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POPULAR Woodworking MAGAZINE

December 2017 ■ #236

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Blade box

Combination plane blades



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Who was Henry O. Studley, maker of the original and now iconic cabinet? Find out in an excerpt from “Virtuoso: The Tool Cabinet and Workbench of Henry O. Studley.” popularwoodworking.com/dec17

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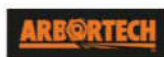


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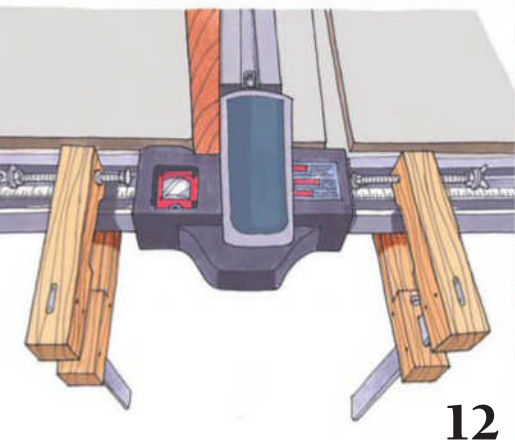
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It Starts With a Stick

All woodworking starts with some form of stick – even if that stick eventually grew into a branch or a trunk.

But my first woodworking “project,” basic though it is, was an actual stick... on which nature did most of the work.

I’m certain I was taught at my summer camp to “take nothing but memories, leave nothing but footprints.” But I took that branch, twisting it off from a live tree. I stripped the bark off the bulk of it with a pocketknife, being careful to leave it on the spiral ridges. I suppose it also counts as my first foray into live-edge work.

I made nothing else until grade-school shop class, and after that, nothing until some L-bracket-joined bookshelves after I’d moved out of my college dorm. Now, I’ve made more than half of the furniture in my house (and parts of the house, too).

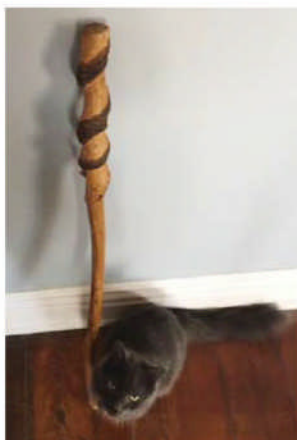
The Boy Scouts had a hand in the first projects of two of my coworkers.

Our online content director, David Lyell, made a birdhouse when he was 9, then in high school shop class he made a wall clock (which, I’m sad to hear, he recently got rid of). Right now, he’s working on a coffee table, just finished rebuilding his porch and is considering what kind of workbench to build.

Scott Francis (our books editor), made a pinewood derby car during his scouting years. It’s a sad story. His well-made car weighed too much, so his dad took a drill to the back of it just before the race and ruined the lines. Plus, he came in fifth. Perhaps it put him off woodworking for a few decades – his next project was a puppet theater for his daughters in 2014. Now, he’s working

on a contemporary dovetailed hall table and has plans for a dining room table.

Brendan Gaffney (managing editor) started young. At 3 years old, he worked with his dad to make cut a triangle shape from Rosewood offcuts. They drilled a hole with a Forstner bit, inlaid a nickel into it, then added a thick bartop finish to protect it from, well, a 3-year-old. It worked – 24 years later, it sits in Brendan’s shop. Now, he makes furniture of all sorts, all the time.



David Thiel, who’s in charge of our video program, also got his start in his dad’s shop. He recalls at age 12 or so hanging out in the shop (his father was a professional cabinetmaker) gluing hardwood scraps to plywood, then filling the joints with wood putty, for a chess board.

He claims to not know what happened to it. After more than two decades on the staff (following going into business with his father), he’s built many projects for the magazine, and for video.

And Jake Motz, who works with David on the videos, also started out with a couple game boards – and a grocery list clipboard that his parents still use – in high school shop class. He’s since built a fancy chessboard tabletop and a coffee table, and is interested in learning more about turning.

These days, my 40-year-old walking stick serves as a (somewhat) decorative reminder to me that every woodworker and every project starts with a stick of some sort. Some sticks become much more, some don’t. Both outcomes are part of the journey. **PWM**

Megan Fitzpatrick

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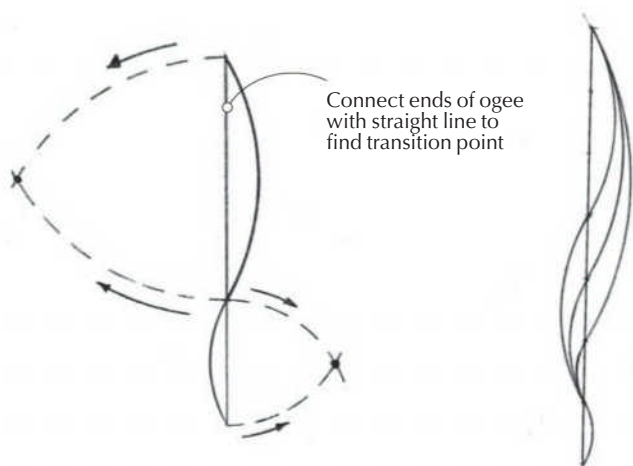
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Finding a Radius in Proportional Patterns



In his February 2016 (issue #223) Design Matters, “Look Beneath the Surface,” George Walker illustrates with lines and arcs how to establish “proportional patterns” in design. I am curious as to how he establishes the radius of the curves.

It seems that this distance, and consequently the radius point, would be critical to the overall pleasing appearance of the curve. How is the radius of that curve established?

Jay Linthicum,
Post Falls, Idaho

Jay,
Here’s a “beneath the surface” look at one of those flowing curves. This simple compass construction was used

by builders and artisans for millennia.

To find the focal points, simply open the compass span to match where the arc begins and ends. Swing a pair of arcs from each end; where they cross is your focal point.

This gentle arc often crops up in mouldings and other curved elements in furniture. You can use this simple construction to help train your eye to see curves. Draw a straight line and divide its length into seven or eight equal spaces. Use those spacings to draw a series of curves along the line. Play with it and let the curves overlap and dance along the line. The possibilities are endless.

George R. Walker, contributor

Fore Plane as Scrub Plane

I enjoyed Christopher Schwarz’s article “The Almost Forgotten Fore Plane” in issue #233 (August 2017). Among woodworking tools, I think handplanes are my favorite.

I had not thought of configuring a long plane as a scrub plane, but I guess one could turn any plane with an ad-

justable toe into a scrub plane.

I have copies of Garrett Hack’s “The Handplane Book” (Taunton) and Scott Wynn’s “Woodworkers Guide to Handplanes” (Fox Chapel). Both authors are silent about such conversions. (I made a scrub plane according to Wynn’s guidelines; the little sucker works like a champ!)

Schwarz is concerned about the scrub plane being too aggressive, but I find a simple line with a marking gauge from an already flattened side helps to prevent taking off too much wood.

Thank you for a very interesting article.

John T. Dodds,
Walnut Creek, California

What’s in the Name?

In the November 2017 issue (#235), Christopher Schwarz writes about the “doe’s foot” (a simple workholding device). I’m interested in how it got its name.

I know it has the shape of the animal’s foot, but a sawbench notch has the same shape, and it’s called a “duck’s mouth”—so why aren’t they the same? Is it because the angle and width is wider on the doe’s foot?

Tommy Reese,
from the PopularWoodworking.com
Shop Blog

Tommy,
I’m not sure. Here’s what I do know: The earliest written reference to this appliance that I know is in André Roubo’s “L’Art du Menuisier,” where it’s named “le pied de biche.” In modern French, that’s “crowbar.” In ancient French, it’s “doe’s foot.” Also, it looks like a doe’s foot.

Christopher Schwarz,
contributing editor

Band Saw Balancing Act

In a post on the shop blog at popularwoodworking.com, I saw Brendan Gaffney heaving a large slab onto the table of the band saw to saw a straight reference line onto the side of the board.

Instead of balancing the wide board on the band saw, why not put a roller stand by the side of the saw to support the edge of the board hanging over the table?

Chuck Molnar,
Meriden, Connecticut

Chuck,
This board was not so massive that I needed a stand, but that’s a fine idea on larger slabs, provided the roller stand

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has solid footing. Out of the shot (in fact, the one taking the shot) was David Lyell (our online content director), and if I'd needed the extra support, I might have called on him.

The other option is to bring the tool to the board—a jigsaw or track saw would've done this just as well, and for larger slabs, I prefer moving the tools, not the slabs.

Brendan Gaffney, managing editor

Blocks vs. Dovetailed Battens

I'm an aspiring woodworker, and I've been following Brendan Gaffney's Instagram feed (@burnheartmade) as he's built various "Anarchist's Design Book"-inspired projects.

I have a question about the coffee table build. In his book, Christopher Schwarz writes about using a sliding dovetail batten to add thickness to the Worktable's top for the staked leg. However, I saw that Gaffney simply glued blocks under the table for additional thickness.

I was about to cut those dovetailed pieces for my project when I saw Gaffney's solution, which looks far simpler than trying to nail the fit on those long dovetails.

Are the glued blocks sufficiently strong to support the staked legs? Also, it looks like the blocks run across the grain of the tabletop; what's the reason for this?

Benjamin Ice,
Auburn, Indiana

Ben,
The table was small enough that blocks were sufficient to add meat to the tabletop, and the glued-on blocks were small enough to ignore cross-grain wood movement concerns. If your table is wider, I'd recommend the sliding dovetailed battens as is shown in the book (I followed the book's approach for my staked worktable). Glued-on blocks are fine for smaller work such as coffee tables, but I'd go with the battens for anything larger.

In addition to adding meat, battens serve to prevent cupping a bit, and are more stable than the little blocks.

Brendan Gaffney, managing editor

Working With Wet Slabs

About a year ago, Christopher Schwarz wrote on his Popular Woodworking blog about using thick, wet slabs for workbench tops, and our being able to read along as he builds the bench. Did this ever happen? I can't find this build anywhere on your site or in the magazine. Can you point me at the series or let me know if it's going to be a book, DVD, VHS, series of telegrams, or if it didn't happen?

Mike O'Malley, via email

Mike,

What a shame you missed our semaphore workbench session...

Chris has written a bit more about working with wet wood, mostly on his other blog (at lostartpress.com), and he and Will Myers made a Lost Art Press video about building an old-school Roubo bench using a freshly milled top, on which they discuss the subject.

But in short, it's far less expensive to buy a 6"-thick wet slab than a dry one. Choose a species for the top that dries readily, such as red oak. For the undercarriage, use wood that is at equilibrium moisture content (kiln-dried is fine here). The wet top shrinks around the dry joints that marry it with the undercarriage.

The top will distort a bit as it dries so you'll need to flatten it probably several times during the first year, fewer times the second year and so on. After a few years, you'll find it doesn't move much. PWM

Megan Fitzpatrick, editor

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Highly Recommended

This is not the first time we've recommended Tiger Flakes, and I'm sure it won't be the last. This dewaxed shellac from toolsforworkingwood.com is primo. I've used Tiger Flakes for many furniture projects, and like it so much that I mixed up a couple gallons to spray on my pine floors (then topcoated with water-based poly).

The flakes dissolve quickly in denatured alcohol, and though I strained the mixture out of habit, I didn't need to—no bug parts. It dries hard, clear and fast, and is available in super blond, blond, amber and garnet (the one to which I'm partial).

— Megan Fitzpatrick



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Safety Note

Safety is your responsibility. Manufacturers place safety devices on their equipment for a reason. In many photos you see in Popular Woodworking Magazine, these have been removed to provide clarity. In some cases we'll use an awkward body position so you can better see what's being demonstrated. Don't copy us. Think about each procedure you're going to perform beforehand.

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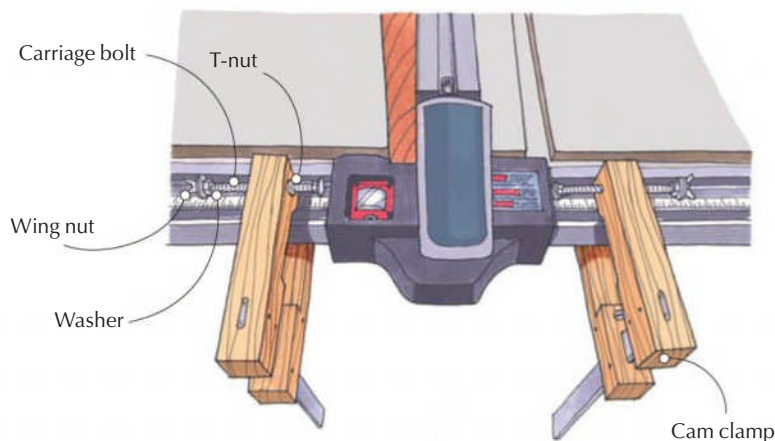
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THE WINNER:

Cam Clamp Fence Micro-adjusters



I have found a simple way to modify a wooden lever cam clamp to move a table saw fence or router fence in fractional amounts, using easy-to-find hardware: a 1/4"-20 T-nut, 1/4"-20 carriage bolt, and matching wing nut, washer and hex nut.

You can make your own cam clamps (there are plenty of YouTube videos on how), or buy them from a woodworking store.

Drill a 5/16" hole in one end of the cam clamp for the T-nut, and glue the nut in place (I used Weldbond adhesive). Thread the bolt through the nut, then cap it with the hex nut, washer and wing nut.

Your micro-adjuster is ready for action.

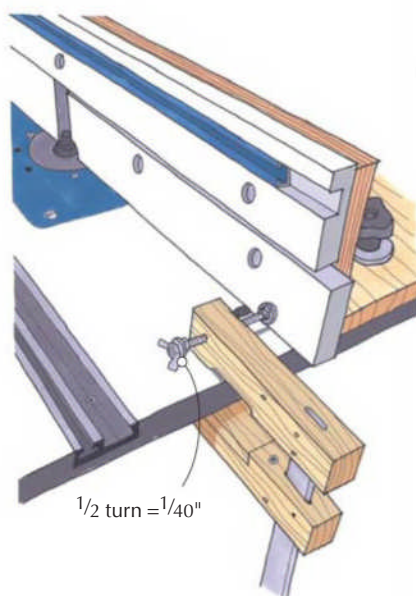
I use these for adjusting the fences on my table saw and router table. Just clamp the jig near the fence and rotate the wing nut, causing the carriage bolt head to move the fence. I made both right- and left-side versions so I can nudge the fence on either side of the blade or bit.

With half a rotation of the wing nut I can nudge the fence 1/40" (a full

rotation is 1/20").

I've found with this simple jig that I can sneak up on the very best settings for my fence. Plus, I can still use the cam clamps for my general clamping needs.

Jim Eckblad,
Decorah, Iowa



Wax Your Caulk Tips

I used to throw away a lot of caulk. It would dry out because I couldn't keep the air out of the tip of a partially used tube. I tried the caps that sometimes come along with a caulking tube. I tried plastic wrap. Nothing worked until I tried wax.

I light a jar candle just prior to finishing my caulking work so the wax will be ready when I'm finished.

After using the caulk, wipe the tip of the tube clean with a paper towel and dip it into some melted wax several times to completely coat the tip. Let the wax cool and set up between dippings so you can build up a couple of layers on the tip. This keeps the air out so the caulk doesn't set in the tip and make the rest of the tube worthless.

I've had a partially used tube of caulk last up to a year using this method.

Lane Epstein,
Naperville, Illinois

Bring Your Block Plane

When I go to the lumberyard, I bring a wallet, my truck and a block plane. The first two help me bring the lumber home; the block plane helps me know which boards to pick. A quick plane swipe in a few spots cuts through the grime and mill marks to expose what's happening under the surface.

Brendan Gaffney,
managing editor

CONTINUED ON PAGE 14

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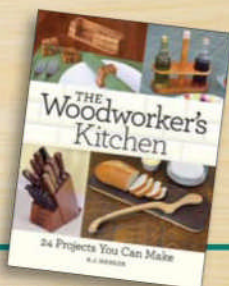
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Show Off Your Woodworking Skills – In the Kitchen

Whether you're outfitting your own kitchen or looking for a gift idea for a fellow foodie, "The Woodworker's Kitchen" has 24 projects – from a knife block to a kitchen island – that are fun to build, use and give:

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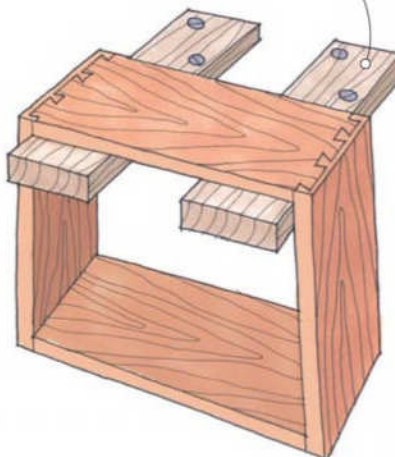
I recently completed a seven-drawer dresser. The drawers featured hand-cut dovetails and are of graduated heights from top to bottom.

Cleaning up the drawers with my handplanes was initially tough because I couldn't get them to remain still during planing. Fortunately, I thumbed through a Charles H. Hayward book recently and came across his solution: a dirt-simple method for easily planing drawers.

He writes, "All fitting is done before the bottom is added, and precautions are necessary to avoid racking the drawer when planing. The simplest way is to screw a couple of stout battens to the bench and place the drawer over these (shown here at center). As a rule, it is necessary to work inwards from each end to avoid splitting out the end grain. Do not remove more than is essential to give a clean finish, and try the drawer in position frequently."

That is all useful advice. But I'm lazy – and I didn't want to put screws into my benchtop – so I reimagined Hayward's technique using holdfasts instead of screws to hold the battens in place.

Charles H. Hayward's drawer planing appliance – screw battens to bench



Lazy solution – use holdfasts to secure battens to bench

This made adjusting the setup much faster than unscrewing them and repositioning them.

Shawn Nichols,
Bay Village, Ohio

Editor's note: The Hayward excerpt is from "The Woodworker: The Charles H. Hayward Years, Volume II" (Lost Art Press).

ONLINE EXTRAS

For links to all online extras, go to:

■ popularwoodworking.com/dec17

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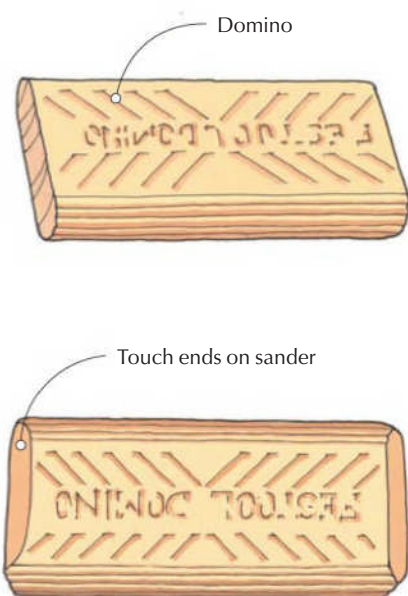


Chamfer Your Dominos

When gluing up a number of boards to make a panel or tabletop it can be tricky to get all the Dominos to engage if there is any warp in one or several of the boards. So I adapted a trick from fitting traditional tenons: a slight chamfer on the Domino end. It makes for much easier insertion of the loose tenon into the second workpiece.

I simply touch the Domino on my belt sander for a second to accomplish this. And if I'm using the "tight" setting on the tool for critical left-to-right alignment, I also chamfer the corners. This might seem to be a "no brainer," but I've found it's helpful in reducing glue-up stress and worth sharing. **PWM**

Anthony Fisher,
Sebastopol, California

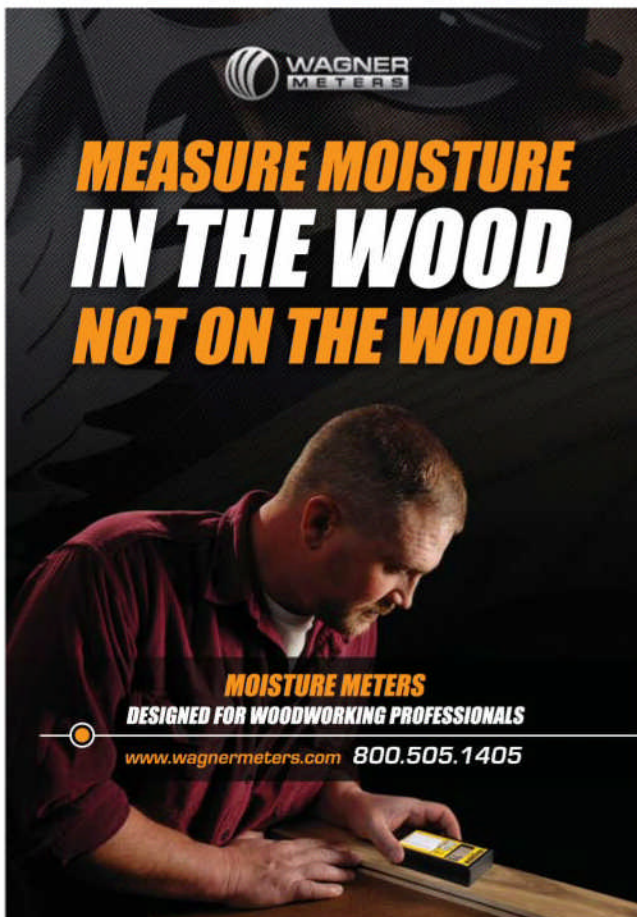


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Shapeoko XL CNC Kit

Desktop-sized digital technology priced for the home workshop.

Generally, CNCs suited for woodworking have heavy construction for stable motion, precision tracking for accuracy and the power to carve through hard woods easily. They come in sizes from very small to huge and are priced from \$3,000-\$12,000 (and beyond).

Until now, there have been few CNC options for woodworkers on tight budgets with small shops. There's a class of CNCs designed for "makers" – hobbyists who build all kinds of things using the latest technology – but these are usually light duty and not suited to machining solid wood. But a new machine, the Shapeoko XL from Carbide 3D, is.

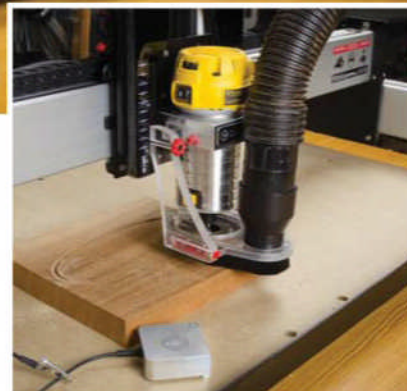
The Shapeoko XL has a desktop-sized footprint – a cutting area of 33" x 17" x 3". It's priced at \$1,499. And, if you have more room, consider the 33" x 33" x 3" XXL version for \$200 more.

Both come as simple-to-build kits. I put my evaluation unit, the XL, together in just two hours. For a spindle (the cutter), the user supplies a DeWalt DWP611 or a Makita RT0701C trim router (Carbide 3D offers both at reasonable prices).

The gantry (the crossbar that holds the router) straddles the wide axis, making it possible to machine boards up to 32" wide. At less than 85 pounds, the Shapeoko XL is small and light, but it's plenty stiff. On a CNC, the gantry and the beams that support it can flex as the machine moves; that creates in-



Home-shop CNC. The Shapeoko XL is an easy-to-build CNC option for the home woodworker. At right are shown two key accessories, the XYZ probe for easy setup and the SuckIt dust boot for easy cleanup.



accuracy. But Carbide 3D's extruded aluminum beams are unusually large and thick. Combined with a light spindle and a 10-gauge steel frame, the XL doesn't suffer from its small size; there is little measurable gantry or bed flex.

With the kit are other key ingredients for newbie digital woodworkers, including the free Carbide Create, a basic 2D CAD/CAM program to create drawings that then work with the CNC's Carbide Motion Software that runs the machine. (Other CAD/CAM programs will work with it, too, but Create is included to get you going.) Unusual in the CNC world, both programs work on Windows and Macintosh operating systems.

So what is it like to use the XL in a woodworking shop? Though the cutting speed is about 75" per minute, it doesn't feel slow. ("Inches per minute" is how CNC speed is specified; more expensive units are not only larger, but faster.) Thanks to fairly large stepper motors, rapid moves (movements be-

tween cutting passes) are quick.

It's also fairly accurate, within .005"-.007". But because it is lightweight and has a small spindle, a measured approach is required for cutting solid wood. Small bits limit cuts to 1/8"-1/4" per pass, depending on species, with a maximum total cut depth of 1". With patience and practice, you can get much of the work done you'd do on a larger machine. I'll get into more detail, techniques, tweaks and modifications on my popularwoodworking.com blog in future posts.

The Shapeoko XL is an excellent entry-level CNC, particularly with the addition of two accessories: The company's digital XYZ touch probe (\$120) makes precision setup a snap. And for easy cleanup, the third-party SuckIt magnetic dust boot (\$89.50) takes the dust away.

— Tim Celeski

Shapeoko XL CNC

Carbide 3D ■ carbide3d.com or 310-504-3637

Street price ■ from \$1,499

■ VIDEO: See how to build a desktop CNC from the Shapeoko kit.

Prices correct at time of publication.

CONTINUED ON PAGE 18

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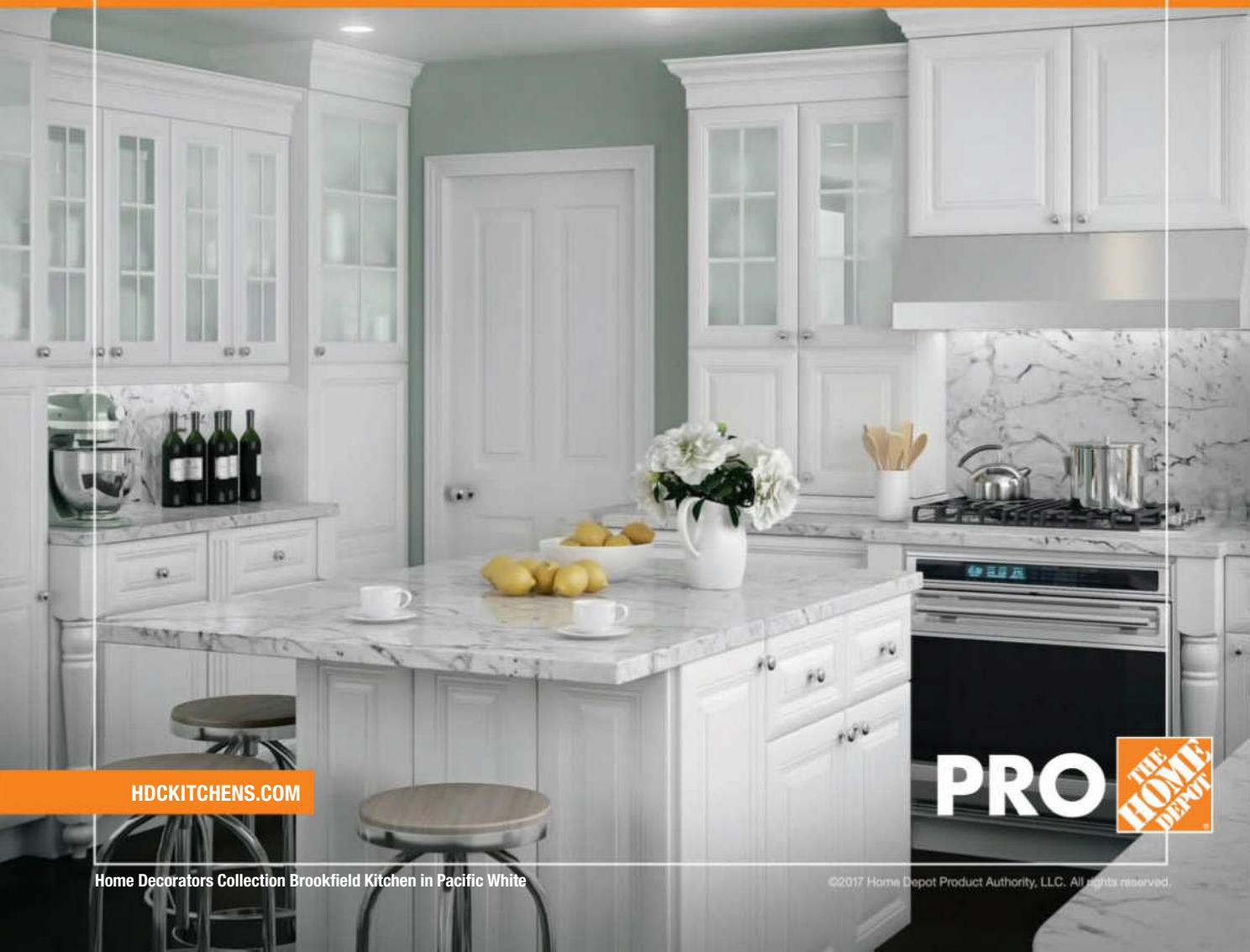


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SensGard Ear Chamber Hearing Protection

Before reading why these SensGard hearing protectors are so good, consider if you share some of the problems I have had with other protectors.

I do not like stuffing things into my ear canals, such as foam plugs that must be compressed with often dirty fingers, then uncomfortably jammed in, only to later work loose. The various silicone plugs, even those with high-tech designs, are nonetheless also stuck in the ear canal like a cork in a wine bottle. I find them unpleasant, especially for intermittent use in the woodshop.

Earmuffs are cumbersome, tend

to bump into things and get sweaty. Worse, despite their soft padding, muffs squeeze the temple arms of my eyeglasses against my skull. It isn't long before I choose the noise over the headache.

The SensGard Ear Chambers solve all these problems while providing great noise reduction. The replaceable foam cuffs (it's good to have extras on hand; they can get soiled) of these incredibly lightweight protectors comfortably surround the entrance to the ear canal — they are not jammed into it. The side pieces vault my eyeglass temple arms — no more skull aches. They go on and off easily, and can hang around the neck or fold compactly to put in a pocket.

The deceptively simple-looking hollow plastic side pieces actually employ sophisticated acoustic technology. The noise reduction rating of this model is an impressive 31 decibels, but the quality of the noise reduction is even more beneficial. When I first put on the SensGards



while running my screaming benchtop thickness planer, I was flabbergasted at the dramatic noise diminishment. I could still hear important shop sounds such as speech.

It is important to put them on according to the simple package instructions.
— Rob Porcaro

Ear Chamber

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■ **BLOG** Your lungs need protection, too; read about our editor's favorite respirator.

Price correct at time of publication.

BearKat Wood's Chair Scraper

There is no doubt in my mind that a chair scraper from BearKat Wood should be in every chair-maker's tool chest. Card scrapers have long been the secret clean-up weapon of woodworkers, and it's clear that this one was designed by someone with an intimate knowledge of the challenges that arise from working wood in complex, curvilinear forms. Everything about this tool makes sense and solves a real-world problem. With a straight edge on one side and varied radii along

the back, flats are no problem, and inside and outside curves from seats to spindles are covered.

The .025" thickness has just enough "give" to make it effective at targeting trouble spots, and the 1095 tempered spring steel holds a nice hook while being easy to sharpen and to turn a hook.

My favorite thing about this scraper is how it fits so naturally in my hands. The shape (coincidentally resembling a bear) offers a nice compromise between the geometry of a curved scraper and the size and control of a rectangular card scraper, providing a wide and comfortable gripping surface.

Because so much of the effectiveness of card scrapers comes down to how they are flexed and manipulated in use, it's nice to have something that responds reliably without inducing hand



cramps. Oh, and don't let the name fool you. This scraper might have been designed with chairs in mind, but it's a true workhorse for any kind of curved woodworking.

It comes shipped in a handy, reusable cardboard storage sleeve with full directions on how to properly tune it for use. At \$15 (plus \$4.20 shipping) adding this lifesaver to your tool arsenal is a smart move. **PWM**

— James McConnell

Chair Scraper

BearKat Wood ■ bearkatwood.com

Street price ■ from \$15

■ **VIDEO** Watch how to use a "Universal Sharpener" to file a scraper.

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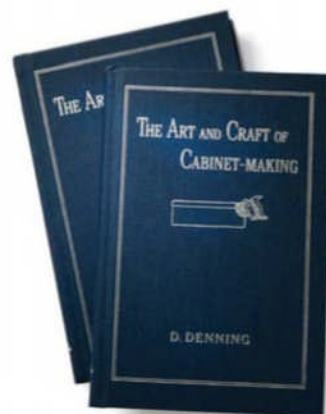
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The hand tool instruction is spot on – Denning was clearly a practitioner, and intimately familiar with the craft. Plus it's simply a good read (and quite funny by Victorian standards).

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Seth Gould: Explorer in Metal

Meet this expert metalworker, toolmaker and locksmith.

Nothing could be simpler than a hammer. That is until you hold one of Seth Gould's cross-peen hammers and discover the balance and heft of a tool that instantly becomes a part of your arm. Suddenly you have a new category for the word "hammer," something with life and spring in your hand, and all those other things you once called hammers are now downgraded to a clumsy dead weight on the end of a stick. This feeling applies across all of his other tools, as well.

Gould is a metalsmith. He forges exquisite hand tools that woodworkers covet both for their function and the way they please the eye. Each design is the culmination of a long process of chasing the ideal form. Yet beyond his obvious mastery of his craft, there is something Gould can teach us all about design and unlocking creative potential.

Arguments about the boundary lines between art and craft have resulted in gallons of ink spilled and tempers flared with not much to show for it. Some separate the two, with art pushed up into the stratosphere and



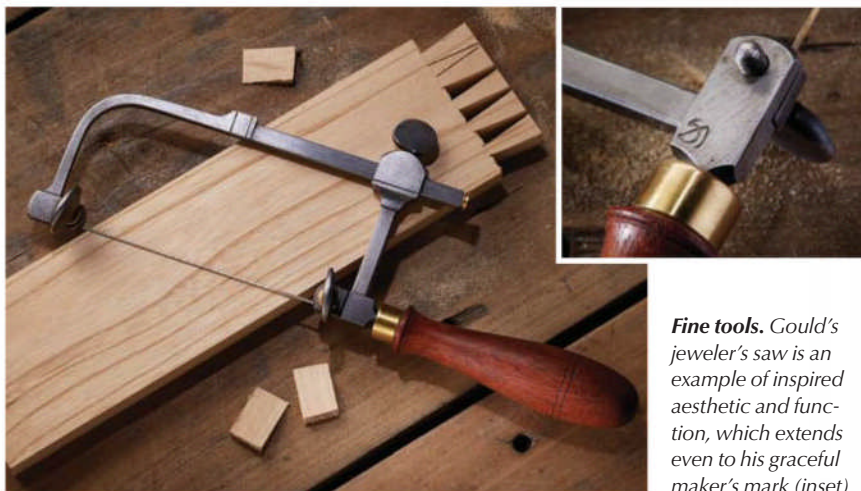
Hard work. Seth Gould is shown here hard at work forging a hammer head. His hammer-making process starts at the forge, followed by hand filing then carefully making wooden handles (you can see a finished hammer on page 4 in the Table of Contents).

craft tossed down in the ditch. Others use a broad brush to meld both together, but in doing so strip both down to the mundane, by touting the art of folding a shirt or the craft of weeding a garden. Yet craft and art are best seen

as partners that elevate one another. Art blossoms from the crucible of craft, and craft reflects art in a never-ending dance. Art is almost always the result of exploration, and that exploration often springs from the mastery of craft.

Building a Foundation

Gould credits his foundation to both formal and informal training. He undertook a formal course of study at the Metalsmithing and Jewelry program at the Maine College of Art in Portland. There he began to hone his creative sense for aesthetics and gained a working knowledge of forging and forming metals. He continued his studies with renowned blacksmith Peter Ross to gain a deeper practical knowledge of traditional metalworking methods and mindset. He also took advantage of an opportunity to study in Japan with traditional metalsmiths.



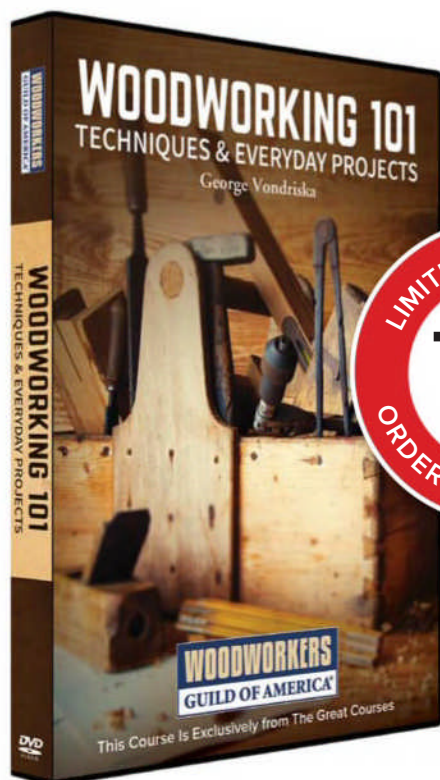
Fine tools. Gould's jeweler's saw is an example of inspired aesthetic and function, which extends even to his graceful maker's mark (inset).

CONTINUED ON PAGE 24



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Progression.
At left, a run of dividers make their way from the forged finish, through filing, to a final product. Below is a finished example.



In addition to these intentional learning experiences, Gould credits having his eyes opened by traveling in Europe and seeing outstanding historical metalwork in museum collections. This foundation was tamped down and made solid by years of working at the forge and anvil, teaching his hand and eye to work in concert.

Forging the Ideal

I asked Gould about his design process when creating tools such as his dividers. He explained his overriding goal is that they must function well – no amount of ornament or pleasing form can overcome poor function. The reality is that the process of chasing that ideal form is just that – making hundreds of dividers and throwing most of them away. Part of that discard

process is nailing down the functional side of the tool, and others are rejected for aesthetic shortcomings. Those that remain hit the sweet spot where function and aesthetics sing together. This may not be an efficient way, yet each reject offers a lesson, even if that lesson is helping to sort out what is the wrong direction.

Toolmaking at this high level offers challenges that are not always found in the fine arts. Some would define art as a work that captivates us at a deeper level. Unlike a painting, a tool can only be fully engaged by working hands skilled enough to appreciate the whole of it. That deeper experience with a tool is realized through the balance, spring and the way it becomes an extension of the body.

This quest for an ideal form can sometimes veer off into an exploration in unexpected directions. Gould created a series of hammer studies playfully exploring what could spring from a tool – especially the most basic of all that goes back to the beginning of humans as toolmakers. This is a fun example of craft moving over into the realm of art.

Foundation as Springboard

Recently, Gould has taken advantage of an opportunity to be resident artist at the Penland School of Arts to extend his metalworking exploration in an exciting new direction. While still de-

voting part of his day to making tools, he is able to spend large amounts of time creating metal puzzle boxes and locks. These are inspired by historical examples, yet infused with his eye for detail and restrained ornament, which gives them a contemporary look. He's also planning another trip to Japan to study traditional engraving and patination techniques (colored surface treatments) to incorporate into future work.

Gould stands as an example of the heights that can be reached by building a solid foundation of craft and coupling it with curiosity and courage to explore. That's a great path for any craftsperson – and one especially relevant for all of us woodworkers. **PWM**

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



Locked up. This lock for a small chest is an exercise in intricate small metalwork.

ONLINE EXTRAS

For links to all these online extras, go to:

■ popularwoodworking.com/dec17

BLOG: Read Seth Gould's article on the "charred finish" he uses for his tool handles.

BLOG: Read more from George R. Walker on his By Hand & Eye blog with Jim Tolpin.

IN OUR STORE: George R. Walker's DVDs.

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About This Column



Design Matters dives into the basics of proportions, forms, contrast and composition to give you the skill to tackle furniture design challenges with confidence.



Playing with hammers. Gould's experimentation with tools has extended to an artistic exploration in tool forms, including his absurdist hammer study shown here.

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Stacking Tool Caddy

A simple-to-build tote, perfect for tool and supplies transport.

I designed this stacking tool caddy to hold small parts and a few tools. It's comprised of three tool trays that stack and interlock together to form a single unit that can be carried wherever needed. Best of all, it stores my screws, nails and small tools so they're all right at hand. It's also handy for transporting other items: sewing supplies, fishing tackle and whatever else you can think up.

The trays are joined with half-laps secured by dowels. The dowels not only add strength but also add a nice decorative detail to the project. To lock the trays together, the main handle pivots, allowing access to the individual trays. A tongue depressor acts as a simple spring latch.

Trays First

The sides for each tray are $\frac{1}{2}$ " x $3\frac{1}{2}$ " poplar (dimensional $\frac{1}{2}$ " x 4" lumber from the big box store). To begin the construction, cut the side and end pieces.



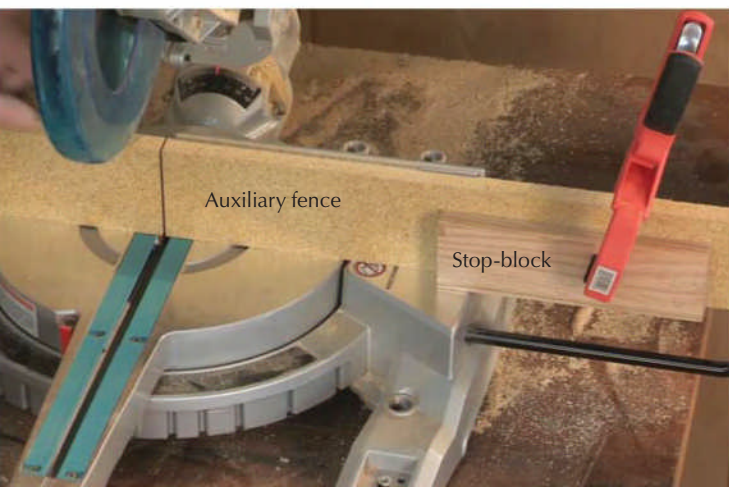
It's vital they are the same length – if they aren't, the trays won't be square and won't stack and interlock correctly. A stop-block can aid in making the repeat cuts accurately. Cut the short tray sides, then reset the stop-block to cut the long tray sides—you should have six of each.

Next, rout a $\frac{1}{4}$ " x $\frac{1}{4}$ " rabbet on each

end of each of the tray pieces for the half-lap joinery. Watch out—the router bit has a tendency to fracture and tear out the fibers as you exit the cut, leaving a jagged corner. An easy way to eliminate the blowout is to first make a small cut with a handsaw to define the exit point of the bit.

Next, glue up the trays. It can be tricky to hold the tray together and glue each side at the same time. To make it less of a juggling act, use some painter's tape to temporarily hold the joint together while you apply glue to the other corners.

Before the glue dries, place the tray in clamps snugly, but not fully tightened, so you can check for square. Measure diagonally from corner to corner one way, then the other—the measurements should be the same. If they're off, that means the tray is slightly racked and has to be adjusted. Once you've got it where you want it, slowly and evenly tighten the clamps. Check for square one more



Matching lengths.

For clean cuts and a good registration surface, attach an auxiliary fence to the stock fence of the miter saw. Also, ensure consistent lengths by using a stop-block. With the saw off, measure from the blade to the block, and clamp it in place. Start by cutting the end of the board square, then put that end against the stop and make your cuts.

CONTINUED ON PAGE 28



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❑ 6	Tray sides	1/2	3 1/2	19 1/2	Poplar
❑ 6	Tray ends	1/2	3 1/2	8 1/2	Poplar
❑ 3	Tray bottoms	1/2	8 1/2	19	Plywood
❑ 2	Handle supports	3/4	1 1/2	14 3/4	Walnut
❑ 1	Handle	3/4-dia.		21 1/2	Walnut dowel
❑ 1	Top tray divider	3/4	5 1/2	18 1/2	Walnut
❑ 1	Middle tray divider	3/4	3	18 1/2	Walnut
❑ 2	Handle stops	3/8-dia.		1	Dowel
❑ 2	Handle spring latches	1/8	5/8	4*	Tongue depressor
❑ 1	Joinery dowel	1/4-dia.		**	Walnut

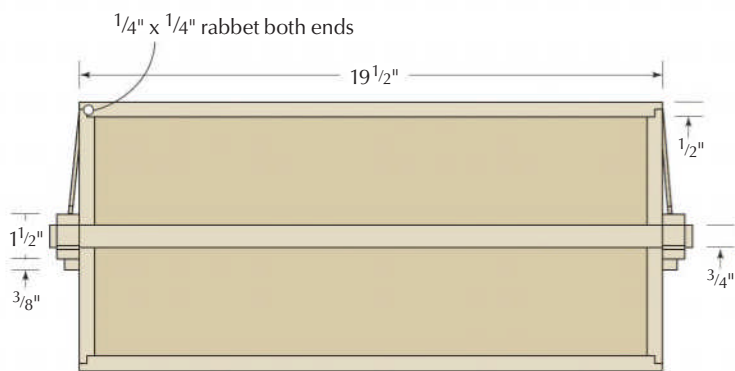
*Cut to fit. **Length varies – 48" should be enough, but buy more to account for error.



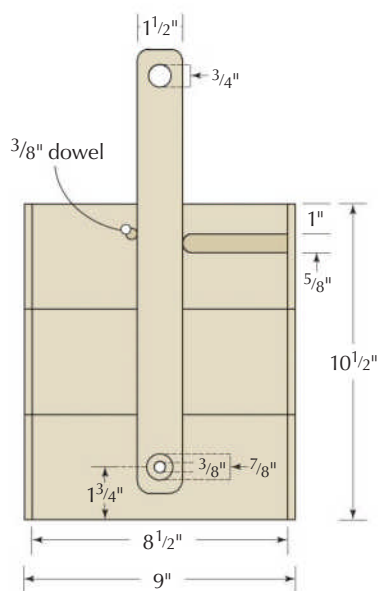
Rabbet. Rout the rabbets on the ends of every tray part. I use a bench hook to hold the work in place and off of the bench.



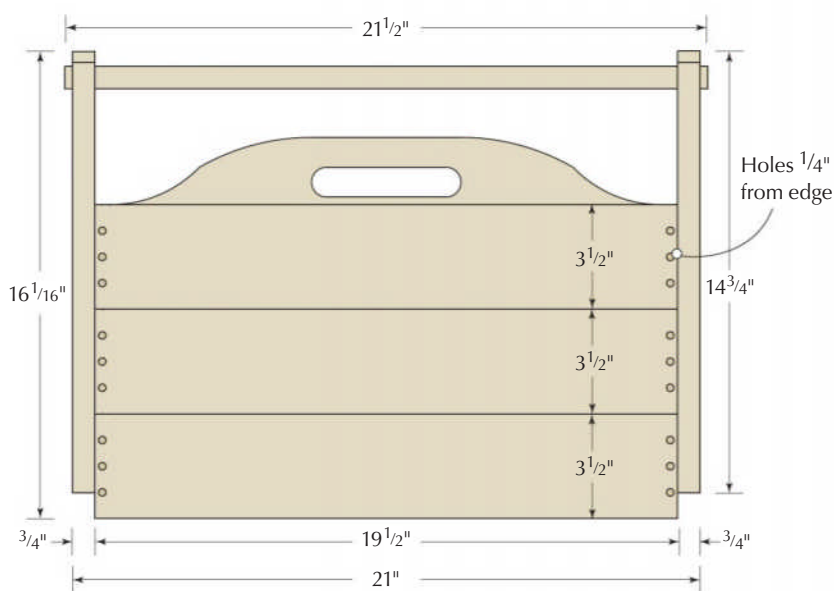
Router setup. Use a 1/4" rabbet bit for the joinery. The bit will automatically make a 1/4" cut in width because of the bearing size, but the bit still has to be set so it's cutting 1/4" down from the base plate.



PLAN



PROFILE



ELEVATION

CONTINUED ON PAGE 30

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Router again. Cut a $\frac{1}{4}$ " x $\frac{1}{4}$ " rabbet on the inside of the top and bottom of the trays, after the glue dries. The router bit and setting are the same as for the joints. When routing on the inside of a piece, make sure to move the router clockwise – you should always move the router so the rotation of its bit is against the direction you're moving.

time before allowing the glue to set up.

With the glue dry, make sure the top and bottom edges are all flat and flush. If necessary, use a block plane to true them up. Then cut a $\frac{1}{4}$ " rabbet on the top and bottom edges – you can use the same router setup as you did for the joinery.

The corners of the rabbets will be round. Use a chisel to square these so that the bottoms' corners will seat fully and so the trays nest together in a stack.

Next, cut the $\frac{1}{2}$ " plywood bottoms to length and width. Because the rab-

bets are only $\frac{1}{4}$ " deep, the plywood sits below the sides by $\frac{1}{4}$ " – this lets the bottom register into the top of the tray below. However, the lowest tray's bottom should not project – it should be flush with the side pieces. Use the router with the same bit and depth setting to cut a $\frac{1}{4}$ " rabbet on all four edges of the bottom for the bottom tray. The rabbets on the tray bottom and tray sides will nest together, allowing the bottom to sit flush with the sides. Make sure when routing the outside of the workpiece that you're moving clockwise around the work. Now glue in the plywood bottoms.

Next, reinforce the joinery with some $\frac{1}{4}$ " dowels by drilling three holes in from the sides through each joint. Refer to the drawings for layout – they are $\frac{1}{4}$ " from the ends, and should be evenly spaced. The end grain will want to blow out during this operation – there are a few ways to prevent that from happening. First, place some tape over the corner to reinforce the fibers while drilling. Also, carefully measure and draw the lines where the dowels should be placed to avoid getting too close to the sides of the boards. Lastly, make sure the drill is up to full speed before pushing down into the wood, or it will tend to tear at the fibers instead of cutting them cleanly.



Dowels. Keeping the dowel long assures you'll bottom out on each hole. After applying glue and tapping it home, cut off the excess with a flush-cut saw.

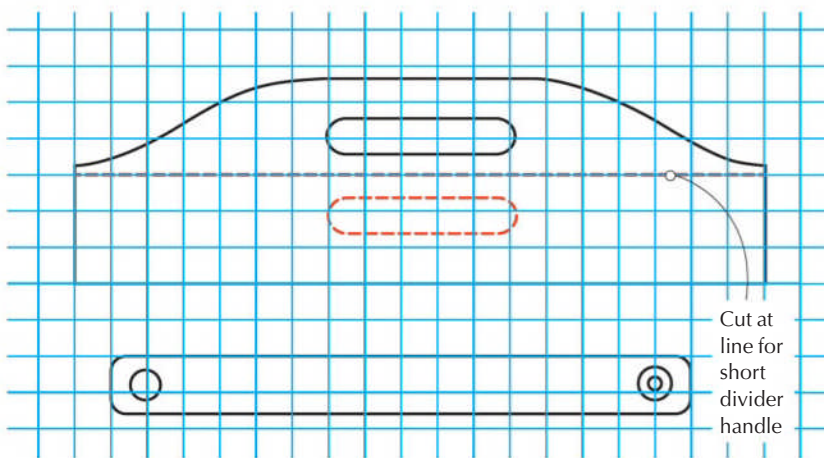
After drilling all the holes, glue in the dowels. To make sure you have the right length of dowel for each hole, keep the dowel long and glue it in one hole at a time. Put glue in the hole and on the end of the dowel rod, then tap the dowel until it's seated. With a flush-cut saw, flush the dowel to the tray surface. Repeat the process for all the tray sides.

Get a Handle on It

The top divider has a tall handle, and the middle divider has a low handle that sits below its walls. From the drawing below, make full-sized templates for the two dividers and trace them onto the wood. Use a jigsaw or other appropriate saw (such as a bowsaw or band saw) to rough out the shape.

Start the finger holds by drilling the outermost holes, then drill several holes in a line between them. Place a sacrificial piece of wood underneath to prevent drilling into your benchtop. Also, clamp the workpiece to the scrap when drilling – this will prevent blow-out on the other side of the workpiece as the drill bit exits the wood.

Chisel to your layout lines, removing the waste left from drilling. Chop about halfway into the work, then flip the board over and finish the work. This will give you better results because by working from both sides the back side won't blow out. File and sand to make the divider's curves and finger holds smooth and comfortable to the touch.



TRAY DIVIDERS & HANDLE SUPPORT

One square = 1"

CONTINUED ON PAGE 32

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But *Ultra-Shear* goes even further, delivering a spectacular surface finish with a technique called **shear scraping**. Roll the tool right or left on your tool rest and you will feel it land solidly on a secondary bearing surface. This sets your cutting edge at 45° to the stock. Coming into the work at this angle, the wood fibers slice cleanly, virtually eliminating sanding. The exclusive shape of the *Ultra-Shear* shaft allows you to switch from aggressive stock removal to super-fine finishing in the blink of an eye.

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Spring latches. The mortises that hold the spring latches are pared with a chisel held at an angle to form a ramp, which causes them to stand proud. A tongue depressor is just the right size and thickness, but any thin piece of wood will work.

To mount the dividers in the tray, find the centers of the tray sides and, with the divider clamped in place, drill $\frac{1}{4}$ " holes from the outside of the tray into the divider. Use $\frac{1}{4}$ " dowel and glue to secure the divider. Both dividers are affixed in the same way.

Before you make the larger exterior handle, make the spring latches and handle stops. The spring latches are made from tongue depressors, which flex to secure the handle vertically. The stops are pieces of dowel that prevent the handle from rotating too far.

From the plans, lay out the lines for the spring latches on the top tray's sides and use a knife to score deep lines to define each latch's mortise.

With a chisel, pare away the wood between the knife cuts at a gradual slope, so that the mortise angles up-

ward. Make sure to test each latch as you chisel its slot – it should be proud enough to hold the handle back but easy enough to press down far enough to allow the handle to pass over. Use glue and small brads to secure the spring latches in place.

The handle stops are $\frac{3}{8}$ " dowels drilled and glued in place. They should be installed so that the handle stops vertically, after passing over the latches.

Now, while the glue for the spring latches and stops is drying, make the main handle. This handle is mounted to the lowest tray by a nut and bolt through the arm and into the tray. The two arms of the handles on either side are connected by a $\frac{3}{4}$ " dowel above the stacking trays.

Cut the arms to length and drill a $\frac{7}{8}$ " hole part of the way through the bottom of each arm. This will allow the bolt heads to sit below the surface. On the same centers, drill through the arms with a $\frac{3}{8}$ " bit, and drill a corresponding $\frac{3}{8}$ " hole into the sides on the lowest tray.

Then drill a $\frac{3}{4}$ " hole all the way through the top of each arm, through which the $\frac{3}{4}$ " dowel will pass to connect the two arms together. Round over and smooth the corners of the arms with a file or sandpaper.

Place a $1\frac{1}{2}$ "-long $\times \frac{1}{4}$ "-20 bolt and washer through the handle arm on each side. Sandwich another washer between the arms and the sides of the tray, then

a washer and nut on the inside of the tray. The nuts might have a tendency to come loose during use, so use Loctite on the bolts before threading the nuts on.

With the bolts tightened and in place, assemble the stacking trays and move the main handle into place. Glue in the $\frac{3}{4}$ " dowel for the main handle. Leave it a little long at this point.

With the dowel in place, but before the glue dries, make the final adjustments on the handle. The arms should be locked in place by the spring latches but still able to pass over them when they're depressed. Adjust the clearance by moving the arms closer or spreading them apart from one another. Once the clearance is correct, let the glue dry, then cut the ends of the dowel flush to the arms. A nail can be driven through the arm into the dowel to further reinforce the joint between the two.

Lastly, sand and finish the parts. I used a simple oil/varnish blend – it applies easily with a rag and gives a soft lustre and a protective finish that isn't too thick. The thin film prevents the finish from chipping or sticking when the trays are stacked together. **PWM**

Chad is the host of the "I Can Do That" video series, available at ShopWoodworking.com.

ONLINE EXTRAS

For links to all online extras, go to:

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PLAN: Download a free SketchUp model for the "Stacking Tool Caddy."

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About This Column

Our I Can Do That column features projects that can be completed by any woodworker with a modest (but decent) kit of tools in less than two days of shop time, using materials from any home center. Our free PDF manual explains how to use all the tools in the kit. Visit PopularWoodworking.com/ICanDoThat to download the free manual.



Hardware. Attach the handle with the $1\frac{1}{2}$ "-long $\times \frac{1}{4}$ "-20 bolts. I'm using Loctite to keep the nuts from loosening – once dry, it acts as a mild glue, but can be reversed with some persuasion.

Drug Companies Fear Release of the New AloeCure

Big Pharma stands to lose billions as doctors' recommend drug-free "health cocktail" that adjusts and corrects your body's health conditions.

by David Waxman
Seattle Washington:

Drug company execs are nervous. That's because the greatest health advance in decades has hit the streets. And analysts expect it to put a huge crimp in "Big Pharma" profits.

So what's all the fuss about? It's about a new ingredient that's changing the lives of people who use it. Some call it "the greatest discovery since penicillin"!

The name of the product is the AloeCure. It's not a drug. It's something completely different. And the product is available to anyone who wants it, at a reasonable price. But demands may force future prices to rise.

TOP DOC WARNS: DIGESTION DRUGS CAN CRIPPLE YOU!

Company spokesperson, Dr. Liza Leal; a leading integrative health specialist recommends AloeCure before she decides to prescribe any digestion drug. Especially after the FDA's stern warning about long-term use of drugs classified as proton pump inhibitors like **Prilosec®**, **Nexium®**, and **Prevacid®**. In a nutshell, the FDA statement warned people should avoid taking these digestion drugs for longer than three 14-day treatment periods because there is an increased risk of bone fractures. Many people take them daily and for decades.

Dr. Leal should know. Many patients come to her with bone and joint complaints and she does everything she can to help them. One way for digestion sufferers to help avoid possible risk of tragic joint and bone problems caused by overuse of digestion drugs is to take the AloeCure.

Analysts expect the AloeCure to put a huge crimp in "Big Pharma" profits.

The secret to AloeCure's "health adjusting" formula is scientifically tested **Acemannan**, a polysaccharide extracted from Aloe Vera. But not the same aloe vera that mom used to apply to your cuts, scrapes and burns. This is a perfect strain of aloe that is organically grown under very strict conditions. AloeCure is so powerful it begins to benefit your health the instant you take it. It soothes intestinal discomfort and you can avoid the possibility of bone and health damage caused by overuse of digestion drugs. We all know how well aloe works externally on cuts, scrapes and burns. But did you know Acemannan has many of other health benefits...

HELPS THE IMMUNE SYSTEM TO CALM INFLAMMATION

According to a leading aloe research, when correctly processed for digesting, the Aloe plant has a powerful component for regulating your immune system called **Acemannan**. So whether it's damage that is physical, bacterial, chemical or autoimmune; the natural plant helps the body stay healthy.

RAPID ACID AND HEARTBURN NEUTRALIZER

Aloe has proved to have an astonishing effect on users who suffer with digestion problems like bouts of acid reflux, heartburn, cramping, gas and constipation because it acts as a natural acid buffer and soothes the digestive system. But new studies prove it does a whole lot more.

SIDE-STEP HEART CONCERNS

So you've been taking proton pump inhibitors (PPI's) for years and you feel just fine. In June of 2015 a major study shows that chronic PPI use increases the risk of heart attack in general population.

UNLEASH YOUR MEMORY

Studies show that your brain needs the healthy bacteria from your gut in order function at its best. Both low and high dosages of digestion drugs are proven to destroy that healthy bacteria and get in the way of brain function. So you're left with a sluggish, slow-to-react brain without a lot of room to store information. The **acemannan** used in AloeCure actually makes your gut healthier, so healthy bacteria flows freely to your brain so you think better, faster and with a larger capacity for memory.

Doctors call it "The greatest health discovery in decades!"

SLEEP LIKE A BABY

A night without sleep really damages your body. And continued lost sleep can lead to all sorts of health problems. But what you may not realize is the reason why you're not sleeping. Some call it "Ghost Reflux". A low-intensity form of acid reflux discomfort that quietly keeps you awake in the background. AloeCure helps digestion so you may find yourself sleeping through the night.

CELEBRITY HAIR, SKIN & NAILS

Certain antacids may greatly reduce your



body's ability to break down and absorb calcium. Aloe delivers calcium as it aids in balancing your stomach acidity. The result? Thicker, healthier looking hair...more youthful looking skin... And nails so strong they may never break again.

SAVE YOUR KIDNEY

National and local news outlets are reporting Kidney Failure linked to PPI's. Your Kidney extracts waste from blood, balance body fluids, form urine, and aid in other important functions of the body. Without it your body would be overrun by deadly toxins. Aloe helps your kidney function properly. Studies suggest, if you started taking aloe today; you'd see a big difference in the way you feel.

GUARANTEED RESULTS OR DOUBLE YOUR MONEY BACK

Due to the incredible results people are reporting, AloeCure is being sold with an equally incredible guarantee.

"We can only offer this incredible guarantee because we are 100% certain this product will work for those who use it," Says Dr. Leal.

Here's how it works: Take the pill exactly as directed. You must see and feel remarkable improvements in your digestive health, your mental health, in your physical appearance, the amount inflammation you have throughout your body – even in your ability to fall asleep at night!

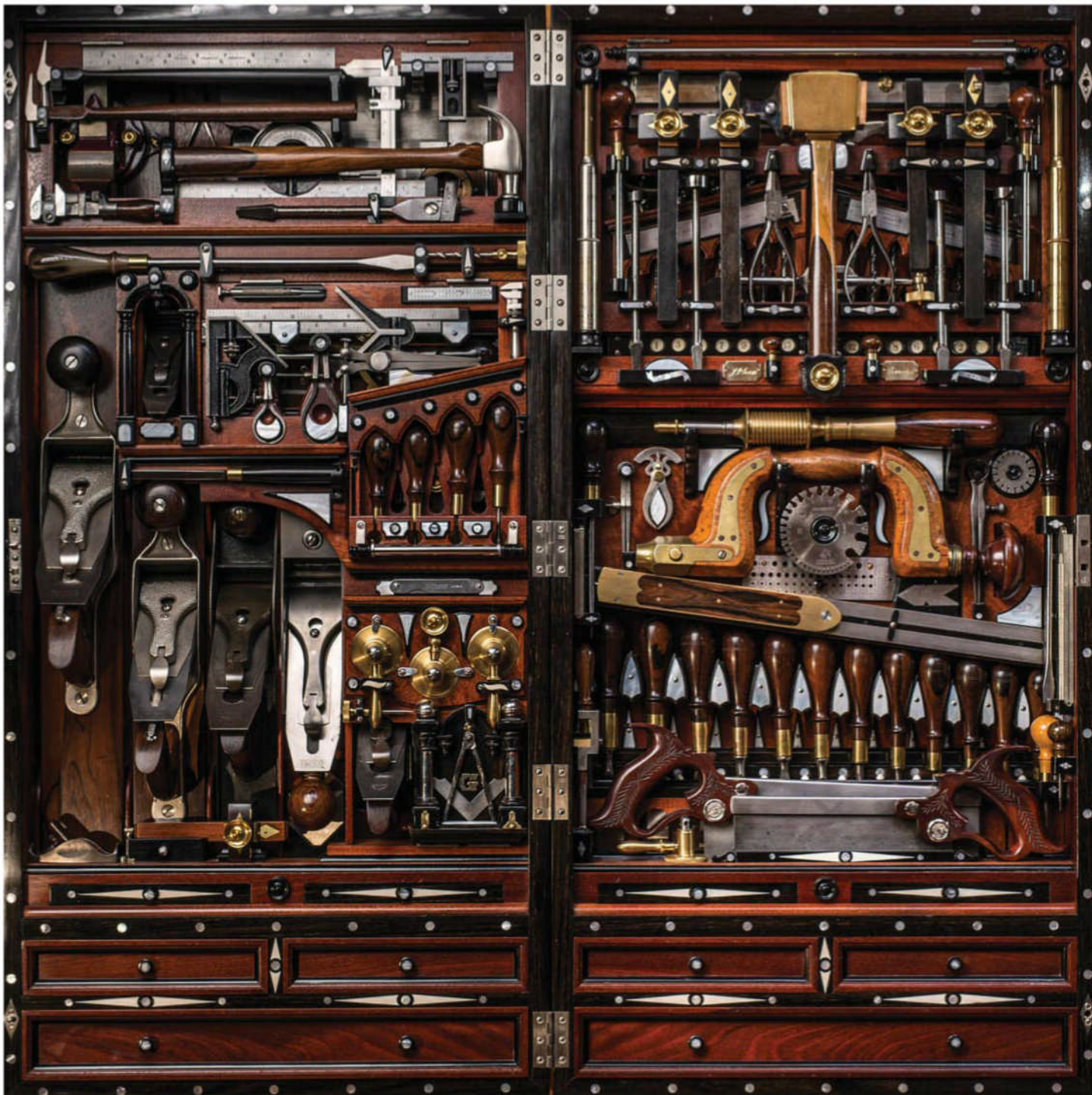
Otherwise, simply return the empty bottles with a short note about how you took the pills and followed the simple instructions and the company will send you...Double your money back!

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 readers of this publication only. All you have to do is call TOLL-FREE **1-800-746-2951** and provide the operator with the Free Bottle Approval Code: **JC025**. The company will do the rest.

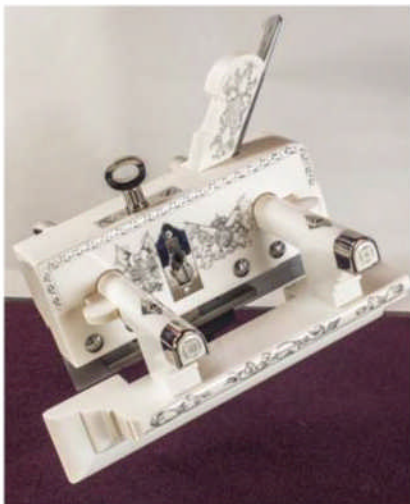
Important: Due to AloeCure's recent media exposure, phone lines are often busy. If you call and do not immediately get through, please be patient and call back.



Recreating Studley

BY DONALD C. WILLIAMS

Jim Moon produced a faithful replica of this iconic cabinet, with a decorative touch or two of his own.



Plow plane. Lessons learned in restoring and making plow planes served Jim Moon well when reproducing the Studley tool cabinet and its contents. This ultra-showy model involved exceedingly intricate work in exotic materials.

In the world of historic furniture-making, Jim Moon casts a long shadow. He is not only a highly respected furniture maker but also has the remarkable output of someone who works hard and fast.

His entree into serious woodworking was as a medical student (he's now a surgeon) four decades ago, when he wanted to give a tall-case clock as a gift. But, he recalls, "there weren't many good antiques in South Dakota, and certainly none I could afford, so if I wanted one, I had to make it myself."

He befriended a cabinetmaker who sold him the walnut to make his clock and mentored him in making it. Eventually, Moon bought most of that cabinetmaker's machinery and embarked on a lifetime of woodworking with an output that can justly be described as nonpareil and prodigious. The Moon home is a gallery of his exquisite work, and he jokes that he might need to start rotating the pieces between the living spaces and the attic if he makes any more.

As Jim's craft gravitated toward handwork alongside his machine work, he caught the incurable affliction of collecting (mostly vintage) hand tools. His passion for plow planes resulted in acquiring, restoring and eventually making hundreds of them.

"Studley's obituary states that the tool cabinet was constructed during his circa 1898-1919 tenure at the Poole Piano Company."

—Donald C. Williams,
from "Studley: The World's Best-known Tool Cabinet"

Those projects integrated high-precision hand and machine work in exotic materials, and I can attest that gawking at his guest room/plane exhibit hall is a marvelous and humbling experience.

This foundation made him unusually well-prepared to replicate Henry O. Studley's iconic tool cabinet—but with just a 1988 poster of the 19th-century piano maker's cabinet as his guide, he didn't think he possessed enough detailed information to undertake the project. So the idea sat simmering on his back burner for decades, unstirred until the summer of 2015.

Enter the Author

Like almost everyone else in the woodworking universe, my introduction to the remarkable Henry O. Studley was through a single tantalizing image of his tool cabinet on the back cover of *Fine*

Woodworking in 1988 (coincidentally the only issue of that publication to ever include one of my articles). I bought the poster. Years of looking at the gently fading poster hanging in my shop only whetted my interest; eventually I spent more than 30 days with the cabinet during the five years I was researching it for "Virtuoso: The Tool Cabinet and Workbench of Henry O. Studley" (Lost Art Press, 2015).

At a 2015 presentation to the Society of American Period Furniture Makers (SAPFM), I recounted the tale of creating that book, and of the Studley Collection exhibit in Amana, Iowa, that spring, which allowed visitors to come within inches of the iconic artifacts. One attendee took the collective interest to a whole new level.

Jim and I chatted at that SAPFM event, mostly about the amazing "bucket list carved Philadelphia highboy" he'd built in the preceding few months—but as a result of my presentation the seed for a new project had been planted.

He left the conference with a copy of the book and a new focus for his remarkable energy and ability—to replicate Studley's incomparable tool cabinet and the previously unknown (to him) workbench. Jim's wife, Mary, chuckled that after that conference, she "could see the wheels turning in his head all the way home."

Once word of his new project started leaking out among our woodworking community, the typical response was, "Jim Moon? Studley? Of course!"

The Tools

Jim is a tool guy. Not only does he use them skillfully, but he has amassed a broad and excellent collection of historic tools, and he has fashioned some of the most remarkable tools, mostly planes, that I have ever encountered. It is clear that he was perfectly suited to channeling Studley in creating and modifying tools.



Chippendale. This "bucket list" highboy was, Jim said, his greatest woodworking challenge—until he met Studley.

Even before getting back home Jim began to devour my written information and Narayan Nayar's sumptuous images in the book. Then he got down to the serious business of making a version of the tool cabinet to hold his own collection that, much to his delight, included many of the same tools as Studley's. One of his hurdles was simply trying to remember where such-and-such an old tool was in his boxes of treasures obtained during tool-meet tailgating expeditions.

Using the tool inventory in "Virtuoso," Jim pursued the missing ones through the Mid-West Tool Collector's Association, online auctions and forums, and tool mongers including Patrick Leach and Martin Donnelly. And like Studley, Jim made or modified tools to fill out the roster when necessary.

His toolmaking ability was integral to the project, because some of the tools are so peculiar that we don't even know their function, much less their availability in the market, and some are so rare and collectible that making replicas was the most sensible route. Jim fabricated those from scratch out of raw metal stock, turning them on his precision machinists' lathe or machining them on his compact vertical boring mill. He also in some cases modified contemporary tools, including a set of rosewood-inlaid machinist's squares.

Like Studley, Jim has a thing for Brazilian rosewood, and has collected bits and pieces of the rare exotic lumber for decades. Thanks to this passion he was able to make replica hammer



A shop divided. Jim has a well-outfitted machinists' set-up for toolmaking opposite the wood-working side of the shop.



handles and turn a graduated set of chisel handles just as Studley did more than a century ago.

The Cabinet

Using the dimensions and images provided in the book, Jim dove in using wood from his impressive stash, which includes some premium vintage mahogany. "I guess he hasn't taken you upstairs to the lumber yard, huh?" said Mary during my visit.

Jim led the way upstairs to the attic above the large shop and garage, where several hundred square feet of floor space is filled with stacks and stacks of cured lumber awaiting the eventual trip down through the hatch to the shop—everything from fitch-cut pear trunks

salvaged from local arborists (stock Jim calls his "curb lumber") to select pieces of hardwoods, softwoods, and exotics acquired over decades.

As for making the mahogany case for the tool cabinet, "that was just a weekend project," Jim says. "There's no rocket science here. Just plain old stock prep and joinery."

The details took much longer. Cutting, shaping and assembling the many subordinate units took many weeks of painstakingly tedious and delicate work.

With the complete tool inventory and images in hand, Jim laid out each of Studley's storage sections on a flat board to establish the precise location and orientation of each tool. For some of the proportions and divisions he wrestled



User-modified. Just like Studley's originals, this set of bench chisels has owner-made rosewood handles and ferrules.



Unladen. Here's Jim's completed tool cabinet, sans tools. Note the many niches and fittings, as well as the hinges, behind which are one or more layers of neatly fitted tool storage.



From wood to iron. Jim made wooden patterns for the vise jaws and handwheels (shown here are the handwheels), then had the parts cast in iron and nickel plated before mounting them on his reproduction bench.



Personal tools. While some of the drawers are fitted and filled a la Studley, like this arrangement of spoon bits and specialized brace bits, others contain some of Jim's favorite personal tools.

with calculations and spacing for the niches and saddles before smacking his forehead with the realization that most of the images of the tool compositions contained machinist's scales. All he had to do was transfer the space in question to the scale in the frame, and voilà – the problem solved itself.

With that information he fabricated all the dividers, moving frames, restraining fittings (the latter mostly in solid ebony) and imparted the remarkable detailing via ebony turnings, fittings and bandings inlaid with mother-of-pearl and ivory elements. The craftsmanship is outstanding in every respect, and includes a few additional decorative touches from Jim, including inseting pearl buttons into the face of each drawer pull.

Jim says these add fun to the process, because he finds making exact, undeviating copies pretty boring. Like

all creative people he revels in imparting little bits of his own vision into the details. Along that line, the contents of a few of the drawers reflect his own tool choices rather than Studley's – an entirely sensible approach.

For the interior spacings he was especially challenged by the minuscule tolerances of the layered three-dimensional arrangements – the parts that move all have to clear their surroundings and the tools have to avoid interfering with others, layer upon layer. Systematically, and with vigorous ongoing and sometimes pungent verbal commentary, he says, he worked his way through every instance of the pieces not fitting and moving perfectly until he resolved the problem.

Jim's most frustrating moments revolved around the closing of the two cabinet sections themselves; he could get the "doors" to about 1/8" apart, then

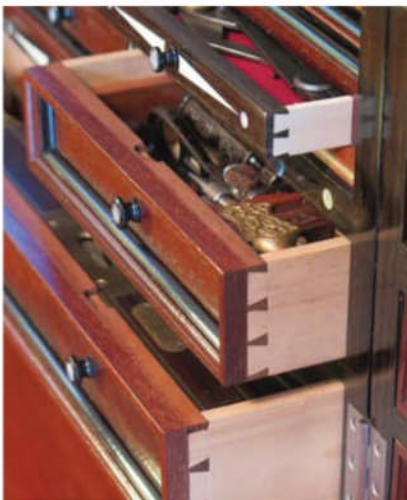
they would close no farther. With flashlight and magnifiers he tracked down the offending components and rectified the problem, moving some fittings slightly, notching some mouldings here, shaving a slight bevel there, until they fit together perfectly.

Jim is convinced through his faithful mimicry of Studley that the master encountered the same issues 125 years ago. We agreed that if he did not, it's probably proof that Studley was an alien or time traveler from a technologically superior world.

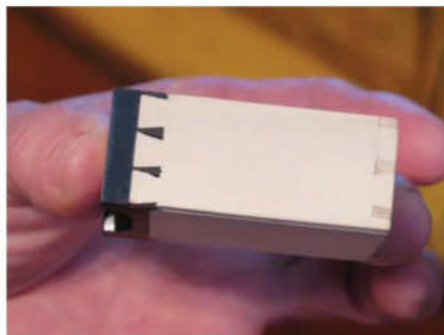
The Workbench & Vises

Studley's workbench base is lost in the mists of history, probably sold as a dressing table at an estate auction, but the original top is a resilient survivor now residing on a splendid base built by the collection's owner (who wishes to remain anonymous). As a workbench junkie myself (I have a possibly excessive nine benches currently in my studio, with at least five more in various stages of construction), I found Studley's bench and vises to be every bit as enticing as the tool cabinet, and built a replica of the top for the exhibit (and later installed it in my shop). So I was delighted to learn that Jim was fabricating a complete bench to reflect the one in the collection.

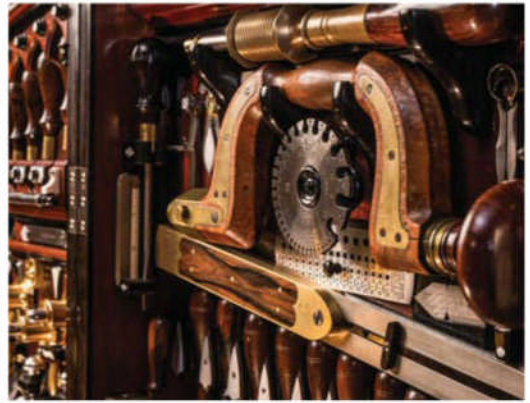
Following the specs of the original top, Jim made his the same dimensions with the identical structure: two white



Drawers. The many drawers in the cabinet are built with the same painstaking care and skill as everything else.



DECORATIVE DETAILS



Details. The Masonic crest on Studley's cabinet proclaimed his membership in the organization, and provided a logical location for dividers. Other details replicated include mother-of-pearl and ebony inlay and toggles that hold various tools in place.

oak laminae for the core with mildly figured mahogany faces trimmed with ebony edges. For the base, he followed the example of the owner of Studley's benchtop in fabricating a kneehole cabinet with mahogany as the primary wood, but deviated from the earlier version by using pear as a secondary stock.

He also fabricated wood patterns for the wheels and jaws, then had them cast by a foundry before filing and polishing, and had them nickel plated.

Epilogue

Jim didn't keep track of the hours he spent on the cabinet, noting only that it commenced in mid-June and was

completed by the end of the year. By massaging the rough estimates he gave of available shop time between office and surgery hours, combined with two days each weekend, my rough guess is that it took 600 to 800 hours for the project as a whole, workbench included.

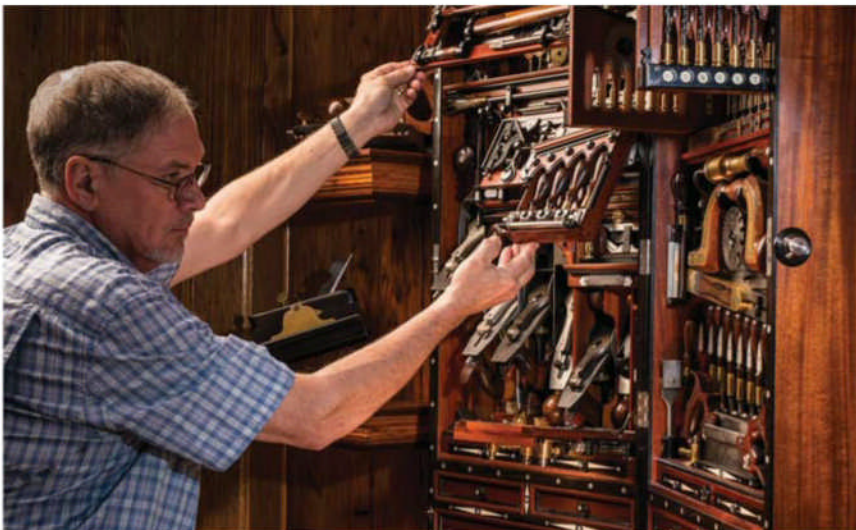
Perhaps no woodworking story of mine has a better ending than this one. I first visited Jim when he was nearing completion of this project, to scrutinize the tool cabinet as he was building the workbench. I contacted the owner of the Studley collection to suggest that Jim would love to make a visit to see the original work in person. The invitation was proffered and accepted.

It was a craft-life highlight for Jim – he was impressed as only those who have seen the workmanship of Studley in person can be (if you were in Iowa, you know this feeling).

Fast forward to a weekend French parquetry class Jim took with me at my shop, The Barn on White Run. With little fanfare, he pulled from his car a velvet bag with the insignia of a fine whisky embroidered on it – but the real surprise was inside. The beech-infilled brass mallet is my favorite tool in the Studley set, and it was his pleasure, he said, to make a replica for me. I was speechless with appreciation, and it now sits in a place of honor in our home.

Jim's chest now hangs over his replica workbench in his elegant paneled study. **PWM**

Don is a furniture conservator, craftsman and writer; see more from him at donsbarn.com.



Lift here. Here, Jim shows some of the many moving parts of his tool cabinet, which now hangs in his study (an elegant room lined with paneling he made out of wormy chestnut salvaged from a local demolition project).

ONLINE EXTRAS

For links to all online extras, go to:

■ popularwoodworking.com/dec17

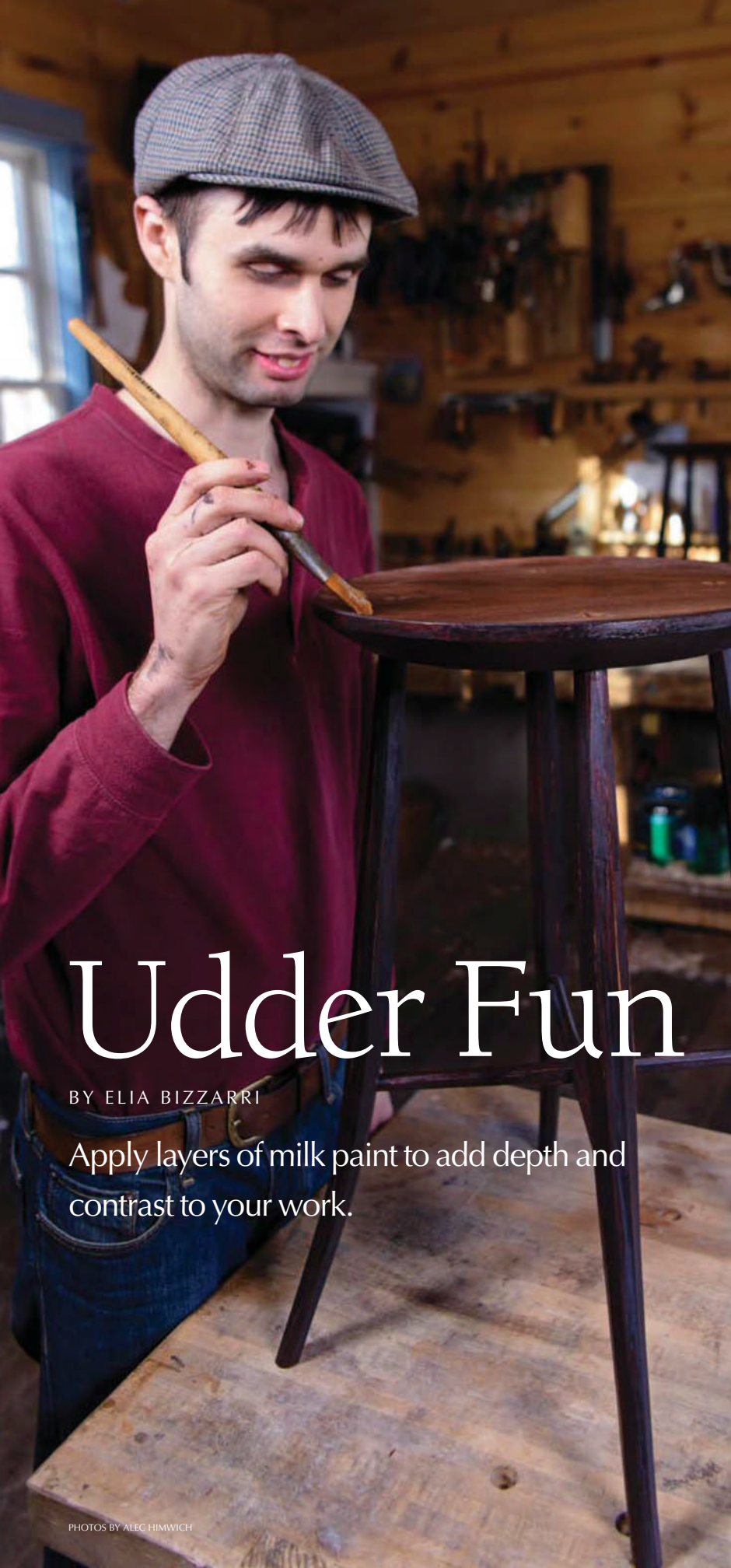
ARTICLE: The 2016 SAPFM annual publication, *American Period Furniture*, has a pictorial on this project.

BOOK: Read “Virtuoso: The Tool Cabinet and Workbench of Henry O. Studley” (Lost Art Press).

IN OUR STORE: “Creating Historic Furniture Finishes” by Don Williams.

Our products are available online at:

■ ShopWoodworking.com



Udder Fun

BY ELIA BIZZARRI

Apply layers of milk paint to add depth and contrast to your work.

A visitor asked, “Paint over wood? Aren’t you obscuring wood’s natural beauty?”

There are two assumptions behind these questions: Wood is naturally beautiful. Paint is thick, looks like plastic and hides whatever it covers. I’d say both assumptions are partially correct.

Paint can unify disparate woods, or add color and variety. It can even highlight beautiful woods. In this article, black over red paint provides a frame, showcasing this table’s unpainted, shellacked walnut top.

Why Milk Paint?

Milk paint’s thinness requires a number of coats. It dries to a rough and chalky surface, and needs to be burnished to add depth and smoothness. Plus, the matte finish of milk paint sometimes needs to be covered with another finish (if you like a shine). So why use it?

If most paints are a woolen coat, milk paint is a silk dress. Exceptionally thin, milk paint allows every pore and growth ring in the wood to show through. Its thinness also allows the use of washcoats, which are a thin layer of color (black, in this case) painted over a different base color (red). The base color peeks through, adding depth.

True milk paint comes as a powder and is made with milk casein, pigments and lime or borax. Some petrochemical paint manufacturers sell a pre-mixed “milk paint” that is actually matte acrylic paint; it doesn’t have the thinness of true milk paint.

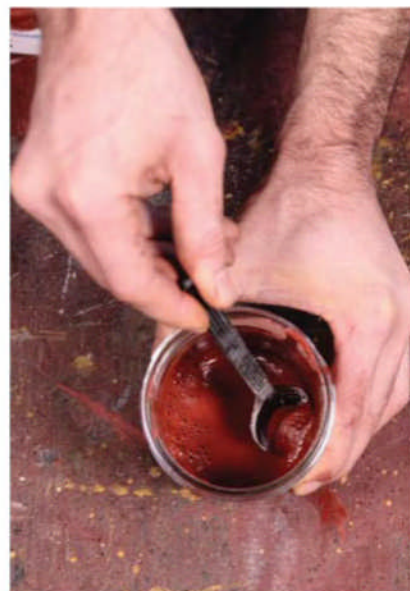
In this article, I show you how to apply my most popular finish to a table—two or three coats of red, to add warmth and depth, under a black washcoat. A final black streaking coat gives the subtle appearance of graining—but also allows the wood’s grain to show through. I then burnish the paint to raise a sheen and apply shellac and wax to add luster.

So follow along with the pictures and give it a try yourself. I think you’ll see that traditional milk paint has a well-deserved place in the modern shop. **PWM**

Elia builds chairs and teaches chairmaking in his Hillsborough, N.C., shop.



1 Mix it up. Mix paint one-to-one with hot water. The ratio of water to paint can vary by brand and color, but this is a good starting point. Stir it thoroughly with a stick then let it sit for an hour or so to allow any undissolved paint particles to soften.



2 Skim the foam. There will likely be a layer of foam on top of the paint. This is difficult to paint with, so spoon off the foam until you get down to the watery-looking paint (you'll see the difference).



3 Strain it. To remove any solid particles, strain it through an automotive paint strainer into another container. A piece of paint-strainer bag from the hardware store also works well. Thin it as necessary, aiming for the consistency of thin cream (measuring roughly nine to 11 seconds with a #4 Ford viscosity cup). Add water slowly; small quantities of water can profoundly change the viscosity.



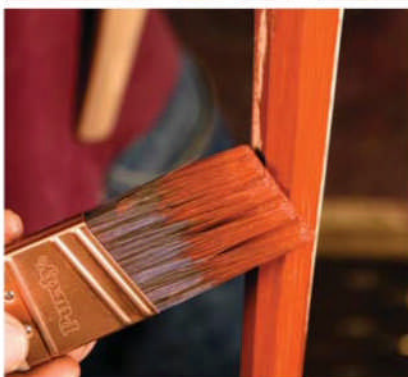
4 Some adhesion necessary. When painting dense woods or woods with pitch (pine, maple, etc.) stir adhesion additive into the first coat to prevent the paint from peeling. The additive is sold by milk paint manufacturers; mix according to the instructions. It changes the look of the paint, so use it only in the first coat.



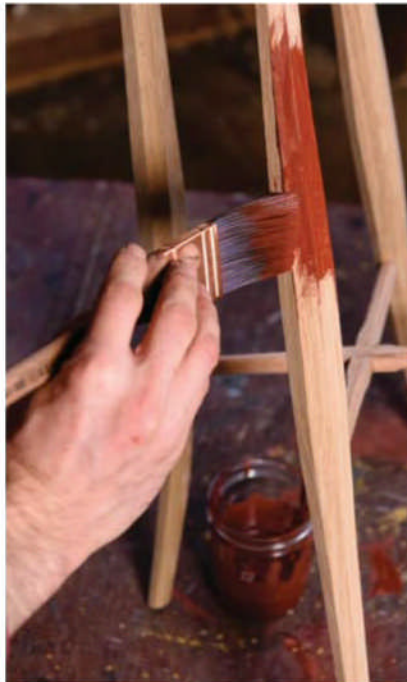
5 Different strokes. I use a Purdy 1½" sash brush with synthetic bristles from the hardware store to apply the paint. Hold it loosely like a pencil, with your fingers on the metal ferrule. The amount of paint on the brush is quite important. This is controlled by how far the brush is dipped into the paint and how much paint you wipe off the brush. The smaller the surface being painted, the less paint should be on the brush. Generally, I dip the bristles ¼" to ½" into the paint, then wipe one or both sides against the lip of the jar.

"I am always doing what I cannot do yet, in order to learn how to do it."

—Vincent Van Gogh (1853-1890), Dutch post-impressionist painter



6 Spread it out. You'll leave a puddle wherever you first put your brush, so start on relatively flat area, move on, get the brush drier, then come back and clean up the puddle.



7 Light touch. Try to touch the wood gently with only the last 1/4" of the bristles. This reduces splatter and leaves a smoother surface.



8 With the grain. At first you can paint in whatever direction is easiest, regardless of grain direction (top), as long as the final strokes are parallel with the grain and as long as possible (bottom). Try to land the brush gently while it is already moving forward, like an airplane rather than a helicopter. This helps keep brush marks to a minimum.



9 Low-angle brushing. Keep paint off an adjacent surface by holding your brush at a low angle relative to the surface you are painting. I'm leaving the underside and top of my table unpainted.



10 A close inspection. Go over the project to look for raised grain, dents and gaps. They'll be more apparent now that the surface has been painted. Fill the dents with water-based putty or cyanoacrylate glue. Sand the raised grain with #220-grit paper (even if you must sand through the paint).



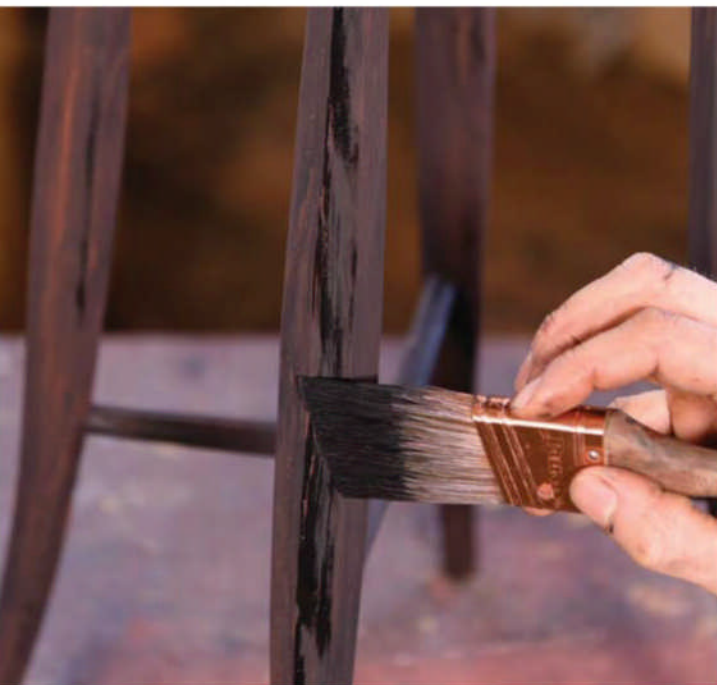
11 Further coats. On subsequent coats, use paint without adhesion additive, and paint exactly as before. Sometimes two coats is enough, but I usually need three and sometimes four coats. Continue to sand raised grain between coats as needed.



12 Black wash. A washcoat is a coat of paint applied thin enough to see through. The paint should be so thin that the red undercoat can just barely be seen through the black as you are painting it on. The washcoat has to go on very evenly or it will look splotchy.



13 Brisk painting. The washcoat needs to go on quickly, yet gently. It should be a distinct layer on top of the undercoat. Working the paint too much will soften the base coats, mixing it into the washcoat (as seen where I'm pointing). A barrier coat of shellac between the two colors will prevent this problem and might be useful on your first few paint jobs. But don't go back and fix any missed spots – you'll make a blotchy mess. Missed spots can be covered on the streaking coat, or even left altogether.



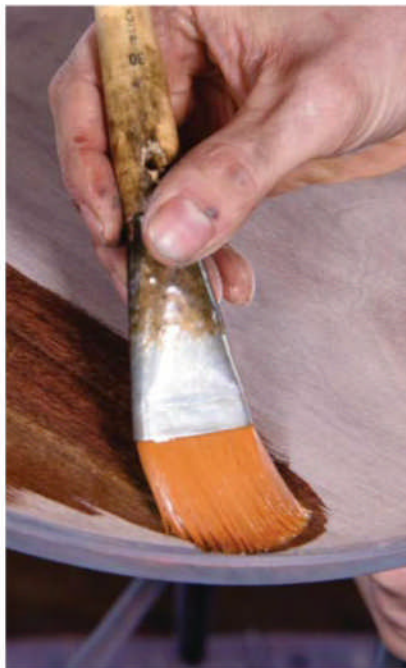
14 A nice streak. I follow the washcoat with a streaking coat, where two-thirds of every surface is painted. It's almost like graining. Barely touch the bristles to the wood, so some of the bristles touch and some don't. This sounds tricky, but it's no more difficult than the washcoat. Anything that results in long lines going with the grain looks good. Stutter marks across the grain don't look as good.

15 Smooth it out. In its natural state, milk paint looks like chalk and feels like sandpaper. It needs to be burnished (but wait a day or so for the paint to completely dry). Use a maroon Scotch-Brite pad to rub it down. You might rub through the paint on sharp corners, but this is a side effect (if a somewhat pleasant one), not the goal.





16 Steel wool. Some paint brands (such as Old Fashioned Milk Paint) will burnish to a fairly high sheen. Test your paint to see if #000 steel wool has any effect. With steel wool, pressure is what causes the sheen, so push on the wool as hard as you can. This will add luster and visual depth to the finish. Wear marks, however, are not my objective; I find that objects wear fast enough without accelerating the process.



17 Finishing touches. I use a thin mix of shellac as the finish for the unpainted top, as well as for the topcoat over the paint. A medium-dark shellac is nice over dark paints, but a light-colored shellac is better for lighter paints. Wiping varnish also works well.



18 Top it off. Shellac, and some wiping varnishes, dry extremely glossy and need to be cut back with #000 steel wool. Dip the wool in wax for lubrication. Rub it on and wipe off the excess. Then let the wax dry for a couple of minutes before buffing with a rag. Paste wax applied over shellac tends to leave white dots in wood pores, so I use BioShield's liquid wax mixed with coconut oil. It smells slightly tropical!



All the colors. Milk paint is available in an array of hues – plus you can combine them for custom colors. Working with them is a lot of fun – give it a try!

ONLINE EXTRAS

For links to all online extras, go to:

■ popularwoodworking.com/dec17

WEBSITE: Visit the author's website and read more about chairmaking and milk paint at handtoolwoodworking.com.

IN OUR STORE: For two hours of step-by-step video instruction on using milk paint for many applications, watch "Master a Classic Milk Paint Finish" (available on DVD or as a download).

ARTICLE: Read "The Apprentice," a short article about the author's time studying with chairmaker Curtis Buchanan.

VIDEO: Watch and listen as Elia Bizzarri plays guitar with his pick-up Bluegrass group.

IN OUR STORE: "Build a Hand-Crafted Octagonal Table" video (available on DVD or as a download).

TO BUY: "Build a Traditional Windsor Rocker with Elia Bizzarri" (available on DVD or as a download).

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A Bench for Kids

Build a small workbench with full-sized features for a budding woodworker.

BY JAMEEL ABRAHAM

“The bench is probably the most important item in the workshop.”

Those are Charles H. Hayward’s first words in his article “Fitting up the workshop: the bench.” As a wood-working wise manufacturer and bench maker, I couldn’t agree more. Tons of ink has been spilled about workbenches in the last 20 years, and I’m one of the guilty parties, so I won’t bore you with design philosophy on this one. OK, maybe a little.

First off, a little background on why I decided to make a kid’s workbench in the first place – perhaps a bit ironic for a 43-year-old bachelor. I’ve lived next door to my brother for a number

of years and have probably spent more time in the shop with my nieces and nephews than if I’d had my own kids. Relationships between parents and children aren’t always conducive to teaching (I’m reminded of why the “Car Talk” guys recommend that parents not teach their own kids to drive). But trying to be the fun uncle placed me in a position to not only teach without the typical parent/child dynamics, but to make the workshop a fun environment instead of a stuffy classroom. In my experience, fun is the key element in teaching kids woodworking.

Earlier this year I decided to build a kid’s workbench as a prize for the Handworks hand tool event in Amana,



Like a pro. Building a bench for a kid gives them a huge boost of self-confidence.





Cash cache. A sliding-lid bank is a great first project for your kid. Especially when you drop a \$20 in the slot before they take it home.

Iowa. The idea was simple. Build the bench, then have kids write their name on the edge of a piece of basswood held in the bench's leg vise, then plane off the shaving (along with their name) and place it in a box for a drawing the next day. The winner would take the bench home with them.

Dozens of kids participated, and it was great fun watching half of them completely ignore the piece in the vise and start planing the top of the bench itself! One young boy spent a long time at the bench and made many shavings (but only one with his name on it). I watched him several times, and it was apparent that he'd spent time in the shop. I was extremely busy both days of the event, and only found one moment to take some video of the kids planing away. It was this boy who I ended up recording and posting to social media. The next afternoon we had a young girl reach into the box of names and pull out one winner. Incredibly, out of dozens of names, the winner was the same boy I had recorded the day before. I knew that this bench was going to a good home.

Designing the bench was rather easy. I'd flipped open my new copy of the "The Woodworker, Volume 4" (Lost Art Press) and there it was on page 1,170: a basic bench that would scale down perfectly. I'd built a few kid's benches over the years and I knew that it only needed a couple workholding features—a face vise and a planing stop. Kids don't need anything more than this. For this bench I used the

Benchcrafted Hi Vise hardware to build a leg vise. But you could use any basic iron face vise, and this is exactly what Hayward shows in his article.

Before you get too deep into building this bench, you might want to dust off an old Black & Decker Workmate and toss some softwoods on it to see if your kid has some interest. I did this early on with the kids, and they were hooked. The Workmate can be set up at the perfect height for a young child, and the clamping capabilities are sufficient for that first dabble into the craft. It's not ideal, though, with its sharp metal



Grandpa's Workmate. The Black & Decker Workmate makes a great tester bench to see if your kid has that first spark of interest.

edges and somewhat awkward layout, but there's no better hook than telling the kid that the next project is his or her own bench.

To get started, I drew all the major components in SketchUp right from

A Bench for Kids

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL
		T	W	L	
❑ 1	Top	1 ³ / ₄	11 ⁵ / ₈	43 ¹ / ₂	Yellow pine
❑ 1	Apron	1 ¹ / ₄	4 ¹ / ₂	45	Yellow pine
❑ 1	Front stretcher	1 ³ / ₄	2 ¹ / ₄	31 ¹ / ₂	Yellow pine
❑ 2	Side stretchers	1 ³ / ₄	2 ¹ / ₄	10 ³ / ₄	Yellow pine
❑ 1	Rear stretcher	1 ³ / ₄	2 ³ / ₄	31 ¹ / ₂	Yellow pine
❑ 2	Side rails	1 ¹ / ₄	2 ¹ / ₄	6 ¹ / ₂	Yellow pine
❑ 1	Rear rail	1 ¹ / ₄	2 ³ / ₄	41	Yellow pine
❑ 2	Front legs	1 ¹ / ₂	2 ¹ / ₄	22 ¹ / ₂	Yellow pine
❑ 2	Rear legs	1 ¹ / ₂	2 ¹ / ₄	23 ³ / ₄	Yellow pine
❑ 1	Vise support	1	2 ¹ / ₄	18	Hardwood
❑ 1	Vise chop	1 ⁵ / ₈	3 ¹ / ₈	24	Hardwood
❑ 1	Tool well bottom	1/2	5 ¹ / ₄	42	Yellow pine
❑ 1	Rear edging	3/4	1 ³ / ₄	43 ¹ / ₂	Yellow pine
❑ 2	End edgings	3/4	1 ³ / ₄	16 ¹ / ₂	Yellow pine
❑	Shelf boards	1/2	*	13 ³ / ₄	Yellow pine

*Width & number of shelf boards can vary; cut to fit.



Go to detention. After ripping, this wood threw a temper tantrum and got bent out of shape, so I pushed it into a corner and let it cool off for a time out. A couple days and a second round of jointing and planing yielded flat stock.

Hayward's plan, then using the scale feature I made the height 24" and all the components scaled down just about perfectly. I've included a cutlist, model and drawings of the bench, but don't be a slave to either. If you want to make a wider or narrower bench, simply make the rails between the front and back legs longer or shorter. If you're using a leg vise, double check that you have enough space between the front and back leg for the screw's length with the vise completely closed. The measurements I used here work with the Benchcrafted Hi Vise hardware.

All the components can be made

from 8/4 stock. I used yellow pine from my hardwood lumber dealer, which comes with the full 8/4 thickness, but you could easily use 2X material from the home center. My legs and rails ended up being 1³/₄" thick. If using 2X material, 1³/₈" would be fine after jointing and planing.

Simple Joinery

Once I had true stock to work with, it was time for joinery. And here was where I enlisted the help of my German friend, Mr. Domino. For full-size benches I never skimp on joinery. I like to view workbenches as miniature tim-

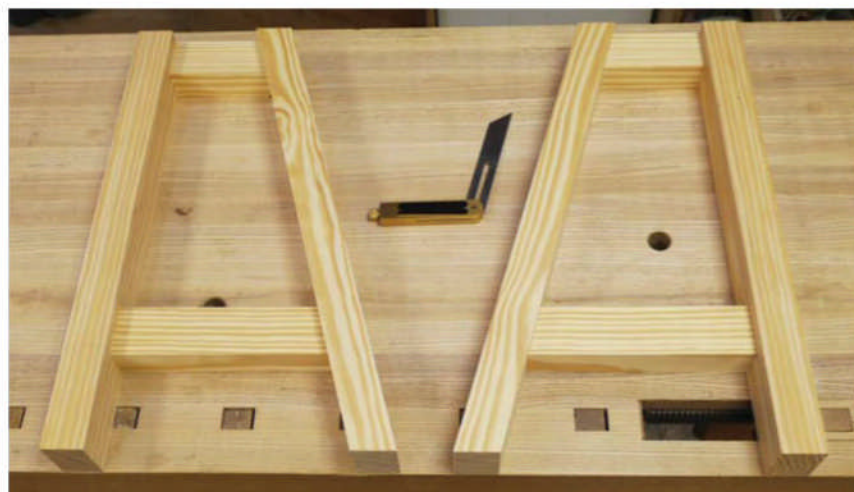
Order & accuracy. Measure up the rail lengths by using a real-time mock-up of the legs – the leg spacing is determined by your choice of bench width. The large square and bevel gauge position the legs perfectly for accurate measuring. The same technique is used to measure the length of the stretchers.

"Skill is made, not born in us, and it advances best through difficulties."

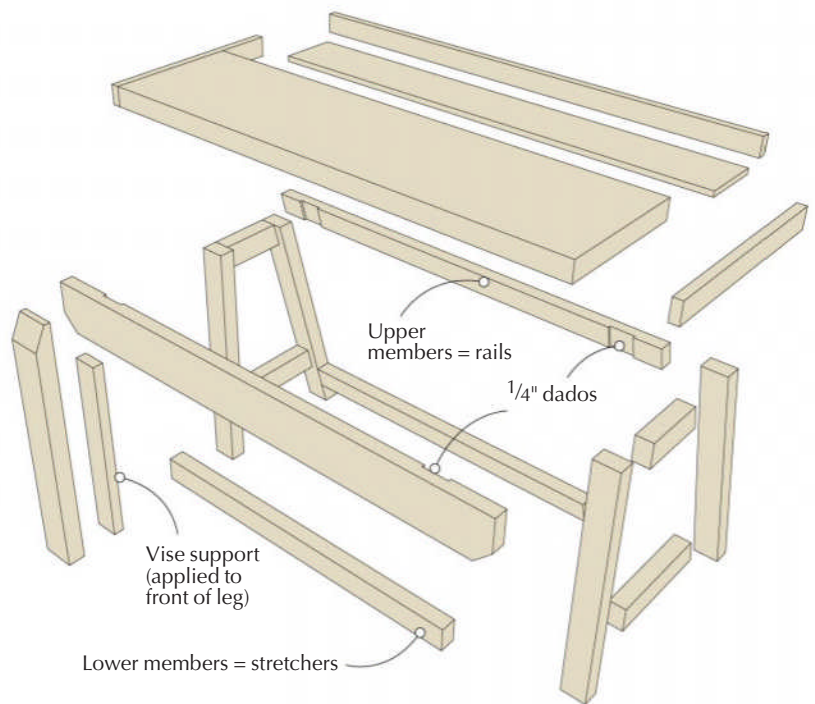
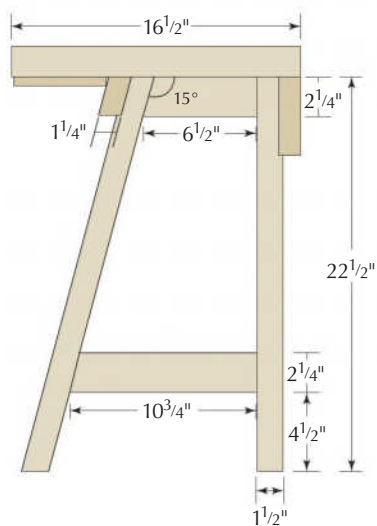
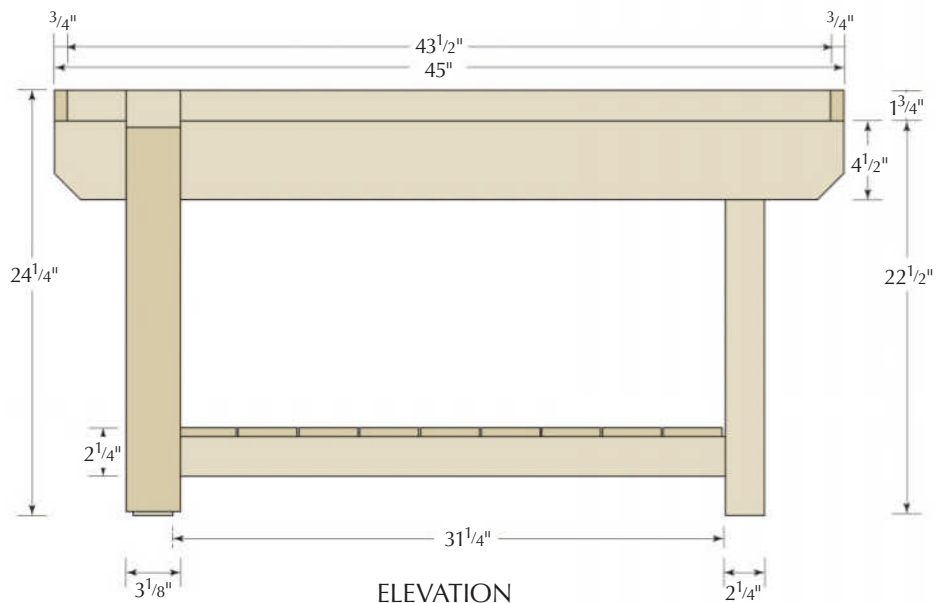
—Charles H. Hayward (1898-1998), British woodworker, author & editor



Don't go to recess. Try to sneak up on the correct length so the top surface of the rail ends up dead flush with the top of the legs. If it's too long or short, it will either be proud or recessed. I nibble away the length at the miter saw during my snack break.



You get an A+. Here are the two leg assemblies cut to final dimension and dry-fit without Dominos.



EXPLODED VIEW

ber frames—I want every bench I build or design to be in use for at least a couple hundred years. But for a kid's bench that won't ever see vigorous use, the Domino is just about the perfect joinery system. It's plenty strong enough, and the speed and ease of layout and cutting means you won't feel ridiculous as you might had you spent a week cutting through-wedged tenons. It doesn't take much more time to double up on the Dominos either, and it adds loads of glue surface

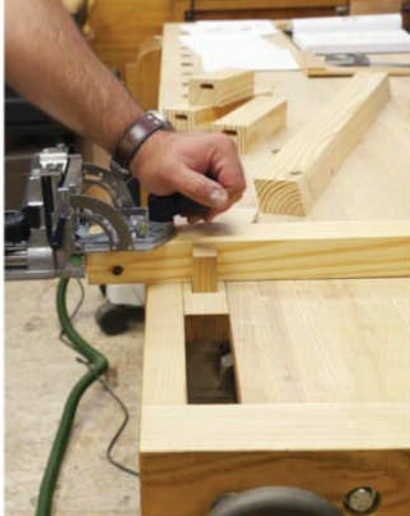
and strength. If you don't have access to a Domino, you can of course build the bench with traditional joinery. I won't tell on you, I promise.

Cutting parts for a project with Domino joinery is straightforward. Just cut each of your legs, stretchers and rails to final lengths. You don't need to add any length for tenons.

Marking the layout for Dominos is also easy. All you need is one tick mark spanning each joint and away you go.

If you've ever used a biscuit joiner, you can use a Domino. I set the fence on the machine for a double tenon centered on the thickness of the stretchers and rails, because they are the thinner members. I cut the first mortise (Domino slot) on all the workpieces, adjusted the fence, then cut all the lower mortises. That step took maybe 20 minutes. The Domino is so fast you'll think you're cheating, so make sure the teacher isn't watching.

Cutting the Domino mortises can



Let's play Dominos. Here's the setup for cutting the mortises – quick and simple. A tail vise and dogs are handy here, but some pupils don't like dogs and their wagging tail vises. I have two words for them: Principal's Office.



Dado no blado. I don't use a dado stack for the mortises because I'm too lazy to mount it. Instead, I take multiple passes with a combo blade, then clean up with a router plane.

be tricky on short and narrow pieces. Festool makes a special table for holding pieces like this. But so do I – it's called a workbench. Mine has a tail vise and bench dogs. I gang up on the little rascals and pinch their sides between the dogs. This gives more surface area for the fences of the Domino. The last thing you want is for your workpiece to jump over a fence during class, so doubling up on these is a good move. It also cuts your clamping time in half, leaving more time for after-school antics.

Once the mortises are cut, it's a good idea to dry-fit every joint. Assemble the bench and make sure every joint goes together with all the Dominos in place (or your tenons, if you went the traditional route). Clamp the leg assemblies together at the front stretcher to mark for the front apron. The front apron is joined to the upper part of the legs in a shallow dado cut into the back of the apron. Clamp the apron to the upper



Textures. Router planes are the greatest. They are like hand tool power tools, if that makes sense.

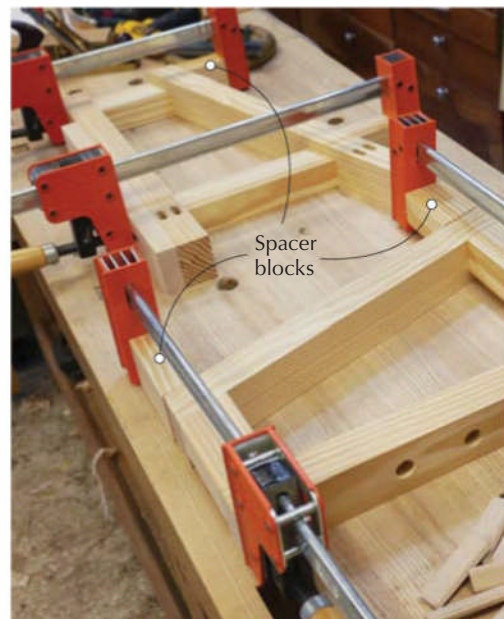


Vised up. Install the leg vise before you glue the bench together.

part of the legs and mark the location of the legs onto the back of the apron. The dado is only $\frac{1}{4}$ " deep, so I cut it on the table saw by nibbling away the waste, then cleaned up the bottom of the dado with a router plane.

The Vise

With the front apron joinery cut, you have a decision to make. Mount an off-the-shelf iron vise or install a leg vise, like I did. I'll talk about how to do the latter. Because the front apron is proud of the front leg by 1", I laminate a 1"-thick piece of hardwood onto the front leg below the apron. This provides a strong place to mount the pins that support the vise mechanism. The vise itself is contained entirely within the leg and chop, so the installation should be completed now, before gluing the bench together. I won't cover all the details of the Hi Vise installation here because you may not be using this spe-



Caul me in the morning. Angled spacer blocks make leg assembly glue-up easy.

cific vise. (Instructions are available, however, at the Benchcrafted website.)

Once you have the bench's top flattened and planed to thickness, you can dry-assemble the bench and get a final length for the vise chop. This allows you to disassemble the vise, cut the chop to length and do any decorative shaping as well.

Finishing the Build

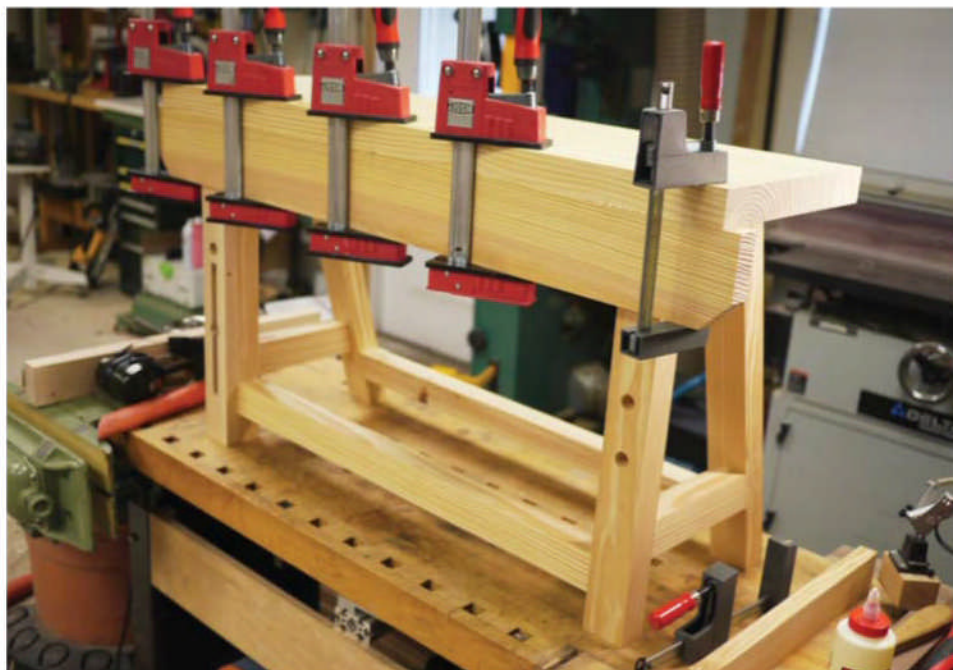
To cut the top to length, mill up the stock that makes up the edging so you have a final thickness. You need this thickness because the top is shorter than the front apron by exactly twice the thickness of the edging. I don't measure any of this, so put your rulers away kids. Rather, hold up two thicknesses



Transfer, don't measure. Here I'm marking the length of the top – the apron length minus two thicknesses of edging.



Get it together. The top is held onto the base with lag screws. Use two in each upper rail. Make sure the front apron is clamped firmly to the legs when you drill and drive the lags. And no matter what teacher says, it's actually OK to drill and drive.



Hammer time. Actually, it's glue time, but hammer time sounds cooler. Get that joint flush or you'll have loads of cleanup planing to do. I'm not gluing the top to the base here, just using it as a support.

of edging to one end of the top (with the other end flush to the end of the apron) and mark the length. No arithmetic here, so it's OK to flunk math. (I did!)

With the top cut to length and width, you can glue the front of it to the apron. Make the joint as perfectly flush as you can, but err on the side of the top being proud of the apron. It will be much easier to flush the edge of the top to the apron rather than vice versa.

Now disassemble the dry-fit base to smooth plane the surfaces. Don't go overboard here. What you want is to just remove the mill marks. If you've built the bench entirely by hand, well, you don't need any instruction from me on how to do this.

Now glue the base together. I use the offcuts from the angled rails as cauls between the clamps and the back legs. After the glue in the leg assemblies

cures, glue and assemble the stretchers to the assemblies. Once the glue in the base is cured, rip the upper back rail with a 15° angle on the top side (and bottom, too, if you want; I didn't) and fit it up just like the front apron, with 1/4"-deep dados. Glue and clamp, then flush it up to the top with a long plane.

Once the top is screwed to the base and the edging is attached, you can install the tool tray bottom. It's just a piece of 1/2"-thick pine nailed on from underneath. I used square cut nails with a robust head. I also leave a 2" gap at the leg-vise end of the well to sweep out shavings. The shelf boards down below are plain, nailed on with two finish nails in the center of each board, with a 1/16" gap between each board. The ends are notched to fit around the legs.

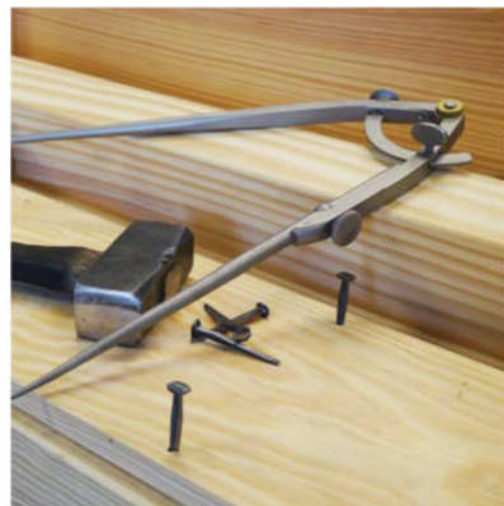
And just like that, class is over, the bell has rung and the bench is done. If you want to paint the base and vise chop like I did, simply unscrew the top from the base and put a coat of oil on it, then apply two coats of paint on the base and chop. I like solid-color deck stain. It looks a lot like milk paint without any of the associated mixing and shelf life.



Cleatus, repeatus. I clamp a cleat to the top on both ends on which to rest the edging to measure its length, drill the screw holes then attach it to the top. The cleat keeps everything lined up and helps you to not think too much.



Handscrew it. To bolster the rear edging I handscrew it to the side edging. This helps keep the wood from splitting while screwing. Hayward says to nail these on, but I'm not Hayward the Magnificent. Nailing into end grain equals splits in my book. Big robust screws and properly sized pilot holes are wonderful things.



I have zero clout. So I try to buy it whenever I can. I use clout nails to attach the tool well bottom, laying out the spacing with a pair of big dividers. There's a nail about every 6".

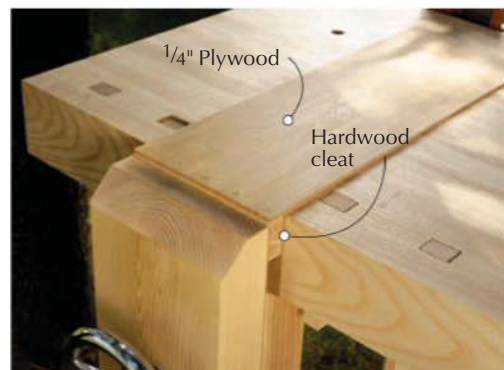
Using the Bench

To hold boards for edge work, just use the leg vise. To plane the faces of boards, also use the leg vise with a planing stop. To make the planing stop, screw a 1" x 2" hardwood cleat on edge to the short end of a 1/4"-thick piece of plywood or hardwood that's about 4" wide x 12" long. Clamp the piece of the hardwood in the leg vise with the longer board flat on the workbench, and it becomes a full-width planing stop. (The one shown at right is for a full-sized bench.) I don't recommend a metal toothed stop for kids for obvious

reasons. This full-width stop is user-friendly and will keep any board from moving about, while teaching good technique at the same time.

To hold boards for end work, use the leg vise or simply clamp boards to the front apron and top with small clamps. You could also add holdfast holes, but that might be a little overkill for a kid's bench. The holes in the right leg are for supporting longer boards. Just stick a 3/4" dowel in and it's ready to go. **PWM**

Jameel is a toolmaker, artist and woodworker, and co-owner of Benchcrafted (benchcrafted.com).



Just plane stop it. A planing stop can be made with two pieces of scrap. It's a great workbench accessory, and will teach good technique.



Bench bench, who's got the bench? I'm using four benches here to flatten the top of a bench, including the bench I'm flattening. Looks ridiculous, I know, but my back is happy. I will enjoy recess today.

ONLINE EXTRAS

For links to all online extras, go to:

■ popularwoodworking.com/dec17

WEBSITE: Visit the author's website and blog, and read more about his workbenches, tools and process at benchcrafted.com.

ARTICLE: Read "Jameel Abraham: Benchcrafted Tools," Steve Shanesy's profile of the author's toolmaking company.

BLOG: For another kid-friendly build, follow along with Yoav Liberman as he builds a tool tote with his students on our blog.

IN OUR STORE: Read "The Workbench Design Book," by Christopher Schwarz, for more ideas on building benches and their essential fixtures and features.

Our products are available online at:

■ ShopWoodworking.com

Digital ARTISTRY

BY TIM CELESKI

How five masterful makers integrate CNC and CAD technology into their woodworking.

Woodworking requires a broad set of skills and strategies, and for most, it's only after mastering the bedrock tools and gaining years of experience that we consider adding digital tools and skills to our workshops.

Yet computer numeric control (CNC) machinery has been around for decades—cabinetmakers began adopting the technology early on, perhaps because the benefits of efficiently cutting plywood parts are obvious.

But furniture makers, instrument makers and other small-scale specialists who create out of solid wood are now adding or considering CNCs and the computer-aided design (CAD) that directs it. Creative professionals in particular are constantly pushing the limits of their tools and their own creativity. New tools—including digital technology—sometimes open up new possibilities.

With machines sized for smaller spaces, and falling prices, part-time and home woodworkers can now reasonably consider CNC technology—so it's a perfect time to peek in and see what a handful of woodworkers who have already made that jump are up to. Here's a look at what five woodworkers are doing with CAD software and their CNCs. The group consists of four furniture makers—Bob Spangler, Curtis Erpelding, Darrell Peart and me, Tim Celeski—and one guitar maker, David Myka.

All of us are based in the Seattle area, and we formed a user group that meets monthly to share ideas, discoveries, methods, techniques, skills and creative new uses for the digital woodworking tools we use regularly.

Though our individual work is different, we've found that we've all benefited from the discussion. Accelerated learning, growing digital woodworking skill sets, finding new ways to blend



Woodworking meets modern tech. Clockwise from left: Tim Celeski, Robinson Table detail; David Myka, arch-top guitar body; Bob Spangler, Blakely Stool; Curtis Erpelding, Lady's Desk detail; Darrell Peart, Greene & Greene-inspired Rafter Tail Corner Table detail.

digital with traditional work and refinement in our individual use of these tools are the results. That's the power of user groups.

It doesn't take much effort to find or start one. If you put out the word via craigslist.com, social media or word of mouth, you'll find there are a lot of people nearby who are as interested as you are in using these digital tools. And, because of the "Maker Movement,"

woodworkers are not the only ones who want to learn about CNC machines and CAD software—different perspectives are a good thing. They mean more possibilities, more ideas and more to share.

In the following pages is a brief overview of each maker in of our group and his work. On the last page, you'll find some of the key lessons we've learned about integrating CAD and CNC into our shops and work.



The maker & his machine. Bob Spangler in front of his CNC. The Blakely Stool behind him is made with a combination of traditional and digital techniques.

After working as a landscape architect, Bob Spangler began woodworking in the early 1970s. He's built period pieces such as Pennsylvania highboys with hand-carved details, but for most of his career, he's focused on designing and building elegant contemporary furniture, often with an Asian influence. Spangler has a diverse portfolio of cabinets, dining sets, beds and large and small-scale pieces that he creates out of domestic and exotic woods for clients across the country.

His introduction to digital tools started in the mid-1990s when he added CAD software to help him design and visualize his work. When he added a custom 48" x 72" x 7" CNC to his shop five years ago, the over-crowded attic full of jigs, fixtures and patterns went away. Since then, he's made great use of his machine. His is built for "over-travel" so that the spindle hangs over the end of its table. After adding clamping stations and jigs, he's able to create complex joinery for his original furniture designs.

"The accuracy and speed at which the CNC can do these tasks is fantastic. In some cases I can do other things while the machine is doing something else. I am finding more and more that I am designing with the CNC in mind. It's a little like learning a new language. I am now starting to think of the CNC as my partner and how can we work together," says Spangler.



Florian table & chairs. This dining set was designed in CAD software. Spangler made the forms for the bent laminations in the chair backs and seats on his CNC.



Joints. Spangler uses his CNC for complex joinery, such as this self-locking joint for the legs on a small table



Repeat parts. Making multiples is another efficient CNC job, such as Spangler's ebony drawer pulls.

David Myka makes extraordinary musical instruments. His guitars range from interpretations of classic designs to unique instruments capable of integrating with a modern studio environment. His guitars exhibit extraordinary details such as custom inlays, and custom fret and neck designs tweaked to a client's individual requirements; his work is in great demand.

Several years ago, Myka began using 3D CAD software to help him explore, develop and visualize his designs, and says it was quite a challenge to integrate the new digital precision with his existing analog designs. As he began the transition, he added a custom 25" x 37" x 7½" CNC to his very small shop.

One of the first things he machined on the CNC was the thin arch tops for his electric guitars. These thin wooden tops consist of a complex compound curves cut down to a mere ⅛" thickness. Traditionally, that's meant a lot of skilled handwork on both sides of the board. Hours and days go by to make a single top, but on a CNC it takes Myka about 30 minutes, followed by hand-sanding. He also uses the digital technology to make guitar shapes, carve necks and curved fretboards, cut out the areas for the electronic components of his instruments as well as create amazingly detailed inlays. The CNC has freed up his time to focus on the highly skilled handwork expected in an instrument of this class.

"Along with CAD, my CNC has revolutionized my design process, manufacturing workflow, the design of my shop and the quality of the work I do," says Myka. "I used to spend a great deal of time roughing out material into shapes that I could more easily work with. Now I program the CNC to remove most of the wood while I spend my time with design and the final fine detail work. This allows me to focus on what differentiates my work from everything else in the marketplace."



Inlay. Intricate inlays such as this one are a hallmark of Myka's work. It's on the ⅛"-thick back of a guitar, and just 4" long. For such work, CNC makes possible what would be awfully difficult to do entirely by hand.



Guitar, machine & maker. With his small CNC, David Myka makes custom guitar bodies, necks and machines precision spaces for electronics.



Guitars. The thin arch tops and delicate cutouts on Myka's guitars are precisely milled, front and back, on the CNC in just minutes instead of hours.



Layout & cutouts. Myka uses CAD for layout and his CNC to achieve the many cutouts needed for guitar electronics.



Darrell Peart. The Klinker Cocktail table in front of Peart makes great use of CNC patterns, parts and joinery.

Darrell Peart is known for his outstanding work in the Greene & Greene style. He started woodworking in the 1970s and worked at high-end custom shops in the Seattle area, where precision was a key component. He was introduced to CAD and started operating large CNCs at one of those shops in the mid-1990s; he's been an advocate ever since.

Peart used to make his furniture using a mix of traditional tools, patterns, jigs and fixtures. Over the years, he started adding patterns and jigs designed in CAD that were output by local CNC specialists. But in 2014, he added a twin-spindle 37" x 72" x 9" CNC to his shop. Now, most of the old jigs are gone, and as new ones appear, they're milled on his machine. With difficult angles, complex details and high precision, his furniture is challenging to make. He often turns to his CNC for patterns, parts and precise joinery, including jigs that allow his other power tools to work better. For example, Peart has developed a custom table saw sled with pin registration to precisely trim unusually shaped parts.

"The most profound benefit of CAD relates to design and took me by surprise. With CAD, I can make a copy of a drawing and have the revision in front of me in short order – while the inspiration is still fresh in my mind. This result is near-instant feedback – and in the process improves my design skills," says Peart. "The precision and repeatability available with CNCs has had a profound effect upon both quality and quantity of work. It's allowed me to produce very complex projects which previously would have been far too time-consuming to produce profitably."

Freemont Nightstand.

Like with the table in the image above, CNC patterns make quick work of the details on this storage piece, including the cloudlifts and finger joints.



Jigs. Peart's cutoff sled uses CNC-made overlays that register on the sled's dowel pins to trim odd-shaped parts.



Blanket chest. Precision finger joints are a snap on a CNC. That's how Peart cut the joinery on this Khaya mahogany blanket chest.



Cauls. Peart's Rafter Tail Corner Table is a challenging glue-up. CNC-made clamping cauls make the stressful process easier.

Curtis Erpelding has been a self-employed woodworker since 1977. Furniture design had been his main interest, but the warmth and appeal of the material has kept his focus on creating with wood. His furniture is often formed, laminated and veneered with complex patterns.

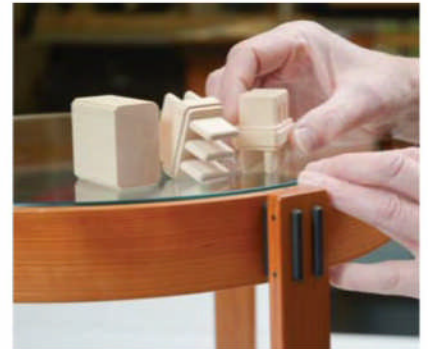
Intrigued with the idea of using CNCs in his woodworking in the mid-2000s, Erpelding's first step on his journey was to learn to draw in CAD. He discovered it was a gateway to a new way to design his furniture. Soon, he took on the challenge of building his own CNC from scratch. The jewel-like quality of his machine reflects the extraordinary furniture he makes. It has a cutting area of 24" x 52" and a Z height of more than 8" – perfect for the furniture projects he produces in his small shop.

Erpelding uses his CNC to cut templates, parts, joinery, carved furniture legs, intricate inlays, bending forms for compound curved laminations and much more.

CNC is, "fast, insanely precise, repeatable and, once you push the run button, automatic. You can stand amazed and watch it go through all its Cartesian moves, or you can wander off and apply yourself to another shop task while it's running," says Erpelding. "The CNC allows me to make joints that are much stronger and more aesthetically pleasing than I could have dreamt of before – and in a fraction of the time."



Shop-made. Curtis Erpelding designed and built his four-axis CNC. He uses it to make forms, parts and joinery for his bentwood stacking chairs and stools (among other things).



Glueless joinery. Erpelding's CNC innovations include the tight, glueless joinery pieces he makes in maple for his laminated stacking chairs and stools. After he blackens the wood, he fits the legs and pins them tight with brass pins.



Lady's Desk. This kingwood, satinwood and Gabon ebony roll-top desk made use of digital tools in countless ways, including patterns, bending forms, detailed joinery, unfolded curved veneer patterns and more.



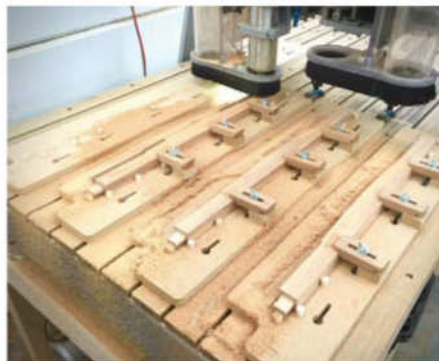
Stacking chairs. Erpelding's Bentwood Collection stacking chairs are of veneered white oak and black leather. The bending forms, patterns and joinery are all done on a CNC.



Man, art, machine. Here's me in my shop, in front of my custom-made twin-spindle CNC. On the wall and to the right are two sculptural pieces designed in CAD and cut using a CNC.



Medina Formal Bench. This 96" long mahogany Greene & Greene-inspired bench is made with patterns drawn in CAD and cut on a CNC.



Multiples. I frequently use a CNC to cut furniture parts. With my setup I can cut up to eight at a time.

My background is in architecture and graphic design. I started out as a hobbyist in the mid-1990s, developed an extensive line of high-end Arts & Crafts outdoor furniture, dropped my old career and went professional in 2000. Because I was already comfortable using software design tools from my previous career, I naturally use them in my woodworking. From the beginning, I'd have patterns, as well as the occasional part, milled out of MDF at a local CNC shop. The result was hundreds of patterns filed and stored away in the attic "library" of my small shop.

It was inevitable that I'd add a CNC to my shop; four years ago I finally made the plunge. I had a custom 36" x 72" x 9" twin-spindle machine built and have never looked back. Since that time, instead of patterns and shaping, if it isn't a straight piece, most of my furniture parts are made directly on a CNC, using the same drawings I created more than a decade ago. I also use a CNC to make jigs, produce joinery, create inlays and for 3D carving and shaping.

What drew me to CAD and CNCs in the first place – the expanded possibilities in 3D design – has had a major effect on the direction of my work; almost all my new furniture designs have added shape and texture. And, after building several hundred pieces of furniture, my focus is moving more into fine art and sculpture – work that uses digital tools. Using CAD software encourages me to push the limits of what's possible in woodworking, and the CNC is the tool that helps me convert those ideas into furniture and art.



Formline. This large alder wall sculpture was designed in Rhino3D and carved on a CNC.



Bench chops. With the help of a CNC, I was able to realize the many different treatments I designed for these chops for leg vises on otherwise traditional Roubo benches that I made for a local wood-working group.



Parts. One CNC use we all share is cutting furniture parts. Here, Peart is milling parts for his Rafter Tail Corner Table out of a single piece of mahogany to keep the grain in alignment.

Learning CNC

Everyone in my user group is self-taught when it comes to CAD and CNC—and we all agree that it's an inefficient way to learn how to use these tools. However, we've each taken advantage of online courses to further advance our skills and, as we've proven collectively, user groups and classes make the learning process go much faster.

Producing Parts

Part cutting is one of the best uses for CNCs in a woodworking shop. Make a CAD drawing of a part and the machine can mill it out.

All five of us regularly use CNCs to cut solid-wood parts (though in varying degrees based on need). Why? Sometimes you need parts in quantity or require a particularly challenging part. Plus, there's the convenience of a machine that can work on its own, leaving you free to focus on other tasks.

The Allure of Precision

The high accuracy a CNC delivers is addictive. We've found that perfect cuts

make for perfect assembly. We've all added precision measurement instruments such as dial gauges and digital calipers to our workflow. And, precision allows us to make more challenging things out of wood—to push beyond 2D into the world of 3D where shape and texture are added to our designs.

The Power of CAD

While you might think about the benefits of fancy CNC machines before considering the value of using CAD software for design, you shouldn't. You don't have to wait for CNC to take advantage of CAD. We've found our digital drawing tools are a key component in our growth as creative professionals. Our work is more accurate, our designs are more creative and modifications along the way are often simple.

Integrating Into Tradition

None of us has stopped using the woodworking skills and tools we already have just because we've added CNCs. Sometimes, the hand-tool skills and hybrid processes we've long relied on are the better way to go.

The two worlds get along quite well—in some cases, they work even better when combined. Some of this is practical. After decades of use, a refined technique or a single-purpose tool might be faster or more efficient than a CNC. If it's already working, why change?

But adding digital tools can enhance the methods we're already using with better jigs, assembly aids, patterns, lamination molds and more. Each of us are dedicated jig makers, but Peart in particular has used his CNC to take this

to a new level. Digital tools are making our traditional woodworking better.

Changing the Process

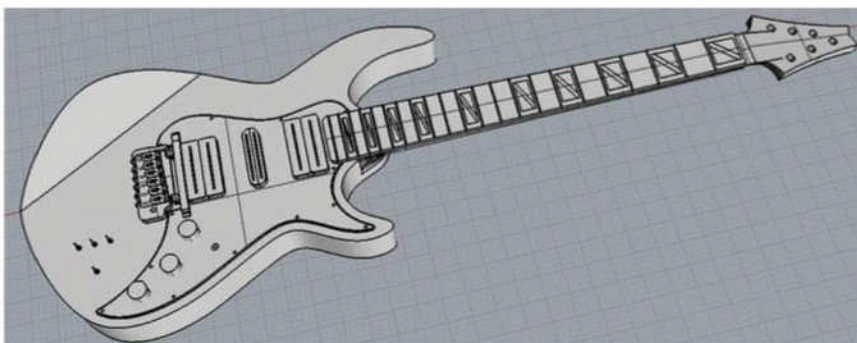
One thing we've all discovered is that CNC thinking has integrated its way into our work. With any new project, CNCs and CAD are now part of it.

We've found that digital tools affect how we think through every woodworking process. Through experience, we've learned which tasks are best done digitally and which are best done using traditional tools and techniques. And, if there's anything that all woodworking professionals have in common, it's that we're always seeking to refine our processes and to eliminate opportunities for mistakes—these tools help us do that.

Conclusion

CAD is integrated into the woodworking design and development of everything that Spangler, Erpelding, Myka, Peart and I do. Naturally, as professionals we're always looking for new ways to be more efficient in our work, but what we appreciate most are the new creative possibilities these digital tools afford. Though we all have traditional woodworking backgrounds and learned the craft using hand tools and traditional power tools, we've each found ways to integrate the power of these new digital tools into our workflow and methods. And with the proliferation of smaller and more affordable machines, CNC technology might be right for you, too. **PWM**

Tim works in the Seattle area, and writes for the PWM Shop Blog on digital woodworking technology. Contact him at tim@woodworking.digital.



Modeling. Whether or not a design gets output on CNC, CAD is a powerful tool for working out details and joinery. Every guitar Myka builds begins with a CAD drawing.

ONLINE EXTRAS

For links to all online extras, go to:

■ popularwoodworking.com/dec17

WEBSITES: Visit the websites of the makers featured here to see more of their work.

ARTICLE: Get an introduction to CNC and CAD technology and terms in "Digital Woodworking."

BLOG: Read the author's posts on digital woodworking on the PWM Shop Blog.

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Folding Campaign Bookshelf

BY CHRISTOPHER SCHWARZ

Learn the tricks to making sturdy furniture that folds flat.

For those with mechanical minds, building furniture that folds into small spaces is great fun. Not only does the piece have to look good and serve its ultimate function as a bookcase, chair or bed, it also has to collapse into the tiniest form possible.

During the 19th century, the British became masters at making collapsible furniture when two things happened:

First, so-called “patent furniture” became all the rage. These are household goods that transform into something else – the classic form is a chair that unfolds into library steps. Second, the British Empire conquered a huge part of the world during the reign of Queen Victoria and needed to send its citizens all over the world to manage its colonies.

As a result, folding or knock-down bookshelves were a common sight in the 19th century, and this example from E. Mascart & Cie of London is notable because it combines hinges that fold the ends flat, with a bottom that expands



its shelf to twice its collapsed length.

Even if you don't build this particular bookshelf, the lessons embedded in it can help you develop your own pieces of folding campaign furniture.

How the Bookshelf Works

The heart of the Mascart bookshelf is its telescoping bottom. The frame comprises two assemblies – think of each assembly as one of your hands. Each has “fingers” that are tenoned into each “palm.” The fingers interlock and slide thanks to tongue-and-groove joints.

The ends of the bookshelf are hinged to the telescoping bottom. When the bookshelf is opened, you lock the ends using a brass door latch on each end – sometimes called a sliding Dutch lock. To keep the bookcase from falling to pieces, a leather belt is screwed to the back. It also makes the bookshelf adjustable.

The original was made using quartersawn white oak. No matter what wood you choose, I recommend it be quartersawn and dry. You don't want the components for the bottom to warp or move much with the seasons.

Begin With the Bottom

After cutting the fingers to size, cut tongues and grooves on their long edges so the fingers interlock and slide. The photos show this better than words – some pieces need grooves, some need one tongue and one finger, the center one, needs two tongues.

When you cut the $\frac{1}{4}$ "-wide grooves, make them a shade deeper than $\frac{1}{8}$ " to ensure the $\frac{1}{4}$ " x $\frac{1}{8}$ " tongues don't bottom out in the grooves. When the



Table saw tenons. Again, the dado stack makes quick and accurate work of these tenons. After cutting the face cheeks, adjust the height of your dado stack and cut the edge cheeks.



Tongues & grooves. I used a dado stack to cut these joints. When you cut the grooves on the fingers, run the finger through the blades twice – once with one face against the fence and a second time with the other face against the fence. This ensures the groove will be centered. Then cut the tongue to fit that groove.

fingers are complete, they should slide smoothly without the tongues rattling around in their grooves.

I find it best to cut the tenons first, then use them to lay out the mortise locations on the ends of the frame (the palm, so to speak). The thickness of your tenons can be anywhere from $\frac{1}{4}$ " to $\frac{3}{8}$ " ($\frac{1}{4}$ " is traditional).

The width of each tenon needs to vary a bit depending on where it is in the assembly, anywhere from $\frac{3}{4}$ " to 1" wide. For example, the tenons at the outside of the bottom should be a little narrower so you don't destroy the frame ends during assembly.

With the tenons cut, put the fingers together and clamp the fingers across their width to keep them in a bundle. Then use that bundle to lay out the location of the mortises on the ends of the frame. This reduces measuring and errors.

Now cut the mortises. To reduce fussing and fitting, the mortises need to be dead centered on the thickness of the ends of the frame. The best way



Completed fingers. With the tenons cut, clamp the fingers together and show the assembly to the ends of the frame. Mark the locations of the mortises.



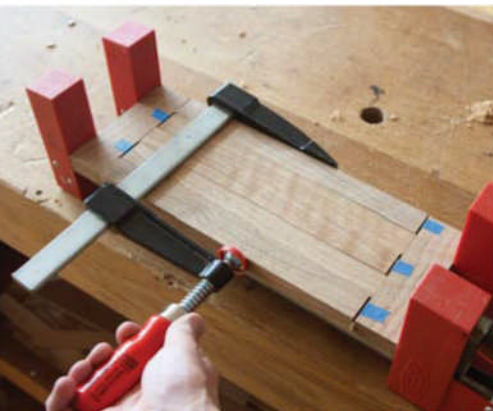
Sliding fingers. Here you can see which fingers are tongued, which are grooved and how they nest together.

“Do not make yourself uncomfortable for want of things to which you are accustomed. That is the great secret of camp life.”

—Flora Annie Steel (1847-1929),
English author



Twice mortised, once fit. To center the mortises, put one face against the fence and cut the joint, then turn the piece 180° with the other face against the fence.



Easy on the glue. I use liquid hide glue because it's reversible and slow-setting. Paint the mortises and tenons with care so there is little or no squeeze-out. You don't want to glue the fingers together.

to do this is to mortise them twice – once with one face against the fence of your mortiser and a second time with the opposite face against the fence of the mortiser. (Just like you did when centering the grooves on the fingers.)

Adjust the fit of all the joinery so the fingers fit firmly into the ends of the frame, yet slide easily open and shut. This is a good time to level the joints and remove any machine marks.

Gluing up the bottom is not difficult if you know the trick. You'll want to clamp the bottom across its width to hold the



Unseen reinforcement. This common mending plate from the hardware store keeps your fingers in line through years of service and heavy loads.

fingers in position. And you'll want to clamp across the length of the bottom to glue the tenons in their mortises.

Add the Ends

The folding ends of the bookshelf can be any shape. The original had Gothic flair. I laid out this shape with a compass (see "Lancet arch," below left). Use the drawings as a guide to replicate this shape. Cut the ends to shape and clean up the edges.

Attach the ends to the bottom using hinges. I used a solid brass piano hinge that I cut into 4" lengths then filed to shape.

Attach the hinges with steel screws first then replace them with brass.



Lancet arch. Set the compass to the width of your piece (5" in this case). Put the point of your compass $1\frac{3}{4}$ " up from the bottom edge. Swing an arc. Do the same on the other edge – you've made a Gothic arch.

SUPPLIES

Lee Valley Tools

leevalley.com or 800-871-8158

1 ■ $1\frac{1}{4}$ " x 3' piano hinge
#00N01.05, \$28.50

Amazon

amazon.com

2 ■ Rockwood 4" solid brass surface bolts
#630-4.3, \$19.53 each

Tandy Leather

tandy-leather.com

1 ■ $\frac{3}{4}$ " halter buckle
#1505-00, \$4.49

50 ■ #9 x $\frac{3}{4}$ " copper rivets
#11281-00, \$19.99

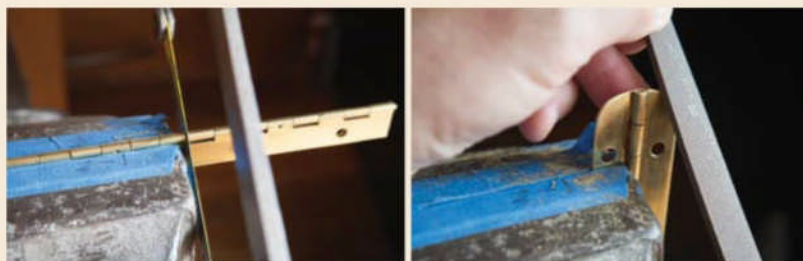
1 ■ Lightweight cowhide leather strip
50" x $\frac{3}{4}$ " wide
#4523-05, \$14.99

Prices correct at time of publication.

On the underside of the bottom, screw a 5"-long mending plate (available at any hardware store) to the outside two fingers of the bottom. This will prevent the fingers from spreading apart under heavy loads.

The last task on the ends is to install the sliding door latch that locks the bookshelf open. This should be centered on the ends. Again, install the bolts first with steel screws and replace them with brass screws.

CUSTOM HINGES



Brass is a hard wood. Cutting and filing brass is easy compared to steel. A few minutes of work with a hacksaw and a file, and you can make some hinges that look appropriate instead of awkward.

Cut the hinges to 4" long with a hacksaw. The screw holes are on 2" centers and the knuckle of the hinge is a great place to start the hacksaw. Lay out the shape of the ends of the leaves (I used a dime as a template). Then file the shape and blend it into the rest of the leaf.

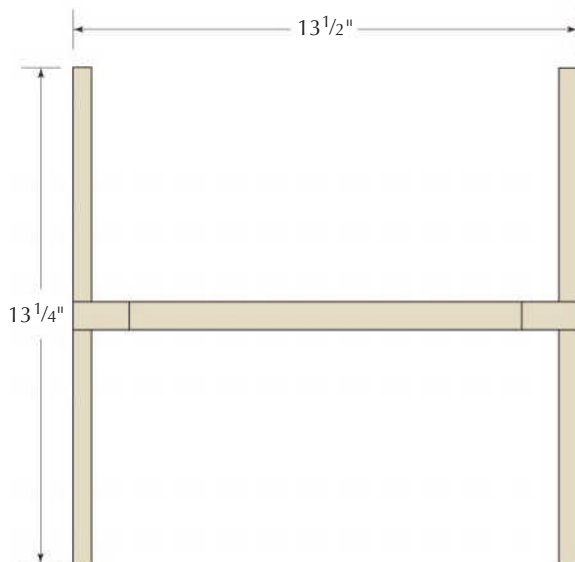
I polished the ends of my hinges using a deburring wheel in my grinder. Finally, I removed the lacquer from the hinges so they would age faster – a torch makes quick work of that task.

— CMS

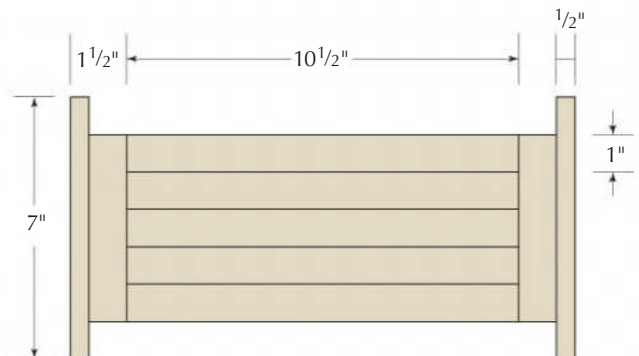
Folding Campaign Bookshelf

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL	COMMENTS
		T	W	L		
❑ 2	Top ends	1/2	5	6 1/4	White oak	
❑ 2	Bottom ends	1/2	7	6 1/4	White oak	
❑ 2	Frame ends	3/4	1 1/2	5	White oak	
❑ 2	Inner fingers	3/4	1	11 1/2	White oak	1" TOE*; 1/4" x 1/8" GBS**
❑ 2	Outer fingers	3/4	1 1/8	11 1/2	White oak	1" TOE; 1/4" x 1/8" TOST†
❑ 1	Center finger	3/4	1 1/4	11 1/2	White oak	1" TOE; 1/4" x 1/8" TBS‡

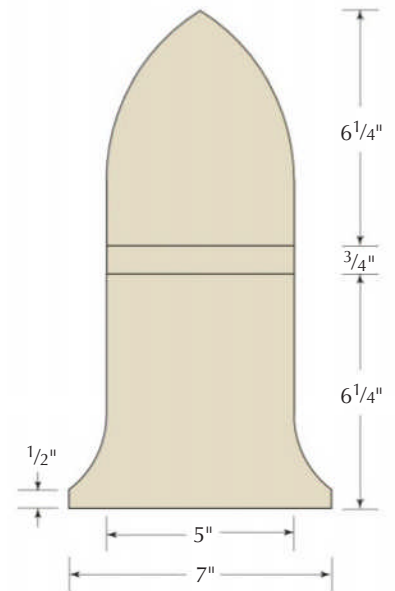
*TOE=tenon one end; **GBS=groove both sides; †TOS=tongue one side;
‡TBS=tongue both sides



ELEVATION



PLAN



PROFILE

Finish & the Belt

Remove all the hardware, clean up any machine marks then apply two coats of super blond shellac, sanding between coats with a fine sanding sponge. Knock off any errant nibs with a folded brown paper bag, then reassemble your bookshelf.

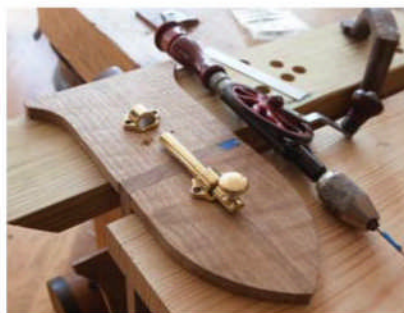
For the belt, feel free to use anything you like – even an old belt from your closet. Before screwing the belt to the back of the bookshelf, cut it to length so you cannot over-extend the fingers, causing your shelf to fall apart.

If you'd like to try your hand at leather working, read the blog entry (see Online Extras at right) on how to do it yourself with simple tools.

With these tricks, plus a little imagination and engineering, you can scale

up this bookshelf or use the fingers and folding parts to create your own collapsible furniture. **PWM**

Christopher is the editor at Lost Art Press and the author of "Campaign Furniture."



Keep it flat. I rigged up this temporary platform to keep the ends open while I installed the door latch.

ONLINE EXTRAS

For links to all online extras, go to:

■ popularwoodworking.com/dec17

BLOG: Learn how to make the leather belt for the bookshelf from the author.

VIDEO: Watch a video of how the bookshelf folds up and see details of its hinges.

MODEL: Download a SketchUp model of this project from our 3D Warehouse.

WEBSITE: Visit lostartpress.com for more information on Christopher Schwarz's "Campaign Furniture" book.

TO BUY: "Build a Campaign Chair with Christopher Schwarz" in our online store (video download).

WEBSITE: Learn more about the many forms of campaign furniture.

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The Zen of Hewing a Froe Club

‘No time to do it right, but time to do it over.’ – Daniel O’Hagan

I hear my mother’s voice every time I walk past those small hickory saplings I saved months ago: “Procrastination is the thief of time.”

I’m not one of those woodworkers who makes many of his own tools – many woodworkers get a lot of satisfaction from toolmaking. They are able to tailor the tools’ shape and function to their own particular purpose. I have never been inclined toward toolmaking, and with few exceptions, have stayed out of it. Simple things like scratch stocks for shaping mouldings are easy enough; I can handle them.

As a green woodworker, though, I am often thrust into toolmaking by necessity. The froe is a tool used to split apart fresh wood into usable “billets” – sections that are then either hewn, shaved, turned or otherwise fashioned into various forms. But the froe needs persuasion to work its way into the log – this comes in the form of a wooden club, variously called a maul, mallet, club, “beetle” (erroneously in that case) and more. I call it a club.

It is too often made on the spot, from green wood, destined to be replaced sooner rather than later. “No time to



Yin & yang. The froe is an essential green woodworking tool, but it is nothing without its mate, the froe club.

do it right, but time to do it over,” I hear Daniel O’Hagan saying to me across the years. Many times, I’ve been guilty as charged. When my “good” froe club finally broke apart from decades of repeated bashing of iron and steel, I had no suitable hardwood from which to make a replacement. With great shame, I often fashion one on the spot from whatever hardwood is on hand. Most recently that was cherry, which is not particularly hard or heavy – it was what I had at that moment.

But I am reformed. I saved a section of hickory sapling to make some froe clubs from it. Soon. Well, soon turned into a month or more later. Hickory has a poor shelf life in the log, and every day I thought “I have to get to that....”

No More Stalling

So I took the bull by the horns and worked up two excellent froe clubs that are now set aside to dry before taking their place in my green woodworking arsenal.

The sapling was 4" in diameter, and I cut two sections about 24" long. The first order of business was to hew one end down to form a rough handle. I used my largest single-bevel hewing hatchet (I reached for the largest because hewing hickory is heavy work). I tapered one end about 10" long, working it into a square cross section. Next I knocked the corners off this square, still using the hatchet. There’s no measuring – the gauge is that thing at the end of your arm. Grab the club by the handle to test the size. I frequently make them too thick, so I have to keep pushing to get them down to a comfortable size.

I sometimes switch to a smaller double-bevel hatchet to shape a curve into the handle. The idea is to have a bit of a swelling at the very end, so the club doesn’t slide out of your hand in use. I chop from both ends to get this curve.

After hewing, I set the club in my shaving horse to clean up the rough surfaces. I work the drawknife with



Up then down. When hewing, I start at the bottom, scoring the wood as I work my way up. Then I chop down, breaking off the chips.

CONTINUED ON PAGE 66

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The patriotism shown for our country today comes from the foundation of the revolutionary war. That very patriotism started at the Liberty tree that once was the rallying point of American colonists who were growing resistance under the rule of Britain. The "shot heard 'round the world" marked the second The American Colonists began their fight for our country's independence in 1775's Battle of Lexington and Concord.

Oath Keepers, Three Percenter's, and today's Minuteman alike have the same patriotism and passion run through their veins that's been passed on by generations who fought for our freedoms. They will stand against any tyranny against our freedoms whether foreign or domestic. As American Civilians we have an obligation to maintain that patriotism and fight for our rights.

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Freud America	5	67	freudtools.com	Teknatool USA	2, 25	46	teknatoolUSA.com
Furniture Institute of Massachusetts	64, 65	16	furnituremakingclasses.com	Titebond	2	14	titebond.com
Gauge-It	2,3	8	gauge-it.com	Tools for Working Wood	69	—	toolsforworkingwood.com
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Harbor Freight	67	76	harborfreight.com	Wagner Meters	15	123	wagnermeters.com
Highland Woodworking	29	22	highlandwoodworking.com	Wall Lumber	20	47	walllumber.com
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				Work Sharp	3	119	worksharptools.com

pulling and pushing strokes to refine that swell at the end. That's about all there is to it. A bevel around the tip of the handle is added for comfort.

I keep the “head” of the club long at this stage. When green, hickory is heavy. I set the club aside to dry, and when it's ready for use, I might trim the thick end of the head to lighten the club enough to be able to use it regularly. I like the thick end to be sawn evenly so it can stand on its “head.” This makes it easier to pick up, rather than having to stoop over and pick it up off the ground each time.

It's worth making at least two of these. I tend to keep one outdoors by my woodpile and the other in the shop. Patience is necessary—I stashed two of these today, and am hoping to not use for them three or four months. That means I'm stuck with those cherry ones a while longer.

While I was at it, I made some wooden wedges (sometimes called gluts, but to me they are wedges) from shorter bits of the hickory. Their story is much the same—a green woodworking tool too often made on the spot from inferior materials. The most common mistake is to make them too large, with too abrupt a taper. (I like them about 2" thick, 3" wide and 14" long, with a 10" taper.) If the stock is long enough, you can make a wedge off each end then saw it apart in the middle. This makes them easier to hold for hewing.

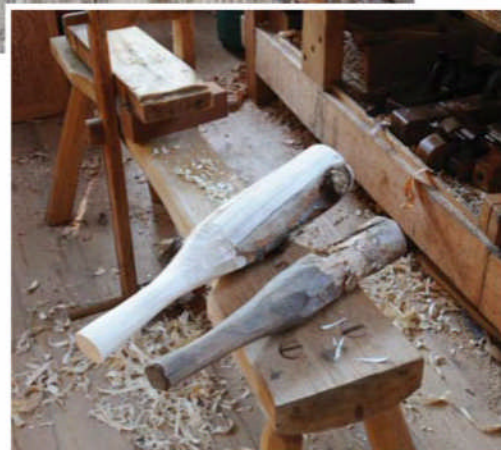


Start square. I'm after a round-ish handle, so I start by making it square, then octagonal, then round.

You can use a drawknife to clean up the surfaces, too—a shaved wedge will last longer because it is less likely to catch on something inside the log. I bevel the edges after hewing the taper and—this is critical—bevel around the top striking surface. Wedges don't last as long as the froe clubs, but good ones will serve you well.

I can't wait for this winter's riving. I'm ready. **PWM**

Peter has been involved in traditional craft since 1980. Read more from him at pofollansbee.wordpress.com.



The waiting game. In a few months, the new club (on the left) will be dry enough to put into service, so it can replace the worn-out, never-good-in-the-first-place cherry club on the right.



Get a grip. To keep the club from slipping out of my hand, I like to keep some thickness at the bottom end. So I have to flip the club and hew from the end toward the middle. I take great care when hewing this close to my hand.

ONLINE EXTRAS

For links to all online extras, go to:

■ popularwoodworking.com/dec17

BLOG: Read Peter Follansbee's blog.

ARTICLE: “The Best Oak Money Can't Buy.”

About this Column

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Oils in Finishing

Learn why certain oils cure better and what makes an oil suitable for finish.

Oil is one of the most important ingredients used in finishing products. Besides being a finish all by itself, oil is an important component in varnishes, polyurethanes and furniture polishes; a primary binder in stains, glazes and pore fillers; a plasticizer in lacquers; and a lubricant used together with sandpaper or abrasive powders to level finishes and rub them to an even sheen.

Despite its importance, oil is poorly understood. To help make sense of it and understand how the various types differ, a little technical knowledge is helpful.

The Nature of Oils

You've probably noticed that some oils stay liquid forever while others get sticky after a while and still others dry completely after a day or two. The explanation is that some oils have more reactive sites than others, and it is at these sites that oil molecules crosslink and cure, usually with the aid of oxygen.

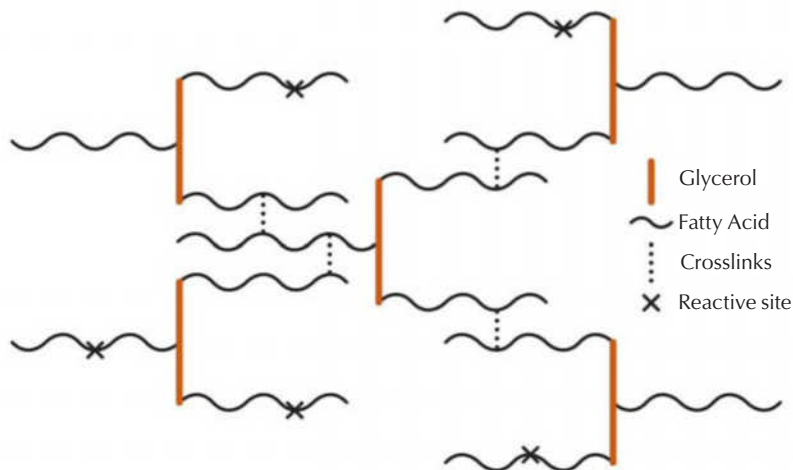
Oils that never dry have very few or no reactive sites, oils that get sticky have a few reactive sites and oils that dry completely have sufficient reactive sites to make this possible.

Oils have three large families: mineral oil, vegetable oil and synthetic oil.

Mineral Oil

Mineral oil is distilled from petroleum and is always a straight-chain hydrocarbon with no reactive sites, so mineral oil never dries.

If you apply mineral oil to wood, it continues penetrating into the wood until it can't go any farther. So what you experience after each application is the surface slowly drying out and losing its rich color until eventually there's enough oil in the wood to keep



Tuning fork comparison. Vegetable oils are made up of triglycerides (glycerol molecules with three fatty acids attached). The tuning fork comparison makes these molecules easy to picture, but the actual fatty acids are curled up tightly and, of course, can't be seen by the naked eye. The more reactive sites on the fatty acids, the better the oil cures – that is, turns from a liquid to a soft solid.

the surface in a semi-permanent oily state. (Washing the surface removes this oil, of course.)

Vegetable Oil

Vegetable oils are pressed from seeds and nuts and make up the bulk of the ingredients in finishes. They are composed of a glycerol molecule with three fatty acids attached. This compound is called a “triglyceride,” a term you're probably more familiar with in the context of blood tests and what is more or less healthy to eat. (Animal fats have the same chemical structure as vegetable oils, so they are also triglycerides.)

There are many different fatty acids, each containing from zero-to-four reactive sites per molecule. Sometimes all three fatty acids attached to a glycerol molecule are the same, but usually they are mixed, so the best way to figure the number of reactive sites in any given oil is to use averages.

Oils with fatty acids containing an average of zero-to-one reactive site per fatty acid don't crosslink enough to ever dry. These oils, including olive, castor and coconut, are called “non-drying” oils.

(Oils without reactive sites are also called “saturated” and are unhealthy to eat because your body can't break them down. Your body breaks oils down at their reactive sites, and oils that have them are called “unsaturated.”)

Oils with an average of one-to-two reactive sites per fatty acid dry better, but it takes a long time and heating the oiled surface is often necessary to help the drying along. Even so, these oils may still remain sticky, so they're called “semi-drying” oils. Examples include walnut, soybean (soya) and safflower oil.

Oils with fatty acids containing an average of two or more reactive sites reach full cure, though slowly, and are called “drying” oils. The most common

CONTINUED ON PAGE 70

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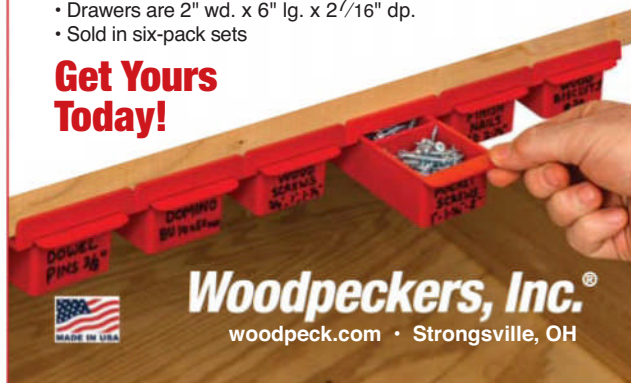
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examples in finishing are linseed oil and tung oil. Curing occurs faster when heat is applied and also when metallic driers are added. These driers (often sold as Japan drier and composed of cobalt and manganese naphthenates) are catalysts that speed the introduction of oxygen into the oil.

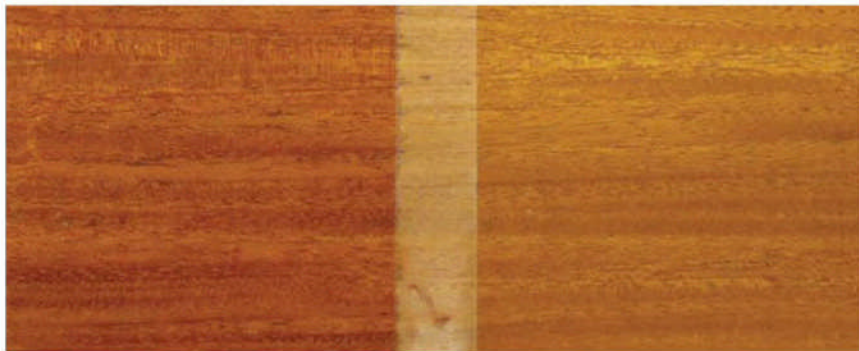
The difference between linseed oil and tung oil can be explained quite easily by counting the reactive sites on their fatty acids.

Linseed oil has an average of about two reactive sites per fatty acid while tung oil has almost three. In addition, the reactive sites in tung oil are arranged better for curing. So tung oil cures faster than linseed oil, and it is considerably more water resistant when cured.

Keep in mind that the linseed oil we're talking about is raw linseed oil – that is, without added driers. When metallic driers are added, making “boiled” linseed oil, the product cures faster than tung oil, which is never sold with driers added. Adding driers to raw linseed oil doesn't make the final cure



Stay safe. Linseed oil and any product containing linseed oil, including oil stains and glazes, can spontaneously combust if the heat created in the drying can't dissipate. So if you work alone (rather than in a multi-person shop where safety protocols need to be established) and want to be safe with these products, drape rags over a trashcan or similar object, without piling them up, until they dry. Then throw them in the trash, which is no different than throwing an oil finished piece of wood in the trash.



Linseed oil for color. Linseed oil has more orange color than most other oils and darkens as it ages. It can be used to deepen and enrich the color under other finishes, especially on darker woods such as the mahogany shown here. The coloring improves with age; it doesn't happen all at once. Also, you have to let the oil dry completely before coating over.

more water resistant, however. It just makes the oil dry faster.

Vegetable oils such as linseed oil and tung oil can be “polymerized” to make them dry faster, harder and glossier – resembling varnish more than oil. The method is to heat the oil to around 500°F in an oxygen-free environment (in inert gases) until the oil begins to gel, then cool it rapidly.

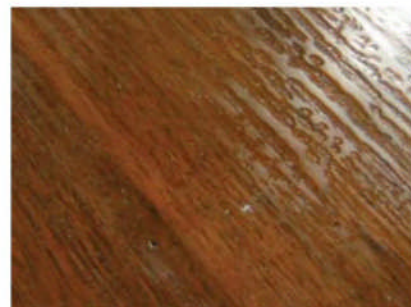
Because there's no oxygen, the reactive sites on the fatty acids crosslink directly (no oxygen atoms in between), so the characteristics of the oil are changed. When the partially cured oil is then exposed to air, it completes its drying very rapidly, considerably faster than varnish.

Synthetic Oil

Synthetic oils generally don't have any reactive sites, so they don't dry. Silicone oil is probably the best known in the finishing world. This oil holds up to very high temperatures, so it's often used to lubricate machinery. It's also much slicker than mineral oil and has a lower refractive index, which creates more depth in finished wood. So silicone oil is often used in furniture polishes.

These polishes have received a bad reputation because the oil is so slick that it causes finishes to pull away forming “fish eyes” or craters. But these polishes are very popular with consumers.

Fish eye can be eliminated by cleaning the surface better with solvents



Fish eye. Maybe the biggest problem in refinishing is “fish eye,” where the finish refuses to flow out over a slick surface. This is caused by furniture polishes containing the synthetic oil silicone having been used for dusting; some silicone gets in the wood. In this case, the finish is polyurethane.

or detergent, adding some silicone oil (sold as fish-eye eliminator or Smoothie) to the finish to lower its surface tension, or by sealing with shellac, which isn't usually affected. **PWM**

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

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How To: Repair Your Body

In a year when several health discoveries have already made headlines, this one may be the biggest yet.

Dr. Rand McClain, the Los Angeles based "Doctor to the Stars," released his new technique for what some are calling the Body Restore formula.

His science is based on technology that was actually partially banned by a U.S. Establishment in 2001. However, Dr. McClain and his partners have found a way that allows them to go and take their discovery straight to the American people.

Dr. McClain revealed he's already offering to his celebrity and pro-athlete clients with incredible results.

In the video presentation, he details how some very big name athletes are achieving increased strength, healthier bodies, and even more energy.

But what's really turning heads is that McClain isn't offering this as an injection, surgery, or medical

procedure — which is what his health clinic in Los Angeles is famous for.

Instead, the method involves one simple thing: A drink. He has all the clinical trials, the data, he's conducted the test groups...it not only works, it works really well. McClain feels the technique — which has been shown in clinical trials — works best for people over 40, particularly those who may be experiencing excessive fatigue, weaker bodies, and even foggy thinking.

And when Dr. McClain dropped the final bombshell — video footage of the results he experienced after using the method on himself — it became clear that the discovery is nothing short of groundbreaking, of course your individual results will vary, as with any new method.

While surgery is the benchmark and Dr. McClain charges \$20,000 and up, he feels he can offer Americans a new method which provides outstanding results.



But the latest development in this story came when the video version of the presentation was made available to the public online. As of this writing, the video has over 3 Million views and is quickly becoming a social media phenomenon.

This is the video that many might not want people to see. But if the link is working, that means the video is still viewable...for now.

Watch the shocking presentation at **www.LCR98.com**

Dr. McClain calls out both the medical industry and certain agencies. One viewer commented: "Why did I not know this before? Rand is telling it like it is...we need more doctors like this!"

See his presentation here **www.LCR98.com**

Woodworking Class in Print

Build 'to the plan' and you just might learn some new skills.

I've been subscribing to *Popular Woodworking Magazine* for years. Each issue inspires me with history, tips and tricks, and keeps me updated on the woodworking world. However, while standing at the mailbox thumbing through a new issue, it occurred to me that I'd never built a project from the magazine. Isn't that the point of subscribing? I was wasting an opportunity to improve my skills.

Between the mailbox and the house I decided to make two of the June 2017 (issue #232) cover project, a modern lounge chair by Caleb James. I finished them by weaving the paper cord seats, as instructed by James in his August 2017 (issue #233) article.

I completed the project and am pleased with the results. In fact, I have a paradoxical emotional issue: simultaneous joy and loathing. The amount of new things I learned is amazing, but I loathe the fact that I've missed so many previous opportunities to grow.

I don't want the same thing to happen to you. If you have a mounting stack of periodicals but haven't made any of the projects, here are five suggestions to help you better make use of the woodworking class in your hands.

Read & Re-read

I wasn't born with photographic memory. Were you? Begin by reading slowly and deliberately. Don't skip pages. Don't only read the captions. And when you're done, read it again. You might even want to write your own directions.

Dare to Ask

Thanks to social media, it was easy to ask questions and get help. Turns out *Popular Woodworking Magazine* (among others) isn't just a static publication — it's a dynamic conversation.



To the plan. The author learned new techniques he'll apply to future designs and builds by following Caleb James's instruction for making a Hans Wegner-inspired lounge chair.

The article's author, the magazine editor and other staff not only offered encouragement, but went above and beyond to answer questions and offer support. They wanted me to succeed just as much as I did.

Reinforce Your Learning

When I was in college, every syllabus included a list of supplemental texts that students were encouraged but not required to read. I applied the same principle while building this project by reading other books on Danish furniture. The project James designed and I built isn't an exact copy of a Hans Wegner design, but it's close. The extra reading allowed me to see and appreciate the changes that James made, which afforded me a better understanding of design in general.

Deviate at Your Own Risk

For many years I took pride in only building my own designs. Unsurprisingly, all my work looked very similar. At the beginning of this project I was determined to follow the instructions to the letter because I wanted to break out of my rut.

Not only did I learn new techniques I also picked up some design elements that will cross over into other projects.

See Clearly Later

Though I had carefully read the article (more than once), some things didn't make sense. I lacked the experience to really understand what the author was trying to communicate. The good news is that the fog lifted one step at a time. I found that elements that didn't make sense in the beginning did once I had the piece in front of me.

Recently, in a class that I paid hundreds of dollars for, I joked that if I could do it anybody could. It became a class mantra that put others at ease.

If you're reading this chances are good that you just came from the mailbox. This is your woodworking class for just \$20 for seven issues.

If I can do it, so can you. What will you make? **PWM**

Eric lives and works in Indianapolis, Ind. You can see what he's up to by following @eric.key on Instagram.

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TYPE 17 POINT

coarse thread
FOR SOFTWOOD
FACE FRAMES

SAME DAY
SHIPPING

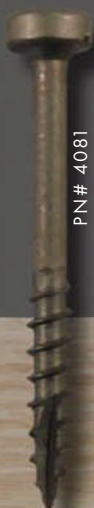
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SELF
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- 3.2" x 5.2" Grip faced pad
- Low profile of 4" allows for easy maneuverability
- Ideal for tight and low profile woodworking spaces
- Optimized ergonomics for a comfortable grip
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- Fast, efficient and dust-free sanding performance
- Bluetooth connectivity pairs with MyMirka App

Dust- Free Perfection starts with the Mirka® DEOS

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