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- Arbor: ⅝"
- Cutting capacity: 25⅝" R, 8" L
- Max. depth of cut: 3" @ 90°, 2⅛" @ 45°
- Approx. shipping weight: 550 lbs.

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Reviews & Awards

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20" PLANERS

- Motor: 5 HP, 240V, single-phase
- Max. cutting width: 20" • Min. stock length: 8"
- Max. cutting depth: ⅛"
- Feed rate: 16 FPM & 20 FPM
- Cutterhead diameter: 3⅛", Speed: 4800 RPM
- Number of knives: 4 HSS
- Table size: 20" x 25¾" (20" x 55½" with extension)
- Overall dimensions: 55½"L x 39½"W x 45⅞"H
- Approx. shipping weight: 932 lbs.

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- Max. cutting height: 12⅛"
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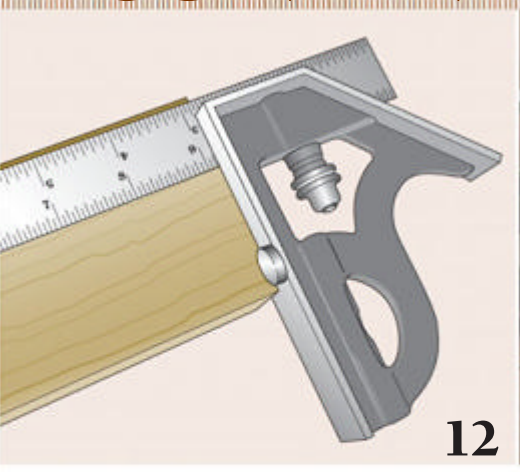

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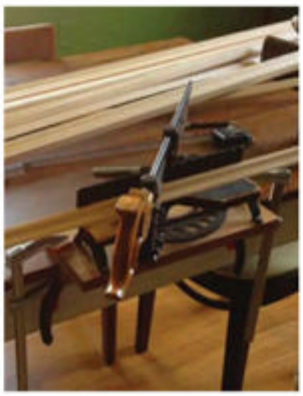
Will Work for Shelter

In mid-April, I signed over the deed on the 1895 house I bought in November 2001, which I began rehabbing just weeks later. I "finished" it at about 8 a.m. on April 15, 2015 (the day of closing) – but I didn't really finish; one never does in an old house. I simply handed over the keys.

But in between buying and selling, I learned a lot.

The first woodworking project – and I use the term "woodworking" loosely – was to remove the kitchen doors and drawer fronts, plug the old screw holes, then paint before replacing the dingy 1980s hardware. I never liked that kitchen – though white paint went a long way in mitigating the ugly on the formerly brown, termite-barf cabinets.



All through the first and second floors, I tore out what seemed like acres of nasty Kelly green carpet (and truly terrifying padding) to reveal the original pine floors. Then I learned how to use a router to cut and fit plugs for knotholes. I hired someone to sand and apply the finish – and I still would today.

But the second-floor hall and study floors couldn't be salvaged, so I taught myself to install new hardwood flooring atop the pine.

I tackled the main bathroom as my next major project, tearing it down to the studs and subfloor, and reframing one wall. By that time – 2007 – I'd learned a bit more about making furniture – and that ruined me for rough carpentry. What the heck is 1/4" "heavy?" Is that 5/16"? Or is it 11/32"? Yes and yes. That wall is framed to 32nds. (Yes, I know I wasted a lot of time with that.)

Then came many small jobs: making and fitting 8"-wide base moulding to match the few remaining original pieces. Repairing and replacing window and door casings. Installing miles of shoe moulding. Crown moulding.

I tried – for want of a proper shop space – to sell the house in 2013. No takers. Turns out, viewers liked the kitchen no more than did I.

So it all came back to where I started.

I ripped out the kitchen. I ran new electric and repaired plaster, installed a new subfloor and floor, put in some new plumbing (because I broke a pipe – oops) and built cabinets with inset doors and drawers, and custom-fitted furniture pieces and thresholds.

I love that new kitchen. But 18 months after I ripped out the first cabinet, and five hours after absolutely everything in the kitchen was declared complete, it no longer belonged to me.

I was sad to say goodbye, but I'm eager to find a new old place – with space suitable for a proper shop – on which to start renovations (and this time with a far less steep learning curve).

In the meantime I'm renting a friend's home that is currently on the market. While 99.9 percent of my tools are at the office (along with my personal bench and tool chest), my miter box is affixed to the small table I set up in my friend's dining room. Part of the cost of my (quite reasonable) rent is to install miles of shoe moulding. If the house sells before I close on my next one, I'll have to move again.

Is there a word for a peripatetic moulding installer?

Have miter box; will travel. **PWM**

PHOTO BY THE AUTHOR

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What's the Best Slope for a Dovetail?

Is there a reason to use a different slope for dovetails based on spacing, depth or other factors? If so, how does one determine this?

Francis Stanisci,
Milton-Freewater, Oregon

Francis,
The answer is yes – but the rationale depends on who you ask.

Just about everyone who cuts dovetails with any regularity has a favorite angle based on aesthetics or something they once read about the "right" dovetail angle. Or, they lay out dovetails with a jig, and are locked into the jig's angle or angles.

But a look at the historical record (and at historical examples) shows there is no one right angle (and not much at all is said about spacing).

Charles Hayward, a well-known mid-20th-century woodworking authority and author, recommends 12° for coarse work, and 7° or 10° for decorative work (with no mention of softwoods vs. hardwoods).

In the 1902 book "Modern Practical Joinery," George Ellis recommends 10° for all dovetails.

Contemporary dovetail guru Rob Cosman uses 10° for softwoods and 8.5° for hardwoods.

Frank Klausz – who uses his eyeballs and experience for layout – says his are anywhere from 10° to 15°.

"The Practical Woodworker," edited by Bernard Jones, reads: "…the angle desired by the worker, which should not be less than 10° or more than 15°."

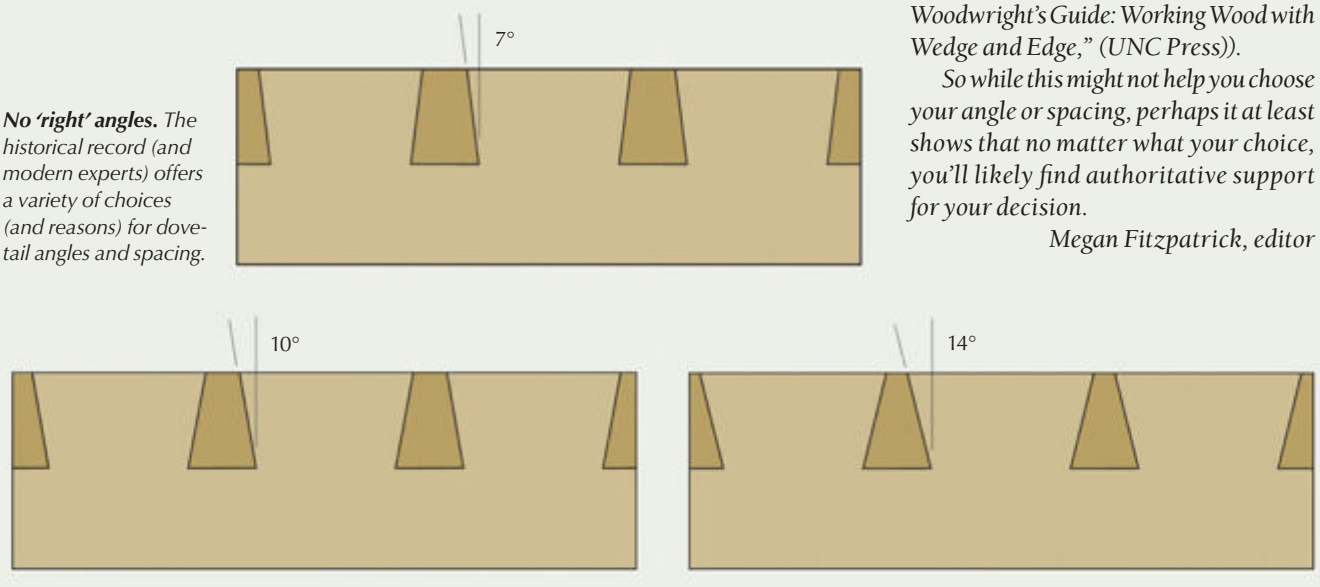
As far as spacing, well, some folks prefer pins and tails of close to equal size (a very strong joint); others prefer wide tails and narrow pins (also a strong joint, but not as much so). It's in large part a matter of aesthetics (and the size of your chisels). Roy Underhill has this to say about it:

"For a heavy chest, you could make them (the pins and tails) equal in size, but even when equal spacing would be stronger, a chest looks far better when the pins are about half as wide as the boards are thick, and the tails are about three times as wide as the pins.

"By this guideline, the thickness of the wood determines how many tails and pins will fit within a given width. For ¾"-thick, 11"-wide boards, this comes to eight dovetails separated by seven pins, bounded by a half-pin on each end." (From "The Woodwright's Guide: Working Wood with Wedge and Edge," (UNC Press)).

So while this might not help you choose your angle or spacing, perhaps it at least shows that no matter what your choice, you'll likely find authoritative support for your decision.

Megan Fitzpatrick, editor



No 'right' angles. *The historical record (and modern experts) offers a variety of choices (and reasons) for dovetail angles and spacing.*

Oak & Blotching

I respect Bob Flexner's experience and expertise. I disagree with him, however, about one particular statement he made in the April 2015 issue (#217).

Bob states that oak does not blotch. I've made many projects from red oak, especially flat-sawn. I have sanded to #150, #180 and #220 grit and it doesn't matter; some pieces blotch when stained. I have even tried thinning the stain for the first coat, but it really doesn't make a difference.

Sanding out a blotchy spot doesn't yield great results, either. Oak has spots that are more porous than others and, even with a conditioner, it will sometimes blotch. I have used all kinds of stains, but some oak blotches.

Martin Hauer,
via e-mail

Martin,
First, it doesn't matter how many grits you sand through; it matters that you sand out

CONTINUED ON PAGE 10

ILLUSTRATION BY MARY JANE FAVORITE

Popular Woodworking Presents

Woodturning with Tim Yoder

— Tune in now. Shows airing each Saturday! —

Popular Woodworking Magazine has teamed up with well-known PBS star Tim Yoder to launch a new online video show, filled with expert and friendly advice that will teach you how to become a better woodturner.

In each 30-minute episode, Tim takes you through the process of making beautiful woodturning projects, from wine stoppers and duck calls to platters and bowls. Along the way, you'll learn his favorite turning tips and techniques, and he'll offer reviews of the latest lathe tools, chucks and accessories to help you determine the best products to buy.

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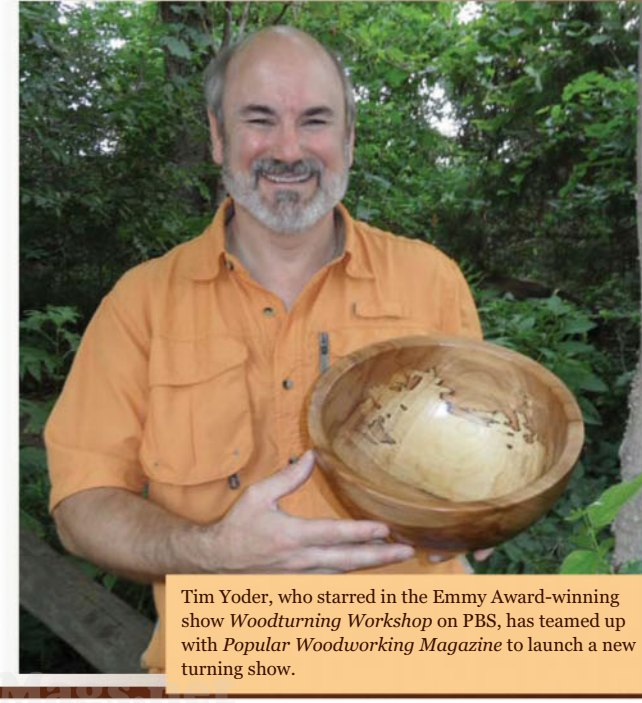

Tim Yoder, who starred in the Emmy Award-winning show *Woodturning Workshop* on PBS, has teamed up with *Popular Woodworking Magazine* to launch a new turning show.

CONTINUED FROM PAGE 8

all the mill marks (from jointers, planers etc.) with the coarsest grit. Then sand to finer and finer scratches with finer grits.

We all sand differently, but in my opinion, you are beginning with too fine a grit. I can often get away with beginning my sanding with #150 grit on factory presanded veneered plywood or MDF, but on solid wood that I have milled myself, I almost always begin with #100 grit, then sand up to #150 or #180.

You may not be removing the mill marks at all unless you are sanding for a very long time with the #150 grit.

Second, the term "blotch" is usually used in a negative way to imply ugliness, and that is how I was using the term. Walnut and mahogany blotch, but most people find that blotching attractive.

Curly maple, curly cherry and rarer curly oak also blotch, but this blotching is valued as well. Other than curly oak, I can't recall seeing blotchy oak in well-prepared wood.

The woods known for ugly blotching are softwoods such as pine and fine-grained woods such as cherry, birch and maple.

As I pointed out in another place in the article, if you followed the manufacturers' directions for using a "conditioner," you won't get good results. So applying this product as manufacturers instruct wouldn't be effective, whatever the cause of the blotching in your oak.

Bob Flexner, contributing editor

Remember Roundover Style?

In his article on charred finishing in the April 2015 issue (#217), Seth Gould said he was "hard-pressed to find mainstream examples of burnt wood…as a finishing technique."

Perhaps he's young enough, or far enough from California, not to have experienced the California Roundover style of the 1970s; but charred and deeply wire-brushed softwood finishes were common on this style.

California Roundover was a classic example of the old saying, "give a child a hammer, and everything he finds will be a nail" – just replace "hammer" with "router and a roundover bit."

Sam Maloof did some elegant desks with rounded edges; California Roundover took the idea way, way past its logical conclusion. But many of the pieces were indeed finished by charring.

Bill Houghton,
Sebastopol, California

Bill,

I did not know that either! I'm probably too young to remember it, too...but that's no excuse (I know Chippendale, after all). I'm having a hard time finding pictures, but I'll keep digging. Thanks for introducing me to a new style.

Megan Fitzpatrick, editor

Paint Transfer Concern

I've almost completed my workbench and I want to paint the base with milk paint. I know Megan Fitzpatrick did the same on her LVL bench. I'm worried the paint will mar anything I clamp in the leg vise. Has this been a problem?

Ron Guritzky,
via e-mail

Ron,

It did at first, but after a few weeks, there was no paint transfer (milk paint dries really hard, but not right away). Also, you could line both sides of the vise – the jaw and where it meets the leg – with leather. I did that on my Roubo bench.

Or one more option for you: My tool chest is also painted with milk paint, but I top-coated it with satin lacquer. Nothing has rubbed off. **PWM**

Megan Fitzpatrick, editor

ONLINE EXTRAS

Letters & Comments

At popularwoodworking.com/letters you'll find reader questions and comments, as well as our editors' responses.

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PHOTO BY MEGAN FITZPATRICK

Highly Recommended

My hands are incredibly dry, and working in the shop around lots of sawdust exacerbates the problem – particularly in the winter. So I've tried just about every cream, lotion, balm and treatment on the market.

While none of them is a magic bullet, the best I've found (that doesn't smell like a perfume counter) is O'Keefe's Working Hands. It's a thick paste in the container, but let some sit in your hands for a few minutes and body heat softens it enough to rub in. Plus, there's no oily residue.

— Megan Fitzpatrick

Popular Woodworking Magazine

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

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CARD #52 or go to PWFREEINFO.COM

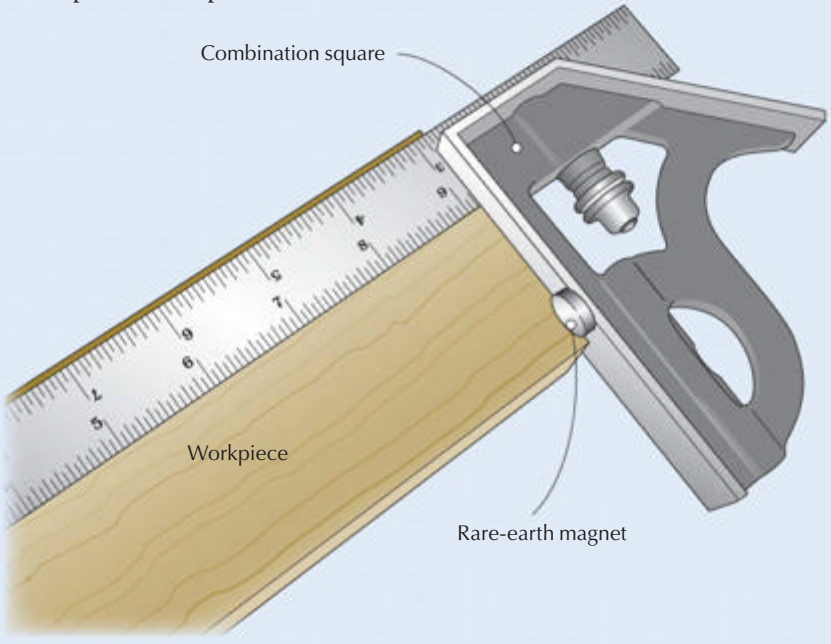
THE WINNER:

'Attractive' Rest for a Combination Square

Some high-end combination squares have a built-in lip or tab for the purpose of resting the tool hands-free on a piece of wood. But because most common combination squares lack this handy feature, I developed this inexpensive solution.

Simply attach a 3/8"-diameter rare-earth magnet to the head. It allows the square to rest in place, no hands needed.

Charles Mak,
Calgary, Alberta



Keep the Correct Allen Wrench Always at Hand

Every power tool in my shop requires an Allen wrench for adjusting or removing components. The problem is, each one is a different size, and some are metric while others are Imperial. I used to spend a lot of time finding and trying various Allen wrenches before finding the one that fit.

Finally, I got smart and glued a rare-earth magnet, with the appropriate Allen wrench attached, to each tool. End of problem.

Bill Wells,
Olympia, Washington

Rice Bags as Base Stabilizers

Some machinery, such as dust collectors and band saws, are somewhat top-heavy and can be a little tippy

To help overcome this slight nuisance, try placing a sand- or gravel-filled rice or bean bag on the base.

These type of bags are usually lined with plastic, which keeps the small grains of sand from escaping, and they have strong, durable handles.

I have also found these sand- or gravel-filled bags to be very useful in large flat glue-ups to press seams level.

Fr. Chrysanthos Agiogregorities,
Etna, California

Finishing Before Glue-up

I had a mortise-and-tenon project on which I wanted to finish the parts before assembly. But finish can contaminate the bare wood of the joinery surfaces and prevent a good glue bond.

I applied masking tape to the tenons, of course. But the 1/4"-wide mortises were difficult to tape off. Instead, I cut lengths of 1/4"-thick plywood and tapped them into the mortises, leaving them proud at the top so I could easily pull them out after the finish dried.

With the tape removed from the tenons and the plywood pulled out of the mortises, I had nice, clean surfaces for the glue joints.

Another plus is the finish allows glue squeeze-out from the joinery to be easily wiped away with a damp rag.

Robert S. Grisso,
Salem, Virginia

On-hand Straightedge

A straightedge is handy in every shop, but I don't think you need to spend money on a machinist's straightedge.

Instead, use your jointer plane (or whatever your longest plane is) as a straightedge. These 22"- to 24"-long tools are more than accurate enough for woodworking.

For the greatest accuracy, take a reading of a surface with the tool on the corner between the sidewall and the sole – you'll easily be able to see where the low and high spots are.

Christopher Schwarz,
Fort Mitchell, Kentucky

Welding Pencil on Dark Wood

If you have trouble seeing layout lines on dark wood, stop by the welding supplies area of your local home center and pick up a welder's pencil or two. These silver pencils show up great on walnut, ebony and the like.

Derek Olson,
La Crosse, Wisconsin

ILLUSTRATIONS BY MARY JANE FAVORITE

Avoid Frustration While Sanding Thin Veneer

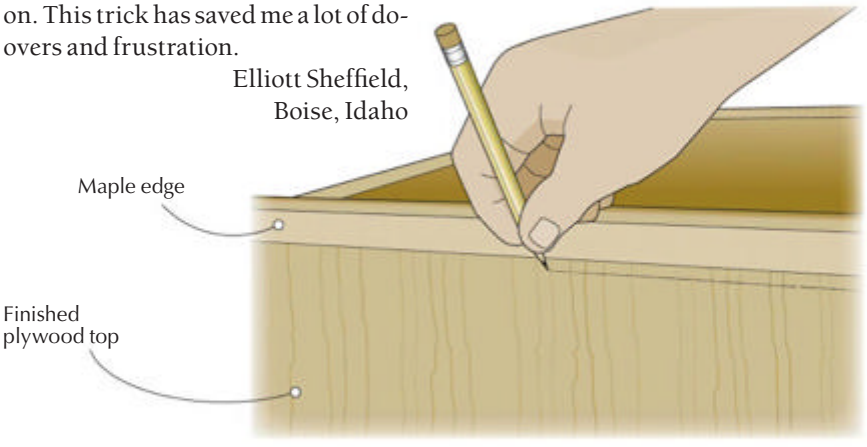
I have been using ¾"-thick birch plywood with an applied maple edge to make some wonderfully grained conference tables and workstations – but there is one issue I have had to learn to deal with.

With the finish veneer on plywood products getting so thin these days, it is easy to sand through the first layer and ruin the look of the top, creating a "do-over." I hate do-overs.

After installing the maple just a fingernail proud of the plywood, I make a #2 pencil line ¼" in from the maple edge on the plywood top.

While sanding the edging flush, as the line begins to fade it's time to move on. This trick has saved me a lot of do-overs and frustration.

Elliott Sheffield,
Boise, Idaho



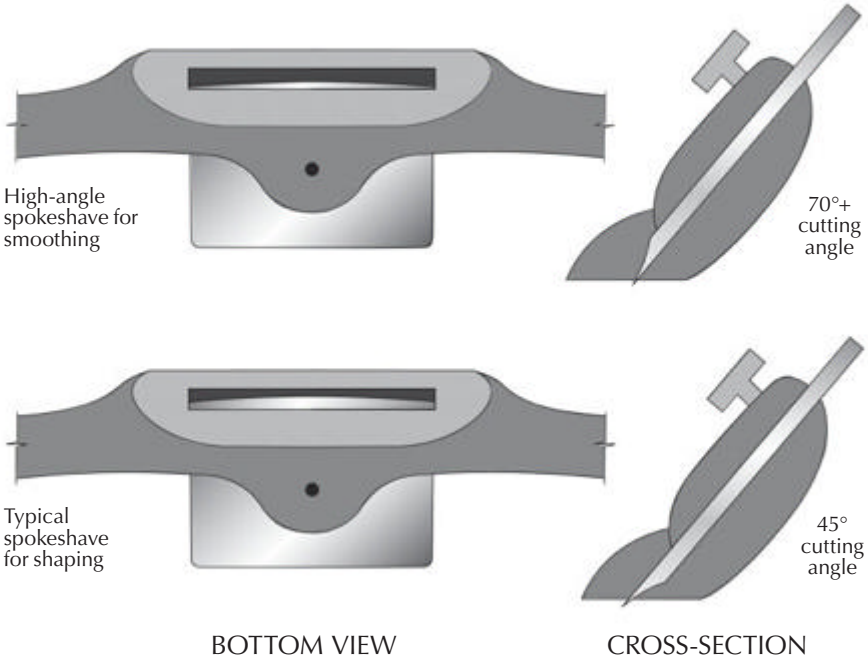
Spokeshave as Scraper On Curved Surfaces

Card scrapers work poorly on curved surfaces with tear-out; they tend to ride the low spots created by deep tears. To overcome this problem, I always work with a pair of spokeshaves. The trick is that one of the spokeshaves should have its blade flipped bevel-up, adding 25° to 30° to the cutting angle.

Every spokeshave I've used will allow you to flip the blade. On a typical spokeshave, this equates to a 70° to 75° cutting angle, which will produce zero tear-out in virtually any wood.

So work with a pair of spokeshaves: one set up bevel-down for shaping and stock removal, the other with its blade bevel-up for a light, tear-out-free finishing cut. **PWM**

Joe Powers,
Palo Alto, California



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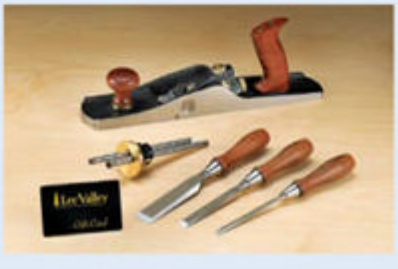

Kreg Precision Router Table

Simple micro-adjust feature and a solid base make this one a contender.

Some router tables have gotten so complex and expensive that they actually rival a decent shaper. I've always preferred simple router tables, so I was curious to assemble and use the new Kreg Precision Router Table.

Like most Kreg products, the parts are well-made, nicely finished and fit together with little fussing. In particular, the base is made from heavy, well-finished steel. And the 1"-thick tabletop is smooth and flat. All the components bolt together, so I recommend you add a little thread-locking fluid to the nuts and bolts to keep the base solid through years of use (router tables tend to vibrate a bit).

Let's start by looking at the tabletop. It's made from a high-pressure laminate over an MDF core. To keep the top from sagging under the weight of a heavy router (or lift), Kreg includes two heavy folded steel supports below that stiffen the top.

The included 3/8"-thick insert plate is made from phenolic and stayed flat when I hung a heavy 1 3/4 horsepower router on it. The insert plate needs to be drilled and counterbored for your particular router, or you can ask Kreg to do it for you. The plate is leveled to the tabletop with eight Allen-head screws and secured with four machine screws.

The router table comes with three plastic throat inserts that have different openings for large and small bits. They lock and unlock cleverly with an included tool. Finally, there is an aluminum T-track at the front of the table so you can use a coping sled or other shop-made accessories that use a miter bar.

One of those accessories is the included router table fence. Surprisingly, it locks like a T-square fence for a table saw on the right-hand side of the table. Then you lock the left end of the fence with a toggle. This system allows the fence to stay parallel to the miter slot, which is handy for cope cuts.

The T-square fence moves smoothly and allows you to square it – both to the miter slot and to ensure the fence is 90° to the table (a nice touch). One of my few beefs with the fence is the toggle clamp on the left end. After setting it to lock nicely, it would loosen up after a couple of operations on the router table. An F-style clamp can fix that problem, or perhaps a little rosin on the threads of the machine screw that locks everything.

One of the nicest features of the fence is its micro-adjust knob. Normally, these are too complex to be effective. The Kreg is ingenious, dead-nuts simple and doesn't get in the way when it's not needed. The fence also includes a decent dust-collection port, a guard to keep your fingers intact and the aluminum T-track on its top so you can add a variety of stops and accessories, such as featherboards.

At $499, you would be hard-pressed to build a router table this nice without some serious scavenging for parts. So if you want a table that is simple, well-made and gets you to the part where you are making furniture (not shop appliances), the Kreg is real contender.

— Christopher Schwarz

CONTINUED ON PAGE 16

Heavy-duty. *The steel base of the Kreg router table helps it stay put when you are running heavy stock, one of its many advantages over benchtop units. Plus, the simple micro-adjust feature allows you to make tiny changes with surprising and measurable ease.*

Precision Router Table

Kreg ▪ kregtool.com or 800-447-8638

Street price ▪ from $499

▪ **BLOG** *If you don't want to own a router table, check out this solution.*

Price correct at time of publication.

PHOTOS BY THE AUTHOR

I CAN DO THAT

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Learn the simple skills and tools you need to build great-looking projects in our new "I Can Do That" video series, with host Chad Stanton. Each episode is free on the PWM site for four weeks.

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CONTINUED FROM PAGE 14

Texas Heritage Woodworks Auger Bit Roll

I've been looking for a long time for the perfect storage and transport solution for my auger bits. For a while, they were wrapped in kitchen towels – less than ideal. I have two of my grandfather's old canvas tool rolls, but they both have holes in them where pointy bits have poked through over the decades. I have a couple leather ones, which work fine, but are somewhat heavy and bulky. And I have one sailcloth one I sewed myself (it works, but it is embarrassingly ugly; sewing is not among my talents).

But, I recently bought (at full price, of course) a waxed canvas auger bit roll from Texas Heritage Woodworks. It is extremely well-made, with double-stitched seams and hand-peened, copper-riveted stress points (the four corners of every pocket), and a supple leather tie that wraps around the roll to keep everything in place.

The roll has 15 full-size pockets that accommodate a full set of standard auger bits, and five small pockets for other brace accessories such as spoon bits and driver tips.

With the pockets fully loaded, it rolls up to a snug 3½" or so in diameter, which fits nicely in the second tray of my tool chest (or in a drawer).

Like all Texas Heritage Woodworks products, the auger bit rolls are made by the company's owner, Jason Thigpen, who recently turned his hobby into a full-time job.

Yes, at $85 it is a little spendy, but given the workmanship, I think that's a more than fair price for something that is well-made, maker-made and will keep my bits protected for years to come. In fact, I like the auger bit roll so much that I'm about to place an order for a tool roll as well, to hold a set of chisels.

— Megan Fitzpatrick

Auger Bit Roll

Texas Heritage ▪ txheritage.net

Street price ▪ $85

▪ BLOG *Read about the company's tool roll.*

Price correct at time of publication.

Trend Diamond Whetstone Honing & Polishing Kit

To be frank, I'm not a fan of sharpening hand tools using diamond systems because I don't find the final edge as ideal as one produced on oilstones or waterstones. That said, the new Trend Diamond Honing & Polishing kit (DWS/KIT/B) gets so many things bang-on correct that it is worth recommending for beginners.

For starters, for a $200 investment, you get everything – everything – you need to grind, hone and polish tools. There's nothing else to buy.

The heart of the system is a two-sided diamond plate. One side is #300 grit (50 micron) for occasional grinding; the other is #1,000 grit (10 micron) for daily honing chores. The stone is lubricated by a light petroleum-based oil (included) that keeps the stone free of rust and swarf. Plus, you get an eraser for cleaning the stone.

The second important part of the system is a honing guide and angle-setting jig. This side-clamp guide is worlds away better than a typical Eclipse guide. It clamps tools up to 2½" wide securely, but has two flaws. It runs on a wide 2½" roller, which is great for straight edges, but prevents you from cambering bench plane irons. Second, it won't hold a blade for a No. 8 and some odd-shaped tools. But all-in-all, it's great for beginners.

Also included is a leather strop with honing compound for a final polish. Stropping a diamond edge will improve its cutting action, but it doesn't produce as durable an edge because of the remaining deep diamond scratches.

You also get an instructional DVD and handy carrying case. In all, it's a good product for people who work in the field or are just starting out. As you become more skilled, you'll want to add finer stones to the system to chase after edges that produce perfect surfaces. PWM

— CS

Honing & Polishing Kit

Trend ▪ trend-uk.com or 877-918-7363

Street price ▪ from $200

▪ BLOG *What do sharpening scratches look like? Check it out in this blog post.*

Price correct at time of publication.

PHOTOS BY AL PARRISH

The Soup-can Curve

We've all done it – but speed does have disadvantages.

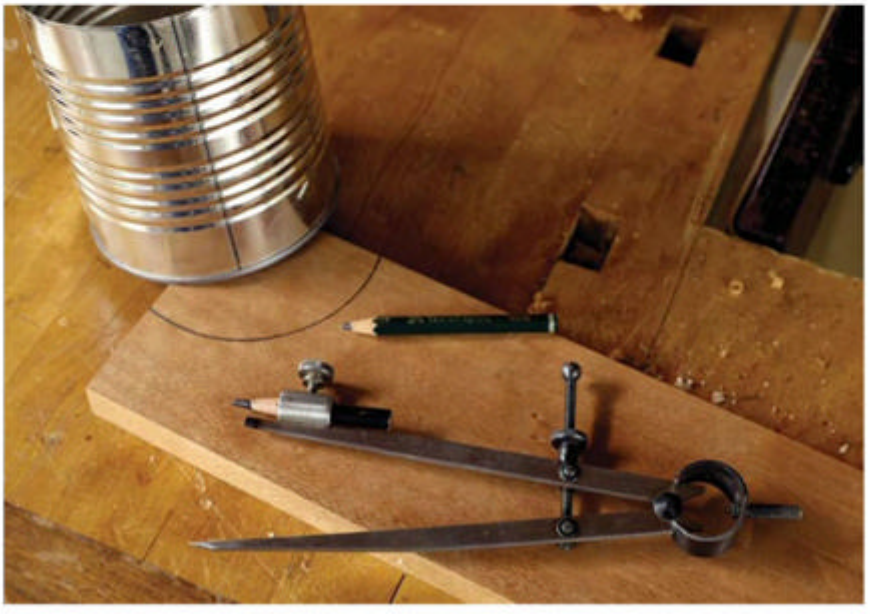
We might admire a graceful curve in nature without understanding what lends it a sense of spring and vitality. Small details can often make the difference between a curve that sings and one that just seems to plod along.

If you're like me, you may have reached for a coffee cup or soup can to trace a curve to guide a saw cut. For a smaller arc, we might fish out a nickel; for a larger arc, we grab a bucket or paint can to trace.

One woodworker shared with me that she used a circular drip pan from a water heater to trace an arc. This method has one primary advantage that cannot be discounted – speed. Just grab that coffee cup off the shelf (being careful not to spill), trace a pencil line around the rim and go.

Yet all arcs traced from a soup can are not equal. There are a few subtle points that lend a natural and organic feel to a curve. Once you understand this, it's a bit of a curse. You'll spot an awkward mechanical-looking curve and think to yourself, "soup-can curve."

Lively curves. *Nature is our model. It is replete with curves that effortlessly carry the eye and have a sense of life.*



It's fast, but ... *If speed is your need, a soup can provides a quick template to trace a curve on that bracket foot. But is there a better way?*

A View Askew

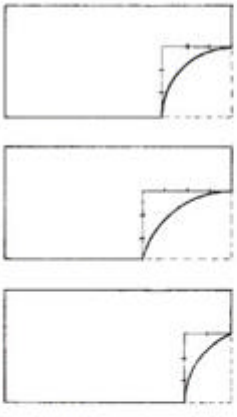
It makes no difference what tool you use, an arc is just a portion of a circle and it doesn't matter whether you trace the rim of a garbage-can lid or draw it with a compass.

I prefer a compass layout for two important reasons. It can be adjusted to any size arc, and, more important, a compass layout helps ensure that the arc has an organic feel to it, and is not static and mechanical looking.

Just how do we avoid a curve that seems forced or artificial?

First, it's important to realize a few things our eyes naturally key on. We all have an awareness of when things are plumb and level. A slightly tilted picture on a wall can drive us batty. Even when we've used a carpenter's level, we still step back and confirm it with our eye.

When it comes to curves, our eye will pick up on any curve that springs up from a straight vertical and flows into a true horizontal. This tends to look static and mechanical, or "soup can."



Rites of spring. *The arc on top is defined by a square and has a mechanical feel to it. The other two have a bit of spring. Note they both fall short of either connecting true vertical or true horizontal.*

Another way to visualize it is that an arc that springs tangent from vertical and flows tangent into horizontal is defined by a square – the height is equal to the width or extension. Perhaps that's what lends it the mechanical feel.

If you observe curves springing from

CONTINUED ON PAGE 20

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W1820 10" Table Saw with Long Ext. Table

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16953

CONTINUED FROM PAGE 18

nature, you will note that they often spring slightly askew of true vertical or end just shy of horizontal. Take a look at the curves in mouldings on traditional furniture. If you observe closely, you will notice the height of the curve compared to its width is not the same, thus it is not defined by a square.

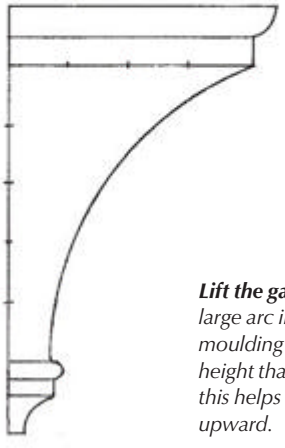
To create a lively looking curve, you want something that appears to spring in motion and flow upward. It's OK to have a curve spring from vertical, but it will have more lift if it ends just shy of horizontal.

Conversely, a curve can flow into a horizontal line, but it will feel more organic if it begins slightly askew from vertical. The key is to not begin at vertical and end at horizontal with the same curve.

Practical Layout Strategies

First, establish the starting and ending points of an arc by asking: what is the curve's function? Do you want it to tie seamlessly into a horizontal line like the cutout that spans a cabinet base? In that case, you might spring it up slightly askew from vertical, then let it flow tangent to a horizontal. This arc will be shorter in height than width.

Or, is this curve meant to carry the eye upward like a large cove in a crown moulding? That curve springs tangent to vertical, but ends just shy of horizontal and will be taller in height than width. You can experiment with different height-to-width combinations to find that "Goldilocks" arc that feels just right.



Lift the gaze. *The large arc in this cove moulding is taller in height than it is wide; this helps the eye flow upward.*

An arc where the height-to-width ratio is closer together, say four parts high to five parts wide, will have a strong, compact sense to it. Increasing the difference, say three parts high to five parts wide, will result in a more gradual, gentle arc.

Once you have established the beginning and ending points, you need to locate a fulcrum point to draw your arc with a compass.

Here is a simple method for locating an unknown fulcrum when all you know is where the curve begins and ends.

First, understand that any two different radii on a given arc will intersect at the center, or fulcrum point. So all you have to do to find a fulcrum is to find two different radius lines.

To locate a fulcrum for an arc that springs up from straight vertical, you already have one radius line given. Just extend a horizontal line from the spring point or beginning point and know that the fulcrum will lie somewhere along that line.

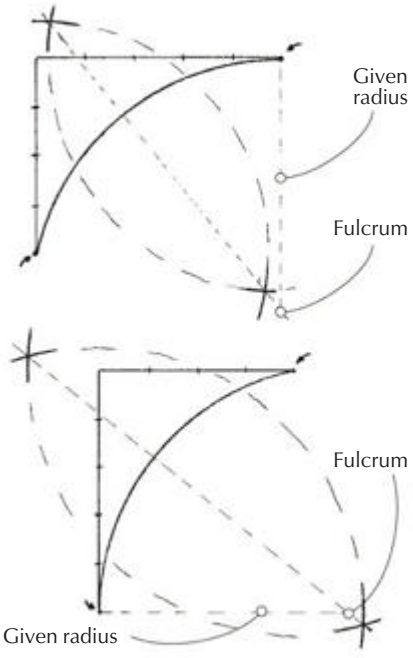
To locate a second radius, open your compass wide and use the beginning and end points of your curve to draw two overlapping arcs. A line drawn through where those arcs overlap is your second radius. Where it touches the given radius is your new fulcrum. Use the same method to find the fulcrum for a curve that terminates at horizontal, but in that case, the given radius is a vertical line dropping from the termination point.

Sharpen Your Inner Eye

OK, I admit that once you understand how to avoid a static-looking curve, you can use that knowledge to trace a graceful arc with just a soup can. But there are other reasons beside the size limitations of the can.

By actually taking your hands and eyes through these simple geometric layouts, you will begin to visualize the arc and its hidden structure (focal point and radius lines) in your inner eye. The ability to visualize is one of the keys to making better design decisions.

So send that empty soup can to the recycle bin. **PWM**



Find the fulcrum. *The given radius springs from the end where the arc runs tangent to vertical or horizontal. Use the end points marked by arrows to draw a pair of intersecting arcs. Connect the intersections with a line and extend it. Where it crosses the given radius is the fulcrum.*

George is the author of two design DVDs (Lie-Nielsen Toolworks) and writer of the Design Matters blog.

ONLINE EXTRAS

For links to all these online extras, go to:

- **popularwoodworking.com/aug15**

BLOG: *Read more from George R. Walker on his Design Matters blog.*

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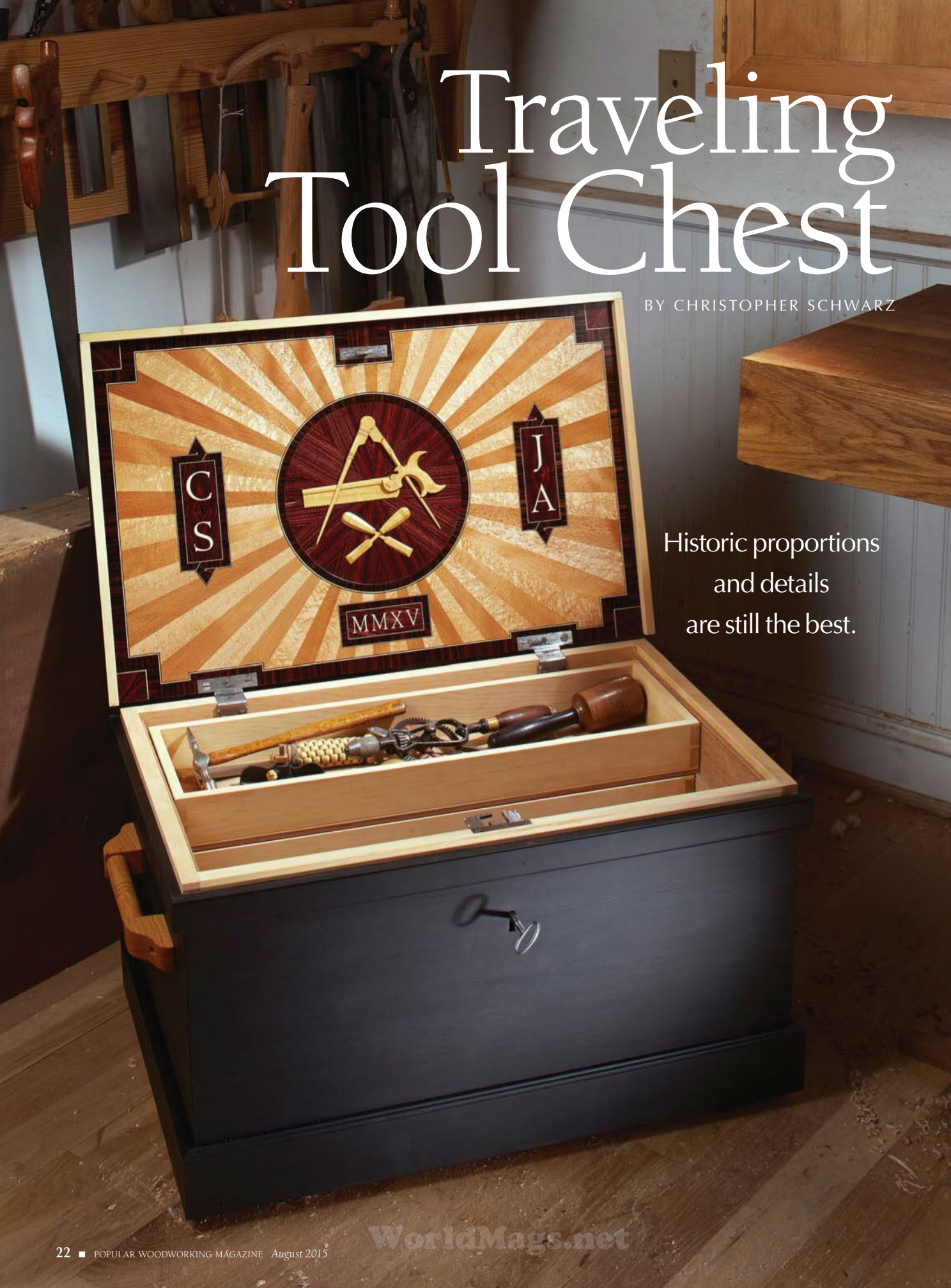
About This Column

Design Matters

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

Traveling Tool Chest

BY CHRISTOPHER SCHWARZ



Historic proportions and details are still the best.

Since I started woodworking in about 1993, I've stored my tools in almost every way imaginable – from plastic buckets to wall cabinets, racks and a variety of tool chests.

After exploring each of these methods, I kept coming back to a traditional tool chest because I have not found a better way to protect and organize my tools. I also appreciate the finite capacity of a tool chest – it forces me to think hard before buying an additional tool.

During most visits to the tool store I conclude: If it doesn't fit in the chest, I probably don't need it.

The Right Chest Size

Tool chests are built in a number of fairly standard sizes that are based on the sizes of typical tools and the limits of our bodies.

Large floor chests are usually about 24" x 24" x 40" and are designed to hold full-size saws and large jointer planes, which can be longer than 30". These chests also hold a full set of moulding planes, bench planes and all the small tools needed to make any piece of furniture. These chests are difficult to move alone, which is a disadvantage if you are by yourself, but is an advantage if someone is trying to steal your chest (the thief needs an accomplice).

Medium-size chests are just big enough to hold panel saws and smaller metal jointer planes – about 18" x 18" x 30" – and can be picked up by one person. It's an ideal size for someone who works alone, has to move the chest on occasion and doesn't require a full set of moulding planes.

This medium-size chest can hold a remarkable amount of tools – two panel saws, three backsaws, the three standard bench planes, a rabbet plane, plow and router plane all fit on its floor. The two sliding trays and rack hold everything else you (should) need.

Smaller chests – the third size – were usually used for site work or by "gentlemen" woodworkers who had a small kit of tools.

The medium-size chest in this article is ideal for someone getting started in woodworking with a small shop and a budding kit of tools. It's easy to build, fairly tough and can easily be transported to schools. When I build tool chests for customers, this is far and away the most requested size.

The gang's all here. *When cutting through-dovetails, I gang-cut the tail boards to save time and effort.*

Ease the entry. *Beveling the interior corners of the tail boards makes assembly easier. And you are much less likely to damage your tails when driving them into the pins.*

How it's Built

The carcase is dovetailed together – the strongest joint available. The bottom boards are, however, nailed onto the carcase so they are easily replaced if they rot. Speaking of rot, the entire chest sits on two oak "rot strips" screwed to the bottom boards, keeping the chest off a wet floor.

The bottom and top skirts on this chest are mitered and nailed to the carcase. I typically dovetail the skirts at the corners, but a well-made miter can survive just fine.

The lid is a thick panel that is surrounded by a dust seal on three sides; the seal pieces are dovetailed at the corners because this area of a tool chest takes heaps of abuse.

Most of the carcase is made from a lightweight and inexpensive wood such as pine. The parts that will see heavy wear are oak. We'll discuss the interior fittings after we get the carcase complete.

Make the Shell

Join the corners of the carcase with through-dovetails – six dovetails at each corner are suitable for a chest this size. Smooth the inside faces of the boards and assemble the carcase. Once the glue is dry, level the joints and remove the tool marks from the case's exterior.

Now fetch the pine bottom boards. The grain should run from front to back in the chest (for strength), and the long edges of the boards should have some sort of joint to accommodate wood movement. I used the tongue-and-groove joint. Then I cut a 3/16" bead on the tongue boards as decoration.

Attach the bottom boards to the carcase with 6*d* headed nails – I used cut clouts. Be sure to leave some room between the boards for expansion and

Long sleeves. *Sleeve the assembled carcase over your benchtop to make it easy to level the front and back of the chest.*

Groove your bottom, then tongue it. *I use a tongue-and-groove plane to cut the joints on the long edges of the bottom boards. This plane cuts both the male and female bits.*

LEAD PHOTO BY AL PARRISH; STEP PHOTOS BY THE AUTHOR;
ILLUSTRATIONS BY DAN PESSELL FROM THE AUTHOR'S MODEL

Tweaked. *If your carcase isn't square, clamp across the long diagonal to pull it square while you nail on the bottom boards.*

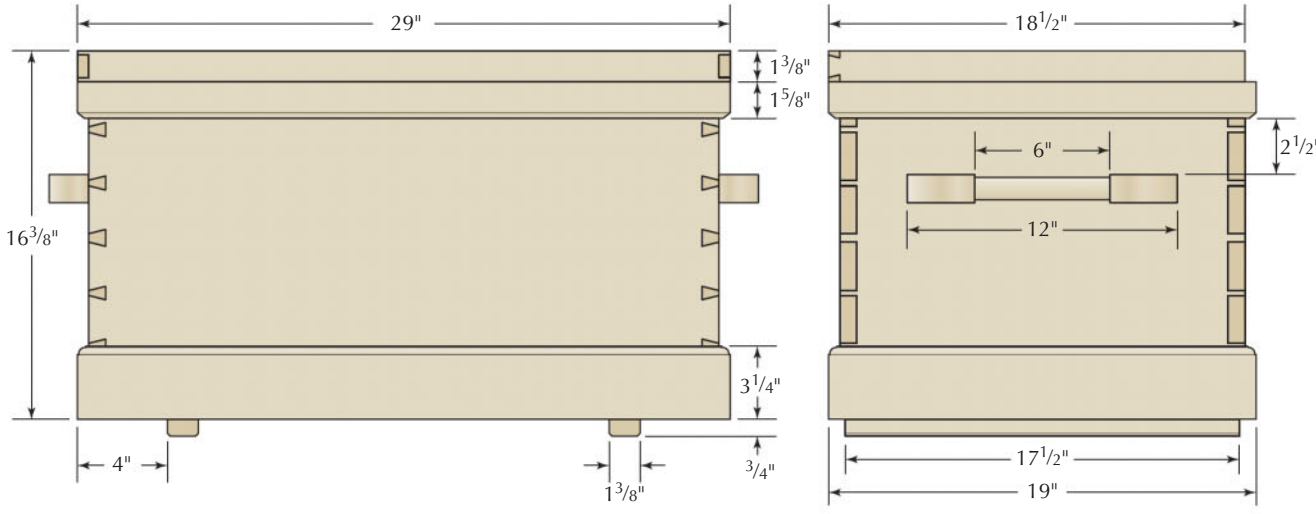
Resist rot. *Either make your rot strips impervious to water (plastic would work, too), or make them so they will rot off immediately by using pine and iron nails. Either way works.*

contraction. Trim the bottom boards flush with the carcase.

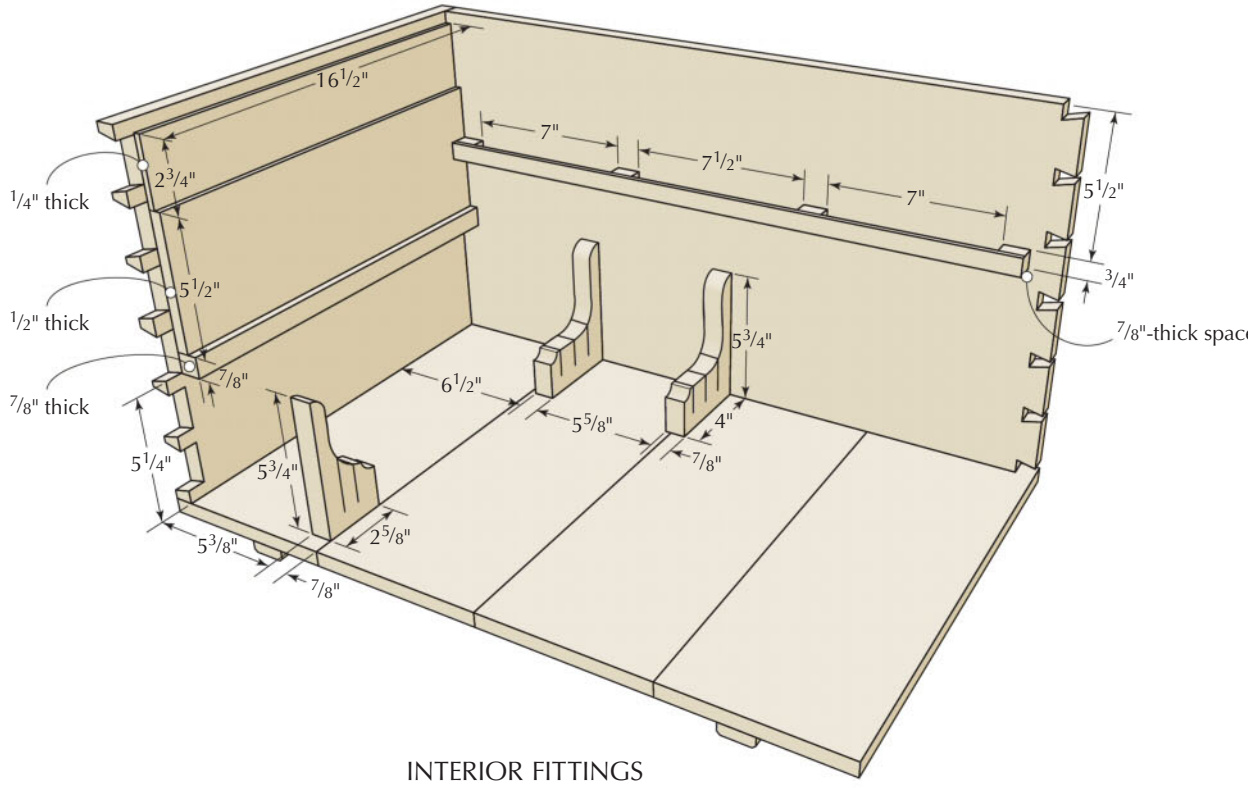
The last bit on the shell is to attach the rot strips to the underside of the bottom boards. I use water-resistant white oak and attach it to the bottom with waterproof glue and brass screws. After finishing, I oil and wax these rot strips to make them repel water.

Mitered Skirting

The bottom skirt protects the carcase from kicks and bumps. The top skirt



ELEVATION PROFILE



INTERIOR FITTINGS

helps seal the interior from dust and protects the lid's dust seal. The skirting is 1/2"-thick stuff that wraps around the entire carcase and is mitered at the corners.

Before cutting the miters, however, cut any moulding or bevels. These are not just decorative – a 90° corner is fragile and will quickly splinter off in the shop. I used a 3/8" square ovolo on the bottom skirt. The top skirt has a 1/8" bead on its top edge and a 30° bevel on the bottom edge.

Now attach the skirting to the carcase. I miter moulding with a miter box, which I find more accurate than power equipment. All the miters here were assembled right from the saw. That's not because I'm awesome; it's because a miter box allows you to put a sawtooth right on a knife line.

Glue and nail the skirting to the carcase – don't forget to apply glue to

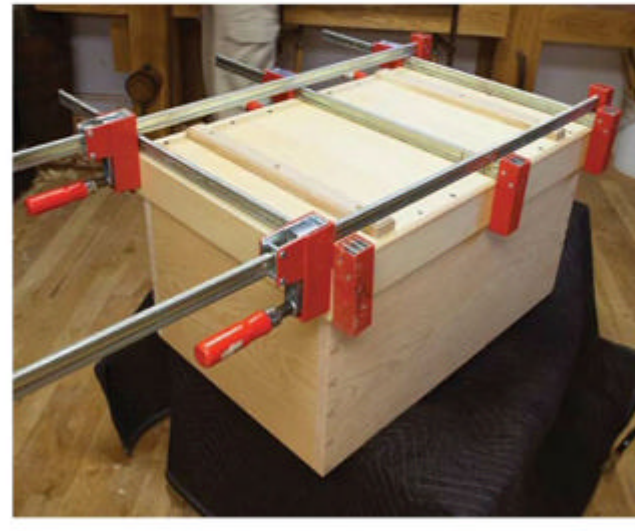
Completely stuck. *Mould the entire stick of wood before cutting it apart for mitering. This ensures the moulding will match at the corners.*

Miters all around. *I begin mitering at one front corner of the chest. I get that joint perfect, then I make my way around the carcase.*

Traveling Tool Chest

NO.	ITEM	DIMENSIONS (INCHES) T	W	L	MATERIAL
❑ 2	Front/back	3/4	14 7/8	28	Pine
❑ 2	Ends	3/4	14 7/8	18	Pine
❑ 1	Bottom*	5/8	28	18	Pine
❑ 2	Rot strips	3/4	1 3/8	17 1/2	Oak
❑ 2	Bottom skirt, front/back	1/2	3 1/4	29	Pine
❑ 2	Bottom skirt, ends	1/2	3 1/4	19	Pine
❑ 2	Top skirt, front/back	1/2	1 5/8	29	Pine
❑ 2	Top skirt, ends	1/2	1 5/8	19	Pine
❑ 2	Chest lifts	1 1/4	1 3/4	12	Oak
❑ 1	Lid panel	7/8	18 1/16	28 3/8	Pine**
❑ 1	Dust seal, front	1/2	1 1/2	29	Pine
❑ 2	Dust seal, ends	1/2	1 1/2	19	Pine
INTERIOR FITTINGS					
❑ 2	Bottom runners	7/8	7/8	16 1/2	Oak
❑ 2	Middle runners	1/2	5 1/2	16 1/2	Oak
❑ 2	Top runners	1/4	2 3/4	16 1/2	Oak
BOTTOM TRAY					
❑ 2	Front/back	1/2	5 1/8	25 3/8	Pine
❑ 2	Ends	1/2	5 1/8	8	Pine
❑ 1	Bottom	1/4	8	25 1/2	Oak
TOP TRAY					
❑ 2	Front/back	1/2	2 1/2	25 7/8	Pine
❑ 2	Ends	1/2	2 1/2	8	Pine
❑ 1	Bottom	1/4	8	26	Oak
TOOL HOLDERS					
❑ 1	Panel-saw till	7/8	2 5/8	5 3/4	Oak
❑ 2	Backsaw tills	7/8	4	5 3/4	Oak
❑ 1	Rack, front piece	1/4	3/4	25 1/2	Oak
❑ 4	Rack spacers	5/8	3/4	1	Oak

*Made from multiple boards; **Plywood if making a marquetry lid



Yes, clamp. *Glue the short grain of each miter and clamp it at the corners. The glue will have more strength this way.*

the miters themselves. Then clamp the corners while the glue dries. At this point I would typically work on the lid and its dust seal. But because Jameel Abraham was working on the lid panel (you'll see that article in the next issue of this magazine), I fitted out the interior with trays, saw tills and a rack.

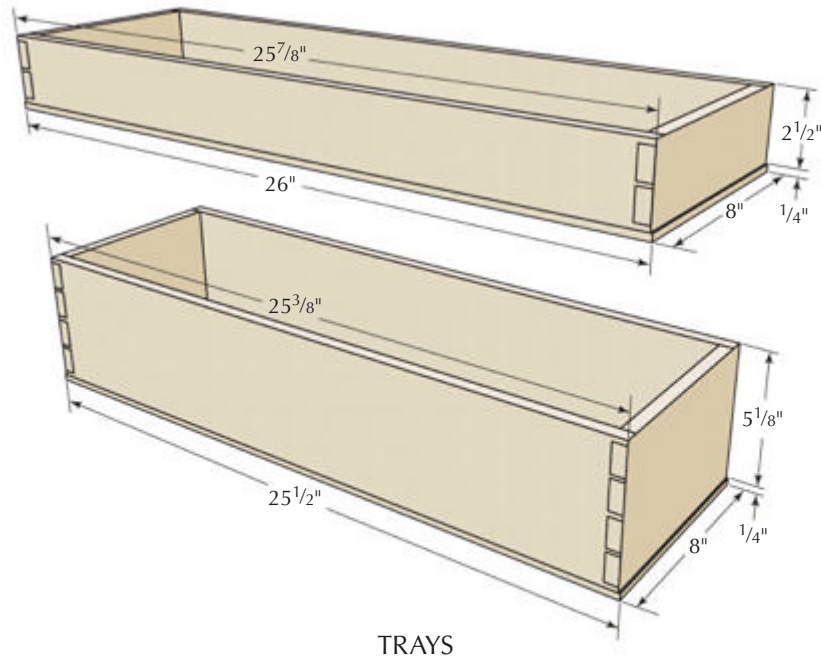
The Interior

The arrangement shown in this chest is typical and works well. On the floor of the chest are two small saw tills – one for backsaws and the other for two panel saws. I like these tills because they take up little space.

Floating above the floor are two sliding trays – one deep and one shallow. The deep tray is for bulky tools such as the brace and bit, plus anything in a tool roll. The top tray is for all the small tools you use every day – layout tools, a block plane, a mallet, hammer and wax, for example.

This high. *The 5¼"-wide spacer acts as a shelf when installing the runner above it. The 5¼" height is critical for holding standard bench planes below the bottom tray.*

Smooth-sliding bottom. *The bottom boards are the only part that touches the runners. So shoot them to perfect length until you get the sliding action you want with zero racking.*



TRAYS

The walls of the trays are made from pine. The bottoms and the runners they slide on are made from oak to resist wear.

On the back wall of the chest is a simple rack for holding chisels and other small or handled tools – dividers, combination squares and screwdrivers.

Install the Runners

The sliding trays run on oak runners that are affixed to the inside of the carcase. There are three layers of runners for the two trays, all of different thicknesses and widths so that the trays can be pulled up and out of the carcase.

The lowest runners are installed 5¼" from the floor of the chest – that gives your bench planes the headroom they need. I install these lower runners by first making a spacer board from some scrap that is 5¼" wide (see photo at left). I use that as a temporary shelf to hold the lower runners in position while I glue and nail them.

After the lower runners are installed, remove the spacer and install the runners above, also with nails and glue. I cut a small bead on the top edge of each to protect the corner from damage and to spruce up the interior a bit.

Build the Trays

The trays are dovetailed at the corners and each has a thin oak bottom that is nailed on. The interesting detail here is that the finished trays are ⅛" smaller than the bottoms are long. In other words, the bottoms are 1/16" proud on either end of the assembled trays.

Proud bottom. *Here you can see how the bottom protrudes from the end of the tray, making the tray a cinch to fit.*

SUPPLIES

Tremont Nail Co.
tremontnail.com or 800-835-0121

1 ▪ 6*d* clout nails
#CT6, $12.71 (1 lb. box)

Peter Ross, Blacksmith
peterrossblacksmith.com,
919-663-3309 or
peter@peterrossblacksmith.com

2 ▪ Chest hinges

1 ▪ Crab lock

Call for pricing.

Rack at the back. *This simple rack can hold a variety of tools. My other favorite form of rack is a board that is poked with 1/2"-diameter holes on 1 1/8" centers.*

Quick saw till. *Kerf the block of wood for the saws, then shape the block so it looks nice (top). Then screw it to the side of the carcase and to a bottom board (bottom).*

Loading up. *The backsaw till offers more protection than the panel-saw till because backsaws are more fragile.*

This detail makes the trays easy to fit. You only have to get the bottoms to slide smoothly on the runners. The trays never touch the runners or interfere with the sliding action.

So fit the bottom boards so they are a close but smooth fit on the runners.

Now dovetail and assemble the trays. Then nail or screw the bottoms on. If you need to use multiple boards for the bottoms, shiplap the joints at their mating edges.

Racks & Tills

I like simple racks and tills for my chests because that leaves more room to arrange the tools. The rack on the back wall is made from scrap bits of oak that I glued together, then screwed onto the back wall with No. 8 x 1 1/4" screws.

The saw till for the panel saws is simply one piece of oak with two kerfs cut into it. One kerf is for the crosscut saw and the second for the rip saw. This till holds the saws at their tips. The weight of the handle and the teeth at the heel of the saw prevents the tools from whipping around in the chest.

The till for the backsaws is made and attached in the same manner. The only difference is that there are two blocks of wood and three kerfs in each for the dovetail, carcase and tenon saw. This till is at the back of the chest.

Chest Lifts

While you should carry your chest by holding its bottom (or put it on a cart), the lifts help you get the chest into position or to balance your load. Each lift is made from a single piece of oak that looks like a dog's bone when you begin. You turn down the center to make a handle. Then shape the ends of the "bone" to make them look nice. I used a simple ogee curve.

The proper way to attach the lifts is to screw them in place from both the outside and the inside of the chest. The screws from the outside pass through the narrow ends of the lifts. The screws

Screwed either way. *Affix the lifts with stout #8 screws from both the inside and outside of the carcase.*

Turn the bone. *The center section of the dog bone is turned down to 1" diameter. Then remove the piece from the lathe.*

Rasp the bone. *Then shape the ends of the lifts. This shape leaves plenty of meat for the screws to bite into.*

from the inside are driven into the thick part near the handle.

The Lid

If you are skipping the marquetry panel, make the lid from a softwood that doesn't move much, such as one of the white pines. And glue it up from several pieces of quartersawn or riftsawn stock to further reduce seasonal movement.

After cutting the panel to size – it's a bit larger than the rim of the carcase – attach it to the carcase with hinges. With the lid in its final position, you then can build the dust seal around it to create a perfect fit.

After building about 20 of these chests, I have found a better way to make the dust seal fit. I rabbet each piece until that piece fits perfectly flush with the top skirt and the top edge of the lid. I can adjust this fit in tiny increments with a shoulder plane.

Then, once all three pieces of the dust seal fit perfectly, I dovetail them together at the corners.

> "There'd be as many as 60 cabinet makers in some of these rooms and they all had these chests all painted black and if you opened them up, oh inside would be veneered and all the trays in mahogany with lids on them. Beautiful."
>
> *— from "Memories of Waring & Gillow of Lancaster. An Oral History by Gillow Craftsmen 1928 to 1962," by Pauline Bell*

I attach the seal using a combination of glue and nails. Glue and nail the front edge of the dust seal to the lid. To attach the "returns" along the ends of the chest, use glue and nails along the front 4" of the lid. Then use nails alone for the rest. This fastening method allows the top to move.

To keep the chest secure, I installed a traditional crab lock – a blacksmith-made lock built for chests that allows for some wood movement. They are easy to install because they are surface-mounted to the inside of the chest. And they are gorgeous.

Keyholed. *The only tough part about installing a crab lock is cutting a well-placed and crisp keyhole. I bore the hole for the round part of the key. Then I cut the remainder with a chisel.*

The Best Finish

Almost all traditional tool chests were painted. It is the most durable and easy-to-renew finish. You can use any paint you like – milk paint, oil paint or latex. Paint the outside of the chest, but leave the inside of the chest bare – or use a coat of wax alone if you like.

If you insist on a film finish for the inside, use shellac. Please avoid oils – they will stink forever.

Once your chest is complete, my final caution is to avoid bringing it into your house. Many chests like this begin their lives intending to hold tools but somehow end up at the foot of the bed stuffed with blankets and doilies. A sad situation, indeed. **PWM**

Christopher is the editor at Lost Art Press and is the author of "The Anarchist's Tool Chest."

Rabbet the seal. *The rabbet on this piece of the dust seal allows you to sneak up on the perfect fit all around.*

Rabbeted dovetails. *This joinery looks a little involved, but it's actually simple. Begin by cutting a tail on the seal, then show it to its mate. You'll then know what to do.*

ONLINE EXTRAS

For links to all online extras, go to:

- **popularwoodworking.com/aug15**

VIDEO: *Take a short video tour of the chest.*

BLOG: *Read more about making "dog bone" chest lifts.*

BLOG: *Read about a commercial crab lock.*

PLAN: *Download a free SketchUp model of the traveling tool chest.*

TO BUY: *"Build a Traditional Tool Chest in Two Days," a video by Christopher Schwarz available on DVD or as a digital download.*

Our products are available online at:

- **ShopWoodworking.com**

Shop-made Saw Vise

BY JASON THIGPEN

Combine wood, leather and steel for a new take on an old tool.

If you sharpen your own handsaws, a proper saw vise is an essential tool. The jaws on a saw vise clamp down tightly on the saw plate, holding it securely as you file each tooth. A well-built saw vise will absorb vibration and chatter, resulting in faster filing, longer file life and better results.

There are a handful of new vises in production today and vintage versions are plentiful. Vintage versions are great, but damage and wear can pose problems. The clamping mechanisms on a lot of old vises are a weak spot, either broken or worn past the point of use.

After months of searching for a well-made unit that wouldn't require a lot of rehab, I began to design my own saw vise. The result is a vise that not only has a classic look, it is a workhorse that has greatly surpassed the performance of any other vise I've tried, new or old.

All you need to make it are a few off-the-shelf components and a weekend. You can use any hardwood you like, provided it's straight-grained rift-sawn or quartersawn material. For this vise, I used some hard maple and white oak scraps.

Clamping Mechanism

This shop-made saw vise excels due to a few key features that all work together. The heart of the system is the 5/8", eight threads-per-inch Acme-threaded screw and wing nut. Acme thread is capable of applying a great deal of force, and the threads won't gall, strip or weaken over time.

I used this combination with great success on a Moxon vise I built during the past year. The wing-nut assembly can be easily made if you have access to a welder. If not, buddy up with a local welder and have him or her fabricate one for you. It's simple and straightforward.

Using a hacksaw, cut a 4 1/2" length of threaded rod. Weld a nut on one end, creating the threaded post. For the wing nut, cut two 2 1/4"-long pieces

PHOTOS BY THE AUTHOR; ILLUSTRATIONS BY DAN PESSELL FROM THE AUTHOR'S MODEL

Ready for welding. *I chuck the handles in my drill press and buff them to a sheen using progressively finer grits of sandpaper. After welding, I apply gun bluing.*

of 1/2" rod. One end needs to be flat, while the other gets a bevel of around 25°. (I've found 25° is just the right angle to provide a solid grip while remaining low profile.) A simple wooden jig holds the components in place while they are welded together. Then apply a coat of gun bluing to the hardware, followed by a few coats of 3-in-1 oil.

(Editor's note: McMaster-Carr sells "Acme Handle Nuts" if you wish to buy rather than make a handle.)

Jaw Prep

I used a single piece of 8" x 18" 8/4 rift-sawn white oak for the jaws, ripping the piece in half after the following steps.

My longest backsaw is 16" long and my largest handsaw is 28" long. The 18" jaw length of the saw vise allows me to sharpen every backsaw I own without repositioning them. My handsaws only have to be repositioned once. Only the top 1" section of the jaws will contact the saw plate.

To accommodate the thicker back on a backsaw, cut a 1/4"-deep recess in all but the top 1" of each jaw. This is best accomplished with a stacked dado set on the table saw.

With the fence set 1" from the blade, make your initial pass on the jaw, then rotate the workpiece and make a pass on the other long edge. Incrementally move the fence away with each successive pass until the recess is complete.

Change to a rip blade, then rip the piece in half. You are left with two jaws that are 4" x 18", and each has a 1"-wide "grip" at the top.

The jaws are shaped to work with the saws in my arsenal. I prepared a template for the jaws using posterboard, then placed each saw I own on it to simulate the actual filing position.

I marked where the handles interfere with the vise jaws, then used those marks to dictate the shape of the jaws. Using a combination of drafting templates, I sketched out a shape that is both pleasing and functional. The tops and backsides of each jaw are angled so I can get up close with my saw files, adding slope to my gullets if needed.

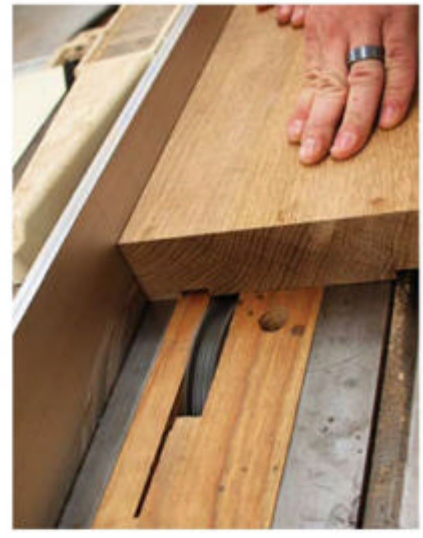
Mark a 1/4" flat along the jaw face, then two bevels on the edges. Then mark and drill 1 1/2"-diameter holes for the inside corners of the jaw cutaway. Rough out the chamfers on the band saw; clean up the cuts with handplanes.

The goal is to remove as much "visual" weight from the vise as possible while retaining its mass and strength where needed (similar to the concept behind Windsor chair seats).

Once the bevels are done, cut the jaws to shape at the band saw, then clean up the cuts using a combination of rasps, files and scrapers.

Leg Prep

The legs are built from 6/4 hard maple and are cut to a final width of 4". I machine all of the components to almost



Quick work. *Hogging out the excess using a stacked dado set is the most efficient stock removal method to create the jaw's recess.*

Cleaning time. *I use a high-angle smoothing plane to clean up all of the jaw surfaces after rough shaping. The 60° tool works well on white oak, leaving behind a glassy surface.*

Shape shifter. *A custom template for your vise jaws allows you to play with a multitude of shapes and configurations. Find one that accommodates all of your saws while leaving mass in the center where it's needed.*

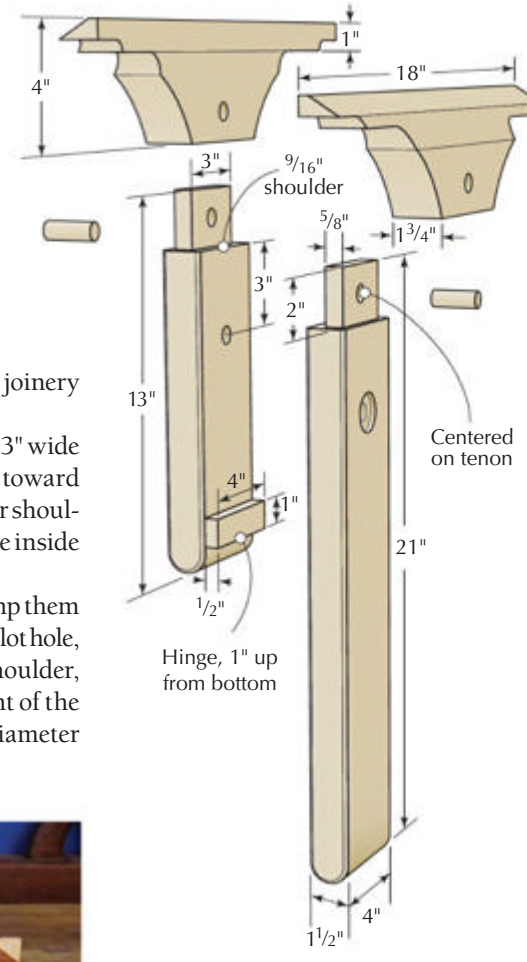
Less is more. *Removing material on the outside of the jaws makes it easier to file, allowing you to add slope to your gullets if so desired.*

> "...There are still some honest men who are not scared to use hand tools, who can sharpen a saw, plane, or adze..."
>
> —L. Francis Herreshoff (1890-1972), Boat & submarine designer & builder

Saw Vise

NO.	ITEM	DIMENSIONS (INCHES) T	W	L	MATERIAL	COMMENTS
❑ 2	Jaws	2	4	18	White oak	
❑ 1	Front leg	1 1/2	4	21	Maple	TOE*
❑ 1	Back leg	1 1/2	4	13	Maple	TOE*
❑ 1	Hinge	1/2	1	4	White oak	

*TOE = Tenon one end



EXPLODED VIEW

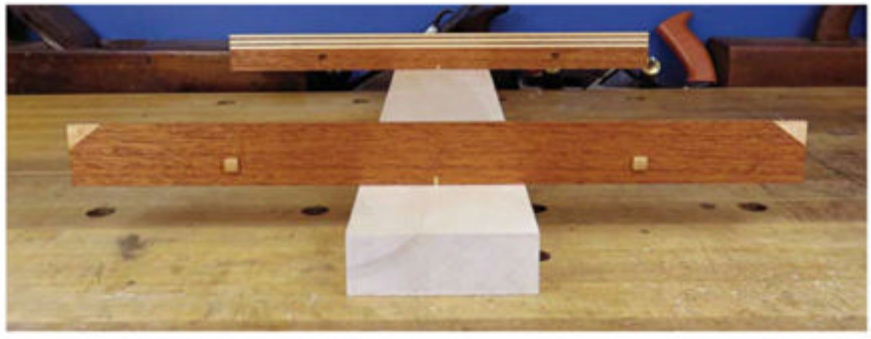
final dimension a few weeks prior to the build to allow them to acclimate to the shop. Then, using winding sticks and handplanes, I fine-tune each one before cutting the joinery. Square stock is vital to this build.

Joinery Prep

To accommodate the massive force that can be applied by the Acme screw, I decided on a drawbored mortise-and-tenon joint between each leg and its corresponding jaw. The parts will be assembled later, but first cut the joinery and drill for the hardware

The leg tenons are 5/8" thick, 3" wide and 2" long. I offset my tenons toward the outside, using a 9/16" interior shoulder to keep a flush surface on the inside of the jaws.

Flush the legs at the top, clamp them together, then mark and drill a pilot hole, located on center 3" from the shoulder, for alignment. Now on the front of the front leg, drill a shallow 1 3/8"-diameter recess to house the washer.



Straight & square. *After roughing out the stock and letting it acclimate, I check for twist using a set of winding sticks. I square the stock using handplanes before laying out the joinery.*

Moxon moxie. *Using a Moxon-style vise to elevate the work, I cut the tenons by hand. (Use your excess Acme thread to make one of these devices; you won't regret it.)*

Plumb the depths. *I hog out most of the mortise waste on the underside of the jaws using a 5/8" Forstner bit at the drill press, then use a wide chisel to clean up the edges and corners. The valleys created by the bit make a good guide to create plumb walls.*

SUPPLIES

Enco
use-enco.com or 800-873-3626

1 ▪ Acme threaded rod, 5/8"-8, 36"
#408-0202, $10.53

2 ▪ Acme threaded nuts, 5/8"-8
#407-2202, $2.56 each

1 ▪ Extra thick washer, 5/16"
#319-8049, $1.24 each

McMaster-Carr
mcmaster.com or (330) 995-5500

1 ▪ 1/4"-20 flat-head socket cap screw - 2 3/4" long
#91253A558, $9.50/pack of 10

1 ▪ 1/4"-20 brass threaded insert
#90016A029, $11.97/pack of 25

1 ▪ 12" length, 1/2" steel rod
#8920K155, $3.32 each

Tandy Leather Supply
tandyleatherfactory.com

1 ▪ 1"-wide x 50"-long cowhide strip
4526-05, $16.99

Prices correct at time of publication.

ADJUSTING THE VISE JAWS

When first setting up your saw vise, the jaws need to be adjusted for the whole assembly to work correctly. Ideally, any saw that is inserted into the vise will be held in place without pressure from the screw.

The ends of both jaws should make contact at all times. It is this contact that holds the saw in place while you fine-tune the position of the teeth. This is where the beauty of the leather-clad hinge is realized. The leather compresses, allowing you adjust the contact between the jaws by tightening or loosening the two screws.

Use an Allen wrench to slowly tighten each screw until the corresponding end of the hinge makes contact. There should still be a gap of at least 1/16" in the middle of both jaws; this will close up when the Acme screw is tightened.

If the contact between the jaws changes over time, use the screws to adjust it until it a saw can be supported.

— JT

Consistent alignment. *Two Allen-head screws pass through the hinge assembly and screw into threaded brass inserts. I like to mark the orientation of my hinge; it helps keep the jaw alignment consistent if you have to disassemble and reassemble the vise.*

No-headache tension. *By tightening each screw, you can increase the tension on each end of the jaws' spring joint. Snug the screws down until a standard handsaw can be supported without any assistance from the wing nut. Adjust the hinge as needed for seasonal changes and wear.*

On the inside surface of the back leg, drill a 5/8"-deep, 1"-diameter hole, then trim it with chisels to form a six-sided mortise to house the captured nut for the wing-nut assembly.

Now drill 5/8"-diameter through holes in each leg for the threaded Acme rod.

Nut housing. *To house the nut on the threaded rod, chop out a mortise on the back of the rear leg. A 1" Forstner bit removes most of the waste; a chisel takes care of the rest.*

Leather Hinge

The jaws on a saw vise don't need to open up a lot to work effectively, because most saw plates are less than .040" thick. A hinge that opens farther just adds potential for slop to be introduced.

By using a 1/2" x 1" x 4" "hinge" of white oak with leather strips glued to each side, the jaws can be opened enough to slip a saw in while introducing a clamping force that holds the saw in place, even with the Acme screw loose. This allows you to fine-tune the position of a saw before final tightening. This force can be adjusted using two hinge mounting screws (see "Adjusting the Vise Jaws" above).

For those screws, drill two 1/4" countersunk through-holes from the front of the long leg, located 9 1/2" up from the bottom of the long leg and 1" in on each side. Now clamp the legs together with the inside faces touching, and mark the inside face of the short leg for the threaded-insert hole locations (1 1/2" from the bottom of the leg).

Though the packaging says to use a 3/8" bit for the threaded-insert mortise, I prefer a 25/64" bit; the tolerances are too tight with the smaller bit.

Drill mortises, and place the threaded inserts in them.

The last bit of drilling is for the two 1/4" through-holes in the hinge (the leather won't hurt the bit).

Compound Spring Joint

The final and most important feature of this saw vise is what I've dubbed a "compound spring joint." This is a spring joint on both the vertical and horizontal planes of the jaw. You're likely familiar with the concept of a spring joint when gluing panels; the concept works the same here. I like to add both spring joints as the final step in shaping the jaws. A lot of material has been removed from the jaws

Depressing work. *Using a block plane, start forming the lateral spring joint by taking a few light passes in the middle, working your way to the edges with each pass. The resulting depression should be approximately 1/16" when complete.*

at this point, so some movement is to be expected.

Check the jaw faces for square and fine-tune as needed.

Use a block plane to create the vertical spring joint. Taper the jaw face inward by a few degrees, starting at the top and working down. When the Acme screw is tightened, the initial contact is at the top of the jaws. As you tighten, the legs will bow slightly inward causing the jaws to ever-so-slightly pull in as well. That results in a solid 1" contact area along the length of the vise.

For the lateral spring joint, start in the middle of each jaw; take light passes and work your way to the ends. The final concavity should be right at 1/16" in the middle.

It is imperative that you don't alter the vertical spring joint while planing the lateral one.

When the Acme screw is tightened and the spring joints close up, the resulting grip on the saw plate is amazing.

Final Assembly

Once the jaws have been shaped, spread a liberal layer of glue into the mortise, insert the tenon and drive that 5/8" dowel home. The joint should be rock-solid and ready for a century or more of use.

After trimming and flushing the dowels, it's time to add the leather strips to the jaws and complete final shaping.

Gluing leather strips to each jaw face not only increases the grip strength, it also protects your saws from damage. Liquid hide glue and plastic wrap make quick work of the leather install.

After the glue sits overnight, remove the plastic wrap and add the finishing touches to the jaws. I like to cut a chamfer on all edges using a drawknife, rasp and spokeshave. The chamfer not only adds visual interest to the piece, it also makes the vise more user-friendly.

Care & Maintenance

The beauty of a wooden saw vise is its ability to be maintained. Like a wooden handplane, a wooden saw vise can be tuned and repaired as atmospheric conditions and wear dictate.

If the top of the jaws get beat up over time, you can remove the leather by applying heat or moisture to the hide glue, then plane the top of the jaws smooth and glue a new strip of wood on top. After blending the new piece in with the existing jaw, glue the leather back on and get back to sharpening.

You can replace the jaw faces the same way, reintroducing new spring joints as you do.

A few coats of boiled linseed oil followed by a 50/50 blend of beeswax and paraffin are my go-to finish for shop tools. I use a polissoir to apply the wax and burnish the wood. The Acme screw will benefit as well from the same wax mixture – a few dabs on the threads will keep them operating smoothly.

Using the Saw Vise

The longer front leg on the saw vise allows it to be secured several ways to your benchtop – it can be gripped in a face vise or leg vise. If you have an apron around your bench, a couple of dog holes and holdfasts can hold it in place.

The additional contact area created by the longer leg helps stabilize the vise during use.

Once the vise is securely mounted, slip in a saw, carefully adjust the toothline, clamp down on the wing nut and get to sharpening.

With a proper saw vise such as this one, keeping your saws sharp is easier than ever before. PWM

Jason owns Texas Heritage Woodworks in Cedar Park, Texas.

Classic joinery. *A 5/8" dowel is used to draw-bore the joint. I used an offset of approximately 1/32"; hardwoods don't require a lot. Using the 5/8"-diameter dowel greatly reduces the odds of it splitting while being hammered home.*

Plastic fantastic. *Using plastic wrap is a great way to hold the leather strips in place where traditional clamps won't work. The angles on the jaw make any normal clamping setup difficult. Because a lot of pressure isn't needed for this application, plastic wrap is ideal.*

Make it safe. *The 90° corners on the oak jaws can be sharp and dangerous. Adding a chamfer is made easier by securing the leg to your benchtop, allowing the jaw to overhang. This gives you access for easy shaping.*

ONLINE EXTRAS

For links to all online extras, go to:

- **popularwoodworking.com/aug15**

WEB SITE: *Visit Jason Thigpen's Texas Heritage Woodworks web site for high-quality tool rolls, shop aprons and more.*

ARTICLE: *"Saw Filing – A Beginner's Primer," free at vintagesaws.com.*

TO BUY: *"Super-tune Your Backsaw with Matt Cianci," available as a DVD or download.*

IN OUR STORE: *"Handsaw Essentials," by Christopher Schwarz, in hardcover or PDF download.*

Our products are available online at:

- **ShopWoodworking.com**

Build a 'Birdcage'

BY ALFRED SHARP

This clever & traditional wooden mechanism allows tabletops to tilt and rotate.

During the first third of the 18th century, tea drinking first became a popular pastime in fashionable homes in England and its colonies, hence the appearance of a new furniture form – the tea table.

Besides the "gee-whiz" factor of a tilting and rotating fixture for the finest tables, the "birdcage" mechanism that facilitated that movement had practical applications. These tables could rotate, allowing hostess and guests to avoid undignified reaching for the teapot, sugar, cream or pastries.

Moreover, until the last third of the 1700s, furniture in homes was customarily pushed up to the walls when not in use, leaving the middle of the room open for multiple activities. A round, rotating tea table that would also tilt to a vertical position could be handily situated in a corner of the room to not only save space, but show off the elaborately carved rim and the fancy grain of the fine, wide, single-board tops. This was the very height of elegance during the Queen Anne and Chippendale periods.

Though a birdcage mechanism looks complicated, it can be easily accomplished using typical woodworking skills, as long as the proper order of procedures is adhered to. This project is a great example of the virtues of "working to your work," or letting the previous step define the next step, and gauging the fit of adjacent pieces directly off one another rather than relying on complicated layout and precise measurements. There is some of that of course, but mistakes and misalignments can be minimized by progressively moving from one logical activity to the next.

So let's begin. I'm making a pedestal for a rather large and fancy scalloped-edge table, but the dimensions illustrated here can be scaled up or down for different sizes and styles.

A birdcage assembly consists of eight parts, not counting hardware – the upper and lower plates, four balusters (or spindles), a notched "washer" and a wedge-key. It all spins on a main spindle (hence the name) which is part of the table's pedestal.

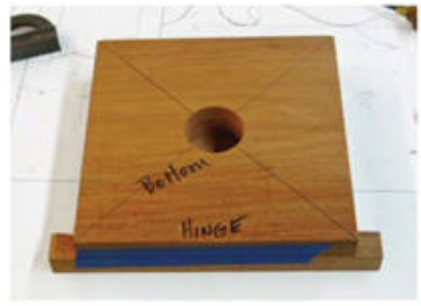
And in typical 18th-century fashion, the mechanism is made from the same primary wood as the table – in this case, mahogany.

Upper & Lower Plates

The structure of a birdcage consists of an upper and lower plate connected by four spindles, or balusters. The plates start with a rough blank approximately 1" x 8¼" x 20". Joint the blank flat, then plane it to 13/16" thick. Edge-joint and rip it to 8" wide. Square one end and crosscut one piece exactly 8" long; this will be the lower plate. Crosscut the remainder to 9½" long; this will be the upper plate. Center the lower plate on the upper plate, grain aligned, and scribe the extents of the lower plate onto the upper plate. Leave 13/16" x 13/16" x ¾"-long "spigots" on either end of one edge of the upper plate. These will become the hinges on which the tabletop tilts.

PHOTOS BY THE AUTHOR; ILLUSTRATIONS BY DONNA R. HILL FROM THE AUTHOR'S DRAWINGS

Two blocks. *Match the upper and lower plates to one another, but leave enough on what will become the top plate for two 13/16" x 13/16" x 3/4"-long "spigots."*



Drilled & marked. *After finding the center point on the exposed faces of the taped-together top and bottom, drill a 1 3/4"-diameter hole through the bottom and into the top; the bit should stop 3/8" above the table.*

Four corners. *Drill through the top plate in the package and into the bottom one, stopping 1/4" from the press table (in other words, drill 1 3/8"-deep holes).*

Carefully band-saw away the waste on the upper plate, leaving the spigot on each side of one end of the upper blank. The grain of the wood should be in the plane of the spigots. Clean up the sawn ends of the upper plate and align it carefully with the lower plate, making sure the grain of both pieces is also aligned. Then fix the two plates flush together with tape along their edges. Label the top surface of the upper plate and the bottom surface of the lower plate.

Locate the center of the lower plate with diagonals; prick with an awl. Turn the package over, establish diagonals on the top of the upper plate (excluding the spigots), and locate prick points 1" in on each diagonal.

Set up a 1 3/4" Forstner bit in the drill press and limit the bit's travel 3/8" from the machine's table. Place the two-part package on the drill press, bottom-up, and drill a 1 3/4" hole in the dead center of the package (stopping 3/8" from the table). Be sure to mark the hinge edge of the lower plate for later registration. This ensures that everything will line up perfectly when it's time to assemble the cage.

Set up a 5/8" bit in the drill press and stop the bit's travel 1/4" from the machine's table

Turn the package over so that the top face is up. Drill a 5/8" hole in each corner of the package on the prick points (stopping 1/4" from the table).

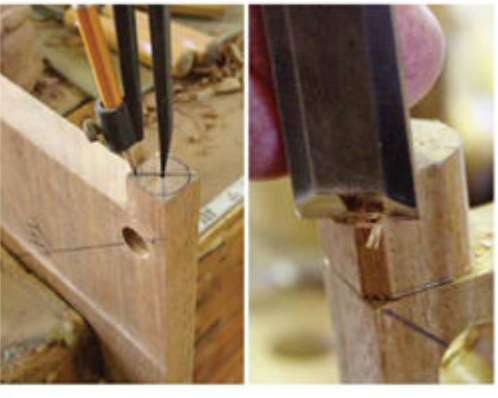
Undo the two-panel package and radius the bottom arris of the lower plate, either with a roundover bit in the router, a block plane or a moulding plane.

Locate the center of each spigot end on the upper plate, scribe a 13/16"-diameter circle, then nick the four spigot arrises flush with the dominant edges. Round the spigots using a chisel.

Drill a 13/16" hole in a scrap piece to test the fit. It's good to be a little tight here at first because the fitting will burnish the surface of the spigots, making them more durable for the life of the tilting movements.

Radius the top arris of the upper plate from one spigot to the other (I use a block plane); this will create clearance for the top to tilt from horizontal to vertical.

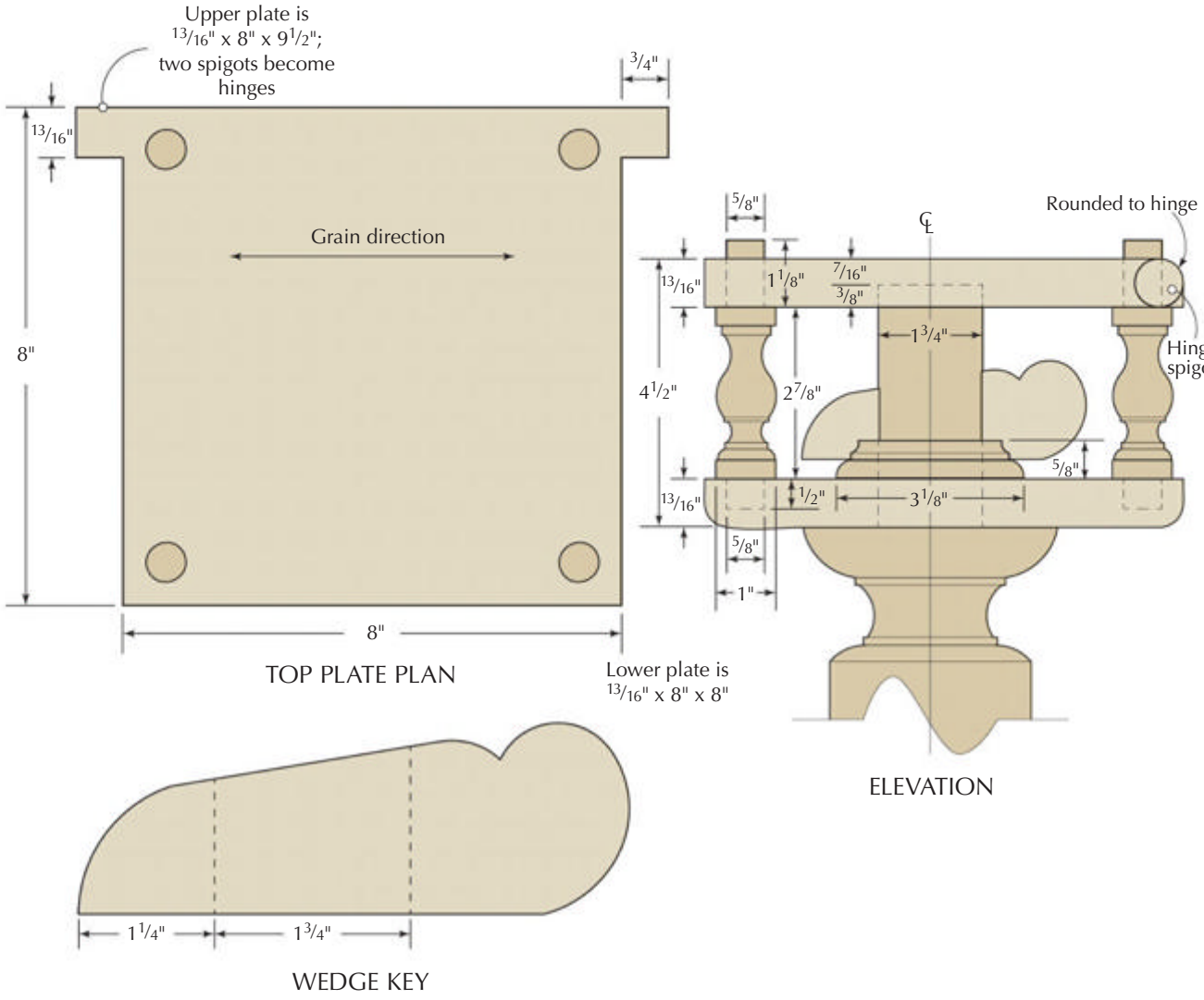
Now you'll need to lay out and mortise for a latch that locks the table in the horizontal position. There are several types of latches available, but a proper one should include a keeper to hold



Scribe, then shape. *After marking a centered 13/16" circle on each spigot, use a chisel to nick the baselines, then pare each one round.*

Plane work. *I use a block plane to round over the edge between the spigots.*

Latch mortise. *You'll need a latch to keep things in place; the one you choose should have a keeper for the tongue. Mortise that into the top face of the upper plate.*



the latch tongue. The keeper needs to be mortised into the top face of the upper plate, on the arris opposite the hinge end. First measure and mortise-in the edge lip. Then position and scribe around the face lip of the keeper. In my case, I have the stylish curves to deal with, so I use carving gouges to chop the edges of the mortise.

Main Spindle

Next, turn the 1 3/4"-diameter x 4 1/16"-long main spindle on which the entire birdcage spins at the top of the table's pedestal. Turn only the spindle section of the blank, as it will be handy to have the ends remain square for the following steps.

Use the tip of a large skew chisel to nick the arrises on the spinning blank first, then clean the spindle area round.

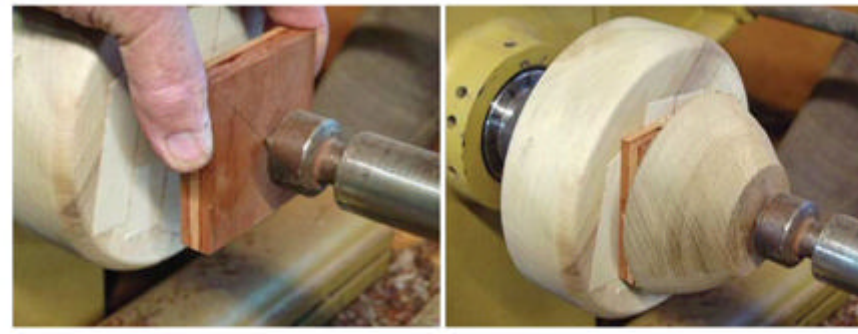
Nick & turn. *After nicking the arris corners, turn the spindle round.*

Measure the actual bit used to drill the center hole in the plates, and turn carefully to that diameter. Use a test block to check the fit. Strive for a snug fit with the skew, and a square shoulder where the birdcage will ride on the lower plate (if it's out of square, that results in rapid wear on the plate). Then work to the final free-spinning fit with sandpaper. There shouldn't be any excess wobble.

The Washer

A notched decorative "washer" and key hold the birdcage firmly to the main spindle. Typically, the washer was turned from a single piece of wood. I have departed from this tradition a bit because the short grain in such a piece is quite vulnerable to breakage. Instead, I laminate three layers of

Strive for perfection. *Use a test block to fit the tenon. It should be just snug enough to spin freely, and be perfectly square to the bottom of the shoulder – check it with an adjustable square.*



Washer mount. *Put a scrap face plate on your lathe's head stock and apply double-sided tape to secure the washer blank. Use the tailstock to locate the center of the blank, then advance the tailstock to secure the blank to the tape. Now place a caul between the blank and tailstock to press the blank firmly in place.*

Edge treatment. *After turning the washer blank round, use a skew and gouges to shape the edge to your liking.*

Now drill. *Using the same 1¾" Forstner bit you used to drill the hole in the top and bottom plates, drill a through-hole in the washer.*

wood to make a ⅝"-thick x 3⅛"-square plywood sandwich. The grain of the middle layer must be oriented 90° to the grain of the two outside layers.

Locate the center of the laminated blank. Fix a scrap-wood face plate to the lathe spindle and apply double-sided tape. Using the tailstock and the center point, place the blank onto the taped face plate. Put a stout caul between the blank and the tailstock, then tighten the tailstock for a few minutes to firmly attach the blank.

Remove the caul, but keep the tailstock engaged for the next steps as a safety precaution. Turn the blank round, then turn a decorative pattern on the edge of the blank. Be sure to leave a fairly wide land at the top of the blank.

Now affix a drill chuck to the tailstock and, using the same drill bit as you used to drill the center hole in the plates, drill through the washer.

Sand, separate the blank from the face plate, then lay out a 5/16"-wide notch for the "key" centered across the top of the washer. Saw and chisel the notch into the washer to about one-half depth, making sure the bottom of the notch is parallel to the bottom of the washer.

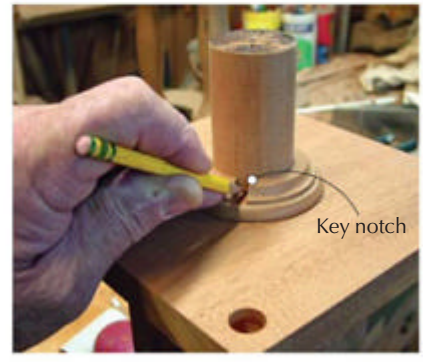
Key Mortise

Place the lower plate on the main spindle, then drop on the notched washer. Mark the location of the bottom of the notch on the spindle.

Fashion a wedge key out of stock thicknessed to a fat 5/16". The dimensions shown in the Wedge Key illustration on page 36 are what matter – the 1¾" represents the diameter of the spindle. The exact angle of the wedge is unimportant – it just needs to be straight along the top, and not too abrupt.

Measure the height of the line closest to the smaller end of the wedge. Transfer this dimension to the main spindle, measuring out from the previously marked location of the notch bottom. This dimension will mark the lower mortise location for the key.

I use a mortising machine to make the slot for the wedge key. So that the grain doesn't bust out on the bottom side of the spindle as the bit exits, you'll need a sacrificial block to support the cut. First, find the closest match to the curvature of the spindle on a French-curved scraper, and mark those extents on the scraper. Then use the scraper



Key mark. *With the lower plate and washer in place on the spindle, mark the bottom of the notch for the key.*

Slot layout. *Using the measurements pulled from the key, mark the location on the spindle for the key slot.*

Arc marks. *A curved scraper can be marked to establish the curve of the spindle. Then use the scraper to scrape a spindle-support trough in a piece of scrap.*

Plunge cut. *After aligning the bit to the center of the blank and supporting the spindle in the scrap's trough, drill the mortise.*

Key angle. *Use a chisel to cut the slope for the wedge key's slot, angling down from the wider side of the mortise.*

Key fit. *Plane or sand the sides of the wedge key to not only a nice finish, but to a good, snug fit in the key mortise.*

Fit to turn. *Test-fit the lower plate, washer and key and give it a spin (it should be a tight fit at this point).*

to make a shallow concave trough in a block of scrap wood thick enough to bridge the gap between the spindle and the mortise table.

Trim the block to just snug under the spindle to support it. Mark the center on the square shoulder of the pedestal blank and line up the mortise bit. Drill the mortise between the two scribed lines.

Now measure the height of the wedge key at the higher side of your 1¾" mark. Scribe that measurement on the spindle above the mortise. Extend the lines formed by the walls of the mortise up to this mark on one side of the spindle.

Carefully chisel in from this uppermost mark on one side of the spindle, angling down to the top end of the mortise on the other side.

Use a square file to refine this sloped shoulder so that the upper angled surface of the key will fully engage the mortise shoulder. Clean up any irregularities in the walls of the mortise.

At this point, the key should still be a little too thick to fit into the 5/16" mortise – so carefully plane and sand the sides until you get a snug fit.

Fit the lower plate, the washer and the key and test for ease of rotation.

Be content at this point if it's still a little stiff; that's better, because finish-planing the plate will make it a little thinner, and you don't want anything to wobble in the end.

You can now go ahead and turn the pedestal below the lower plate, and dovetail it for the table's legs.

> "Nothing is hard, some things just take longer than others."
>
> —Jim Ipekjian, cabinetmaker

Balusters

Now it's time to turn the four small balusters that connect the upper and lower plates. You can turn two spindles on one blank without experiencing any serious chatter; two 1" x 1" x 10" blanks will do the job.

Lay out the 1⅛"-long top tenons on either end of the blank, along with a little excess for the lathe centers. The baluster portion is 2⅞" long. Finally, mark ½" tenons for the lower plate. Leave space at the juncture of the two lower tenons to allow you to cut them to final length once they're off the lathe.

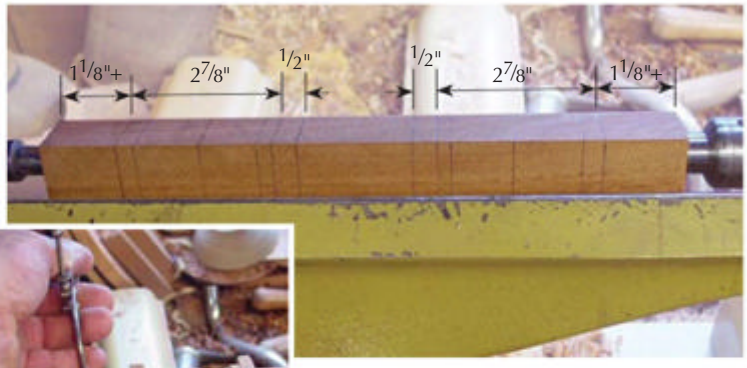
The most typical baluster pattern is shown in the Elevation illustration on page 36, but you needn't match it.

Carefully nick the portions of the turnings that remain square so as not to shatter the fine arrises (just as you did when turning the spindle). Turn the baluster profiles. Strive to get a good match from piece to piece, but don't get too OCD about it; a close examination of most originals shows a surprising amount of discrepancy between different turnings on the same piece of furniture.

Turn the tenon portions to a close ⅝"-diameter. Mark the cut-off points on the tenons and separate the pieces using either a band saw or backsaw.

The tenons in the upper plate will be wedged. So center and square a layout line atop the long tenons and saw to about ¼" above the baluster shoulder.

It is important that this kerf be paral-



One blank; two balusters. *This 1" x 1" x 10" blank will yield two balusters.*

Balanced balusters. *Strive to have the turnings match, but 18th-century examples prove they needn't be exact. The tenons, however, must be 5/8" diameter for a good fit.*

Kerf. *Saw a kerf for a wedge to about 1/4" above the tenon shoulder.*

Wedge. *After assembling the mechanism, glue and insert the wedges perpendicular to the grain of the upper plate.*

lel and perpendicular to the square sections of the baluster. Why? The wedge must be inserted perpendicular to the grain of the upper plate, so that driving it in won't split the plate's grain. And because the balusters must be square to the perimeters of the plates, the kerf must also be.

Now stain and finish the balusters and the inner surfaces of the plates – because it would be difficult to do after the birdcage is assembled. Be sure to tape up the tenons and temporarily plug the holes so the finish won't interfere with the glue joints later.

Assembly & Hinge

To put the birdcage mechanism together, first glue the balusters into the lower plate. Use a relatively slow-setting glue, and make sure the kerfs in the balusters' tops are perpendicular to the grain of the plates.

Square the balusters to the lower plate. Put the assembly onto the main spindle to ensure everything will go together as it should and still spin.

Apply glue to the appropriate surfaces of the balusters and upper plate, and assemble and clamp everything into place. Again, make sure the wedge kerfs in the baluster tenons are perpendicular to the grain of the upper plate. Drive appropriately sized wedges into the kerfs of the tenons.

When the glue is dry, trim the upper tenons and finish the top of the birdcage.

The hinge spigots fit into 13/16" holes that just verge into the edges of cross-grain battens that will be installed on the bottom of the tabletop.

This allows the top to sit flat on the top of the birdcage. Locate the holes to center the birdcage under your top. (Of course, the battens will need to have elongated screw slots at their ends to allow for wood movement in the top.)

When it's time to finally assemble all the components, rub a little beeswax on the main spindle and shoulder, the bottom of the washer, around the main spindle holes in top and bottom plates and on the hinge spigots. Don't put wax on the wedge key or its slot. Everything should work smoothly and look very smart.

Now congratulate yourself on a job well-done. **PWM**

Alf is an award-winning furniture maker who lives and works in Woodbury, Tenn. See more of his work alfredsharp.com.

Hinges*. The hinge spigots are fit into 13/16" holes drilled into battens that will attach to the underside of the tabletop.*

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18th-century Reflections

BY JOSHUA KLEIN

Make a classic mahogany looking glass by hand.

Even before the days of Facebook and selfies, Americans were undeniably conscious of self-image. In both Europe and America, the 18th-century genteel elite kept specialized accessories for maintaining appearance. Among the most important of these was a reflective mirror. Because these "looking glasses" were typically heavily ornamented with elaborate fretwork and gilded carvings, the looking glass itself has become an icon of refinement.

This looking glass is based on a piece sold at Skinner Auctioneers in 2014. What drew me to this example in particular is that it is a vernacular expression of a form often punctuated by excessive ornamentation. It's charming because it reveals the maker's obvious awareness of high-style fashion but intentional artistic restraint.

Traditional Construction

Traditionally, mouldings were stuck in long lengths (8' or more) with moulding planes, then miters were cut along the length to ensure consistency of the profiles at the corners.

As much as we all may appreciate the efficiency of wooden moulding planes, not every woodworker has access to properly tuned ones. But is there another way to cut custom profiles simply, efficiently and inexpensively? There is: Just scratch them.

Using a scratch stock is a straightforward method for making elegant cus-

PHOTOS BY THE AUTHOR; ILLUSTRATIONS BY DONNA R. HILL FROM THE AUTHOR'S DRAWINGS

A true start. *Holding your stock secure, true and square is essential to get the frame to come together right.*

Tilt into it. *By leaning the top of the scratch stock forward, the cut magically becomes smooth. If you're bouncing off your tracks, slow down and tilt forward more.*

Fading in. *It's hard to start the profile on the very edge so I just fade it in. As you progress, the pencil marks will be scraped away.*

Four sticks. *With the moulding shaped and the four pieces ripped from the board, plane them all to final dimensions.*

Stand tall. *Instead of attempting to plane the rabbet with the profile down, turn it on its outer edge. It seems counterintuitive but it works like a charm.*

tom moulding profiles without fancy tools. I trace out the profile onto a cutter blank (a piece of an old handsaw blade) with a fine-point Sharpie. Then it takes only a couple minutes of file work to shape the profile (keeping a square edge will help in use). Some folks use slipstones to finish shaping the profile but, because we're using this scratch stock on long grain that is tame, I have not found that extra sharpening step to be necessary.

Because of the consistency of the profile, the primary benefit of scratching moulding is that it is possible to utilize short offcuts for this project.

Start by planing a square edge onto an overlong (and wide) piece of mahogany. It's impossible to get a good-looking profile at the ends; the extra length allows you to fade the profile in and out. The extra width makes it easy to hold the work firmly in a vise.

Draw hatched pencil marks across the surface.

Now, holding the fence of the scratch stock up tight against the stock, slowly begin pushing the cutter away from your body down its length. It helps to tilt the scratch stock forward because it tends to produce a smoother and more controllable cut that way.

The first passes work better when only moderate downward pressure is applied. Continue scratching until you see the profile begin to emerge through the penciled hatch marks. When the pencil is gone, you're done in that spot.

Short passes are not a problem for the initial scratching; it's for only the last few that you need to make full-length passes with the cutter.

With the moulding scratched (feel free to touch it up with #180 grit if needed), use a marking gauge to establish a line for the thickness of the frame pieces and rip the piece free.

Once the pieces are scratched and ripped, place them profile side down and plane them to final thickness. (A toothed planing stop provides excellent workholding for this.)

Rabbets & Miters

The next step is to plane the rabbets in which the mirrored glass will be set.

Planing rabbets on small, short stock like this can be a little tricky. The key is to stand the pieces up on end so that you have enough clearance to your bench-top for the planing.

Because you will be exerting sideways pressure with the plane's fence, you will also find a notched batten (also known as a "doe's foot") to prevent lateral movement a boon.

With the rabbets cut, turn your attention to the miters. I used my miter box for this, but you could use a shop-made miter box or even cut freehand to lines laid out with a bevel gauge. Because I used my miter box, the accurate miter was easily cleaned freehand with my smoothing plane. This method is easiest if the plane is placed on its side to the bench and the sawn miter is brought to the iron.

Glue the Frame

Forget fancy jigs. You don't even need clamps to glue the frame. All you need is a little hot hide glue. One of the reasons I love hot hide glue is its self-clamping property. In my conservation studio, I routinely exploit this quality when attaching tiny broken fragments that would be near impossible to clamp. I merely hold the pieces in place for a few minutes until the glue gels. As it dries, it pulls the pieces together. The same technique applies here.

To assemble the frame, glue one corner at a time, working your way around. Apply the hot hide glue to each side of the mitered joint, then press the pieces together. Depending on the ambient temperature, I will hold them with finger pressure for two to five minutes (I use 192-gram-strength glue). Once the first corner is glued, you can move to the next. But move the frame gently – the glue is still drying.

If something goes awry, use warm water and take the frame apart to reglue it. (That's another beauty of hide glue: infinite repairability.)

The next day, saw a kerf into each corner and glue in splines from veneer stock. After that glue is dry, cut the splines close to the surface with a backsaw, then pare them flush with a chisel.

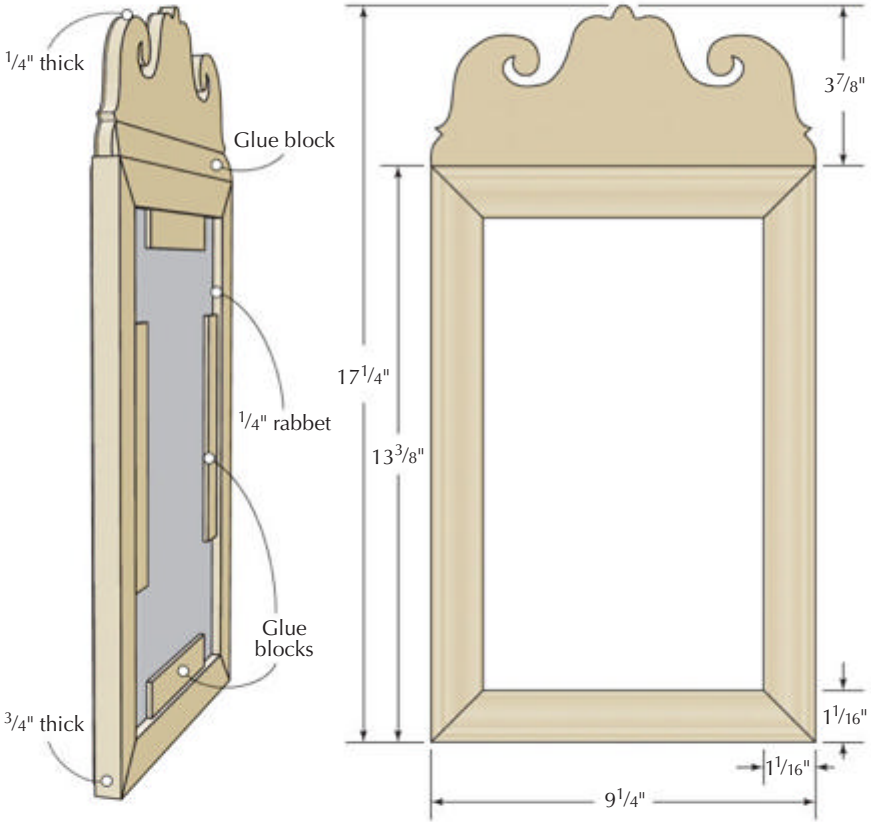
Though the glued miter joint should hold up for a long time, it never hurts to have the splines as backup.

Fretwork

The elegant fretwork on period looking glasses was often constructed of a figured mahogany veneer glued to a secondary wood such as pine. So I followed that practice.

I resawed and planed the pine to thickness, selected my veneer piece, then hammer-veneered the crest veneer to its substrate.

Hammer veneering is based on the same self-clamping property of hot hide glue exploited for the miters. Ap-



Hold tight. *With nothing more than finger pressure pushing the joint together, hot hide glue will hold the miter joint tight as it dries.*

Check, please. *Don't neglect to check for square along the way. It's easier to adjust things while the glue is still tacky.*

Extra insurance. *Adding splines in the corners of mitered frames is an historic fail-safe in case the glued miter ever lets go.*

18th-century Looking Glass

NO.	ITEM	DIMENSIONS (INCHES) T	W	L	MATERIAL	COMMENTS
❑ 2	Top/bottom	3/4	1 1/16	9 1/4	Mahogany	Final size*
❑ 2	Sides	3/4	1 1/16	13 3/8	Mahogany	Final size*
❑ 1	Crest substrate	1/4	3 7/8	9 1/4	Pine	Final size*
❑ 1	Crest veneer	1/16	3 7/8	9 1/4	Mahogany	Final size*

*Use overlong & overwide stock; cut the frame pieces to final width & length after sticking moulding

ply glue to both the substrate and the veneer, then press them together with a veneer hammer. The tool functions just like a squeegee, squeezing out the excess glue while pressing the pieces together. The tack of the glue helps to pull each piece together. After a couple minutes of "squeegeeing," the veneer can be left to dry.

Sometimes the glue pulls so hard it will actually cause the substrate to cup. To counteract this, I place the heart side of the pine toward the veneer. This typically works well, but the use of veneer of period thickness ($1/16$" or thicker) allows for a small amount of planing to regain flatness if needed.

After allowing the veneer to dry

PATTERN TRANSFER

There are many fancy ways folks have come up with to enlarge and transfer a pattern. The simplest and most enjoyable way I've found is to search for the proportions with my dividers and transfer them to a piece of posterboard of the final width and height. Historic furniture (yes, even vernacular pieces!) was usually designed using classical proportions. This system may sound intimidating but it's so easy to use because it's nothing more than finding simple whole-number ratios. That's why I say it's enjoyable. Besides, how deep will your understanding of the piece be if you just traced a template someone else (or some copy machine) made for you?

Taking the few minutes to investigate the logic of the design not only informs you of what the artisan envisioned, but it also teaches you to design. This is a case of the "give a man a fish versus teach a man to fish" proverb.

Start hunting for the dimensions by drawing a box around the fretwork in your picture. (It is only necessary to do one-half.) First off, spot the high and low spots as well as any peaks. You will find that these key areas in the design are likely going to be laid out in some whole-number ratio. You will notice the bottom of the inside of the scroll lines up exactly in the center of the box you've drawn around it. Also, the spurs on the side peak exactly one-quarter of the way up from the bottom.

As you define these key points, transfer them to your posterboard template. Pretty soon you will begin to see the road map for the lines emerge. After you have mapped as many places as you can find, it's just a matter of connecting the dots. With a little practice and an eraser, freehanding the curving lines between points is not difficult, especially if you pencil in grid lines. When all is drawn, carefully cut both sides out together.

—JK

Box it in. *Start by cutting a piece of posterboard to the exact width and height of the fretwork. Because the design is symmetrical, you can then fold the paper in half lengthwise. You will only be drawing one half of the design. This way, if your cutting is a little off somewhere, everything is still perfectly symmetrical. Don't waste your time drawing this design twice.*

Dividing lines. *Drawing in these proportions makes seeing the logic of the design a whole lot easier.*

Posterboard pattern. *I made this posterboard pattern by pulling dimensions off a photograph of the original. Dividers are handy for transferring key dimensions.*

Bird's mouth. *An L-shaped jig with a notch in the top surface for the saw blade makes it easy to saw out the scrolls of the crest, with plenty of support for the work. Because the bird's mouth is designed to clamp in a vise, it's easy to adjust the height as needed.*

Crest support. *The crest is not very thick, so adding a glue block on the back is wise. Make sure to taper it on the top and sides so it's inconspicuous.*

Beautiful old color. *This new old stock veneer has an incredible depth of color not seen on most mahogany available today.*

A little at a time. *Add your layers of dye a little bit at a time. It's impossible to get a convincing color in one fell swoop.*

overnight, transfer the crest pattern, then cut it out with a coping saw on a bird's-mouth fixture. Cut right on the line. Because there typically was not a lot of clean-up done on period fretwork, leaving saw marks is period-appropriate.

Attaching the crest to the frame is easy: Plane it flat on the bottom and glue it to the frame. I made a triangular glue block to attach to the back for additional support.

200 Years in 20 Minutes

The finish is fun. With a combination of shellac, dyes, pigments and paste wax, 200 years of grime and patina can be convincingly mimicked in no time at all. I think the majority of the finishing time on this project was somewhere around 20 minutes split between two sessions. Because of alcohol's fast evaporation rate, multiple layers can be applied one right after the other.

I loved the beautifully rich color of the crest veneer (it is new old stock), so I shellacked the crest a couple times to use it as a reference for the color of the rest of the piece.

To begin working up the color on the frame and the edges of the fretwork, apply with a rag TransTint dyes mixed in alcohol. In order to give the color an authentic-looking depth, it is important to layer colors on a little at a time.

I ended up using Medium Brown, Reddish Brown, Van Dyke Brown and a touch of Honey Amber, each applied individually in a dilute concentration.

As you apply each layer, you can subtly shift your "brown" to the red side of the spectrum with Reddish Brown or shift it the opposite direction (green) with Van Dyke Brown.

After about 15 to 25 back-to-back layers of color, I gently padded on shellac. This, of course, can lift the color—so don't re-pad an area until it's dry to the touch (only a few minutes). When you are confident that the color is locked in you can apply more shellac until the pad begins to drag.

At this point, stop and let it dry a bit. After an hour or two, give it a quick scuff-sand with a maroon Scotch-Brite sanding pad to cut some of the dust nibs. Then it's back to padding.

With the finish a little tacky, I dropped burnt umber powdered-earth pigment into the creases of the moulding. Don't worry about being too per-

Muddy it up. *By using earth pigments over the shellac, the grain becomes partially obscured. This goes a long way in mimicking years of grime.*

The tools of the trade. *Just a few simple tools and materials make quick work of matching the frame to the crest.*

SUPPLIES

Homestead Finishing Products
homesteadfinishingproducts.com or
216-631-5309

1 ■ Shellac Flat
#7080, $17.95 (16 oz.)

1-4 ■ TransTint liquid dye(s)
$18.50 each, 2-oz. bottle

1 ■ Antiquax paste wax
#2045, $18.95

Prices correct at time of publication.

snickety here, because you can always wipe mistakes off with alcohol.

Pad shellac over the pigment to lock it in. By this point you should have lots of layers of colors, pigment in the creases and all the shellac completed. If it looks too monochromatic during the coloring process, you can carefully wipe layers off with alcohol. I almost always do this in the coloring process. It really helps the final look.

After letting it sit overnight, gently level the finish with a maroon Scotch-Brite pad, then wipe down the dust with a cloth and then with your bare palm (it's way better than tack rags).

The next step is, I think, the key. Too often in faux-patinated pieces, low spots and partially filled pores are left with a higher gloss than the surrounding areas. This is the opposite of what we find on truly antique pieces, because the dirt and grime in these places is always duller than the surrounding areas.

To simulate this, brush on a final coat of matte shellac before rubbing out. I use Homestead Finishing's Shellac Flat – an additive that cuts down on the sheen – for this job. After an hour, you can safely rub the shellac to sheen. I used "natural" Antiquax paste wax mixed with burnt umber pigment, applied with Liberon #0000 steel wool. The thing I love about Antiquax is that I can buff it to sheen after only a minute or two. Other waxes I've tried seem to take a lot longer to haze before buffing.

> "Let us be grateful to the mirror for revealing to us our appearance only."
>
> —*Samuel Butler (1835-1902), English author*

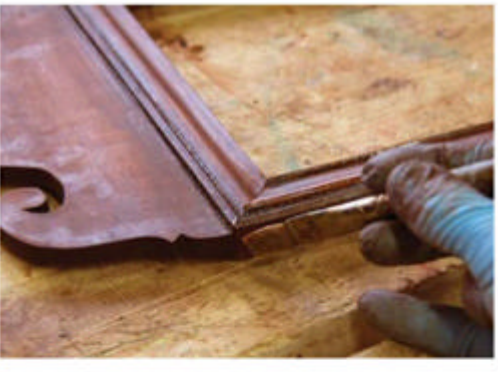
Add Glass & Hang

For the mirror, I used a small piece of salvaged 19th-century material. You can purchase 1/8"-thick glass and have it cut to size from glass suppliers. Or – if you feel up to the task – you can buy a glass-cutting tool from any hardware store to cut your own. It's simple enough to score your line and snap it off.

The glass is held in the rabbets with glue blocks. To hang the mirror, attach picture-frame wire (I wrapped it around slotted screws).

This project is a great introduction to working with hand tools because it's not big or complicated. It could easily be made in a weekend and it makes an elegant handmade gift for a loved one – and it reflects well on your skill. **PWM**

Joshua is a furniture conservator and period furniture maker who lives and works in Brooklin, Maine.



Matte it down. *Using an artist's brush, coat the sanded surface with matte shellac. As the alcohol evaporates, you will see the sheen dull in only a minute or two.*

Rub it up. *With Liberon steel wool and wax, rub the sheen back up. Excess wax is trapped in the pores, simulating years of grime. A soft, clean cloth buffs it up to a mellow shine.*

Blocked in. *Apply a glue block in the rabbet on each of the four sides to hold the glass in place.*

An authentic look. *The sawn edges of the fretwork and the deep, variegated color are the details that make this looking glass appear 200 years old.*

ONLINE EXTRAS

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BLOG: *Read Joshua Klein's blog to find out more about his work (and coastal Maine) at workbenchdiary.com.*

PLAN: *Download a free SketchUp model of this project.*

WEB SITE: *Visit the author's furniture restoration web site at kleinrestoration.com.*

IN OUR STORE: *"Building an 18th-century Jointer Plane," a video by Bill Anderson.*

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Furniture Restoration

BY BOB FLEXNER

Learn how to repair typical damage.

Waiting for renewal. *This Empire chest-of-drawers looks bad now, but you can easily repair the damage.*

Thirty-five years ago, I traded $125 worth of work for the mid-19th-century Empire chest-of-drawers pictured here. You could argue that I paid too much, because the amount of work involved in restoring it was considerable, but it was an impulse trade and I could see that the chest would be beautiful when fully restored.

Alas, more than 30 years had to go by before the motivation to tackle the project presented itself – the desire of my daughter-in-law to have the fully restored chest-of-drawers.

The problems were typical for Empire chests-of-drawers, or for any old veneered chest-of-drawers for that matter. Veneer was missing in several dozen places, and the drawers didn't slide well because of wear to both the bottoms of the drawer sides and the runners the drawers slide on.

In addition, the shellac finish was so badly crazed that it almost totally hid the beautiful wood underneath.

In this article I'll show you how to make the repairs. But first, a word about animal hide glue.

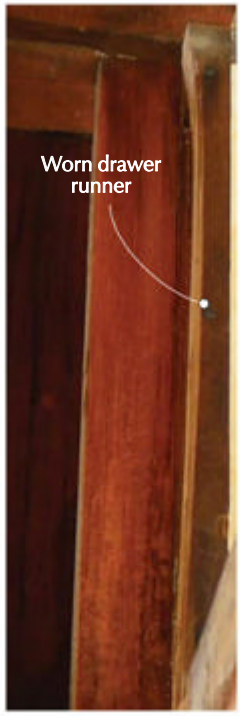
Animal Hide Glue

Almost all furniture glued up before the 1950s was glued with animal hide glue. This is glue made by soaking and cooking animal hides to remove the protein, or collagen, which becomes the glue. Many types of hides can be used, but cowhides are the most common.

The great virtue of this glue for furniture restorers is that it is much easier to deal with than modern glues and adhesives. Joints are usually fairly easy to take apart by dissolving the hide glue

Renewal. *Repaired veneer and drawers, and a new shellac finish, give this piece new life.*

PHOTOS BY THE AUTHOR



Worn drawer runner. *Drawer runners, the strips of wood that drawers slide on, typically become hollowed out after many years of use. They should be replaced.*

Remove the runners. *The runners in this chest-of-drawers were nailed and glued with animal hide glue. They were easy to remove by first removing the nails, then crystallizing the glue bond by inserting denatured alcohol. Finally, applying pressure with a chisel separated the bond.*

Clean separation. *In most cases, the runners popped off clean.*

Runners, nails & tools. *Here are the removed runners and nails, together with the tools I used.*

with hot water or steam, though using denatured alcohol to crystallize the glue is much easier and is the method I use. Once the glue is crystallized, joints can be knocked apart with a mallet, and veneer or wood strips can be separated with pressure from a dull chisel.

The glue is then easy to remove from the surfaces by washing it with hot water. This needs to be done to achieve "clean wood" before regluing with any modern adhesive, and it's usually a good idea even with hide glue.

To read more about using hot animal hide glue, see the online extras at the end of this article.

Drawer Runners

I've seen all sorts of repairs tried to fix problems with drawer runners, but nothing works as well as removing them and replacing them with new wood, or the same wood turned upside down (to preserve the original wood).

The runners in this chest were nailed and glued, so I had to remove the nails first. The glue bonds were still strong because the grain of the runners and the structural rails they were glued to ran in the same direction. Nevertheless, with the aid of some alcohol, I was able to pop off the runners.

Drawer Sides

There are two typical levels of damage to the bottoms of the drawer sides. The easiest to repair is simple concave wear. The more difficult problem occurs when the drawer sides split at the groove the drawer bottom slides into.

In the first case, the easy repair is to turn the drawer upside down on a workbench and clamp a 3/4" plywood or MDF panel, cut to the approximate interior size of the drawer bottom, to the drawer and the workbench.

Set a straight 1/2" router bit to the maximum depth of the concave wear and slide the router along the clamped panel to remove enough of the wood to create a flat surface to glue to. Stop

Worn drawer sides. *Like the runners, the bottoms of the drawer sides also wear concave after many years of the drawers sliding in and out of a chest.*

Flatten the wear. *As long as the wear to the drawer side hasn't cut into the groove into which the drawer bottom slides, or split the wood, the easy way to build out the wood is to first flatten the wear with a router and 1/2" straight bit using the jig setup shown here.*

Glue on new. *With the bottom of the drawer side perfectly flat, it's easy to glue on new wood, followed by trimming it with a handplane so the drawer slides easily on the new runners.*

the router just short of the drawer front and use a chisel to remove the final piece of wood. Finally, glue on strips of wood to rebuild the sides and trim to size with a handplane.

If the damage has penetrated the groove, or if the wood has split at the groove, the best repair is to remove the drawer sides, cut off the damaged part, glue on replacement wood, and recut the groove for the drawer bottom.

> "When we build, let us think that we build forever. Let it not be for present delight nor for present use alone. Let it be such work as our descendants will thank us for."
>
> *—John Ruskin (1819-1900) artist, scientist, environmentalist, philosopher, critic*

Veneer

The veneer on this chest is rich Cuban mahogany with a tighter pore structure than mahogany commonly available today. It is also double or triple the thickness of modern 1/32" veneer.

One of the primary lessons furniture restorers learn early on is: Never throw anything away. And indeed, I had saved some old solid pieces of Cuban mahogany. These matched the color and texture of the existing veneer perfectly, which made the finishing process much easier.

The easiest way to patch missing veneer is to make straight cuts with the grain at the edge of the damage using a box knife or a chisel. Then fit replacement veneer, also with straight cuts, into the voids.

Wash off the deteriorated hide glue on the substrate and clamp on the replacement veneer. I used hot hide glue, but you could use any adhesive. Finally, trim the patched veneer if necessary.

Finishing

This chest-of-drawers was originally finished with shellac, which was used on almost all furniture from the 1820s to the 1920s. As you can see from the "before" picture on the first page, this finish was in very bad shape.

To strip the old shellac, you can use any paint stripper, but for flat surfaces I like laying out cloths or paper towels, then wetting them with denatured alcohol. After a few minutes, it's usually easy to simply wipe off the shellac. This avoids complications with many strippers, including having to remove all the residue wax in some, or having to dry out the very slow-evaporating solvents in others.

For the new finish, keep in mind that high-performance finishes such as polyurethane and catalyzed finishes will be very difficult to strip in the future without damaging the wood. Oil and wax aren't good choices in my mind because they are too thin to create the proper appearance, nor do they offer much protection.

Shellac or lacquer would be best, but shellac has the downside of being available only in gloss sheen. To make it satin to create an "old" look, you have to rub it out with an abrasive such as steel wool, and this leaves noticeable scratches.

But the chest was originally finished with shellac, and my daughter-in-law likes gloss, so shellac is appropriate. Had the chest still been in my shop, I would have sprayed the shellac. But I had taken it to my daughter-in-law by this time, so I brushed the shellac, sanding between coats and thinning each new coat more to reduce brush marks almost entirely.

So after three decades on hold, my bartered chest became a great gift. I'd call that an excellent trade. **PWM**

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

Crystallize hide glue. *Veneer glued on with animal hide glue is usually easy to crystallize by inserting alcohol under the veneer. I find a syringe to be useful for directing the alcohol.*

Separate the veneer. *With the hide glue crystallized, it's usually easy to separate the veneer from the substrate using a chisel. To avoid cutting into the substrate and losing control, I prefer that the chisel be dull.*

Build out substrate. *Often the drawers have worn into the front rail of the chest so that the wear has to be built out before the veneer can be replaced. Here, I'm using a chisel to cut a flat surface for the patch to be glued on to.*

Trim the patch. *The patch should be left proud, then trimmed level with the substrate.*

Clamp the patch. *Thick veneer is actually very easy to work with. It can often be clamped without using a backing board.*

Trim the veneer. *Because the veneer used on this chest-of-drawers was considerably thicker than modern veneer, I used solid wood for the patches. Then I trimmed each patch level with a handplane.*

Dovetailed end grain. *The glue bond of the veneer at the edges of the drawer fronts was weak because of the large percentage of end grain in the dovetail tails. Some of the veneer had popped off, leaving ragged edges. So I cut a straight line with the grain using a box knife just inside the damage and removed the waste with alcohol and a chisel.*

Veneer patch. *There was nothing to do about the weakness of the bonds to end grain. It's the nature of the way these dovetails were cut. So I trimmed pieces of solid wood with a closely matching grain pattern perfectly straight on one edge with a block plane, then glued them into place, butted tightly against the existing veneer. After the glue dried, I trimmed the excess.*

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ARTICLE: *Dive into the details of hide glue with Bob Flexner.*

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Steam Powered

BY MICHAEL DUNBAR

Successful wood bending with heat and water is more art than science.

Long ago, some caveman made a curious discovery: Wood becomes pliable when it is both hot and wet, allowing it to be bent to a desired shape that it retains when dry. Ever since, woodworkers have been bending the stuff.

Bending, like carving and turning furniture parts, does not usually create a finished object. It is a technique you incorporate into your work, and is a skill worth developing because it makes you much more versatile. As you are about to learn, bending wood is more of an art than a science.

Bending is used by lots of woodworking trades, including boatbuilding and cooperage. It is most closely associated, however, with common chairs – ladderbacks, "Fancies" and Windsors – because every one of these forms incorporates bent parts. But I've used bent parts for all sorts of other projects, too, ranging from a coat rack to a steering wheel for an antique car.

Wood is capable of being bent – a state known as plasticized – when it is both hot and wet. Those conditions are reached at 180° Fahrenheit and 25-percent moisture content.

The old guys boiled their parts in a metal trough called a chairmaker's copper. Boiling water in a long container is awkward, and fishing out the parts is risky. That is why I prefer steaming, and rely on an efficient and easy-to-build steam box (see "PVC Steam Box," page 52).

Tension & Compression

You will better understand bending if you are aware of what happens during the process. Look at wood under magnification and you will notice its similarity to a sponge. If you wet a sponge, you can squeeze it a lot. However, it does not stretch nearly as much.

When plasticized, wood is also capable of being squeezed, but like the sponge, it does not stretch well. As wood bends, its thickness contains a neutral line. The wood inside that line is in compression (being squeezed); the wood outside the line is in tension (being stretched).

This is why bendings most commonly fail on the outside surface. Whenever possible, I use a bending strap, a metal strip as long as the part with stop blocks on each end. In use, the bending strap becomes the neutral line, so all the wood is in compression.

Unfortunately, a bending strap is not always practical and I am forced to bend some parts without support.

If getting wood hot and wet was all that mattered, bending it would be a lot easier and far less complicated. However, you do face a number of constraints. Accept the hard reality that bending is an art; failure is sometimes unavoidable. The best you can do is to achieve a sustainable success rate. The following will help you avoid failure as much as possible.

Species & Sources

Wood selection is paramount. Some species bend better than others and choosing the wrong wood for the job is an invitation to disappointment. A

PHOTOS BY THE AUTHOR

Partial bends. *Crest rails, such as the various designs shown above, are partial bends, which are likely to be successful in a range of species. (Note: It's easier to do any carving or shaping while the wood is flat, then bend it.)*

Complete bends. *When attempting more severe bends, such as these back bows for various types of Windsor chairs, choose a species such as oak or ash that, ideally, is split and air-dried, and has no grain runout.*

species suitable for one shape of bend will not work for another. So, the shape of the bend and suitable species are linked.

I divide shapes into two categories: partial bend (crest or slat) and complete bend (a sack back's U-shaped arms and bows, and two-plane continuous arms). Many species will yield a successful partial bend. Complete bends are far more demanding and require the best bending woods, such as oak or ash.

Your wood source is as important as the species – you want material with uniform strength along the entire bend.

That's unlikely to be found at the typical lumberyard, where the wood is almost always sawn, and thus weakened by grain runout. (Avoid runout by using wood where the same layers of annual growth run from end to end.)

Plus, lumberyards most often offer only kiln-dried stock; the drying process drops the moisture level in the wood below 15 percent, which sets the lignum so it will not soften and allow the wood to compress.

I have made partial bends from kiln-dried wood by soaking the part until it is waterlogged. I will attempt this, however, only if I have no alternative, and I select my material carefully, only using straight-grained wood.

Logs, Riving & Storage

I rive the wood my students and I use in chairmaking. Riving is a process of controlled splitting. It begins with a visit to the log yard where I select my logs based on their straightness and absence of defects.

When asked what I look for in a log, I respond "telephone poles." However, it is far more involved. Decades of experience has taught me which logs will most likely split open into straight bolts – yet I still receive the occasional unpleasant surprise.

Once a log has been opened, I split the halves into quarters, then eighths. Finally, I cleave off the pith. The end of an eighth of a log is pie-shaped, so this means I remove the pointy piece of the pie. This is the oldest part of the tree, laid down when it was a sapling. The pith usually contains small branches that broke off long ago.

An eighth-log minus its pith is light enough to carry to my resaw band saw with its 3" blade. Following the grain, I rip the eighth into bending stock – pieces with the grain running from one end to the other.

A delivery of four logs yields me enough stock for a couple of years. However, it must be prepared all at once, because left in the log it will decay. Then I stand the stock upright in an unheated area so air can circulate through it and allow it to air-dry.

> "The better class of workmen would rather part with the clothes off their backs and the beds from under them, than make away with their tools."
>
> —*Henry Mayhew in* The Morning Chronicle, *July 11, 1850*

Stock stored this way will remain suitable for bending indefinitely. I frequently bend riven-then-ripped air-dried stock that is several years old.

Prep & Forms

Before bending, you need to shape the part. There is always a risk of breaking, so when making a complete bend, I invest the minimum amount of effort possible, putting off the finish work until after the part has dried.

Partial bends, such as crest rails, are another story – particularly when

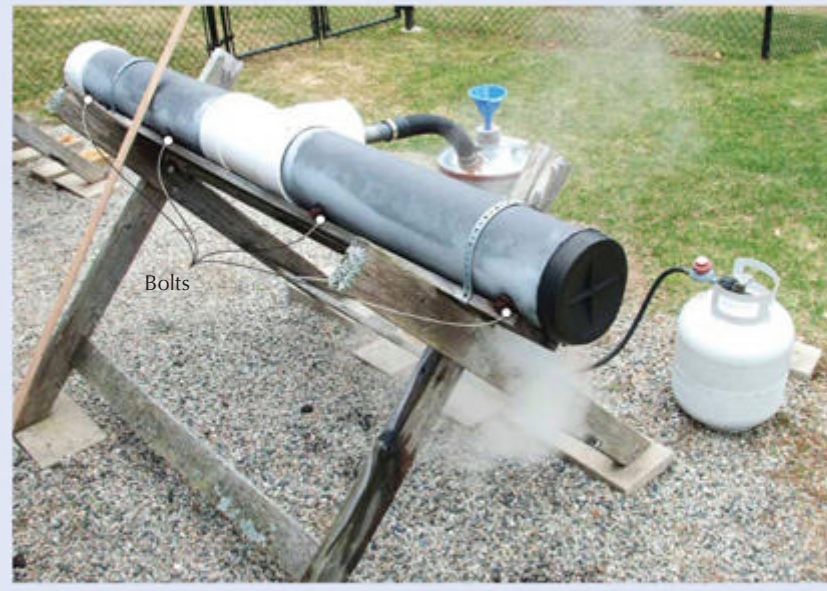
Split pieces*. Riven logs (in this case, red oak) yield pieces that are split along the grain line, with no runout.*

Ripped & ready. *After riving the stock into eighths, I use a 3" resaw blade to follow the grain line and rip the pieces into bending stock, then leave it to air dry.*

PVC STEAM BOX

My steam box does such a good job that I have not improved it in years. It is assembled with easy-to-find, off-the-shelf materials.

There are two things I think you want in a steam box: imperviousness and good insulation. If made of wood, the box will have to saturate before it can begin plasticizing your parts. If made of metal, much of the heat radiates into the air rather than doing its intended job. Also, you risk burning yourself if you bump the tube.



I use Schedule 80 PVC Drain-Waste-Vent pipe because it has both of my required properties. Being plastic, it is impervious. Once you have steam, the box goes immediately to work. It is such a good insulator that when the setup is running full tilt, I can comfortably hold my hand on the box, even though live steam is a mere 3/8" away on the inside of the pipe.

To hold the large number of parts a class bends in an afternoon, I have two steam boxes made of 6" pipe. Most of you will likely find 4" pipe ample – and a lot cheaper. My boxes are 6' long, which is a length sufficient to accommodate continuous-arm and settee parts.

I cut the PVC into two 3' sections and joined them with a T fitting. With this configuration, the steam is introduced in the middle and flows evenly in both directions. I connect the boiler spout to the fitting with a radiator hose and seal one end of the box with a test cap and the other with a threaded cleanout. If you use your box only occasionally, test caps are fine on both ends.

Excellent insulator. *The PVC pipe provides such good insulation that snow remains on top in the winter even when the steam setup is going at full power.*

The steam is generated in a boiler (I use a galvanized steel utility can) sitting on a propane burner – the kind used for cooking crawdads or deep-frying turkeys. I do not use an electric heater, because these will not produce a vigorous, roiling boil. Steaming wood is a case where bigger is better and less is not more.

The PVC tube is pierced by four evenly spaced stainless steel bolts. The bolts serve as a rack and hold the parts in the top half of the tube, up in live steam. If you don't use stainless, cover the bolts with flexible plastic tubing. This will prevent them from marking the wood.

I drilled two 1/2" vent holes on the bottom of the tube a short distance from the ends, but far enough in to avoid being covered by the test caps. With copious steam and somewhat tight fittings, the tube will develop a bit of pressure, causing plumes of water vapor to shoot downward from these vents. These plumes tell me at a glance when the box is operating at full tilt.

When explaining the box to students, I liken it to a table saw. Both are very effective, but both are dangerous – and you must shut off both before making any fixes.

In operation, the tube is full of steam that will scald as fast as a table saw will take off a finger. Remember, steam rises. So when you open the tube, "up" is the direction the steam is instantly heading. To avoid burns, pull the cap straight off. Then use tongs to remove parts and approach with your hand from below the opening, never above. Do not try to fish out a part that is beyond easy reach of the tongs.

Close the tube by putting the cap's bottom edge in place, then the top. — MD

Press. *Partial bends are done in a two-part press, with pressure supplied by a vise. Each half matches the shape I wish to accomplish.*

Forms. *For complete bends, I use a form that matches the shape I wish to accomplish. The block at the top of each holds a wedge in place.*

A little help. *With two people working, and a strap providing the neutral line to keep all the wood in compression, a steamed piece can be bent around a form all at once.*

using riven stock – because they rarely fail in bending.

In Windsors, crest rails often have carved volutes in their projecting ends, called ears. Volutes are easier to carve while the crest is flat because the stock can be clamped securely.

Partial bends are accomplished in a two-part press made to yield the desired curve. I secure the press's two halves in a vise, so bending is as easy as turning a handle. When done, I secure the press in a clamp so it can be removed to free up the vise for the next bend.

Each chair style has its own form, and they are not usually interchangeable. My bending forms for complete bends all have a center block that allows the piece to be secured at its midpoint with a wedge.

Working alone, I bend each side independently. If I have a helper, we bend both ends at once. Bending is an amazing process to watch. We think of wood as hard and rigid, but right before your eyes it magically changes shape. It is even more exciting to be the person doing the bend.

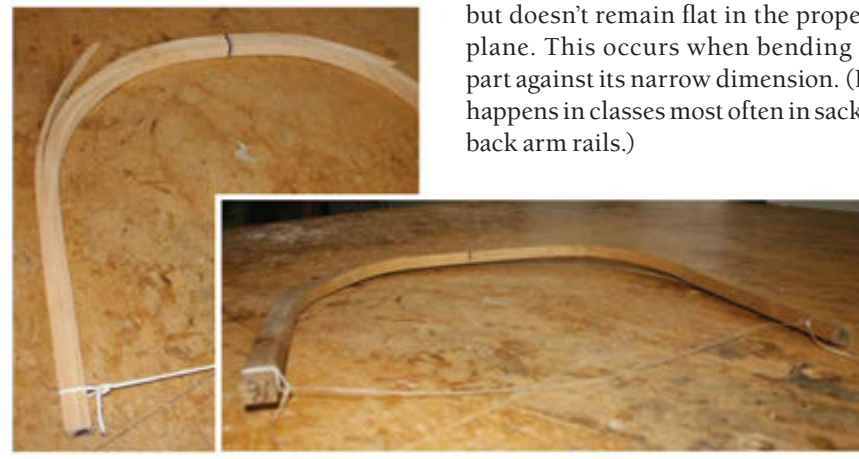
To overcome that excitement, I advise my students before beginning, "Speed is your enemy." While they work, I repeatedly warn them to slow down. Bending must be done gradually, because unlike a sponge, wood compresses more slowly. Rushing the job will result in more breakage. A complete bend can take up to 45 seconds (less for a partial bend).

That said, you don't want to stop for a cup of coffee on your way from the steam box to the bending form.

The Bad News: Failures

If a bend is going to fail, it will happen in one of four ways. The most common is a delamination; the part separates along the grain.

Second most-common is roll up, where the piece bends as desired, but doesn't remain flat in the proper plane. This occurs when bending a part against its narrow dimension. (It happens in classes most often in sack-back arm rails.)



Delamination & roll up. *A delamination failure (left) – where the part separates along the grain – is common. A roll up failure (above) refers to the piece not remaining flat in the proper plane as it dries. Notice how it lifts off the surface at the top right.*

Tension shear & compression. *In tension shear (left), the fibers simply tear during bending. A compression failure (right) – where fibers wrinkle instead of bend – typically occurs on an inside curve.*

Stacks of arms. *A continuous-arm chair back (bent in two planes) needs to stay on the bending form for three days, so the forms are stacked in a drying room equipped with a heater.*

Tension shear is the third-most common. Here, the wood fibers tear like a piece of cloth.

Finally, instead of compressing, wood will sometimes collapse in a compression failure. The result is reminiscent of ribbon candy.

I seldom have the luxury of choosing the day I will bend. We do it Monday of every class, because the wood has to be dry so we can use it later in the week. I am forced to ignore the reality of good bending days vs. bad. There is a marked difference, and when blessed with a favorable day, we have far fewer problems.

On a bad day we can lose 15 percent, while good days frequently achieve 100-percent success. The good-versus-bad-day phenomenon is counterintuitive. To bend, wood has to be wet, but days that are gray and drizzly are the bad ones. Crystal-clear, dry, low-humidity days are best.

Drying Time

A successful bend has to dry before it can be used. Once cool to the touch, a complete bend in a single plane can be removed from the form and its ends tied with string. A double-plane bend (a continuous arm) has to dry on its form, and a partial bend remains in its press.

I have a special kiln for continuous-arm forms because they are awkward to stack. We use our furnace room for drying our other bends. The space stays at 90° year-round, making it an effective kiln. During the summer, we increase the room's "oomph" by adding a dehumidifier and a heat lamp. Our bent parts are ready to use in two to three days.

You can determine on sight when a bent part is completely dry because it takes a compression set. Rather than springing back, the bend closes slightly. A string that was taut when the part was removed from the form will droop. A continuous-arm bend that was tightly secured to its form will loosen; the clamp will fall off a press.

So, with all that in mind, how long does it take to go from dry stock to bent pieces? Wood is plasticized by making it both hot and wet. In steam, it gets hot fast. And if it is already wet – that is, it has a high moisture content as does our riven bending stock – it is ready to come out of the box in about 20 minutes and put to use on a form or press.

While you don't need to worry about over-steaming, you can under-steam.

And with steam-bending in your woodworking arsenal, you'll never again have to worry about getting past flat. **PWM**

Strung up. *Once a piece is cool to the touch, a single-plane bend can be tied in place with a string and removed from the form. Notice that the string shown here is loose; the wood continued to compress after it was removed from the form.*

Mike is the founder of The Windsor Institute, a school in Hampton, N.H. He's been teaching folks how to make Windsor chairs since 1980.

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For links to all online extras, go to:

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Indispensable Mortise & Tenon

Drawbore it for a joint that will last centuries.

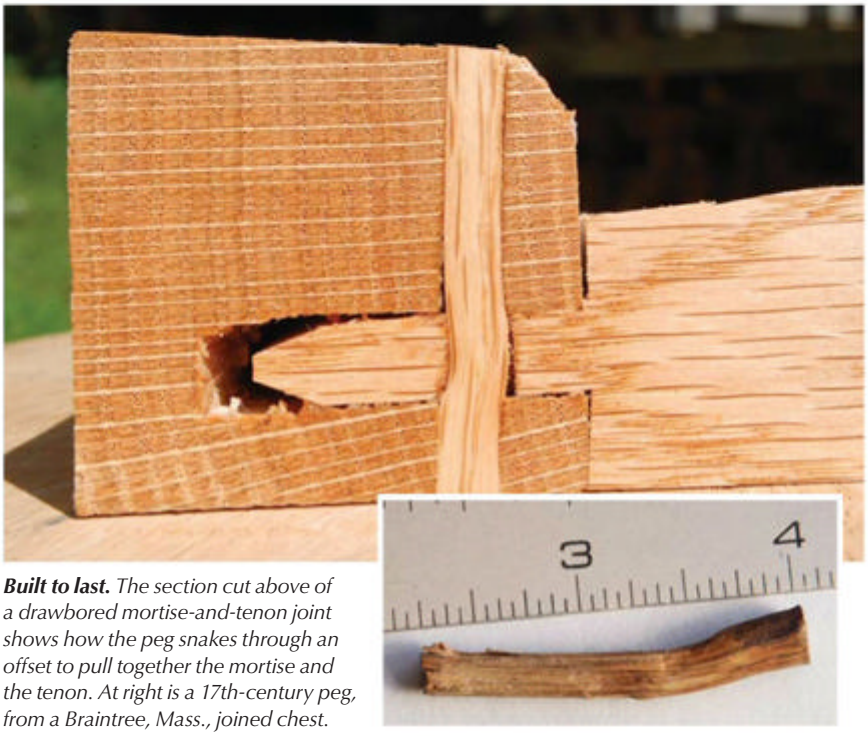
I once had a visitor to my shop remark that he'd like to see a book about all the types of joints that I use. I told him it'd be a pretty short book: One page for the rabbet joints I use in boxes and drawers, and another for the mortise and tenon.

I never really learned to cut dovetails until I'd been a furniture maker for more than 20 years. But I lean toward fanaticism and, early on, 17th-century joiners' work captivated me completely. And it was there that I learned just how many places you could use the mortise-and-tenon joint.

It's a joint that can take you from the cradle to the grave, almost. House frames and the wainscoting around the walls. Cabinet doors in the kitchen. Cradles, chairs, tables, chests and cupboards. Stools. Benches.

You can picture most any piece of furniture in the stile-and-rail format. Drawers are the exception; I've never heard of, and wouldn't want to see, a drawer made with mortises and tenons.

Hence the rabbet. While some are dovetailed, most 17th-century drawers in English work are just rabbeted and fixed with nails. It's not the showiest technique, but if a drawer lasts 350-plus years, is it really poor construction?



Built to last. *The section cut above of a drawbored mortise-and-tenon joint shows how the peg snakes through an offset to pull together the mortise and the tenon. At right is a 17th-century peg, from a Braintree, Mass., joined chest.*

Square Pegs, Round Holes

The oak boxes I make are based on studies of period examples. These are sometimes called "Bible boxes" – a term I despise. There was a period term for these items that was quite straightforward: a "box."

A box. *In the 17th-century-style work I do, boxes aren't typically dovetailed. They're rabbeted, then nailed.*

They are almost always rabbeted, usually secured with iron nails through each corner, and use no glue. A small percentage used rabbets that were glued and pinned; square pegs in round holes make a tight fit.

Rarely, you find boxes like this with dovetailed corners. You're more likely to find period boxes that feature nailed butt joints than dovetailed examples. They're out there, but they're quite unusual.

Wet/Dry Joint

As a chairmaker, the round mortise and tenon was the first joint I learned in detail. How many ladderback chairs have been made on this earth? A lot.

Windsors, too, use a round mortise and tenon. I've formed these with Forstner bits, spoon bits, auger bits and more. All of them worked. Turned tenons, shaved tenons, even whittled. The heart of the ladderback's mortise and tenon is the wet/dry joint – a super-dry tenon in a mortise that still contains moisture. Shrinking mortise, swelling tenon – it works like a charm.

The tapered, round mortise and tenon used in a Windsor chair seat-to-leg joint is another nifty item. Bore the mortise, ream it, then turn a tapered tenon. Sit on it and presto! Tighter and tighter it goes. Mostly these are still split and wedged from above, sort of a belt-and-suspenders approach.

Joint for a Lifetime

But bored mortises and shaved or turned tenons won't get you a chest

PHOTOS BY THE AUTHOR

or cupboard. When I began to study joinery, I saw that the rectangular mortise and tenon was the entire basis for the craft.

I had made mortise-and-tenon joints before this; some of my earliest non-period, non-chair works were bookcases that used through mortise and tenons, fastened with a wedge.

Later, I employed these again in our bedstead – not a traditional 17th-century technique unless you're building a Dutch barn. I even remember once or twice making fox-wedged joints.

But my favorite is the drawbored version. Even beginners can make joints that will last a lifetime with this technique. You need a couple of chisels, a backsaw, a mortise gauge, and a brace and bit – all basic tools that most shops have, or should have.

And you need practice. For my joints, I use no glue, but tapered wooden pins to hold it together. I've used the same format, but slightly different techniques in timber-framing buildings. That was actually where I first learned about drawbored joinery.

Dovetails? Meh

Dovetails, of course, have their place, and now they are a sort of gold standard for woodworking joints. I think the emphasis on the "perfectly cut" dovetail is more a reaction against machine-made work than any measure of a craftsperson's abilities.

Roy Underhill has remarked that the dovetail joint is incredibly strong in one direction, but can come loose in the other. Maybe that's why 17th-century versions of the joint are often nailed through the tails into the end grain of the pin board. The belt-and-suspenders method of dovetailing: Leave nothing to chance.

I did come around, and I learned to cut dovetails. I've made lots of boxes with that method, either just for the fun of it, or so I could delve into other disciplines beyond the English period joinery that is my specialty.

Nailed tails. *While they are rare, there are a few surviving examples of 17th-century dovetails. But most feature nails through the tail board.*

Champion Joint

But for versatility, the mortise-and-tenon joint is unbeatable. Whenever I turn someone on to their first joint, it's always the drawbored mortise and tenon. The good ones are hooked right away. Then, 25 years later, if they're still interested, they can fiddle with dovetails. **PWM**

Peter has been involved in traditional craft since 1980. Read more from him on spoon carving, period tools and more at pfollansbee.wordpress.com.

DRAWBORE A JOINT

Fit. *First, show the tenon to its mortise.*

Mark. *Use an awl to mark the hole location on the tenon. Then remove the tenon and offset the center point about 1/8" toward the shoulder, and drill.*

Pinned. *Use a drawbore pin to test-fit the joint after drilling the holes in the tenon.*

Pegged. *Now drive a peg (preferably of riven oak) into each hole.*

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Contemporary Side Table

Simply change the 'drawer' and finish to change the look of this easy piece.

The first step in building this contemporary side table is to go shopping for the basket that serves as a drawer – then adjust the plans as necessary to fit your choice.

The one shown here is an 11"-deep, 7"-tall, 17"-long sea grass basket from Organized Living – but a basket, tray or cloth tote of many sizes and shapes would work (and you can easily change the style of the project with your "drawer" and finish choice).

The key thing is that your basket/tray/tote not be deeper than 11¼", which is the actual width of 1x12 – the widest dimensional lumber available at the home center.

So, with my basket selected, I headed to the home center for No. 1 white pine.

This project is dirt-simple and, including the $24 basket, cost less than $100. It took just a couple of hours to shop, build and apply the finish – yet I've seen similar projects in various catalogs and stores priced anywhere from $200 to $600.

I know it's easy to fall into the trap of "I could just build that," then never get around to it – but with this side table, there's simply no excuse.

Stock Layout

The shelves, sides and top are all the full 11¼" width of the 1x12 stock, so all you need to do is cut the pieces to length.

I started with the shelves, so I marked then cut one 18"-long piece at the miter saw, and used it to mark the length of the other so they'd match. Then I did the same with the 27¼"-long sides. After making your cuts, confirm the parts match their partners; if they're off even a little, stack them flush at one end, then trim them simultaneously at the miter saw. They need to match.

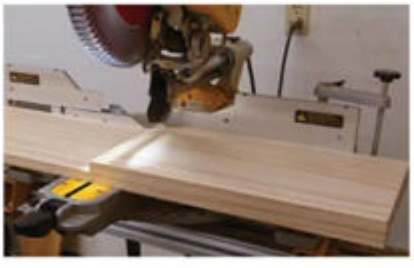
Note that if you don't have a miter saw, or if yours won't make an 11¼"-wide cut, you can easily use a circular saw, running it along a straightedge to keep the cut square.

Hold off on cutting the top to length until you've assembled the base.

Now lay out the shelf locations. I decided on a 7" opening at the top for books and the like. My basket is also 7" – but I wanted a little room at the top to be able to easily reach in to pull it out, so that took an 8" opening.

After I marked the shelf locations, I showed the basket to the side to make sure it would fit. Trust, but verify.

Before moving on, sand the sides and shelves to #150 grit or more to remove mill marks. (You can probably get away with stopping at #120 grit if you're going to paint your side table.)



Matched sets. *Measure, mark, then cut the first shelf and use it to lay out the length of the second shelf. Do the same for the two sides.*

Grab Your Drill

The joinery is simply two pocket screws on the underside of each end of both shelves. But because this was all moving along far too quickly, I decided to add a dash of fuss (two minutes' worth) by measuring and marking locations

CONTINUED ON PAGE 63

LEAD PHOTO BY AL PARRISH; STEP PHOTOS BY THE AUTHOR; ILLUSTRATION BY DAN PESSELL FROM THE AUTHOR'S MODEL

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15260652

SUPER COUPON

RAPID PUMP® 1.5 TON ALUMINUM RACING JACK

PITTSBURGH

- 3-1/2 Pumps Lifts Most Vehicles
- Weighs 27 lbs.

SAVE $60

$59.99

REG. PRICE $119.99

LOT 69252
60569/62160
62496/62516
68053 shown

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15191208

SUPER COUPON

72" x 80" MOVER'S BLANKET

HaulMaster

LOT 66537 shown
69505/62418

SAVE 66%

$5.99

REG. PRICE $17.99

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15165762

WOW SUPER COUPON

12" SLIDING COMPOUND DOUBLE-BEVEL MITER SAW WITH LASER GUIDE

SAVE $165

NEW

CHICAGO ELECTRIC POWER TOOLS

LOT 61776/98194/61969/61970/69684 shown

$134.99 $299.99

REG. PRICE $299.99

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15170033

WOW SUPER COUPON

18 GAUGE 2-IN-1 NAILER/STAPLER

SAVE 57%

CENTRALPNEUMATIC

LOT 61661/68019 shown

WE CARRY A FULL LINE OF FASTENERS

$15.27 $22.99

REG. PRICE $35.99

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15229765

SUPER COUPON

44", 13 DRAWER INDUSTRIAL QUALITY ROLLER CABINET

US GENERAL PRO

SAVE $330

- Weighs 245 lbs.

LOT 68784 shown
69387/62270/62591

$369.99

REG. PRICE $699.99

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15160565

WOW SUPER COUPON

1650 PSI PRESSURE WASHER

SAVE OVER $49

PACIFIC HYDROSTAR

- 1.3 GPM

LOT 69488

$80 $129.99

REG. PRICE $129.99

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15229603

SUPER COUPON

4" x 36" BELT/ 6" DISC SANDER

CENTRAL MACHINERY

SAVE $80

LOT 62502
97181 shown

$59.99

REG. PRICE $139.99

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15185580

SUPER COUPON

24" CLAMP AND CUT EDGE GUIDE

PITTSBURGH

SAVE 53%

LOT 66126

$6.99

REG. PRICE $14.99

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15200225

SUPER COUPON

2.5 HP, 21 GALLON 125 PSI VERTICAL AIR COMPRESSOR

SAVE $70

CENTRALPNEUMATIC

LOT 67847 shown
61454/61693

$149.99

REG. PRICE $219.99

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15236425

WOW SUPER COUPON

14" OSCILLATING SPINDLE SANDER

SAVE $50

CENTRAL MACHINERY

LOT 69257 shown
95088/62146

$99.99 $149.99

REG. PRICE $149.99

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15166035

SUPER COUPON

2500 LB. ELECTRIC WINCH WITH WIRELESS REMOTE CONTROL

BADLAND

SAVE $100

NEW

LOT 61258 shown
61840/61297/68146

$49.99

REG. PRICE $149.99

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15180039

SUPER COUPON

29 PIECE TITANIUM NITRIDE COATED HIGH SPEED STEEL DRILL BIT SET

WARRIOR

LOT 5889/62281/61637 shown

NEW $9.99

REG. PRICE $24.99

SAVE 60%

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CONTINUED FROM PAGE 60

for the pocket screws before drilling. I hope the cats and bugs are impressed by the perfect symmetry that no person will ever see.

The only (slightly) tricky thing about using pocket screws for assembly is making sure your parts stay perfectly aligned as you drive the screws. But clamp a thick, straight piece of wood along the layout line (and to the bottom of the Workmate to keep the side from shifting), and the challenge is overcome. You'll also see in the picture at right that I've another clamp pulling the shelf to the block – that's because the shelf boards developed a slight but noticeable warp after I cut them to length; the clamp pulled the warp out to make the shelves nice and level.

After you drive the pocket screws on one side, flip the piece on top of the second side and again clamp the block to your layout lines to keep things in place as you finish assembling the base.

But before you tighten the clamps, grab a 12" combination square and confirm that the setup is indeed square.

Once the base is all together, set it on the ground and confirm the length for the top. Yep – in this case, 19½" as planned. But you never know.

Cut the top to length at the miter saw and use a sanding block on the ends to remove any mill and burn marks from the saw blade. Then – if like me, you're persnickety – use your combination square to mark a line ⅜" in along each end, and mark nail locations symmetrically along that line, then align the top with the base and drill pilot holes for 6*d* finish nails.

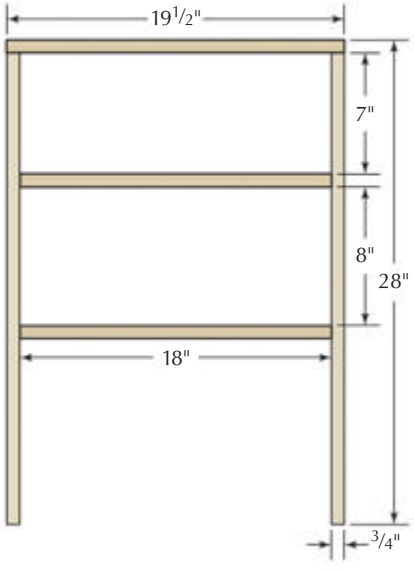
Drive each nail so it's almost flush to the surface, then use a nail set for the final hammering of each to sink the heads slightly below the top and not damage the wood.

Easy driving. *A block clamped in place to the layout lines makes it simple to hold the shelves perfectly in place as you drive the pocket screws. (Note: Because I'm using pine, a softwood, I used coarse-thread screws.)*

Eschew 'Frenching.' *A nail set helps you avoid inadvertently marring ("Frenching") the tabletop as you drive the nails slightly below the surface.*

Contemporary Side Table

NO.	ITEM	DIMENSIONS (INCHES) T	W	L	MATERIAL
❑ 2	Sides	¾	11¼	27¼	Pine
❑ 2	Shelves	¾	11¼	18	Pine
❑ 1	Top	¾	11¼	19½	Pine



ELEVATION

The Finishing Steps

Sand the top to the same grit as you did the sides and shelves, check the entire build to make sure everything is smooth to your satisfaction, then ease all the edges with sandpaper.

Now break out the stain or paint. I chose a gel stain (in hickory) because gel stain basically sits on top of the surface and thus tends to blotch less on pine than a penetrating stain. And it's the consistency of pudding, so it doesn't drip and run. It also imparts a deeper color than penetrating stain… which is why some people don't like it – it obscures the grain more than a traditional stain.

After donning gloves, rag on a coat (not too thick – but sufficient to cover everything), let it sit for about five minutes, then wipe off the excess with a clean rag.

Wait for the stain to dry (it can take as long as 12 hours), then apply a topcoat (I used a satin polyurethane). After it dries, slide your basket in place, and voilá – an easy contemporary side table for little cash and little time, but with a lot of style. **PWM**

Megan is the editor of this magazine. She can be reached at megan.fitzpatrick@fwcommunity.com.

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PLAN: *Download a free SketchUp model of the "Contemporary Side Table."*

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Our I Can Do That column and video show feature 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. Visit PopularWoodworking.com/ICanDoThat to watch the videos featuring host Chad Stanton, and to download the free tool manual.

Working Memory

Rebuilding a toy chest is a connection to the past and the future.

I do not stem from woodworking lineage, at least not the kind you hear about. My dad wasn't overly handy. While growing up, I recall most things either went unfixed or someone else was called to remedy the situation.

My grandfather worked as a maintenance man fixing this or that. Generally speaking though, grandpa was more of a frugal DIYer than a fine craftsman.

Nonetheless, their hearts were always in the right place and sometime in the early 1970s, they both set forth to cobble together a toy chest for my siblings. Over the years, the chest held action figures, dolls, baseball cards and most likely someone's illegal stash. It moved from the bedroom to the basement sometime in the late '90s. There it sat until recently.

While visiting my mom, she asked me if I could reconfigure the toy chest with a new lid and safer hardware. This way, my two little girls could use it when they came to grandma's house. I made my way into the basement and, with one look, became awash in childhood memories.

As I took second and third glances, I was able to see the piece with a woodworker's eyes. I noticed the construction techniques: less-than-perfect case miters, screws, wood putty and heart.

How did they cut these long case miters? Did they fill these screw holes with plugs? They didn't have a table saw or a plug cutter, did they?

Over the course of several months I rebuilt the chest. I disassembled the structure, discarded the ugly plywood top, and planed down the boards to discover a beautiful pine bottom and maple sides.

More importantly, I was able to create linkages between my aging grandfather, my deceased father and my little girls. Working with this piece conjured up unexpected memories, questions and connections.

Not to get lost in metaphysics, but it's as though I could feel my dad's hands through the boards. It created an unanticipated comfort, because I no longer can touch those hands.

My dad was both a farmer at heart and by trade. As much as I rejected the simplicity of his ways as a teen, I rejoice in them now.

I scored some reclaimed wormy chestnut for the new top. I broke down these old boards by hand using grandpa's recently restored (by me) Disston D-8. I experimented with breadboard ends, milk paint and cut nails for the first time. New and old intertwined at each step in the process. In my mind, I could see their smiles and I appreciated their guidance on this build.

The chest is back in use at the old homestead. Currently, it stores lots of pink and purple, but one day it might house an anarchist's tools or grandma's blankets – or maybe it will just be a place to set down a well-deserved drink. I look at it fondly each time I visit: a vestige of a life cut short and a legacy I promise to pass on. **PWM**

Shawn lives in Cleveland, Ohio, with his wife and two young daughters. When not using his spare time to build furniture, he's thinking about it.

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