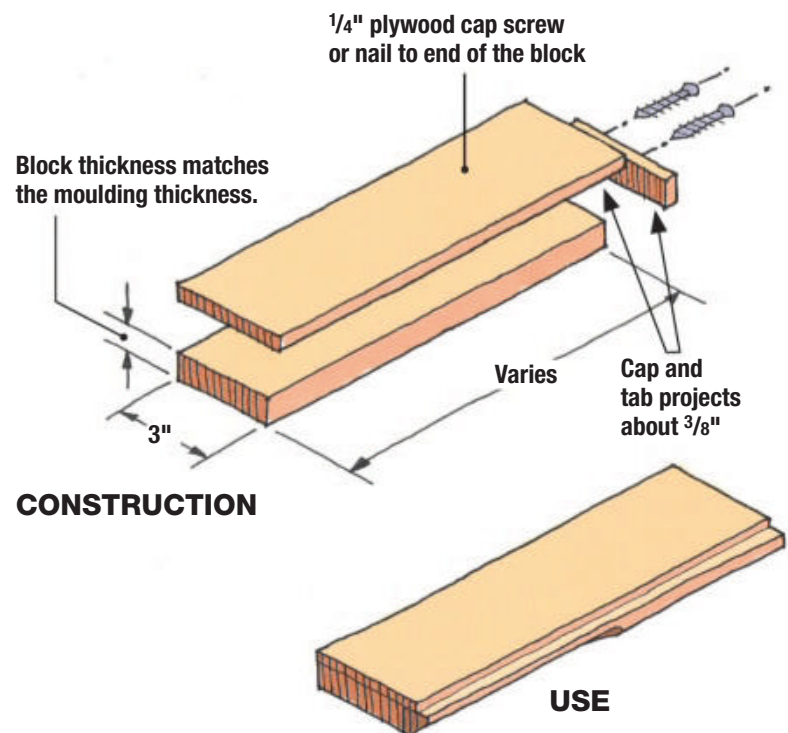
8 JOINTING FENCE

Make a perfect jointing fence by ripping two strips of MDF to 4" wide. Glue them together and bore a clearance hole for the bit and you're nearly there. The key to this fence is the application of laminate to the outfeed side of the fence. You can use one or two pieces of laminate, depending on the amount of material you'd like to remove. Align the outfeed of the fence to the bit and you'll be jointing in no time.



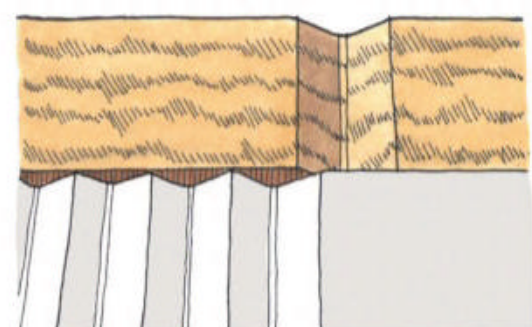
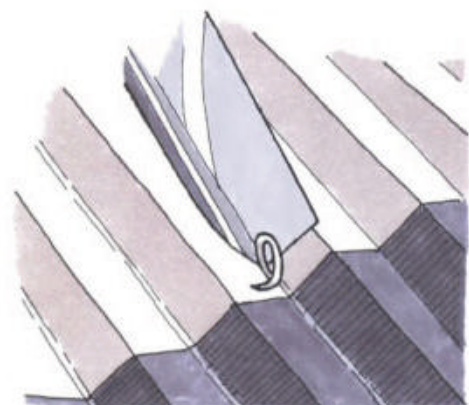
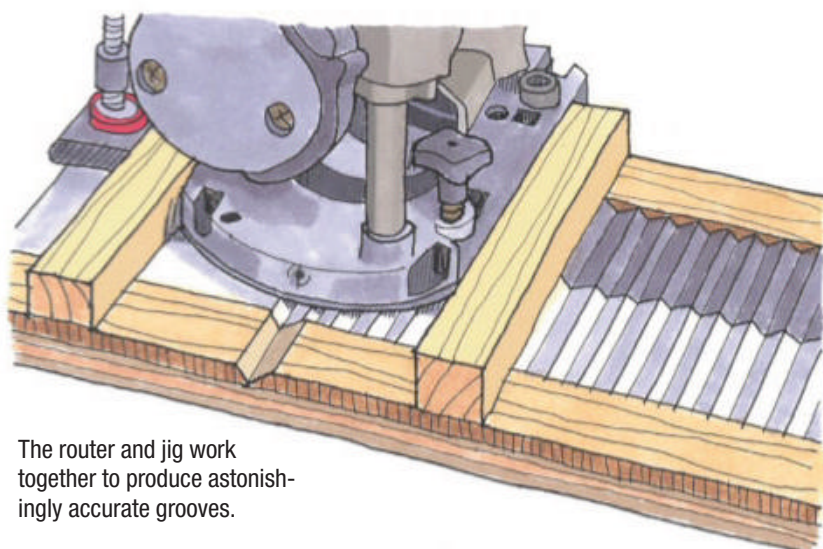
9 MOULDING PUSHER

The length of this push block doesn't matter as much as the width. Keeping your fingers 3" from the bit is always a great idea. When pushing moulding through a shaping bit that's less than an inch wide, use this pusher. The 1/4" plywood cap and back tab are the essential parts of this pusher.



10 DIAMOND BANDING JIG

You can make diamond banding with just a V-bit and small jig. Your jig needs to be wide enough to span your workpiece, and you'll need a 120° bit or an angle of your choosing. Slide the sled over to your next mark with each pass. The bottom of each groove will need just a quick clean out with a gouge. Then, glue up mating pieces and cut them to size for your inlay. **PW**





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Ruled by a Ruler

Get out of your comfort zone and trust proportions.

By George Walker

I like hanging out with woodworkers, yet a few topics are surefire argument starters. Sharpening is one of those topics, and hand tools versus power tools is another. Yet the argument for using the Imperial measuring system vs. the metric system might just win the prize for generating the most stubbornness.

It's a fool's errand to go into the pros and cons of each system so I'll cut to the chase: both systems can be a real hindrance to developing your design sense. Measurements transferred from a tape measure or ruler can convey important information needed to define and build a project, but they offer little or no help when it comes to proportions. Achieving proportional harmony is one of the key skills of furniture design, and numerical measurements shed no light in that area and can even obscure the proportional relationships in a design.

I say this after spending a lifetime building things from wood and metal and relying on my measuring tools. I finally came to the conclusion that a

ruler is a dead thing when it comes to understanding proportions. Here's an example of why proportions are so important to a design.

A few years ago I visited a construction site near my house and watched as luxury condos went up (at least that's what the sign said). Then one day I drove by and saw this view of one of the buildings (Figure 1). This is what you could see from the road and was the first impression after going through the gated entrance. I had to take a picture of what I call a mouse entry. To my eye, the diminutive door at the bottom of the space reminds me of a tiny hole a mouse might gnaw into the base of a wall. This door is completely out of proportion with the space around it. I'd venture to guess that anyone trying to use that door in the wee hours of the morning would get a feeling of exposure and vulnerability.

First Clues

One of the experiences that changed my reliance on rulers and tape



The project above was designed using only proportions and the material at hand.

measures was finding user-made tools from the pre-industrial era. We often think of this time as the golden age of cabinetmaking, when artisans worked to a high level of precision and had an eye for proportions. Often these rulers were crudely marked out in coarse increments and begged the question: How could an artisan build precise furniture with such lousy rulers (Figure 2)? The answer I'm driven to is that rulers then were used differently than they are today. Rulers were used to



1. Ouch—an example of not paying attention to proportions or not caring about them.

2. Crude, but this should tell us something about a different approach.

PHOTOS BY THE AUTHOR

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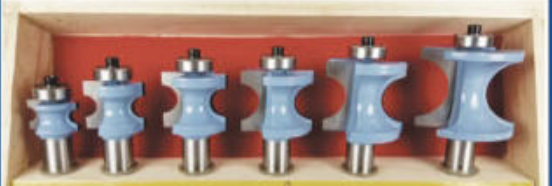
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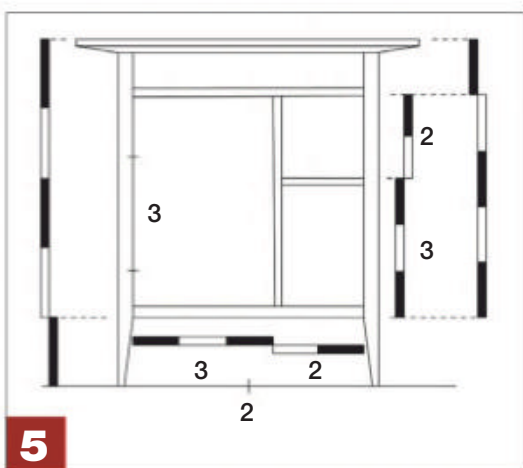
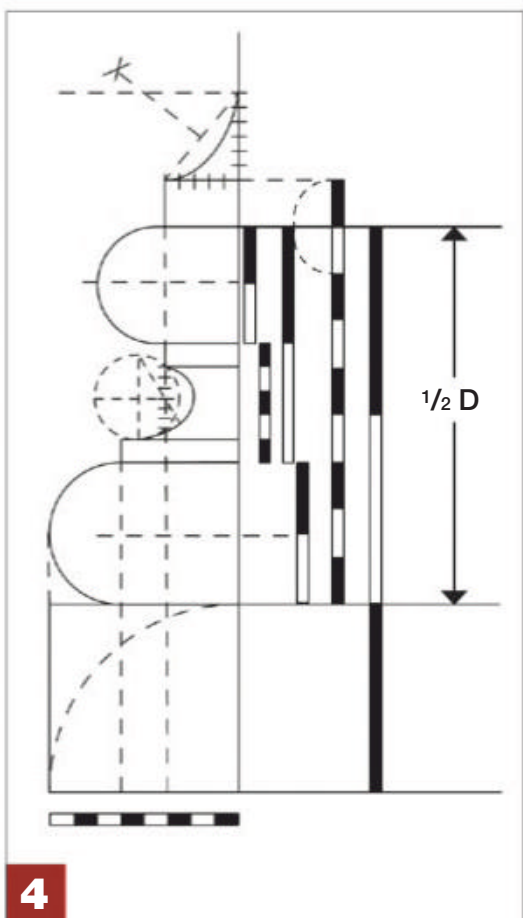
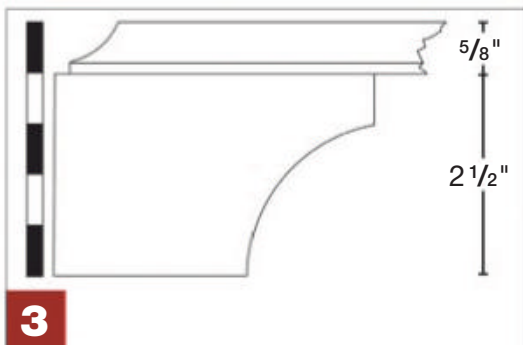
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3. The scale shows what dimensions fail to reveal: the link between the molding and bracket foot.

4. This design is governed by proportional relationships, not measurements.

5. Can you unpack this design? Each scale identifies dance partners and the proportions between them.

get in the ballpark; a rough tool was all that was needed. They had other tools and methods to measure and execute precise joinery.

Dividers were used to mark important joinery locations and at the same time used to step off proportions that would make the design sing. Tiny pinpricks left from divider points left a physical mark to register a knife for cutting layout lines to be followed by a saw or chisel. These simple tools take advantage of the built-in accuracy of the toolset. A line executed by a sharp marking knife is precise and makes a perfect guide to register a chisel. Rulers couldn't add to this level of accuracy but instead added the risk of making a math mistake.

These artisans understood something about proportions that's often clouded by our dependence on numeric measurements. Dimensions, whether made using the Imperial or metric system always relate back to an external standard. An inch is just $1/12$ of a foot, which in turn is a portion of a yard, just as a centimeter relates to a meter, an external standard. I'll grant there's pure genius in standardizing our measurements. It's a key part of industrial manufacturing and commerce and we'd be shipwrecked without it.

It's just that to understand proportions and create harmony in a design, we need a way to visualize parts internally, one with another. If a drawing called for a $5/8$ " high molding to cap off a bracket foot that's $2\frac{1}{2}$ " high (or 1.6cm for the molding and 6.35cm for the bracket), you might be able to guess in your mind the sizes of the two parts. But would you be instantly aware that the molding is $1/4$ the height of the foot and linked proportionally (Figure 3)? Our inch fractions actually hide that important proportional relationship rather than highlight it.

Trail of Breadcrumbs

The second eye-opener that helped me understand proportions was the

odd scales that peppered early furniture drawings in historical design books (Figure 4). Those proportional scales aren't some obsolete relic but instead a key to gaining a clear grasp of how the proportions are linked together in a design. The first thing to understand is that these scales aren't connected to any sort of external standard like an inch or foot. The sole purpose of these scales is to show the internal proportional relationships that tie the design together. They don't tell us anything exactly about the numerical measurement of a piece but they do point out clearly how the internal proportions are linked.

If you don't get anything else from this article, understand that when you see a proportional scale on a drawing it's revealing the thought process that ties the design together. It usually spans two parts and lets you clearly see that they're linked in harmony. I can't emphasize this enough. It's actually more important to know which parts are linked together than the specific proportional ratio that binds them. Perhaps this is the greatest lesson these proportional scales offer. They point out the dance partners in the design so we can then make judgments about how each part is to be sized to make the composition flow.

Deconstructing a Design

Here's a little exercise to help focus your attention toward proportions. Take a look at this drawing (Figure 5) and look closely to see what the proportional scales are revealing. Note which parts are linked together and what the proportional relationship is between them.

You may find yourself reaching for your dividers rather than your trusty tape measure next time you work up a design. **PW**

George Walker is the co-author of two design books and writer of the By Hand & Eye Blog (with Jim Tolpin).



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- Cutterhead diameter: 3"
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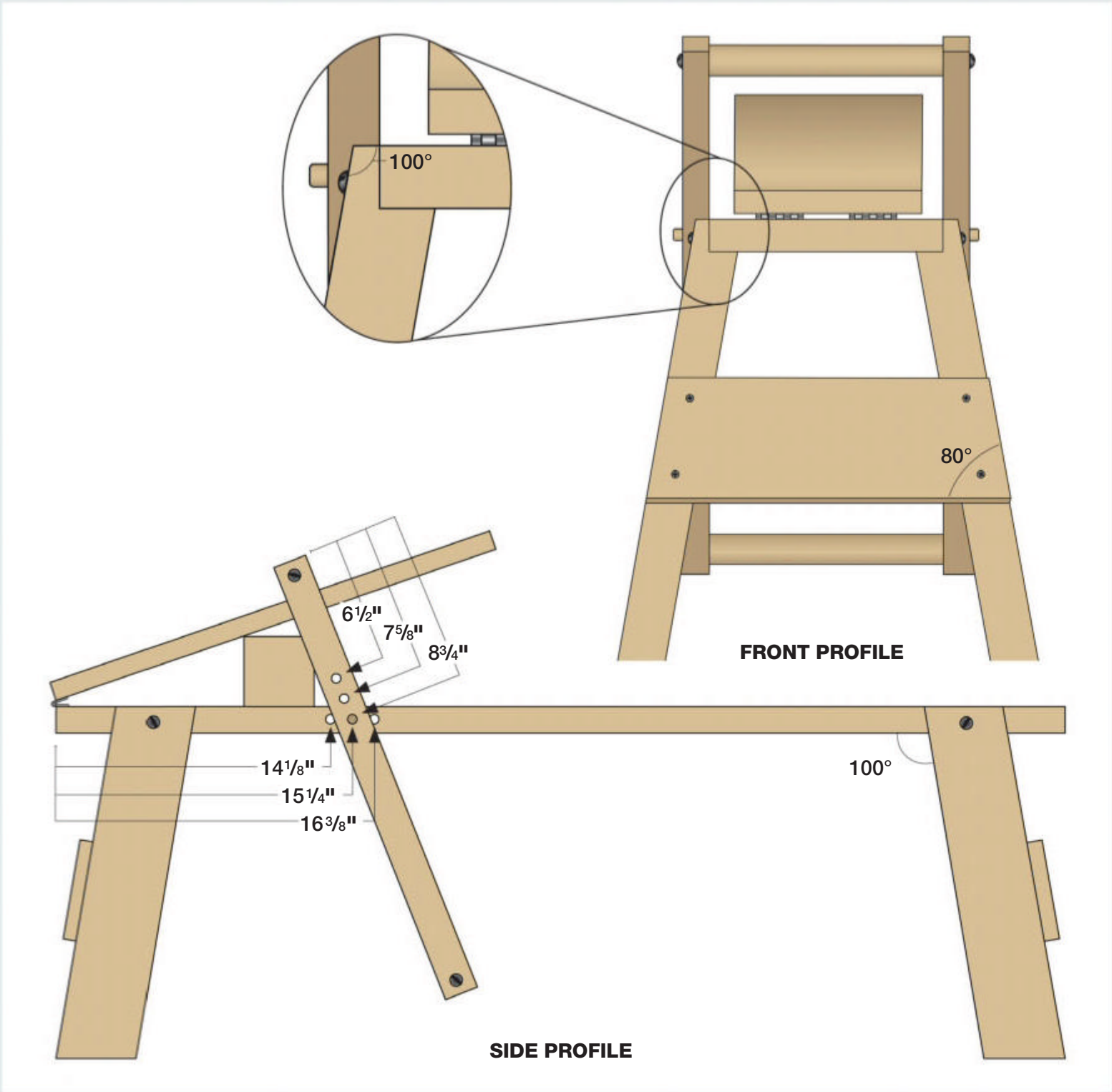
■ Build a Knockdown Shave Horse

This small-space friendly design is perfect for apartment woodworkers.

By Amy Pate

I'm based in Brooklyn, where finding space to work is one of the greater challenges. Many woodworkers make-do with small shared workshops or even their apartments. With this in mind, I approached Joel Moskowitz at Tools for Working Wood with the idea to teach a knockdown shave horse class. He said, "Great, come up with a design!" We agreed the design should have the stability and strength of traditional shave horses, paired with the option to be broken down. The resulting design uses affordable materials, is buildable in a short period of time, and is easily disassembled and stored. Tools for Working Wood offers a hardware kit (including full plans), and I teach the class several times a year. The building of the bench itself requires minimal machinery, and the finished product uses threaded inserts and bolts to allow the legs and clamp arm unit to be easily removed.

Knockdown Shave Horse



Cut List

No.	Item	Dimensions (inches)			Material
		T	W	L	
1	Bench seat	1 1/2	10	48	Douglas Fir
4	Legs*	1 1/2	3 1/2	19 1/4	Douglas Fir
2	Leg stretchers*	3/4	8	12	Pine
1	Working board	3/4	8	24	Pine
2	Vertical clamping arm	1 1/8	1 3/4	24	Maple
2	Horizontal clamping arm	-	1 3/8	10 1/4	Oak dowel
1	Working board support	4	4	8	Douglas Fir
2	Pivot pins	-	1/2	5	Oak dowel
1	Spacer	2	4	10	-

*80° compound miter on each end

**Length is measure from short to short with 80° angle on both ends

Hardware

No.	Item	Details
8	Bolts	1/4-20, 2" long
8	Washers	1/4"
8	Threaded inserts	1/4-20, 0.781" long
8	Screws	#8 pan head, 1 1/2" long
2	Hinges	2" butt style

*80° compound miter on each end

■ Knockdown Shave Horse

1. The legs should end up parallel with the top of the seat and splayed forward (or back). It's good to double-check this on the bench. Once those cuts are made, mark the two pairs of legs.

2. I make a non-through cut, halfway through the thickness of the leg, on a sliding miter saw to establish the depth of the shoulder. This uses the same compound 80° angle as the top and bottom leg cuts. The sacrificial fence is there to make sure I'm able to cut the depth all the way through and limit blowout on the back of the cut.

3. Lay out the rest of the shoulder. The legs should meet the bench board at a 90° angle.

4-5. A handsaw is the safest and quickest way to cut the rest of the shoulder. I start the cut on an angle to establish a kerf, then readjust the leg in the vise to finish the cut.

Cut the Shoulders

Once your lumber is cut to size, your first step is to create the shoulder your bench will rest on. The bench seat rests within shoulders on each leg, which gives the shave horse its stability. Pair off your legs

and label them. The bottom of each leg sits flat on the ground, splaying out and back from the bench seat. The top of your leg should be parallel with the bench. I find it helpful to label on the inside of all four legs; this allows me to quickly know my orientation when assembling.

Next, cut your shoulders. The first step is to make a depth cut on a sliding compound miter saw to establish the bottom of the shoulder. The miter saw gives a clean and identical surface on all four legs for the seat to rest on. You could also cut the shoulders by hand, but this is a much quicker method. Make a mark on the inside of each leg, 1 3/8"



down from the top. At the miter saw, set up for the same compound 80° miter as was done for the legs. Set your depth to roughly half the thickness of your 2x4. You'll want to place a sacrificial block against the fence—I use leftover scrap 2x4 material. When you place your leg in front of the block, the sliding compound miter saw will create a cut of consistent depth. Remember, you're establishing the bottom of the shoulder so you want to cut on the inside of the line into the waste material.

When you've made all four depth cuts, you'll head back to your workbench to finish your shoulders.

You want to scribe the outline of your shoulder, providing a guide for the handsaw to follow. First, scribe a 90° line on both sides of your depth cut. Place one leg in your vise. Scribe a line between the two 90° lines, creating an outline of the shoulder for your saw to follow. I find it best to cut out the shoulder incrementally, cutting first at an angle from one side, then perpendicular straight across the top, then at an angle from the other side. Take your time with this step; it's important that you achieve a 90° angle for your seat to sit snugly in all four shoulder joints.

Start by sawing at 45° to the

corner of your board. Remember, saw on the waste side of your line. Following your scribe, saw down to meet the depth cut established by the miter saw. Next, make a shallow cut straight across the end grain perpendicular to the leg, cutting just deep enough to establish the kerf to the other side of the leg. Rotate your leg and saw the other side at a 45° angle down to the shoulder-depth cut. You should be left with a clean and straight outline for your shoulder—cut the remaining material away. After sawing, clean up any unevenness with a chisel to allow your bench seat to sit snugly in each shoulder.



4



5



Attach the Stretchers

Once you have your shoulders cut, it's time to give your legs some structure and stability by attaching the stretchers. You'll do this one pair at a time, utilizing a spacer that's cut to match the width of the bench seat. Pick one pair to start and place the legs on your bench top with both shoulders facing each other. Clamp the spacer within both shoulders and orient them so the outside is facing up. You want the stretcher on the outside of the legs. This step can be difficult to visualize, so this is a good moment to reference the finished shave horse at the beginning of the article. Your leg pairs are angled both out and back from the bench seat for maxi-

6. Attach the stretchers for each pair of legs, paying special attention to their orientation. A spacer, cut to the same width as the bench board, helps keep things aligned.

7. I use a simple jig to drill the three pivot pin holes along the sides of the bench board. The jig is just a scrap of hardwood and a piece of plywood to guide the drill straight into the center of the bench board.



mum stability.

Scribe a line $6\frac{1}{4}$ " up from the bottom of both legs. Align the bottom of the stretcher with your lines. Check that the stretcher is flush with the outside of the legs, and clamp in place. Pre-drill and attach four pan head screws, one in each corner of the stretcher. Repeat the process with the second pair, and set both leg units aside. You'll find they can stand upright on their own, which always brings me a sense of satisfaction having built a well-balanced structure.

Drill for Pivot Pins

The bench design has three horizontal pivot points for the user to select based on the size of the project or personal preference. These three holes are drilled along both edges of the bench seat. Take your bench seat and choose the front and top, and place it bottom-side down on your workbench. Scribe three lines centered on the material edge at $14\frac{1}{8}$ ", $15\frac{1}{4}$ ", and $16\frac{3}{8}$ " from the front of the seat. Do the same to both sides. The holes can be 2-3" deep.

This can be done on the drill press or with a jig. My jig is made of $1\frac{1}{2}$ " x $1\frac{3}{4}$ " x 9" long oak stock and 12" x 6" plywood. The oak is pre-drilled through the $1\frac{1}{2}$ " face with three $\frac{1}{2}$ " diameter holes $1\frac{1}{8}$ " apart on center. The plywood is attached to the top of the oak block, will rest on top of the seat, and can be easily clamped in place. The jig helps drilling straight into the seat—be mindful that you're positioned correctly as you drill.

Attach the Legs

Stand your legs upright on your bench top with the leg toes roughly 48" apart. Place the bench seat within the shoulders of the leg units. Both leg units should be angled out from the seat. I align the toe of the leg units with the edges of the seat. Next, install the threaded inserts. This can be a chore, but the inserts provide the ability to take apart,



store away and reassemble the shave horse repeatedly.

Check that your bench seat sits snugly in all four shoulder joints, and that all four feet are resting on the ground. Install one insert per leg, one leg unit at a time. Drill a pilot hole with a $\frac{1}{8}$ " bit through to the seat on both sides of your first leg unit. Once you have your pilot holes, take your bench seat out of the shoulders. Drill a $\frac{5}{16}$ " hole through the pilot holes in your legs and a $\frac{3}{8}$ " hole in both sides of the seat. Install the threaded insert into the $\frac{3}{8}$ " seat hole; this can be done by hand with a hex key or with a drill. Set your bench seat back in your shoulders and thread and tighten the bolts with washers into the inserts. Repeat the same process on the other leg unit.



8-10. Clamp your two sets of legs in place and drill for the threaded inserts. Do one insert at a time, first drilling through both the leg and the bench with an $\frac{1}{8}$ " pilot bit. Then remove the leg and drill a $\frac{5}{16}$ " hole through the leg and a $\frac{3}{8}$ " hole for the insert into bench. Then repeat for the other leg attachment points.



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11. The working board is attached to the bench with a pair of butt hinges. It's made to move to accommodate different thicknesses of wood in the clamp, but folds flat against the bench when not in use.

12-14. Three 1/2" holes in the middle of the clamp arms for dowels create an adjustable pivot point, and then threaded inserts in 1 3/8" dowel lock the clamp together at the top and bottom.



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The Clamp Arm

The clamp arm unit has three vertical pivot point options and can be broken down completely via bolt and threaded inserts at all four joints. The two vertical clamp arms each receive three $\frac{1}{2}$ " holes for the adjustable pivot pins, as well as two $\frac{1}{4}$ " holes for the bolts on either end. The $\frac{1}{2}$ " holes are centered on the material at $6\frac{1}{2}$ ", $7\frac{5}{8}$ ", and $8\frac{3}{4}$ " from the top end of the clamp arm. The $\frac{1}{4}$ " holes are centered on the material $\frac{3}{4}$ " in from both ends. I recommend drilling the clamp arm holes on a drill press. In order for the clamp arm mechanism to swing with ease, the holes need to be drilled as perfectly as possible. This is a job for the drill press, but if you don't have one, a jig like the one I

built for drilling out the seat can be used. With your vertical clamp arms drilled out, install the threaded inserts (one insert in both ends of each $1\frac{3}{8}$ " dowel). Clamp the dowels vertically in your vise, drill a $\frac{3}{8}$ " hole on center and install as you did for the legs. Place components aside.

Working Board & Arms

Attach the two 2" butt hinges to the underside of your working board and the top of the front end of your seat. Placement for both is approximately 1" from the working board edge. Once attached, lay the working board flat on bench seat.

Now to attach the clamp arm unit around the bench seat, first, prepare your pivot pins; they may need

some sanding since you want them to go in and out with ease. The pins can also be waxed to allow smooth pivoting. Slide two vertical clamp arms onto the pins, and bolt the dowels between the arms.

You can choose to finish your bench or leave it unfinished (as I've done). Before you put it to work, though, attach a square of leather to your working board. This provides a non-slip work surface. If you don't have a square of leather handy, cork roll or even an old yoga mat can be used, and held in place with double stick tape. Happy shavings! **PW**

.....
Amy Pate is a woodworker and teacher based in Brooklyn. See more of their work at patewoodwork.com.



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15-16. Attach a piece of leather to the angled board, and you're ready for all kinds of workholding. And, the shave horse can be broken down and stowed or transported wherever your green woodworking adventures take you.



PROJECT #1902

Skill Level:

Intermediate

Time: Two days

Cost: \$50

■ Shinto-Inspired Bar Stool

This understated design is at home in any setting. **By James McConnell**

PHOTOS BY THE AUTHOR

When it came time to replace the dated and worn bar stools at our kitchen island, I wanted something simple, sturdy and elegant and so I took a few design cues from the Torii gates marking entrances to Shinto shrines in Japan. The curved tops and simple lines of these beautiful thresholds provide the perfect inspiration for a streamlined stool that looks at home with any décor.

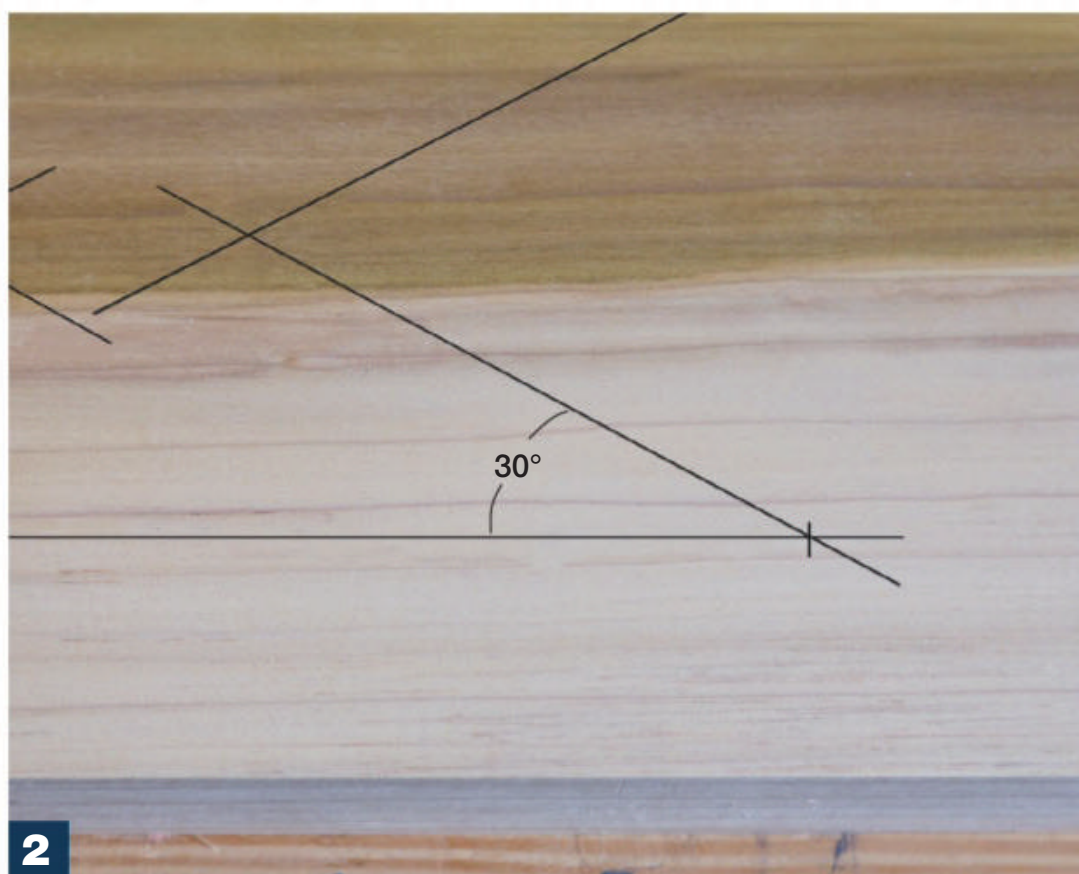
Start With the Seat

The heart of this stool is the simple, shapely seat. This will be a visual focal point of the finished stool, so choose a species that looks good and doesn't split easily. I used poplar. It's inexpensive and, as a "softer" hardwood, it makes strong, workable chair seats.

Begin with a slab of 8/4 lumber. Square and flatten all faces, edges and ends to final measurements of $17\frac{1}{2}$ " x $9\frac{1}{4}$ " x $1\frac{7}{8}$ " before laying out the four leg mortises. These four points are located on the bottom of the seat, 2" in from the front and back and $2\frac{1}{2}$ " in from each end. Use a straightedge to connect the points along the front and back of the seat and draw sightlines at 30° from each of the four points toward the center of the seat using the connecting line as a reference.

The mortises are bored at compound angles giving the legs an eye-pleasing rake and splay. This increases stability, keeping the finished stool from tipping in any direction. To account for this rake and splay without dusting off your high-school trigonometry, use a 30° sightline and 12° resultant angle. Begin by marking drill points for the mortises on the bottom of the seat. Set your bevel gauge to 12° and tape it to the seat in line with the sightline. Bore $\frac{5}{8}$ " mortises at this angle in line with each sightline.

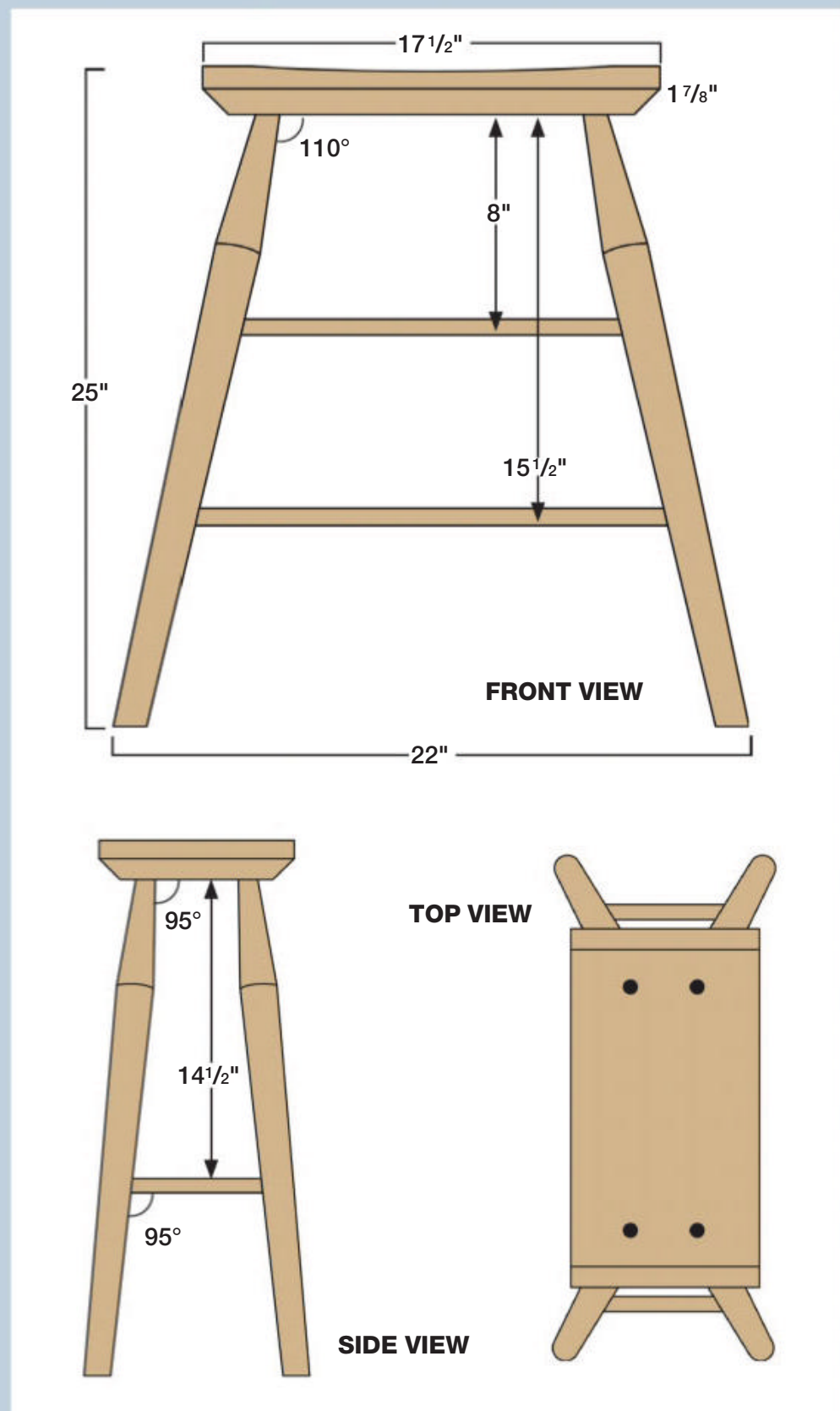
Sight from behind the bit to make sure it doesn't lean to either side and periodically check the angle from the side. A small try square placed at 90° to your sightline and a pause from



1. Mark the leg mortises 2" in from the front and $2\frac{1}{2}$ " in from the sides. Connect the dots so that you can lay out your sightlines.

2. Skip the math and use sightlines to drill your mortises.

■ Shinto-Inspired Bar Stool



Cut List

No.	Item	Dimensions (inches)		
		T	W	L
1	Seat	2	9 1/2	18
4	Legs	2	2	26
3	Long Stretchers*	1	1	21
2	Short Stretchers*	1	1	11

*Actual length derived from stool.

NOTE: One full stool can be cut from one 48" x 12" slab of 8/4 material.

time to time, is all you need. It's difficult to change course once the auger is more than a third of the way into the wood, so make corrections early on. This process sounds more complicated than it is, and once you've done it once or twice, it becomes second nature. After all mortises are bored, switch to a tapered reamer and power drill to open them up so that they will accept tapered leg tenons. I've found the matching tapered reamer and tenon cutter from Lee Valley / Veritas to be ideal for this sort of construction. Use a 1" dowel tapered down to 5/8" as a "dummy leg" to periodically check the angle as you ream.

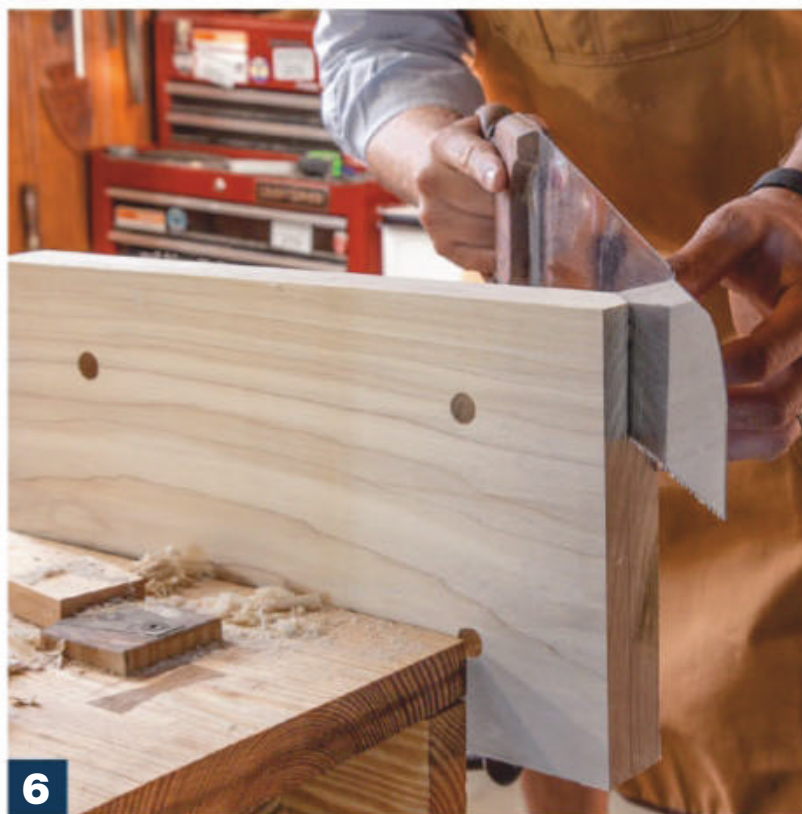
After the mortises are drilled and reamed, it's time to give the seat some visual interest (and make it comfortable!). Lay out the curve for the saddle, making two pencil marks along the top of the front edge 1" in from either side and another mark 1/4" down from the top directly in the center. Mark a fair curve between these points with a template or drawing bow. Commercial drawing bows are available, but you can make your own from a thin strip of wood notched on either end and a string. Set the bow to hit your pencil marks and trace the curve. Mark the back to match. Pencil in guide lines across the seat from front to back 1" in from either end, and then hollow out the saddle with traversing strokes using a jack plane starting in the middle and working out to the lines.

Bevel the underside of the seat in order to reduce the visual weight. The bevels on this stool are created by laying out lines 1" in from the sides and 1" up from the bottom. Work to those lines with your tool of choice. If you're using hand tools, you'll want to use a panel saw to remove most of the waste on the end grain bevels. A drawknife and handplane make quick work of the long edges. Finish all beveled surfaces with a sharp handplane and ease sharp edges with sandpaper or a spokeshave.



3-4. A 90° square will help you see if you're wandering left or right from the bevel that rests on the sightline.

5. A homemade drawing bow will help you lay out the seat.



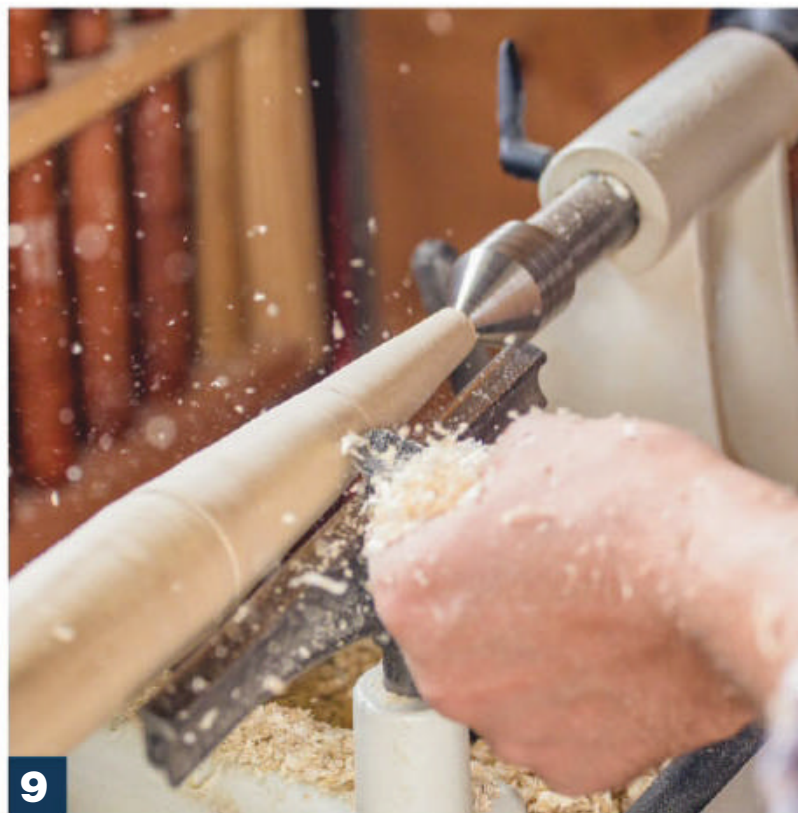
6. Remove the bulk of the chamfer on the end grain with a panel saw.

7. Traversing strokes with a plane will remove the bulk of the material before you finish with sandpaper or a spokeshave.





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Simple, Sturdy Legs

Each leg is turned from a blank 26" long x 2" square into a simple "cigar" shaped leg. There are only two tapers to the design with the lower taper drawn out to lighten the visual weight of the piece. After rounding the blank, layout the target diameters at the bottom and top of the leg with a parting tool and caliper. The diameter of the top is $\frac{5}{8}$ " and the bottom is $1\frac{1}{4}$ ". Next, mark the major diameter and the midpoint of the upper taper. The major diameter is $1\frac{3}{4}$ " located 7" from what will be the top of the leg. The midpoint of the upper taper is $1\frac{1}{4}$ " in diameter and $3\frac{1}{2}$ " from the top of the leg. Establish the diameter and then use a skew or a detail tool to mark these positions. A quick story stick with these positions marked ensures a measure of uniformity among the legs. Use a tapered tenon cutter to fine-tune the tapers that will enter the seat.

Sight the Stretchers

The easiest way to get the stretchers even and parallel is to measure the stretcher location from the seat. With the legs firmly seated but not driven home, clamp a long scrap

with a known straight edge to both legs across the front of the stool. Adjust the height until the straight edge is $15\frac{1}{2}$ " from the seat. Use a square to mark this height on the inside of the leg. This is the center for the position of the lower front stretcher. Before measuring for the next stretchers, place a bevel gauge directly on the leg and set the angle by eye to match the angle between the leg and the straight edge.

On the same set of legs move the straight edge to a height of 8" from the seat and repeat for the upper stretcher. The side stretcher locations are achieved in the same manner but marked 1" higher (closer to the seat) to offset the mortises. Set a second bevel gauge to the angle between the legs and side stretcher. Repeat the first procedure for the spindle across the back legs.

Accurately drilling the $\frac{5}{8}$ " mortises for the stretchers is easy with a simple drill press jig and the bevel angles set above. Using a V-shaped cradle centered and clamped to your drill press table, place the leg in the cradle and angle the table to match the angle of the drill bit to the angle of the bevel gauge. Drill the holes at least $\frac{5}{8}$ " deep. Repeat

8. A story stick will help ensure that your legs all look similar. Mark the beginning of the taper and the half-way point before turning the end of each taper with a parting tool.

9. Work from the major diameter to the middle and on to the turned end. The taper at the top of the leg will receive additional treatment from the tenon cutter, so don't fuss over it too much.

the process finding the angles for the side stretchers and the second front stretcher. Grain orientation is important here. You'll want to orient the grain of your legs 90° to the grain of the seat. This means for the front stretchers you'll be drilling into the "face" grain and for the side stretchers, you'll be drilling into the "edge" grain.

Reassemble the legs and seat and measure for stretcher length from the inside of the mortises. Turn the stretchers from 1" square stock to length making sure to bring the last $\frac{3}{4}$ " of the ends down to $\frac{5}{8}$ " in diameter as tenons. I usually start by turning the tenons and then shape the simple double tapers from a $\frac{3}{4}$ " maximum diameter in the center.



10. Use the bottom of the seat as your reference for the stretchers. Marking 15½" down for the front bottom stretcher will give you an ideal place to rest your feet. The upper stretcher is just 8" below the seat.

11. Use a square to mark where the holes for the stretcher will be drilled. The side stretchers are just 1" above these. Mark the orientation of your legs to keep everything organized.

12-13. Use a cradle to keep the leg locked in place. A ⅝" Forstner bit will give you a clean mortise for the stretcher.





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14. Liquid hide glue will provide all the strength you need and give you a chance to reverse the process if things go sideways during glue up.

15. The tapered tenons on the legs may be long at this point. Place the seat on risers so that you can pound the legs home without the bench interfering.

16. Pound wedges into the tenons perpendicular to the grain. The legs are now locked in place.

17-18. After scribing the legs with a pencil, crosscut with a backsaw.

19. Chamfer the legs with a spokeshave or block plane.



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Assembly

Check to make sure all the parts fit before you get the glue out. I use liquid hide glue for these stools. It lubricates the parts as they come together and doesn't swell the wood like PVA. The tops of the legs will need kerfs to accept wedges. Orient the wedges with the grain of the legs and 90° to the grain of the seat.

When all parts are ready for assembly, begin by assembling the front and back flat on the bench. Add the side stretchers and then work the tops of the legs into their mortises. Place the seat on two riser blocks and drive the legs home with a heavy mallet. After the legs are seated, double-check to make sure the tenons are still tight and turn the stool over onto its feet. Check everything for square by eye (from the front and side) and make any adjustments before driving the wedges home.

Trim the wedges flush to the seat removing the bulk of the waste with a flush cut saw, and carefully trim the remainder with a wide gouge or chisel. Use a card scraper and some sandpaper to clean the seat up and get it ready for finish. Level the stool with wedges and mark a line around the bottom of each foot with a half pencil and a small scrap block. Trim the legs level along those lines with a cross-cut saw and chamfer the feet with a spokeshave or sandpaper.

The finish is entirely up to you. I used three coats of General Finishes Arm-R-Seal (satin) on the seat with a topcoat of wax. The legs are painted and waxed to accentuate the design and add a contrasting pop of color. These simple, yet elegant bar stools have quickly become favorite perches in our house. Hopefully, they'll find a place in your home as well. **PW**

James McConnell is a woodworker, writer and photographer who calls North Carolina home.

A Simple Mitered Credenza

Routed joints reinforced with floating tenons make a sturdy, seamless case.

By Andrew Zoellner

This credenza was built for my dining room to house overflow dishes, table linens and the rest of our fancy accoutrements that only come out during holidays. It's built almost entirely out of quartersawn white oak, with the exception of the maple drawer sides and red oak legs. With a large cabinet on one side and a half-dozen drawers on the other, there's room for just about everything.

The drawers are made with a lock miter router bit. It's one of my favorite ways to batch out drawers that look good and are strong enough for everyday use (see page 52). The doors are a frame-and-panel construction, with a panel made from "woven" veneer and dowels. This gives the doors some interesting texture and a mid-century vibe.

Finally, the base is made from the offcuts paired with oak dowels for the legs. The credenza is finished with a few coats of tinted Danish oil and buffed with wax for a satiny finish that'll hold up to regular use in our dining room.

Start with the Miters

First things first: mill your lumber, joint your edges and glue up your panels. I used my track saw for a

lot of this work—it's my go-to for making precise cuts on big pieces of lumber. I used it to cut all of my panels to length and as a stand-in for a jointer. (see "Track Saw Edge Jointing" page 50.)

Once your case panels are cut to size, it's time to make your miters. The miters are made with a 45° router bit. The panels are 7/8" thick, so you'll need to make sure you have a large enough bit miter bit to cut these miters. Many miter bits top out at 5/8" material thickness, but there are a handful of bits made for thicker material—up to 1 1/4" thick. That's the one you want for this project.

The key to these miters is a straight reference edge for the router bit; I used a scrap of MDF. Cut the miter in multiple passes, I leave about 1/32" for my last pass to make sure I can remove any burning from the bit.

With the miters cut, I begin the floating tenon joinery. I use 5mm dominos in each joint to help align the miters and give strength to the corners. I cut a few test joints to dial in the precise position of the mortise—about 1/4" from the inside edge of the miter, with the domino joiner at 45°. Each miter received 8 dominos.

PROJECT #1903

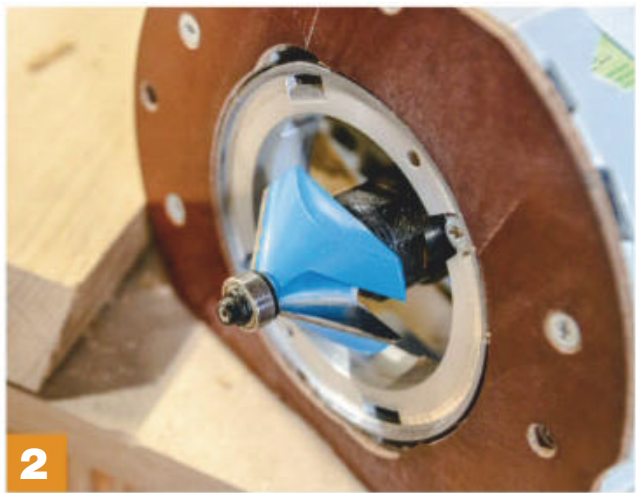
Skill Level:

Advanced

Time: 4 Days

Cost: \$350





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1-2. Miter the ends of each panel with a 45° miter bit. Line up the edge of each panel with a straightedge under it. Cut in multiple passes, leaving just a hair for the final pass.

3. Reinforce the miters. I laid out the 8 mortises 1/4" from the inside edge of the miter. The fence on the Domino is set to 45°.



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PHOTOS BY THE AUTHOR

Add Stopped Dadoes

Then it's on to a pair of stopped dadoes for the cabinet divider. I use a stopped dado to give the appearance of a simple butt joint from the front, while retaining the strength and alignment that dados provide. I made a quick dado jig from MDF and plywood.

First, I built two fences from MDF. I used two layers of $\frac{3}{4}$ " MDF for each fence because my top-bearing router bit is a big one ($1\frac{3}{4}$ ") and I only needed a $\frac{1}{4}$ " deep dado. Square up one fence to the plywood rails, then sandwich an offcut from the divider with the other fence and screw it in place, keeping everything square.

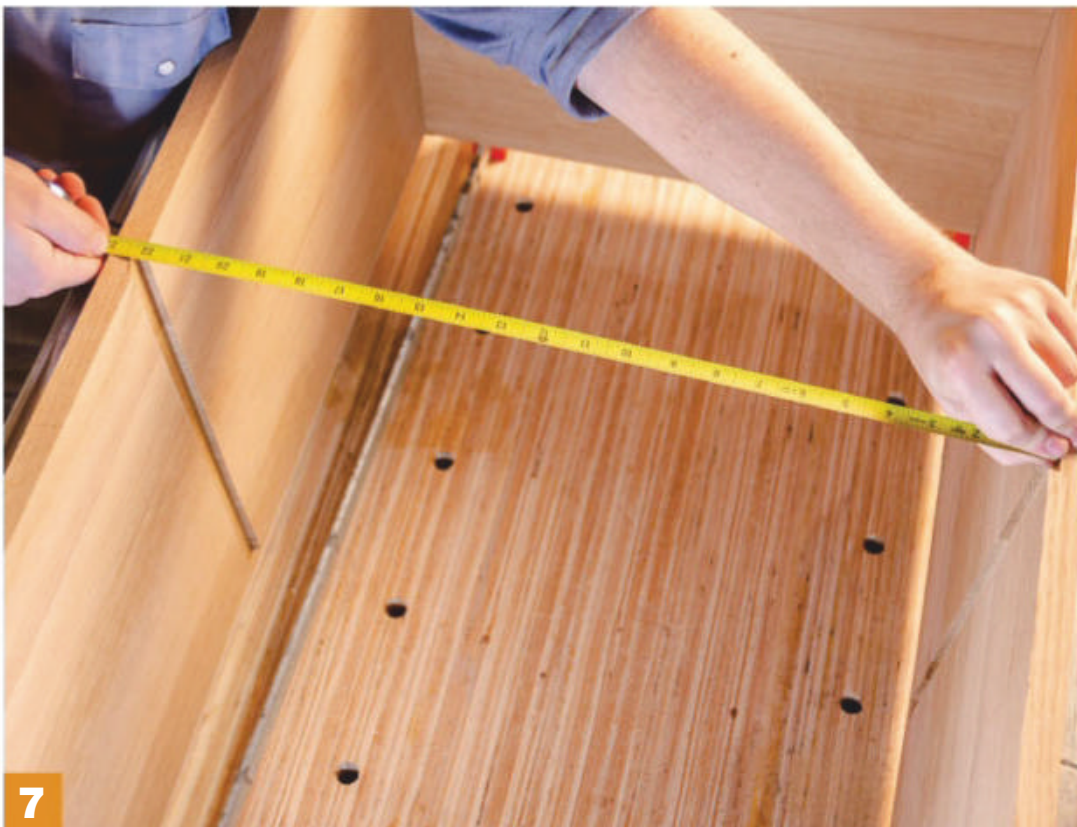
To use the jig, align it with your dado layout marks, then use a top-bearing router bit to cut your dado. I used a bit just a tad narrower than my dado, and made two passes to $\frac{1}{4}$ " deep with my plunge router. I also marked a stopping point on the top of my jig, knowing I'd come back and square up the dado. After the first dado is cut in my top panel, I mark the matching dado on the bottom of the carcass. Once both dados are cut, square up the stopped end with a bench chisel.

At this point, dry assemble the case. With everything clamped together, measure for the height of the divider panel and cut it to length. Then layout and cut the notches in the front of the panel so it fits into the stopped dado. It goes pretty quickly with a handsaw. Refine the fit with a sharp chisel.

Glue Up the Carcase

Carefully disassemble the dry fit case, make note of panel orientation and then get everything in place for the glue up. I used Titebond III for the glue up because it has a longer open time than Titebond I (which is my go-to in the shop). Before I began, I made sure I had all of the clamps I needed in place and ready to go, with a few extra just in case.





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With four mitered joints, I started with the two bottom corners of the carcass. I spread a healthy amount of glue on the dominos and mitered edges, got the pieces in place and brought them almost all the way home with a rubber mallet. Then, I added some glue to the bottom dado and fitted the divider in place. Then it was time for the top. The process was pretty much the same here. I aligned all of the dominos with their mating mortises, added some glue to the top dado, then brought everything home. Finally, I used parallel jaw bar clamps to clamp everything together. Do a final measurement of diagonals to make sure the case is square, and then let the glue cure.



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4-5. Make a router dado jig from MDF and plywood. A cutoff from the divider panel will give perfect spacing between the fences.

6. Cut the stopped dado for the divider in two passes with a top-guided flat bottom bit that is slightly smaller than your dado.

7. Dry assemble the case and measure one last time for your divider panel.

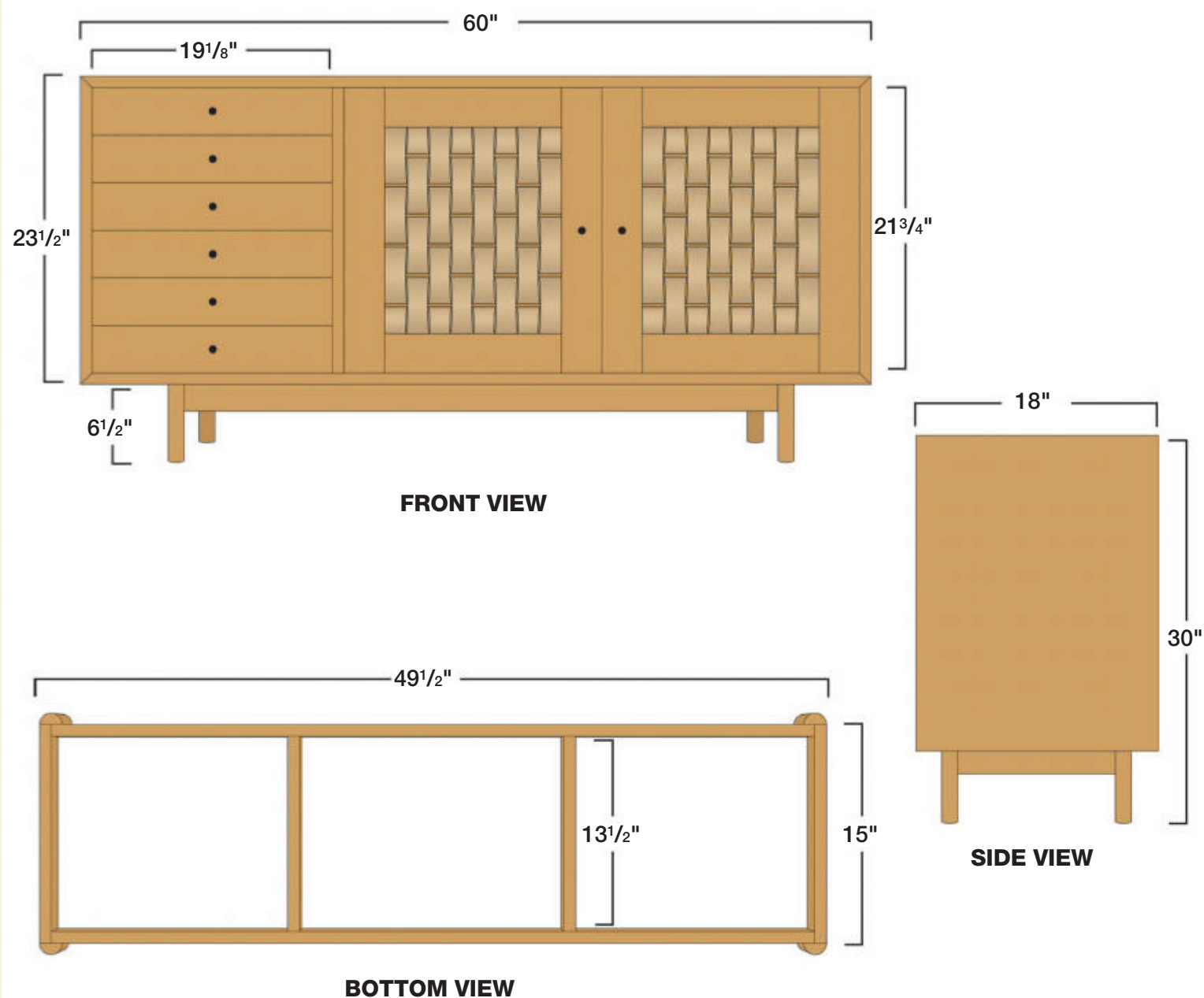
8. After the divider is trimmed to length, cut notches to fit the stopped dado.

9. The most hair-raising part of the build: the glue-up. I used Titebond III for the longer open time and moved quickly. Having a friend provide backup (and emotional support) is also a good idea. Clamp the carcass, measure for square and let the glue cure.



9

A Simple Mitered Credenza



Cut List

No.	Item	Dimensions (inches)		
		T	W	L
CARCASE				
2	Top/bottom panels	7/8	18	60
2	Side panels	7/8	18	23 1/2
1	Divider panel	7/8	17 3/4	23
1	Shelf	3/4	16	43 1/2
1	Back*	1/4	23	59 1/2
DOORS				
4	Door stiles	3/4	3	21 3/4
4	Door rails	3/4	3	13 1/8
16	Veneer strips	1/16	1 5/8	17
12	Dowels	1/4	1/4	18 5/8

No.	Item	Dimensions (inches)		
		T	W	L
DRAWERS				
6	Fronts	5/8	3 5/8	19 1/8
6	Backs	5/8	3 5/8	19 1/8
12	Sides	5/8	3 5/8	17
6	Bottoms*	1/4	16 1/2	18 5/8
BASE				
4	Legs	1 1/4	1 1/4	6 1/2
2	Front/back	3/4	2 1/4	48
2	Ends	3/4	2 1/4	15
2	Dividers	3/4	2 1/4	13 1/2

*Material is plywood.

Make the Doors

The frames are joined with floating tenons and the panels are made of dowels and “woven” veneer.

First, I cut my rails and stiles to width and length. Then I used the domino to cut two 10mm mortises in each joint. You’ll need to drill holes for the 1/4" dowel rod in the stiles that the veneer will weave through at this point. Finally, I cut thin grooves in each of the rails for the veneer. With all of that done, it’s time to assemble the doors.

I cut my dowels to length and insert one end into a stile. The dowels just friction fit in their holes. I add glue in the domino mortises and spread it evenly on the dominos and edge grain. Then I add the rails and repeat the process on the other stile. Once the glue has cured, I cleanup the squeeze out and get the door ready for finishing.

It’s easier to finish the door before you weave the veneer. I used fruit-wood-tinted Danish oil to contrast with the natural white oak veneer. With the doors finished, it’s time to weave. First, I cut my veneer to longer than I needed but to the precise width. I did a little experimenting and found that I liked seven 1 5/8" wide strips of veneer in each door. Weaving it is a simple process. Put one end in a groove then go over the first dowel, under the next, until you reach the other end. Then, trim your veneer to length and squeeze it into the other groove. Alternate the next strip, and so on, to create the woven pattern. The strip is just held in space by the tension in the veneer.

Make and Install the Drawers

I wanted mitered edges on my drawers, but they needed to have a good mechanical joint to stand up to being opened and closed. Enter the lock miter router bit. I used 5/8" stock for my drawer front, sides and back, with a 1/4" plywood bottom. You can see how to make the drawers in the article on page 52. Make sure your



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10. Measure your cabinet opening, calculate your door size and cut rails and stiles to length. The rails and stiles are 3" wide. I used 10mm dominos to join the rails and stiles.

11. Cut a kerf on the inside edge of each stile. This is where the veneer will slide into during the weaving process.

12. Drill holes for the 1/4" dowels. I used a drill press with the fence set so the 1/4" hole is exactly in the center of the board, and drilled 6 evenly spaced holes within the frame opening. Assemble the doors. The dowels are just friction fit, and the tenons are glued in place.

13. After the frames are assembled and finished, you can weave the veneer through. Cut your veneer to 1 5/8" wide and about 1" longer than the frame opening. Then just go over and under the dowels, and tuck the veneer into the kerfs in the rails. It takes some patience and you may crack a few pieces of veneer, so cut extra strips.



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14. Make drawer boxes with a lock miter bit (see Lock Miter Drawers, page 52). Rout 1/2" stopped grooves in each side of the drawer, 1/4" deep, then square the ends 1" from the front of the drawer with a chisel.

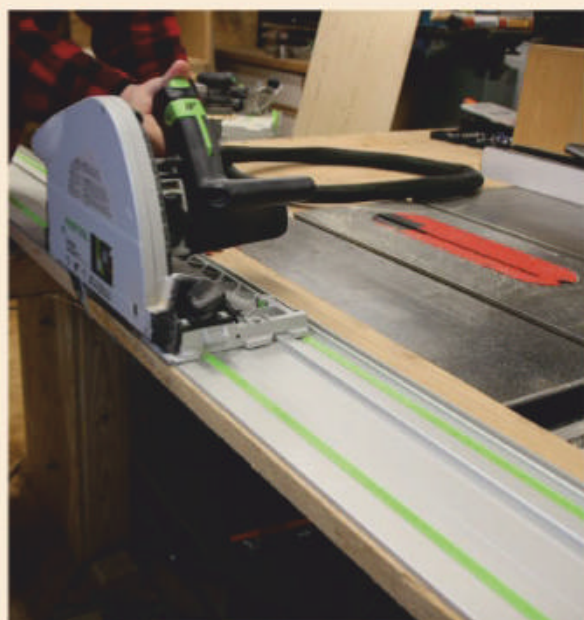
15. Mill the UHMW runner stock to slightly less than drawer-groove size, and then install runners in the cabinet. Careful layout and plywood spacers keep things aligned.

16. Keep in mind the 1/2" recess when you're installing the hinges in the cabinet. The easiest way I found was to measure in from the front edge (keeping in mind the recess), then hold the door in place while you drive a couple screws in. European hinges have a little adjust built into them, so as long as it's close, you can dial in a precise door fit.

17. I drill shelf pins with a shelf pin jig. There's only one shelf, and I know it'll usually be in the middle of the cabinet, so I drilled five holes for each pin starting roughly in the middle of the cabinet. A plywood spacer keeps the jig registered.

18. Attach the base to carcass with Z clips. Two in each small piece will keep things in place but still allow wood to move with the seasons.

19. Install the door and drawer pulls. I found these small brass pulls at my local home center.



Track Saw Edge Jointing

I first discovered this trick when I was gluing up a bunch of 8/4 ash to build a tabletop. Each board weighed about 75 pounds and was difficult to square up on my short-table 6" jointer. But then it hit me: I could use my track saw to put a precise, 90° edge on my boards. Once I had a good edge on one side, I could run the boards through the table saw to square them up. With a glue line rip blade, the joints off the saw were ready to glue up without any additional prep.



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drawer front and back pieces are exactly the same width as your cabinet opening and all of your sides are the same depth. For this cabinet, that means fronts and backs are $19\frac{1}{8}$ " wide, and the sides are 17" deep. Once you've made your drawer boxes and the glue has cured, you can move on to getting them ready to install.

The drawers have grooves in each side that ride on runners. I cut the stopped grooves in the drawer sides on the router table. I centered the groove in the drawer side and made a reference mark on my router table top to know when the end of the stopped groove was approaching. I used a $\frac{3}{4}$ " flat bottom router bit to cut a $\frac{1}{4}$ " deep groove in each drawer side. With a bit this size in maple, I made the cut in two passes, taking off about $\frac{1}{8}$ " at a time.

Then I went ahead and milled and cut the drawer runners to size. The runners are made from UHMW (ultra-high molecular weight) plastic. It's a uniform material that mills easily on woodworking equipment and gives the drawer sides a slick surface to ride on. My material was $\frac{3}{4}$ " thick, but I needed to plane it just a touch to get it to fit in my drawer grooves. Then, I cut runners off at the bandsaw, each $\frac{1}{4}$ " thick.

With the runners cut to size, I laid out and installed them in the



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cabinet opening. The drawers are inset in the cabinet about $\frac{1}{2}$ ", so take that into account along with the stopped grooves in the drawer sides. The easiest way I found to do this was to stack the drawers, then measure where the grooves in the drawer end up. Then, I used a series of templates made from leftover $\frac{1}{4}$ " plywood to mount the runners.

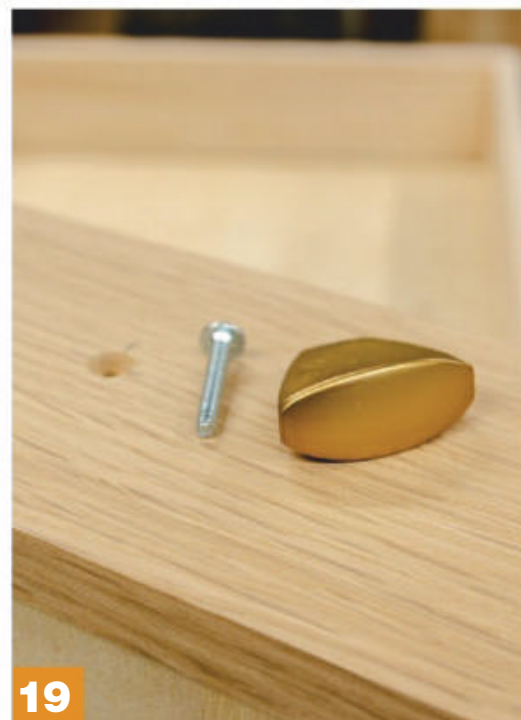
Finally, fine-tune the fit of the drawers. You may need to shave a bit off the sides or tops. I used my No. 4 plane for this task, numbering the drawers once I got the fit I wanted.

Install the Doors

I used European-style 32mm hinges for the door because they stay out of the way and they allow you to dial in the fit. I used Kreg's European hinge jig to drill the hinge cups in the doors. It's easy and foolproof, especially when your door is fully assembled and ready to install. I also used a shelf pin jig to add an adjustable shelf to the cabinet.

Add the Base and Back

The base is really just a big rectangle with a couple reinforcements. The trick to making it look seamless, though, is cutting the half-lap in the legs. This is a little tricky, but it goes quickly with a band saw. I secure the leg in a handscrew clamp, with



19

my layout lines square to the blade. Then just two cuts and they're ready to attach.

The main structure of the base is joined with dominos but before you glue up, cut grooves in the short pieces for Z-clips to attach the base to the carcass. Then, glue on the legs. I also drove a couple pin nails through each to keep them in place until I could get clamps on.

Finally, use a rabbeting bit to rout out a recess for the plywood back. You'll need to use a chisel to square up the corners.

Sand and Finish

It's easiest to finish the base and carcass separately. Sand the whole thing to #180 grit, then wipe on a few coats of your favorite finish (I used Fruitwood-tinted Danish oil). Do the same with the drawers. (The doors are finished prior to weaving—you can leave the weaving until the last step if you'd like.) Then reassemble everything, nail on the back, and put it in place. All that's left is to load it up and start living. **PW**

Andrew Zoellner is the editor of Popular Woodworking. He wants you to keep making awesome things out of wood.



PROJECT #1904

Skill Level:
Intermediate
Time: 1 Day
Cost: \$75

Lock Miter Drawers

This versatile router joint is perfect for production work. **By Andrew Zoellner**

When I need to batch out a bunch of drawer boxes, I use a lock miter router bit. Not only does this bit create a joint with a clean, mitered look on the outside, but the profile of the bit gives the drawer a good mechanical joint with plenty of glue surface (making it a good choice for drawers). The joint can be made on end grain (which is how I'm using it for drawers), and it can be used on edge grain, too. It's often employed when making hollow legs and other furniture parts where a strong mitered edge joint is needed. And, the joint is self-aligning and easier to glue up than a regular miter joint.

A lock miter bit is always used in conjunction with a router table.

When making drawers, you'll be routing the ends of drawer fronts and backs, so a miter gauge or sled is important to keep your work square to the fence. You'll also be routing the ends of drawer sides, upright against the fence, so a taller fence is nice to have.

Companies make bits to be used with material ranging in thickness from $\frac{1}{2}$ " to $1\frac{1}{4}$ " material. Expect to pay about \$100 for a quality bit. Because these bits are $1\frac{1}{2}$ " in diameter or larger, your router needs to be capable of running the bits at slower speeds. Most $2\frac{1}{4}$ horsepower variable speed routers meet the specs for both power and RPM. The bit I'm using here is made for stock

between $\frac{1}{2}$ " and $\frac{3}{4}$ " (my drawer stock is $\frac{5}{8}$ " thick), and I'm using it with a $2\frac{1}{4}$ hp router, dialed down to its slowest speed (approximately 10,000 RPM).

Prep Your Stock

Cutting accurate lock miter joints starts with good lumber prep. Mill your drawer fronts, backs and sides to all be the same thickness and cut to length. Because we're routing end grain, there's a tendency for the bit to tear out at the back of the cut, so leave your parts a little wide and trim them to final width after the joints are cut. Also, mill up some extra parts for testing your setup. You'll need at least two extra fronts and a side, as well as an offcut of the same thickness as your drawer pieces for the jig. Finally, because the joint is cut in one pass, it's helpful to remove a bit of the waste on each end of your stock. I do this on the table saw with a miter gauge, just trimming off the corners.

Set Bit Height

The first step in setting up a lock miter bit is setting the height of the bit in your router table. The middle of the bit (right below the "finger" in the profile) should be aligned with the exact center of your board edge. There are a bunch of different set-up blocks and gauges designed to help you with this process, but I've found the best way to do this is eyeball it, make a test cut, and adjust as needed.

Before you make your first test cut, set your fence to cut roughly the thickness of the board. Get it close, but we'll dial it in after we have the bit height set. It's also helpful to adjust the edges of the fence as close as you can to the edges of the bit, to give your drawer pieces as much support as possible as you're routing them.

Make two cuts on your test pieces on the end grain, with both pieces flat against the table. You

want the faces of the boards to be perfectly aligned when they're fitted together. If the faces are proud of each other, your bit is too low. If they're shallow, your bit is too high. I use the same two drawer fronts over and over for this. If they're not aligned, I chop off the ends on my miter saw and rout them again. I can usually dial in the height after two or three test cuts.

Set the Fence

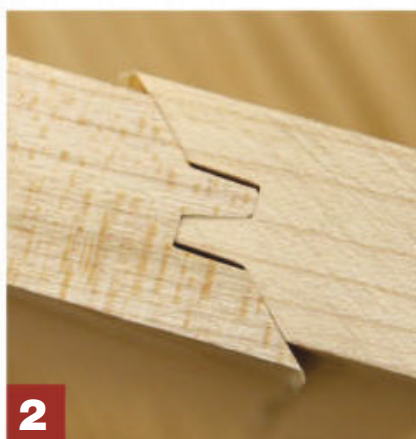
Before we think about cutting our drawer sides with their faces against the fence, we need to make a quick jig. It's just a shorter piece of drawer stock attached to a piece of plywood. It's enough to hold and keep your hands away from the router bit, but also lets you firmly clamp your piece to the jig and keep it against the fence.

With your jig assembled and bit height set and locked in place, it's time to set the fence. The fence should be set back from the front edge of the bit by the exact thickness of your drawer sides. Again, I use a drawer side against the fence to eyeball this setup, lock the fence down and make a test cut. If you're using a miter gauge (as I am here), you also want to make sure your fence is square to your miter gauge.

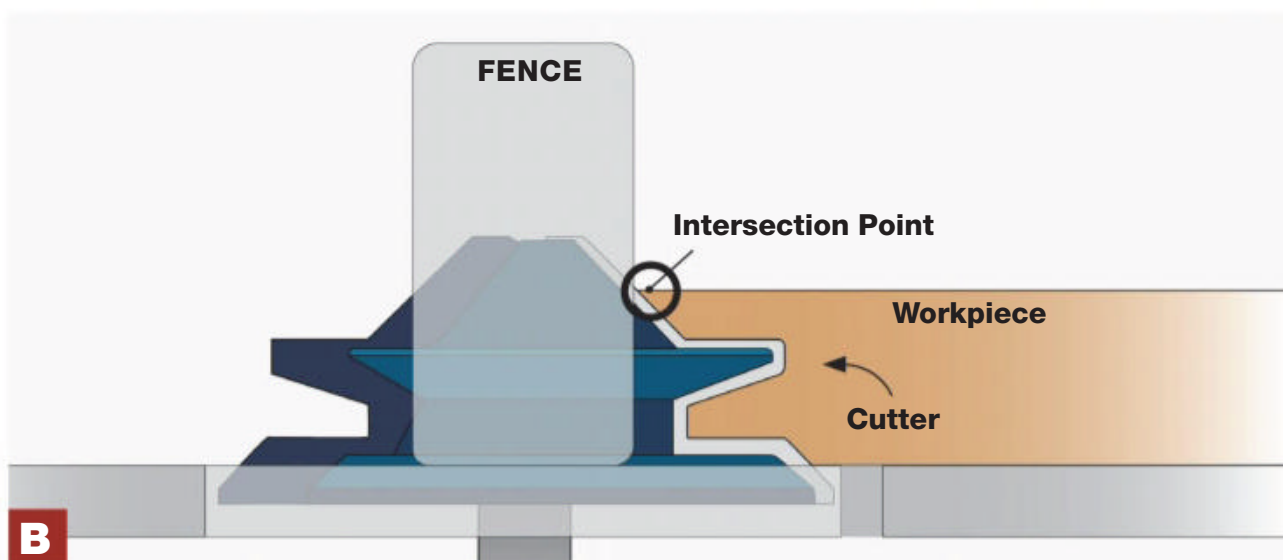
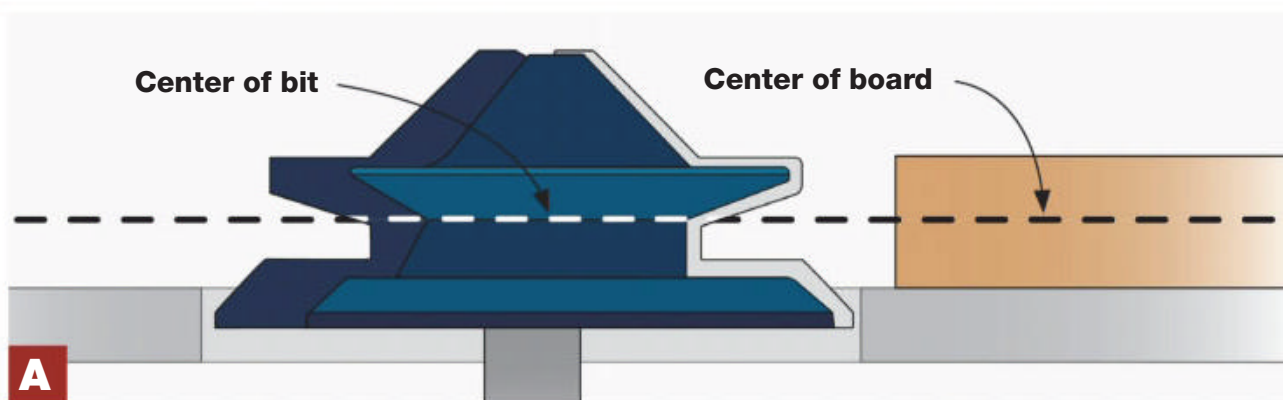
As you're cutting the lock miter joint on your test drawer side, you're looking for a nice sharp end. If there's a flat edge on the end, your fence is too far forward. If your end is sharp, but doesn't perfectly align with your test drawer front, the fence is too far back from the front edge of the bit. Once you have your drawer front and side cuts perfectly dialed in, mark the two pieces with their thickness and save them as setup blocks for next time. They'll help expedite setting the bit height and fence when you do this again.

Route Your Parts

First, I rout my drawer fronts and backs flat against the table. This



1-2. Set your bit height. A good starting point is to keep the bit roughly centered in your piece of stock. Cut two test piece pieces—they should align perfectly when the bit is at the right height. If they don't align, your bit is either set too low (left) or too high. Use a miter gauge or sled to hold your piece firmly as you rout the end grain.



A. The router bit height is properly set when the center of the bit profile lines up with the center of your material.

B. The correct fence position has cutter, fence and top of workpiece all intersecting at top edge of the workpiece.

Lock Miter Drawers



3. This simple jig, made from an offcut of drawer stock and a piece of plywood, makes it easy to keep your drawer side square against the fence.

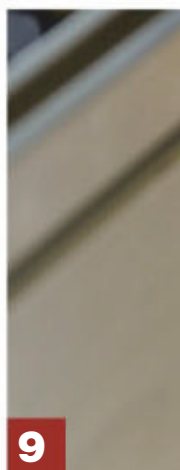
4. With the height dialed in, cut a mating piece against the fence and test fit. You'll need to move your fence in or out to get things to match perfectly.

5. With your bit set up, cut reference setup blocks so you can get your cuts dialed in quickly next time.

6-8. Cut lock miters on your drawer parts. Make sure to label your stock. I cut my fronts against the table and my sides against the fence. Once all of your parts are mitered, cut parts to final width (eliminating any tear-out from the router bit).

9. Cut a groove for the drawer bottom. I cut my drawer bottoms so there's 1/4" of material to support the bottom, with a 1/4" bit 1/4" high. Pay close attention to which face of the board you're routing—the inside faces of the drawer parts should be against the table.

10. Cut drawer bottoms to size and assemble your drawer boxes.





goes pretty quickly. Pay attention to your feed rate and listen to your router as you're routing. You're making a pretty big cut for a router of any size. It's better to err on the side of going slowly and steadily versus fast. Each end of your fronts and backs gets routed, with the inside faces against the router tabletop.

Then, I rout my drawer sides against the fence. Again, with the jig, you want to keep things square against the fence and feed the side slowly and steadily. I make the cut and when I hear and feel the bit go into my waste/backer board, I stop, shut off the router (waiting for it to spin down), and then remove my drawer side. Again, each end of the drawer side is routed.

With all of my front, back and side joinery routed, I rout a $\frac{1}{4}$ " groove in the bottom of each piece for a plywood drawer bottom. I also do this on the router table, with a $\frac{1}{4}$ " straight bit. I use an offcut of the drawer bottom to set the distance of the bit from the fence to $\frac{1}{4}$ ", and to also set the height of the bit to $\frac{1}{4}$ ".



Assemble the Drawers

With the joinery for all of your drawer fronts, backs and sides routed, the next part is the most satisfying: assembly. I dry clamp one drawer and then measure for the plywood drawer bottom. I cut the plywood to size, dry clamp the drawer again to check the fit, then unclamp, glue, and clamp the drawer.

For glue, I use a small brush to get a nice, even coating of glue on all of the glue surface of the joints. I fit the drawer bottom in the two sides of the drawer, then add glue to the drawer front and back, then clamp the whole thing together. Measure corner to corner to make sure the drawer is square, then set aside to let the glue cure.

The end result is a drawer with good, mechanically strong and mitered corners. And you can make a bunch of them efficiently, which is what I like so much about the lock miter router joint. **PW**

Andrew Zoellner is Popular Woodworking's editor and CRE (chief router enthusiast).



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Common Staining Problems and Their Fixes

With this information you may be able to avoid the problems entirely.

By Bob Flexner

PROBLEM #1

Different boards on glued-up panels take stain differently, some boards coming out lighter than others.

FIX Apply more stain to the lighter boards either directly on the wood or by adding some of the stain color to the finish and shading them darker. It's seldom possible to get an exact match, but you can reduce the contrast significantly. Another way to even the coloring is to bleach the wood using a two-part bleach (sodium hydroxide and hydrogen peroxide), then stain the wood to the color you want after sanding to remove the fuzz.

PROBLEM #2

The stain dries before you can get all the excess wiped off.

FIX This problem is fairly common with water-based and lacquer-based stains because both dry rapidly. Apply more of the same stain, the thinner for the stain, or if necessary, a paint stripper, and remove the excess stain. If the color is then not even, or it's too light, you'll need to apply more stain. Switch to a slower drying stain, work on smaller sections at a time, or apply and wipe off the stain faster by using a cloth or spray gun to apply the stain and a large dry cotton cloth to remove the excess stain. You can also get someone else to perform one of the steps while you do the other. Stains that thin or clean up with mineral spirits (paint thinner) dry the slowest, but you have to wait longer before applying a finish.

PROBLEM #3

While sanding the sealer coat, you sand through the stain on some edges.

FIX Replace the color by applying some of the same stain to the area and wiping off all the excess, or by using a touch-up marker.



3. If you sand through an edge, an easy way to put the color back is with a touch-up marker. Then apply some finish to prevent the marker color from being wiped off.



2. Try dividing large objects into smaller parts, or get someone else to apply or wipe off.

PROBLEM #4

The end grain on raised-panel cabinet doors gets too dark when you wipe on and wipe off a stain.

FIX Sand the end grain so there's absolutely no remaining roughness, or spray the stain in light enough coats so you don't need to wipe off any excess. The darkening is caused by more stain lodging in the rough areas in the end grain than in the smooth-sanded areas in the long grain of the rest of the door. Spraying stain without wiping deposits an equal amount of color everywhere, so the roughness doesn't impact the darkness of the color.

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L:50" R:60"	MAX MITER CAPACITY (LEFT/RIGHT)	L:50" R:60"
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PROBLEM #5

The stain highlights gouges and machine marks (“washboarding”) left by a jointer or planer. Also highlighted are the sanding scratches left by coarse-grit sandpaper and the squiggles left by random-orbit sanders.

FIX Re-sand the wood to below the depth of the problems up to #150- or #180-grit sandpaper. Before beginning, wipe off as much of the stain as possible using naphtha, lacquer thinner or acetone so the stain doesn’t clog the sandpaper. You don’t have to remove all the stain color before re-staining, just get the remaining color fairly even.



5

5. A common flaw when staining is machine marks such as those shown here telegraphing through and, in fact, being highlighted. You need to sand these out before applying the stain.



6

6. To avoid blotching on softwoods and most tight-grained hardwoods, apply a washcoat before staining. Oil- and varnish-based washcoats are commonly sold as “wood conditioner.” These dry slowly, so you should give them six or eight hours before applying the stain.

PROBLEM #6

The stain blotches the wood even when you remove all the excess.

FIX The blotching is caused by flaws in the wood that absorb more stain, so the solution is to keep all the stain very near the surface of the wood. You’ll have to remove any blotching that has occurred by sanding. Then switch to a gel stain (which doesn’t flow so it doesn’t penetrate deeply), partially seal the wood with a washcoat/wood conditioner (to keep the stain from penetrating deeply), or spray the stain and don’t wipe off the excess. This will leave an equal amount of stain everywhere.

PROBLEM #7

Spray stain doesn’t color inside corners well.

FIX The turbulence created by the air pressure prevents the stain from reaching these recessed corners. So reduce the air pressure to the minimum possible, while still getting good results, or brush the stain into these areas.

PROBLEM #8

Places where sweat has dripped on the wood during sanding come out darker when you apply the stain.

FIX The sweat (or any water for that matter) raises grain and roughens the wood, so more stain lodges. Follow the directions in problem #5 for sanding the problem and re-staining.

PROBLEM #9

The stain you’re using doesn’t get the wood dark enough.

FIX Commercial stains vary in the ratio of pigment or dye they contain relative to vehicle (binder and solvent). The higher the ratio the darker the stain colors the wood. So an easy solution might be to change brands or to add some pigment or dye to the stain you’re using.

There are two other possibilities. One is to sand to a coarser grit: #150 instead of #180, for example, or #120 instead of #150. Just don’t get so coarse that the stain highlights the scratches. You’ll have the greatest success if all the sanding-grit scratches from the last sanding go with the grain.

The other is to leave some stain on the wood during the wiping stage. This is called a “dirty wipe.” To achieve success you must wipe every part the same, so it’ll help to have a sample panel to match. Apply a coat of finish to this panel to bring out the full color.

PROBLEM #10

The color of the stained wood is just a little off.

FIX Add a little of the opposite color in the color spectrum to the finish and tone the wood. For example, if the wood is too warm (reddish), add green. If the wood is too cool (greenish), add red. You can also add black to reduce brightness. Keep in mind that lighting plays a part in how colors appear. Fluorescent lighting causes colors to appear cooler. Incandescent lighting causes colors to appear warmer. **PW**

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

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 of 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
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- Supports Healthy Immune System
- Improves Sleep & Brain Function

HOW TO GET ALOECURE

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.



The Lasting Influence of Tage Frid

Through teaching, this master craftsman's work lives on.

By Bill Rainford

Early on in my woodworking career I discovered Tage Frid and his iconic three-volume book set, *Tage Frid Teaches Woodworking*, and it forever changed how I approach the craft and how I teach others. In the text, Tage teaches you virtually all the traditional woodworking joints, common tools and techniques so that you can take on any sort of project that comes your way. This breadth of knowledge is freeing—you can solve complex construction problems independent of workshop conditions. This understanding will also improve your design skills.

Meet the Master Craftsman

Tage Frid was a Danish-born woodworker who helped revive the art of handmade furniture in America. He helped start the modern studio furniture movement and influenced generations throughout the years he taught at the Rochester Institute of Technology's School for American Crafts and started the furniture design program at the Rhode Island School of Design. He was *Fine Woodworking's* first contributing editor and amassed a sizeable body of written work there. His books were published by Taunton Press.

Tage was a gifted teacher with an acerbic wit and the ability to read a room. When asked about teaching repetitive tasks such as cutting the same old dovetail Tage responded, "Maybe you left too early. I always demonstrate difficult joints and techniques depending on what the audience wants. The dovetail is just the overture. What I like about teaching is that I learn something new every day. A student asks me, why can't I do it this way, and I think, why not? Then we figure it out."

Design Around Construction

Tage's design philosophy focused on teaching solid joinery; form should follow function. He would always remind his students that wood has a beauty of its own that should be enhanced and not hidden, and that developing an innate sense of proportion was the product of a keen eye for detail.

Tage believed that a designer should understand the medium he or she was working with while also understanding the needs of the customer. As a craftsman, you could easily tweak a design to better suit a client as opposed to a factory that would have a lot more overhead. Tage also stressed production techniques that would allow folks to

make a living from woodworking and stay competitive when compared to comparable factory-made furniture.

The Infamous Critique

His pragmatic approach to design and construction favored clean, modern lines, free from ostentatious details (typical of Danish-Modern furniture). Tage's teaching style ensured that his students could build in any style and encouraged his students to experiment with design.

This freedom of design didn't come without a price. Known for his sharp tongue and impish smile, Tage wasn't shy about expressing his thoughts on a design and many of his students found the critiques to be nerve-racking as they were often accompanied with a biting zinger



Above: A rocking chair, circa 1984, made with an aluminum frame, sandwiched between walnut, with nylon parachute cords for the seat.

Right: The iconic Tage Frid 3-legged stool (1982), made from walnut.



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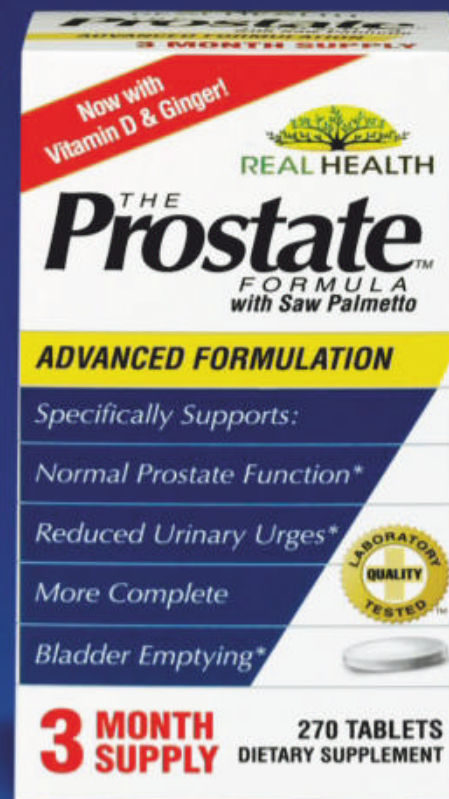
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***“The best tool is the eye; train the eye.
The eye guides your hands to achieve the form.
If the eye says it’s right, it is right.” —Tage Frid***

such as, “Oh, good curve. Too bad it’s the wrong one.” Or, “Nice dove-tails. What’d you use, a chainsaw?” The goal wasn’t to put anyone down, it was to help each student stay humble and push him- or herself to reach new heights in a paternal kind of way.

Notable Works

Tage enjoyed a career of more than 50 years as an active cabinetmaker, but most folk likely picture his iconic 3-legged stool when they think of his work. The design for this stool was conceived while watching a horse show and sitting on a fence and realizing how it supported him. The stool supports your ‘rump’ and the underside of your thighs, and the back supports your lower back at a comfortable angle. From there the seat, back and leg structure were worked out and the lines and joinery refined until they reached the form you see in the finished piece.

The austere lines of the stool are interesting from all angles. When approaching the stool, the rear leg almost disappears visually; the form draws you in. When you sit on the stool it’s surprisingly comfortable to sit on but also has a sturdy feel. The form is versatile enough that you can turn the chair around and comfortably sit on it facing the other way.

Volume three of *Tage Frid Teaches Woodworking* focused on specific furniture projects that leverage the myriad techniques taught in the first two volumes. Many of the projects are later forms that Tage refined over his career and they range from a drafting table and iconic Scandinavian workbench with a shoulder and tail vise (see *Popular Woodworking* issue #230), to a wide range of chair



Tage Frid (right) helping a student at the School for American Crafts in Rochester, New York.

and table variations, to a grandmother clock and built-in cabinets.

During Tage’s long career, he worked on a wide variety of projects (especially when compared to some of his contemporary craftsmen like Sam Maloof, George Nakashima or Wharton Esherick). Tage’s work included turned wooden bowls, executive office furnishings, ship interiors, kitchen cabinetry, altars and large crucifixes. Many of these and similar projects aren’t easily moved and thus don’t hit the secondary market as often. Tage lamented that he wished he took more photos of his earlier works. Nonetheless these often large and challenging projects helped to further demonstrate the broad applicability of his design philosophy.

More importantly, Tage’s devotion to educating generations

of designers and makers has had a lasting impact on the studio furniture movement. While finding Tage’s furniture pieces in the wild can be challenging, his impact can be witnessed in the work of the men and women who directly studied under him, and his students or those, like me, who learned a lot from his books and magazine articles. I highly encourage you to seek out Tage’s writings and allow the Great Dane to help guide you on your woodworking journey. **PW**

Bill Rainford is a traditional joiner, woodworking instructor and author of the forthcoming Lost Art Press book *Go, Go, Go: The Life, Woodworking and Influence of Tage Frid*. You can learn more about Bill and his work on his blog, RainfordRestorations.com.

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