

7 RULES FOR BRUSHING A FINE FINISH

Build Our
One-Weekend
Coffee Table



POPULAR Woodworking

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DECEMBER 2008 #173

**Miter Saws:
We Test
The Best**

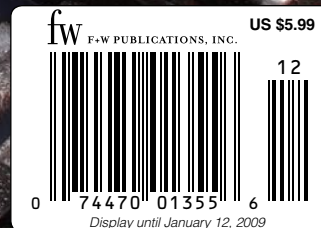
**5 Simple
Shaker
Serving Trays**

**12 Best New
Tools of 2008**

**Build Your Own
Jack Plane**

**\$4,000 Stickley
Mantle Clock**

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DECEMBER 2008

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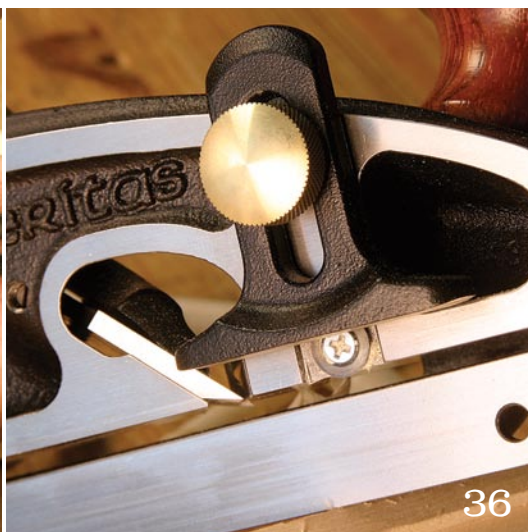
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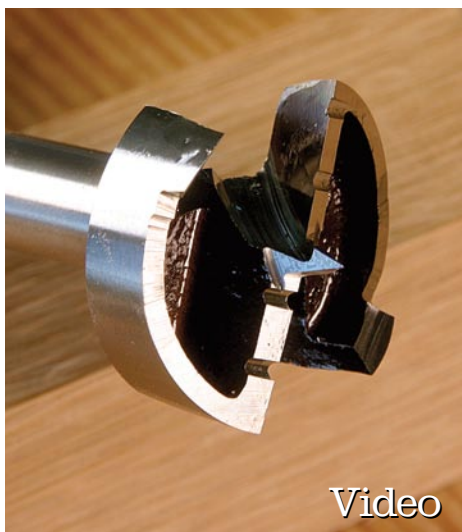
You can't go wrong with any of the six 12" sliding compound-miter saws we tested for this issue. The choice depends on your must-have features. Page 42.

COVER PHOTO BY AL PARRISH





Video



Video



Blogs

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We've retooled our web site – now, you'll find five times more content, and it's all free! Plus, there's a new searchable directory of woodworking tool and equipment suppliers – one click and you'll find what you need – fast! popularwoodworking.com

Video Gallery

Free-form Sculpting

This month, Marc Spagnuolo (a.k.a. The Wood Whisperer) shows you how just a few simple tools and techniques can add sculpting skills to your woodworking arsenal.

popularwoodworking.com/video

Incredible Forstner Bits

The new German-made Colt MaxiCut Forstner bits are among our Best New Tools of 2008 – and this video will show you why. Watch as we cut cleanly – and incredibly quickly – through the hardest stock with no clogging or burning.

popularwoodworking.com/video

Miter Saw Test

Get an inside look at our test of the six 12" sliding compound miter saws in our cover story – how clean the cuts are, ease of adjustment and more!

popularwoodworking.com/video

On the Blogs

Fuming Oak

The Stickley mantle clock on page 48 in this issue is finished in the traditional way – fumed with ammonia then shellaced. Senior Editor Glen D. Huey takes you step-by-step through the process on the blog. Plus, you'll find information on ordering our custom clock face.

popularwoodworking.com/blogs

And More!

Visit popularwoodworking.com/dec08 to find a complete list of all the online resources for this issue – including videos, additional drawings and photos.

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Michael Dunbar has been a chairmaker since 1971, and has written seven books, and authored countless magazine articles. In 1980, he and his wife, Sue Dunbar, founded The Windsor Institute, a New Hampshire-based school that teaches all things Windsor. Since then, Mike and his staff have taught more than 3,000 students to build Windsor chairs and settees. For information on available classes, visit thewindsorinstitute.com.

In this issue, Mike writes about two tools that are integral to making Windsor chairs: the spokeshave and draw-knife. The story begins on page 72.



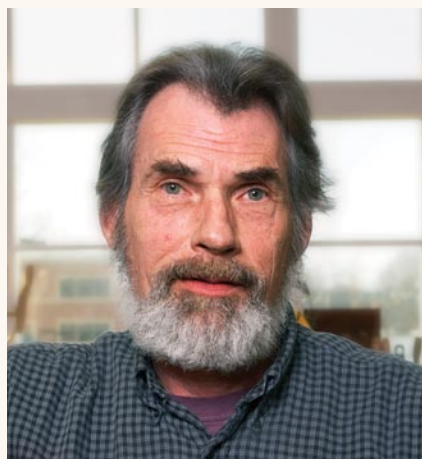
Bob Flexner If you're a regular reader of *Popular Woodworking*, you know Bob as our finishing guru. What you might not know is that Bob sort of stumbled into his role as a finishing expert after not being able to find answers to his own finishing questions. He spent more than two decades running a woodworking and restoration shop, where he was often frustrated by a lack of good finishing information. So, he decided to write down everything he discovered. Years later, he's the go-to guy for all things finishing (in addition to remaining an expert in restoration and repair).

In this issue, Bob shows us how to brush on a finish (page 82) – it seems simple, but finish manufacturers' directions can muddy the waters.



Robert W. Lang "Drafting & Design for Woodworkers" (Popular Woodworking Books), the latest book from Senior Editor Robert W. Lang, is now available at popularwoodworking.com. (Check out his other books on Craftsman and Greene & Greene furniture at his web site: craftsmanplans.com.)

For this issue of the magazine, Bob tested six 12" miter saws and wrote the cover story (page 42).



PUBLISHER & EDITORIAL DIRECTOR Steve Shanesy
x11238 ■ steve.shanesy@fwpubs.com

EDITOR Christopher Schwarz
x11407 ■ chris.schwarz@fwpubs.com

ART DIRECTOR Linda Watts
x11396 ■ linda.watts@fwpubs.com

SENIOR EDITOR Robert W. Lang
x11327 ■ robert.lang@fwpubs.com

SENIOR EDITOR Glen D. Huey
x11293 ■ glen.huey@fwpubs.com

MANAGING EDITOR Megan Fitzpatrick
x11348 ■ megan.fitzpatrick@fwpubs.com

ASSOCIATE EDITOR FOR THE WEB Drew DePenning
x11008 ■ drew.depenning@fwpubs.com

PHOTOGRAPHER Al Parrish

CONTRIBUTING EDITORS

Adam Cherubini, Bob Flexner, Troy Sexton

F+W PUBLICATIONS, INC.

CHAIRMAN & CEO David Nussbaum

SENIOR VP, MANUFACTURING & PRODUCTION Phil Graham

VP, MANUFACTURING Barbara Ann Schmitz

EXECUTIVE VP, INTERACTIVE MEDIA John Lerner

VICE PRESIDENT IT, CIO Mike Kuehn

F+W PUBLICATIONS, INC.
MAGAZINE GROUP

PRESIDENT David Blansfield

VP, CONSUMER MARKETING Sara DeCarlo

DIRECTOR, BUSINESS PLANNING Tom Wiand

CONFERENCE DIRECTOR Sara Dumford

CIRCULATION DIRECTOR Linda Engel

NEWSSTAND DIRECTOR Susan Rose

PRODUCTION COORDINATOR Vicki Whitford

ADVERTISING

ADVERTISING DIRECTOR Don Schroder
331 N. Arch St., Allentown, PA 18104
TEL. 610-821-4425; FAX 610-821-7884
d.schroder@verizon.net

ONLINE SALES DIRECTOR Jay Gussak
TEL. 212-447-1400 x266
jay.gussak@fwpubs.com

DISPLAY & CLASSIFIED ADVERTISING
SALES COORDINATOR
Krista Morel
TEL. 513-531-2690 x11311
krista.morel@fwpubs.com

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The Power Of Candlepower

I put the candle on the floor and stepped back. My wife, Lucy, eyed me warily.

I moved the candle a few feet and shifted myself a few feet away. Lucy crossed her arms, like she was about to scold one of the children for dressing the cat in doll clothes.

"What," she asked, "are you doing?"

"I'm working," I replied, and I turned my attention back to the candlelight.

Today is the third day of intermittent electric power in Cincinnati after the last fingers of Hurricane Ike flicked out the lights for about 90 percent of us in the city. The first couple days without electricity were spent figuring out how to eat (I made chicken with Thai yellow curry on our gas grill), and how to get around in the dark (wind-up flashlights and nasty scented candles we swore we'd never use).

On the third day, we opened our eyes to the darkness.

Furniture looks different when it's illuminated by small globes of weak light – instead of overpowering overhead illumination. In fact, my furniture now looks nothing like I expected when I designed it.

The most interesting pieces by candlelight are the ones designed before the electrification of the American household. In one alcove of our living room, I have a reproduction Shaker cupboard that I built in 2005.

I took great pains to reproduce the proportions, the lines and the mouldings at the top of the cupboard. In daylight, the piece is pleasant to look at, but it's not the kind of

project that grabs you by the gut and tosses you down the basement steps into the shop, all the while screaming "build me!"

But by candlelight, this modest project takes on an ominous air. No matter where you put a candle, the project looks different. The mouldings are in sharp relief. Shadows, both on the cupboard and made by the cupboard, become a part of the carcass.

Sitting here in the near-dark, I have to wonder if our forbears considered the shadows as they designed things. Or did they conceive of a project like I do: In a brightly lit space that looks something like an empty computer screen.

Senior Editor Glen D. Huey and I chatted about this one morning after we had both stumbled on the same revelation about our furniture in the near-darkness (Glen made eggs over easy on his grill, by the by). Wouldn't it be cool, he said, to switch places with our ancestors for a couple

days to see their furniture and living spaces through their eyes? And they could see how furniture looks with our electric light.

It would be cool indeed, I agreed. But when it came time to send our ancestors back to their time, Glen said, they'd probably pull a gun on us to stop it from happening.

Cool-looking furniture is one thing. Cable television, ice makers and plunge routers are another. **PW**



Christopher Schwarz

PHOTO BY THE AUTHOR

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Safety Note

Safety is your responsibility. Manufacturers place safety devices on their equipment for a reason. In many photos you see in *Popular Woodworking*, 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.

What's the Origin of the Word 'Frog' (as it Refers to Handplanes)?

Can you tell me the origin of the word "frog" as it refers to a handplane? Is it because it resembles the shape of a frog?

— Tom Keady, Lincoln Nebraska

The origin of the word "frog" as it relates to handplanes is somewhat murky.

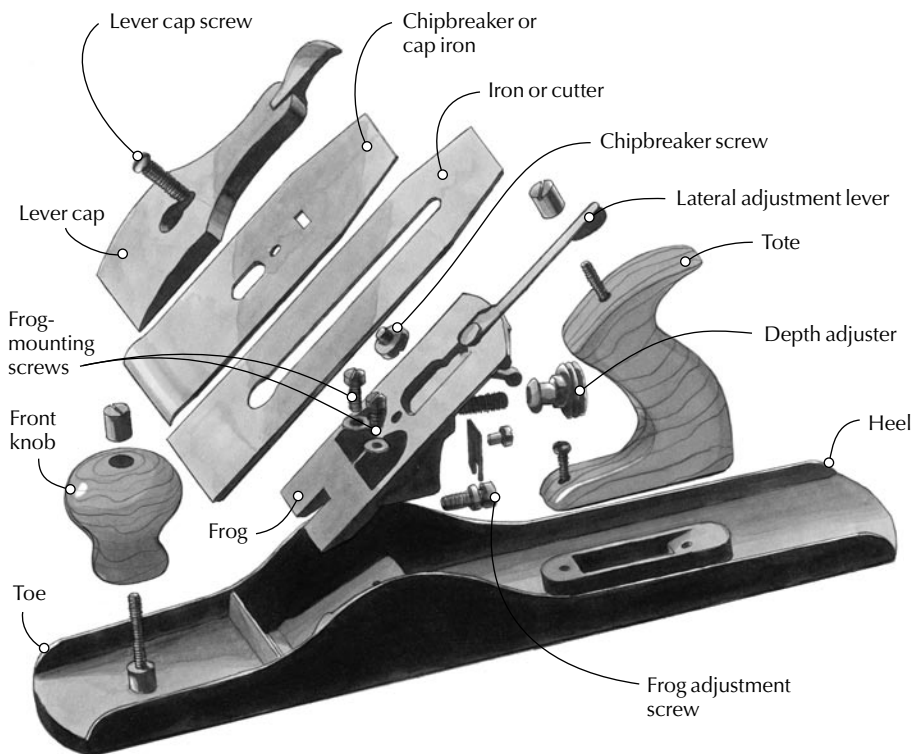
Stanley lore has it that an employee named it the frog because the frog is placed in the plane's throat, i.e. "There's a frog in my throat."

If you think that's unlikely, other origins of the word point to the frog as a support structure or something with a triangular shape like a plane's frog.

A frog can be the support for a flower arrangement. Or a frog can be the triangular area that is a shock absorber behind a horse's hoof. A frog is also the area in a railroad where rails cross in what's called a "turnout" — which is where one line of rails veer off from another. Another intriguing clue: A frog can be the linkage between a belt and a sword's scabbard.

If anyone knows any other "frog lore," please let us know, and we'll publish it on the blog.

— Christopher Schwarz, editor



ANATOMY OF A HANDPLANE

Why Select Ash Over Oak or Maple for 21st-century Workbench?

I read Robert Lang's article on his new workbench in the October 2008 issue (#171) and I have a couple questions:

1. Why did you select ash instead of oak or maple for the benchtop?

2. Why did you use a lag bolt in the upper side rails instead of a dowel/pin (as it is glued anyway)?

I like the design, but I probably would have left the opposite side (away from the double vise) with at least a 3" overhang for extra clamping capacity.

— Ron Bland, Sr., Appleton, Wisconsin

I chose ash for money reasons. It fits the criteria for building a bench (strong, hard, dense) and at the moment there is an abundance of this wood on the market here in Ohio. It cost a few cents per board foot less than poplar, and about half of what maple would cost.

There are a number of woods that can make a good bench, and one of the traditional criteria for selecting a wood is cost.

The upper side rails are not glued so the bench can be taken apart for moving. The lapped dovetail and the lag bolt are sufficient to hold it together. It could, of course be glued, but then the bench would be much more difficult to relocate.

With the space between the top and the upper

rail, there isn't any need for an overhang to clamp something down to the top of the bench. The handle of an F-style clamp will fit in this space.

— Robert W. Lang, senior editor

What's Causing Gummy Black Film on Oak and Cedar Chest?

I have a puzzling finishing question and am hoping you will know what the cause is, and by association, the solution.

Two years ago I built a hope chest for my daughter. It's solid wood with raised-panel construction, made of Kentucky red oak. The entire inside of the chest is lined with cedar.

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ILLUSTRATION BY HAYES SHANESY

The cedar I used is the type you buy at a home center for lining closets – 3" wide, 1/4", tongue-and-groove slats.

Before I installed the cedar, I finished the chest inside and out with a Minwax water-based golden oak stain followed by a Minwax Polycrylic brush-on water-based finish. The cedar I left untreated in any way.

Here's my problem: All of the oak surfaces on the inside of the chest that are not covered by cedar have a gummy black film building on the surface.

The outside of the chest is completely unaffected but the 1" of exposed oak on the sides above the cedar and the entire underside of the top has this coating, and it seems to be building in thickness. The items in the chest are unaffected and the cedar has no film.

If you have any insight as to what may have caused this, it would be greatly appreciated.

— Rob Service, Glasgow, Kentucky

Your problem is caused by the vapors from the aromatic cedar resin (the stuff that creates the aroma and kills moths) attacking the water-based finish, softening it and swelling it, just as paint stripper does. There's no way to fix this. You shouldn't have put any finish on the inside of the cedar-lined chest. Notice that old cedar chests are always left unfinished on the insides.

My guess is that the finish will be gummy on the oak that is covered by the cedar also, because the fumes will have found some way to work their way underneath.

I don't know what caused the black color. Dirt that stuck to the gummy finish?

At the least, you will have to strip all the exposed wood on the inside of the chest. It will be messy and a challenge to keep from getting some of the stripper on the outside. You may have to strip both the inside and outside, then refinish the outside.

You also may have to remove all the cedar lining from the inside and strip the finish from the oak. Then reinstall the cedar lining.

Finally, sand all the wood you have stripped to smooth it and be sure that all the finish has been removed.

Sorry to have to tell you this, but I imagine you had probably suspected it yourself.

— Bob Flexner, contributing editor

Table-saving Suggestions

I read your "Out on a Limb" column in the October 2008 issue and I agree it is often hard

to get your friends and family to be honest critics of your work. I am an amateur woodworker, but I have made my living as a graphic designer and I know good design when I see it, whether it be art, furniture, sculpture or automobiles. So if I may, I would say this about your table (assuming it's the one pictured in the article).



First, it looks very top heavy. The top is very thick and the legs pinch in at the bottom and it has the appearance that it would not take much to tip it over. If the top were undercut with a cove or even a steep bevel cut it would look much lighter.

The legs also look too heavy; they should curve out at the bottom and have some shaping in the middle and upper portions like James Krenov was so good at doing. The side elements look like they are headed in the right direction, but appear they are about to be crushed by those massive legs. I also think a more rectangular shape would help; it looks like the top is square in the picture.

It could be that you have been building too many workbenches of late. If you made this table twice as long and left the legs square, and added straight rails to the bottom of the legs, all it would need is a tail vise to complete it.

I hope this has been of help to you. You are far more experienced at woodworking than I am, but sometimes we get so close to a project

that we can't see where we've gone wrong with it. Sometimes with a painting you get to a place where you know it's just not right. So you set it aside for a few days, even turned toward the wall. Then when you turn it back around and look at it, you can immediately see the problem and correct it. Hopefully.

— Paul Gallaway, Elizabeth, Colorado

Thanks for the thoughtful letter. I've received many interesting critiques of the table in the photo at left – perhaps some of the first honest feedback I've seen in a while. I appreciate it.

The photo was taken of the table in its first iteration. It went through two more cycles before I abandoned it. I indeed slimmed the legs and top and tried some alternative curves at the foot. But still, after a week of working on it in fits and starts, it was time to let it go.

Maybe I'll take it up again. The criticism has been very stimulating.

— Christopher Schwarz, editor

Online Offerings are Great Benefits

I like what you and the staff at the magazine have done with the publication. I had let my subscription lapse due to too many magazines coming in, but after a few months I re-subscribed because I missed it. I think the web site (popularwoodworking.com) and the regular e-mail newsletters had a lot to do with that.

Keep up the good work. **PW**

— Greg Smith, Gastonia, North Carolina

Question? Comment? We want to hear from you.

Popular Woodworking welcomes comments from readers about the magazine or woodworking in general, as well as questions on all areas of woodworking. We are more than happy to share our woodworking experience with you by answering your questions or adding some clarity to whatever aspect of the craft you are unsure about, and if you have a complaint, we want to address it whenever possible.

Though we receive a good deal of mail, we try to respond to all correspondence in a prompt manner. Published correspondence may be edited for length or style. All correspondence becomes the property of Popular Woodworking.

Send your questions and comments via e-mail to popwood@fwpubs.com, or by mail to:

Letters
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THE WINNER:

Mitered Banding

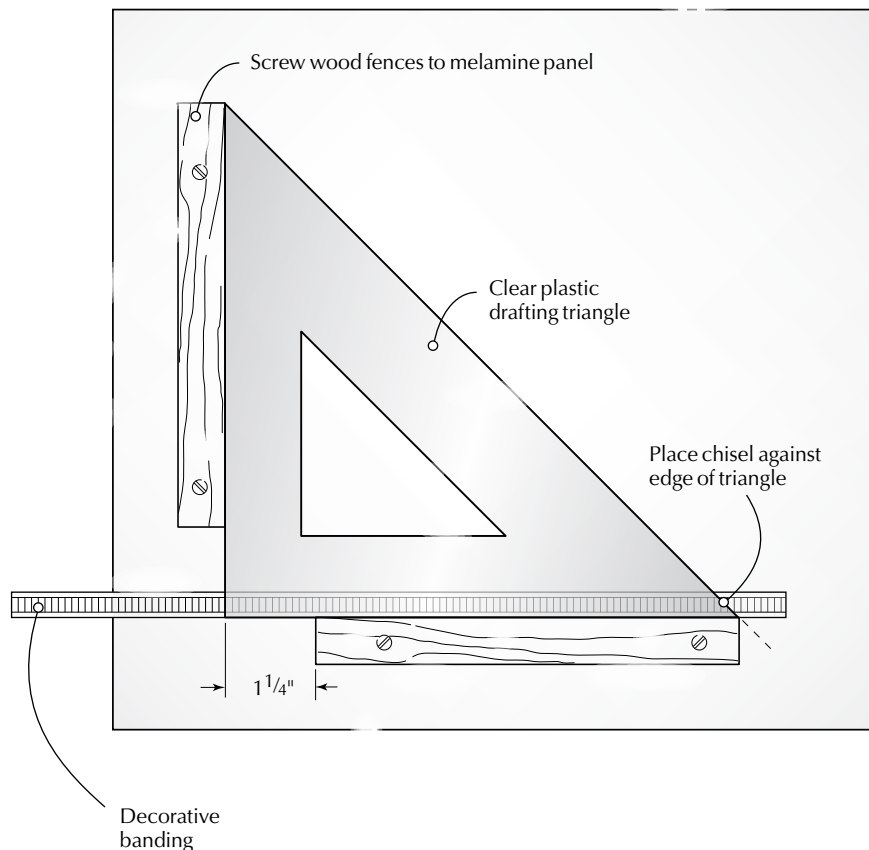
I like to augment tabletops and drawer fronts with decorative banding, inlaying it around the perimeter. The problem has always been the fussy trimming of the mitered corners. It's hard to cut the miters perfectly using a chisel freehand while cutting to a layout line. I recently cobbled up a jig that simplifies the process and virtually ensures perfectly fitting miters every time.

The jig consists of two short wooden fences screwed to a $\frac{3}{4}$ "-thick melamine panel at 90° to each other. Position the fences so that one end of each terminates at the 45° tips of a clear plastic drafting triangle as shown. The opposite end of each fence should stop short of the triangle's 90° corner by about $1\frac{1}{4}$ ".

To use the jig, place the marked banding good-face up against the appropriate fence. (I apply a short section of masking tape to the banding for layout line visibility.) Lay the triangle on top, pressed against both fences. Slide the banding as necessary to align your cutline with the long edge of the triangle. Make the cut using a razor-sharp chisel, with its back pressed against the edge of the triangle. I find that it's best to angle the chisel a degree or so inward to create a slight back-cut, which ensures that the top faces of the miter butt tightly against each other.

— Bill Coker, Hillsboro, Oregon

CONTINUED ON PAGE 20



Cash and prizes for your tricks and tips!

Each issue we publish useful woodworking tips from our readers. Next issue's winner receives a \$250 gift certificate from Lee Valley Tools, good for any item in the catalog or on the web site (leevalley.com). (The tools pictured at right are for illustration only, and are not part of the prize.)

Runners-up each receive a check for \$50 to \$100. When submitting a trick (either by mail or e-mail) you must include your complete mailing address and a daytime phone number. If your trick is selected for publication, an editor will need to contact you. All entries become the property of *Popular Woodworking*. You can send your trick by e-mail to popwoodtricks@fwpubs.com, or mail it to Tricks of the Trade, *Popular Woodworking*, 4700 E. Galbraith Road, Cincinnati, OH 45236.

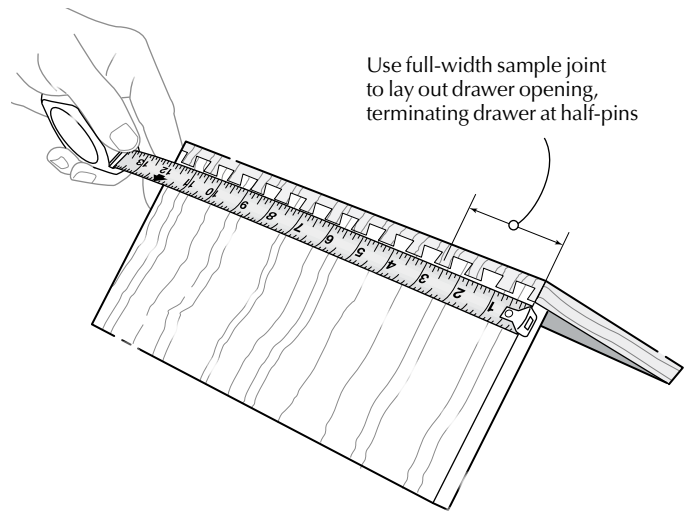


A Dovetail Reference Joint

Like many woodworkers, I own a basic half-blind dovetail jig, which I use only occasionally for making utility drawers. During the interim, I tend to forget the setup procedures and spacing required to create those elusive “perfect” dovetails. To help refresh my aging memory, I made up a full-width sample joint that I can refer to when determining drawer-box heights.

When using a jig like this with a fixed-finger template, it's best to design your drawer openings based on the jig's tail spacing. Ideally, a joint should begin and end with half pins for aesthetics and strength. The sample joint quickly offers up my spacing options so I can design my drawer heights to suit. I also use it to determine where to set my table saw fence for plowing the drawer-bottom grooves. As another benefit, it's a convenient sales tool for educating my customers in the various methods of drawer joinery.

— Craig Bentzley, Chalfont, Pennsylvania



Safe Straightedge Storage

When I bought my expensive 24" machinist's straightedge, I wasn't sure where to store it. It didn't include a hole for hanging, and I was reluctant to drill into the hard steel for fear of devaluing the tool or compromising its accuracy. I didn't want to stash it in a drawer or on a shelf where it might be damaged by other tools. I finally came up with an easy solution. I removed an adjustable shelf from one of my

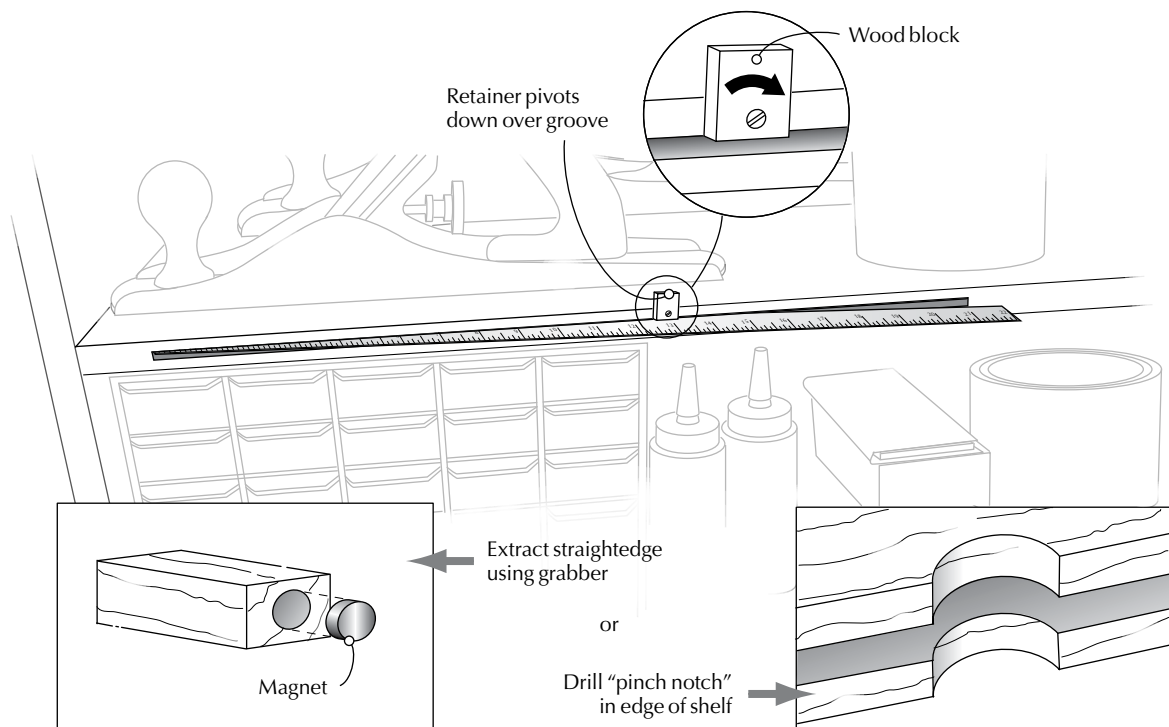
shop cabinets and plowed a groove into its front edge to accommodate the straightedge. I made the groove about 1/16" wider than the thickness of the straightedge, and deep enough to completely house it. I screwed on a pivoting wooden retainer for safety. I also use this trick to store an auxiliary 18" blade for my combination square.

How to remove the straightedge from the

groove? I use a little “grabber” that I made by embedding a small magnet in the end of a wood block (cushioning the magnet with thick tape.) Alternatively, you could drill a small “pinch notch” into the edge of the shelf to offer finger access—handy for non-magnetic aluminum. Select a strong or lightly loaded shelf that won't be subject to bending.

— Rob Porcaro, Medfield, Massachusetts

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A Fence Extension on the Cheap

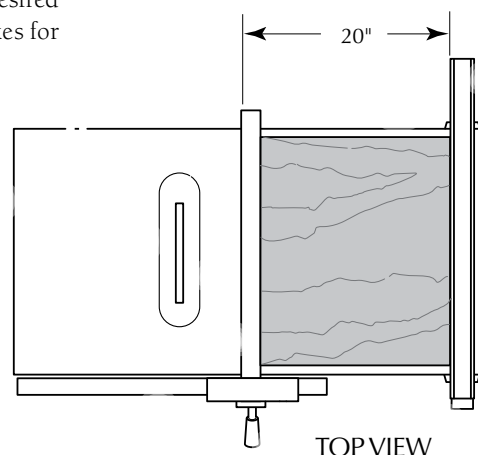
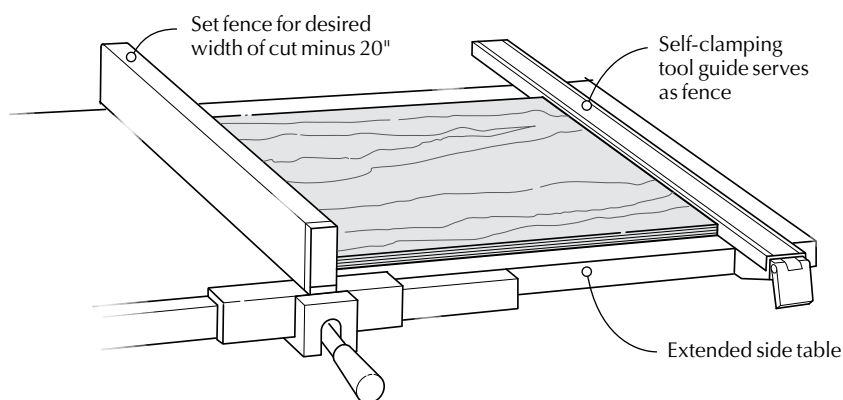
The rails on my contractors' saw fence aren't long enough to allow ripping very wide boards. I could upgrade to a more expensive fence, but I don't cut enough wide panels to justify the cost. Instead, I simply built a longer side table for the saw, and use a commercial self-clamping aluminum tool guide for a fence, securing it to the table.

Of course, with this basic approach, you would lose the benefit of your fence's mea-

surement scale as well as the fence's ability to automatically lock parallel to the blade. To solve those drawbacks, I made a plywood panel the width of which is 20" minus the width of my fence. Now, when I need to make a cut that's beyond my fence's capacity, I use my fence scale to set the fence to the desired width of cut minus 20" (which makes for

quick math), and place the panel against the right-hand face of the fence. I clamp my tool guide against the edge of the panel, and after I remove the fence, I'm ready to rip.

— John Uhler, Tatamy, Pennsylvania



Clean, Easy Epoxy – the Pastry Chef Way

In the past, I have found mixing two-part liquid epoxy to be kind of messy, stirring the resin and hardener on a palette of some sort, then applying it with a stick or nail. I usually end up with sticky fingers in the process. I finally figured out a much better approach. I squeeze the proper amounts of resin and hardener into the corner of a strong small plastic bag, then knead the bag to mix the two parts together. Pinch the mixture toward the corner of the bag and puncture or cut an appropriately sized hole right at the very corner. You can now squeeze the mixed epoxy through the hole directly onto the intended surface with fine control and without getting glue on your fingers. Cleanup is as easy as throwing away the bag. Works great!

— Ron Dolittle, Denver, Colorado

Soft Screw Safety

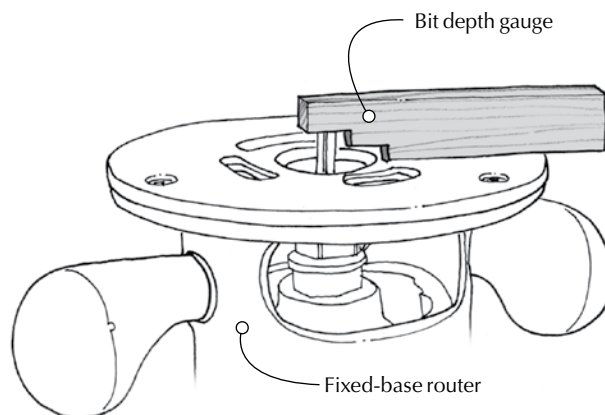
When screwing together a jig for a table saw, router or other power tool, it's best to use brass or aluminum screws in any area that comes near the cutter. In case of accidental contact, steel blades or bits won't suffer serious damage, and carbide will just laugh.

— Archie Riverdale, Tucson, Arizona

Quick Router Depth Setup

When routing dados and grooves deeper than about $\frac{1}{4}$ ", the cut must usually be made in several passes to prevent straining the tool and bit. When using a fixed-base router, setting up the depth of cut multiple times with a ruler can be a hassle. It's much quicker to use a stepped wooden gauge for the job. You can cut the steps quickly and accurately on the table saw using a tenoning jig. (Just make sure to begin with stock that's oversized in length for safe work at the saw.) I keep several of these gauges on hand for routing to commonly cut depths. **PW**

— Paul Anthony, *Popular Woodworking* contributor



18th-century Chairmaking

Building a Philadelphia Chippendale chair – PART 2

This is part two in my series of what will probably be several articles detailing the construction of a formal Philadelphia Chippendale chair. In the last article, I built up the structure of the chair's back, but did none of the shaping or carving. It would be nice to simply document the construction as I build it. But I'd like to have an article on carving, not little bits of carving in every article. Moreover, I'm attempting to show what I think the building process really looked like in the period. I believe Philadelphia's finest chairs were carved by professional carvers in the 18th century. Some of the shaping and carving would have been done "in-house" in the chairmaker's or cabinetmaker's shop. I'm going to attempt in a future article to show where I feel the work split was. In this article, I'm going to build up the chair's front and attach it to the back. My focus will be on structure and joinery.

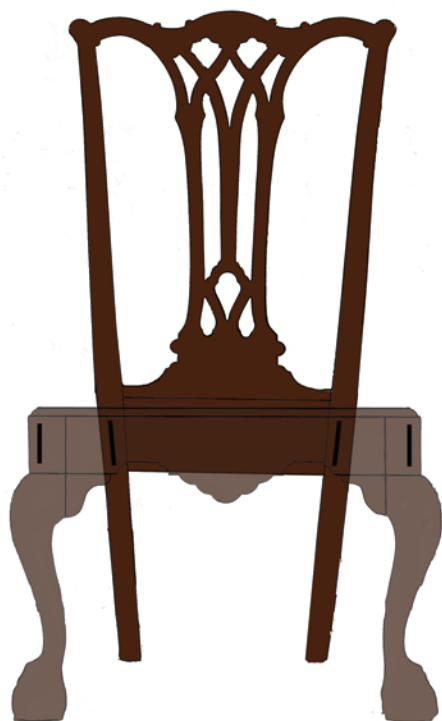
Understanding the Structure

At first glance, the structure of this chair is fairly simple. Each of the four seat rails attaches to its adjoining legs with mortise-and-tenon joints. The rear seat rail is relatively easy. You have to cut angled shoulders. The front seat rail is completely square. No problem there. The challenge is cutting the side seat rails. The trapezoidal shape of the seat means angled shoulders. But the side seat rails are further complicated by the difference between the vertical front legs and angled rear legs. As a result, the side seat rails are essentially twisted along their length. The combination of the angles and the twist make this part fairly tricky to build.

I've seen different craftsmen wrestle with this and attempt to find more elegant solutions. Some try to keep the mortises square with the back legs and angle the side rails' tenons. This is nothing new. If you look at Queen Anne



Beginning stages. No I haven't switched to Tansu-inspired studio furniture. This really is the beginnings of a Philadelphia Chippendale chair. If it weren't for the discrete, strategically laid out tenons between the splat and the crest rail (see my article in November 2008, issue #172), this basic chair form could assume any of a wide variety of styles. In this article, I complete the basic structure and find a few new challenges to test my abilities.

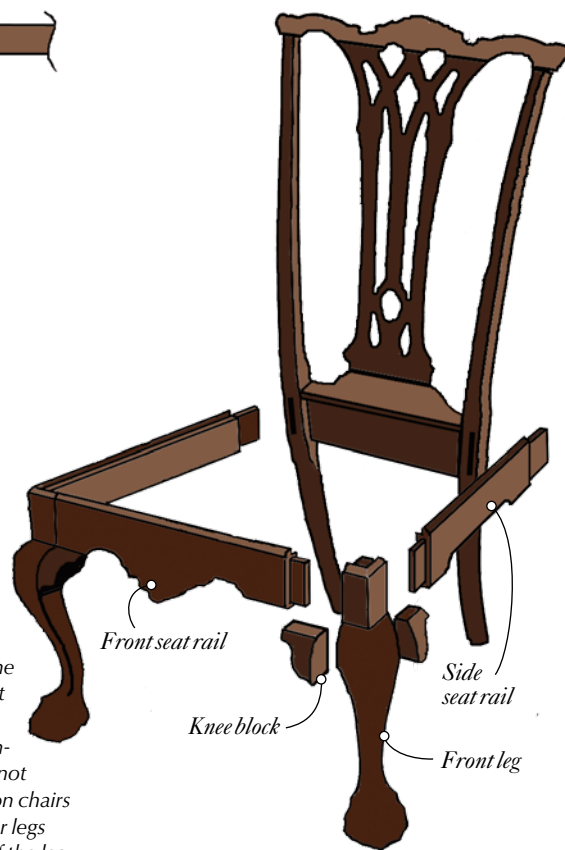


Simple structure. The basic structure of this sort of formal chair is simple enough. The seat frame is mortised and tenoned together. Knee blocks, glued in later, help visually blend the joint between the seat rails and the legs. They aren't structural. The picture above is missing glue blocks at the inside corners of the seat rails. I'll cover them in a future article.

Through tenon typical of Philadelphia and London

Tenons mitered for maximum length

Angled mortises. Looking down at a cross section of the right seat rail, the mortises are angled in the legs to keep the tenons running straight with the side seat rails. Tenons are sometimes mitered in the front leg joint to allow maximum penetration. These tenons are typically, but not always, pegged. Philadelphia and London chairs are unique in that the mortises in the rear legs are typically cut through the thickness of the leg. I've shown the tenon proud above, but these are always sawn flush with the back leg surface.



Front seat rail

Knee block

Side seat rail

Front leg

Parallel mortises. The mortises in these chairs run parallel to their attending legs.

chairs, you'll see elaborate balloon-shaped seats. These complicated looking seats almost always offered easier, square tenons at the back legs. The side rails came out of the rear legs square, then ballooned out into a pleasing shape. On some Queen Anne chairs, the front legs tenoned into the balloon from underneath. The result was a dramatically sculpted chair with fairly straightforward joinery. I don't want to scare you or make excuses for my poor execution of this chair. But I believe this to be the most difficult form of seating furniture, and perhaps one of the most difficult pieces of furniture to build.

Stock Prep Conundrum

What should I do to prepare the stock for the side rails and front legs? I need two reference faces on the inside surfaces of the legs. I'll do all my lay out from these faces. But the outer faces? They are going to get carved away. I think for the sake of the carving I need to rough in the square shape. This will establish the widest part of the knee and help with the carving of the foot as well. I marked both sides of the leg blank and simply sawed the blank square. To

keep a saw cut square in a thick block, I typically flip the board periodically.

The front seat rail is just straight and square, so no troubles there. But the side rails? I don't really think it matters. It's helpful to have the board uniform in width. I squared up one edge with my try plane, then gauged across $3\frac{1}{2}$ " to set the width and simply sawed to the line. This stock needs to be thick. I'm using $5\frac{1}{4}$ " stock, which seems about right. With the stock ready, it's time to cut the joints.

Laying Out the Mortises

A good accurate layout of the seat rail mortises is essential to cutting them correctly. The front leg mortises meet inside the leg to allow the maximum length of the seat rail tenons.

I started laying out the front legs by scribing a $1\frac{7}{8}$ " square in the end grain, gauging in from my two reference faces. I set my bevel to the side-rail angle and marked that from the gauged corner. I ran these lines all the way across the end grain and down each face. Eventually I'm going to have to saw to these lines.

I marked out a $\frac{5}{16}$ " mortise about $\frac{5}{16}$ " in from my gauged line. I set my mortising

gauge against the inner face of the leg (my reference face).

For the back legs, I again used my mortise gauge to mark a $\frac{5}{16}$ " mortise, $\frac{5}{16}$ " in from the outer surface of the leg. But these are through-mortises. My experience cutting through-mortises tells me it's best to come in from both sides with my mortise chisel. I'm thinking I



Leg layout. Mark the outer surfaces of the legs using the inner reference faces. The angle of the side seat rails must come from a full-sized drawing or existing chair.

can't just mortise straight through without splitting the wood at the back of the leg. This means I have to mark the mortise front and back, which is no simple task. The leg stock is only slightly uniform in width here and these legs are different left to right.

Cutting the Mortises

With everything marked out, cutting the mortises should be a simple matter. That wasn't exactly my experience. I'm going to show you what I did, but I'm not convinced this was the best way to go about it. I made myself a little

guide block with the seat rail angle accurately sawn. I used this block not only to check the angle of my chisel as I chopped, but also to guide my chisel while I pared.

On the front legs, the mortises for the front and side rails intersect to allow maximum tenon length. This should be nothing new. I did the same job on the "forme" I built for the October 2008 issue (#171). You just have to go slowly and use less force as you get closer to the other mortise. My paring technique really helped here.

On the back legs, the through-mortise was a little trickier. I think the thing to do is cut down halfway from each side and hope for the best. Structurally, the front and back of the mortise matter more than the middle. If the mortise is a little sloppy through the center, it will just hold the hide glue better. This diamond-shaped mortise has actually been seen in period chairs. Whether it was intentional or not is anyone's guess.

Alternative Methods?

There doesn't appear to be any evidence of these mortises having been drilled and pared, though that is a possibility. There don't appear to be little nicks in the side wall where a bit went astray. But many more chairs need to be examined specifically for this to say with certainty what was done or not done. Center bits or shell bits would have been the tools of choice. Paring an angled surface is not easy. If you try going the wrong direction, it's easy

CONTINUED ON PAGE 28



Mortise conundrum. When I first learned that through-mortises were typical of Philadelphia and London chairs, I thought that this must have been some productivity improvement. The first thing that came to mind was the ability to cut the mortise from the backside. This would eliminate the need to support the legs on a block as shown above. But you really can't mortise through without risking splitting out wood (spelching?). You must work from both sides. An examination of Philadelphia chairs revealed evidence of scribe lines on both sides of the rear legs.



Just right. I placed my bevel gauge against the front face of the leg and measured over from the gauge to the mortise. This 1/2" chisel was just right.



Chisels for marking. I flipped the leg over, and measured in from the bevel using the same chisel. I like using chisels as gauge blocks. In the 18th century, you'd be lucky to have a ruler with eighths marked on it. But even today, this helps eliminate measuring errors and when you can do it, you can mark and measure at the same time.



Set, then reset. I reset my marking gauge to mark out the mortise. Because the left and right legs differ slightly in thickness, this setting won't work on the opposite leg.



Guide block. I used a guide block to check the angle of the chisel before I chopped. The surface of the leg was such that I thought this would work better than a bevel gauge.

to undercut, which may or may not be a big problem. The bigger challenge seems to be keeping the brace at the correct angle. The first thing that came to my mind was using a smaller-diameter bit. I tried this and it was a bit more difficult than just cutting the mortise directly with the mortise chisel.

Sawing the Tenons

I do a lot of sawing. But I find a bit of practice helpful before I start a complicated job. I practiced my sawing on the easier front leg joints. These are straight tenons with an angled shoulder. The only trick is to leave the outer face of the seat rails proud a heavy $\frac{1}{16}$ " to allow carving of the rails.

The back legs' tenons are harder. You have to accurately transfer the angle as well as the exact position of the mortise onto the seat rail. I put the chair on my bench to check the front leg and reference face on the rear legs with a framing square. Then I marked the tenon directly. The seat rail must be aligned such that its top outside corner lines up with the corner of the rear leg. I may have done a better job with a bevel gauge.

Conclusion

All my blind mortises went well. I don't think I pared any tenons or mortises. I know I only corrected one tenon shoulder. My blind joints fit straight from the saw. I did have trouble with the through-mortises, however. I chopped more from the front side than the back. When I worked in from the back, my angle was off slightly. Paring the walls created more troubles. The mortises got pretty raggedy. I made other mistakes that complicated matters. For example: When I cut the back-leg mortises, I hadn't yet leveled the feet. Once they were sawn flat, I lost a good $\frac{1}{4}$ " and the mortises were that much too low.



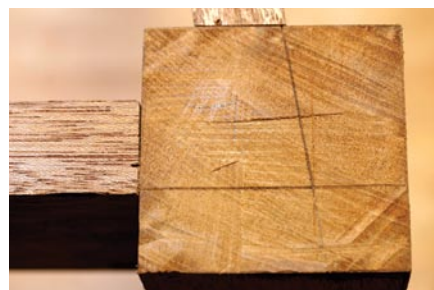
Jig – of sorts. I like to pare out the waste in my mortises. I squeezed my gauge block against the side of my mortise to help me maintain the correct angle. This is as close as I get to using jigs.

Despite my initial impression, it's now clear to me that 18th-century Philadelphia and London chairmakers used through mortises because they are better than a blind joint. They certainly aren't easier. The through-tenon is longer, which makes the stress in the joint lower. There also is more glue surface area. The through-tenon also allows access to the mortise to perfect the fit or make repairs in the future.

A close examination of period chairs indicates that many or most were assembled with two tiny wedges in each rear side-rail tenon.



In position. I have the side seat rail positioned correctly. The exposed material to the right of the leg will get planed flush with the back leg later.



I hope I left enough! The seat rails need to be proud of the pencil lines to allow for a small carved detail at the base of the rails. Eighteenth-century carvers didn't need much to produce a three-dimensional design. Some relief carvings are only $\frac{1}{16}$ " deep.

These were slid into saw cuts, purposely sawn in the tenons at the time of construction. This feature would help chairs that lack lower stretchers survive rough treatment.

Though this is one of the single-most difficult and important joints of the chair, more challenges are ahead. I'm going to repair my mistakes without too much fuss and move on. I have no delusions that this chair will be a showpiece. One of my favorite woodworkers, Colonial Williamsburg Journeyman Cabinetmaker Kaare Loftheim, says it takes maybe a dozen of these chairs to get the bugs worked out. From the twinkle in his eye, I don't think he was exaggerating. I don't know if I'll complete a dozen, but I hope this article and those that follow will help you complete yours. **PW**

Visit Adam's blog at artsandmysteries.com for more discussion of traditional woodworking techniques.



Tough job. This is the toughest joint in a chair full of tough joints. Something went terribly wrong marking out this tenon, but at least I got the rail positioned correctly! Turns out these tenons were typically wedged, but not with the massive $\frac{1}{4}$ " block in this one. As bad as it looks now though, I'll bet it will look a lot better with a couple wedges and some leftover mahogany veneer from my standing desk. We may be surprised when it's done.

Coffee Table

Uncomplicated construction and an easy, attractive finish make this table tops.

The construction of this handsome red oak coffee table is uncomplicated. The top and shelf units are made of four individual pieces of lumber. Each leg is two pieces, attached to the top and shelf with screws. Add in the pieces that put the finishing touches on the sides and ends and this coffee table is ready for a finish.

Making the Top and Shelf

Construction begins with the top and shelf pieces. Each of the two identical assemblies is made of four pieces of 1x6 stock cut to length. Knock off the sharp edges with sandpaper or a block plane. Position four of the top/shelf pieces on a flat surface (best face down) and align the ends. Add clamps to help pull the pieces tightly together as well as to keep things from shifting as you attach the battens.

The battens are 21³/₄" lengths of 1x4. Center one batten, then position the other two 2" from each end. Drill countersink holes, then attach the battens with one screw (#8 x 1¹/₄") in the center of each of the 1x6 pieces.

Repeat these steps for the second assembly then set them aside.

A Leg Up

Cut the leg material to size and set four of the pieces to the side. The remaining four pieces need to have ³/₄" taken from one long edge. Mark the cutline and jigsaw as close to the line as possible without crossing. Use a block plane to square the cut edge to the line.

I made the angled foot cuts at the miter saw, though they also could be made with the jigsaw and cleaned up with a block plane. On a miter saw, you can't set any angle past 45° or so, and so we need to base the cut off of the 90° setting. Position the saw to cut a 15° angle, set a temporary stop and set the cut to leave 2¹/₈" of stock at the bottom edge of the leg. Make



Living-room centerpiece. A solid and handsome coffee table is an integral part of a comfortable living room. This one, in red oak, is simple to make with just a basic set of tools.

the cut on the four full-width pieces, then set the stop so the cut is at 1⁵/₈" on the pieces that were ripped to ³/₄" less with the jigsaw.

Add glue to the long edge of the narrow blanks and clamp the leg assembly together. Repeat the steps for each pair of leg blanks and set the legs aside to dry.

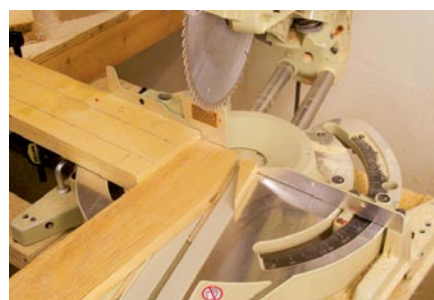
Time to Assemble

Position the top with the face down and raise the unit off of the bench with a couple ³/₄" scraps. Next, position the shelf so it hits the legs 3¹/₂" above the terminating point of the angled cut. I found that two stacked soda cans at each corner worked great to hold it in place while I set the clamps.

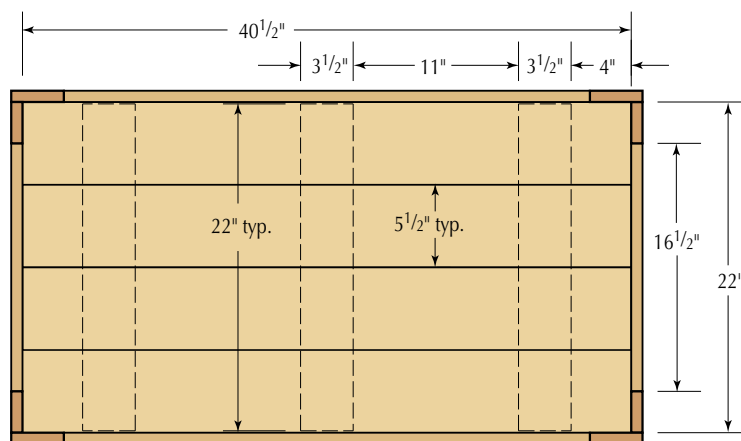
Set the cans at each corner and position the shelf, face down, on top of the can supports. Next, position the legs at each corner and add a clamp to each side. Once the clamps are in place, mark the location of the top edge of the

shelf as it hits the legs (to position the shelf after removing the cans).

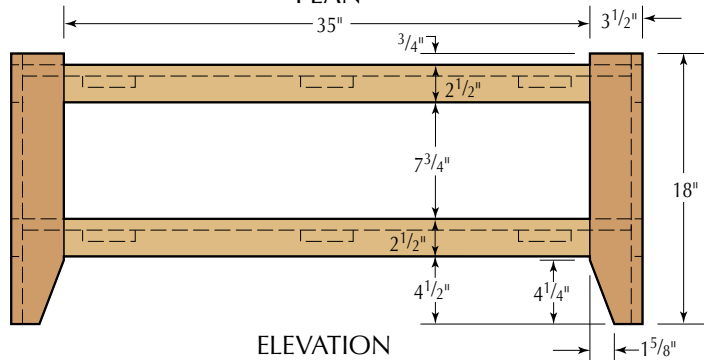
Loosen the clamps slightly and slide the shelf upward. Remove the cans and tighten the clamps while repositioning the top at the marked lines. Do the same for the opposite end, and you're ready to attach the legs to the top and shelf.



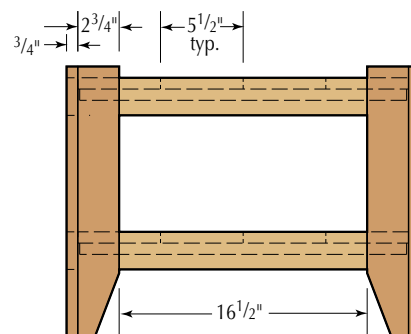
The right angle. The setup shown above allows you to create the beveled feet with a miter saw.



PLAN



ELEVATION



PROFILE

Coffee Table

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL
		T	W	L	
8	Top & shelf slats	3/4	5 1/2	40 1/2	Oak
6	Battens	3/4	2 1/2	21 3/4	Oak
8	Leg sides	3/4	3 1/2	18	Oak
4	End rails	3/4	2 1/2	16 1/2	Oak
4	Side rails	3/4	2 1/2	35	Oak

Before joining the two, make sure that the entire table is flat on the bench. Tapping the unit with a rubber mallet or a hammer and a block of wood can make slight adjustments.

Drill pilot holes with a combination pilot hole and countersink bit. Then drive #8 x 1 1/4" screws through each leg and into both the top and the shelf. Each leg will have a total of eight screws installed.

Before the clamps are removed, cut and fit the rails that complete the sides and ends. A snug fit is required. Use a pocket-hole jig and bit to drill a hole at the lower edge of each of the rails. After the pieces are fit and readied for the screws, attach the rails to the leg assemblies

with the recommended screws.

Drive nails into the side rails, three per side, and through the end rails into each piece that makes up the top and shelf. Two nails per end piece – 1/2" from each edge.

Use a drill bit or begin the hole with the nail itself in the drill. The nails will allow for seasonal movement and help keep the wood flat because as the lumber moves, the nails will bend to and fro.

The countersink part of the drill bit leaves room for a 3/8" plug. These plugs can be purchased from the supply store, or cut from scrap material with a matching 3/8" plug cutter.

Add glue in the hole and on the plugs and tap them in place with a hammer. Plane them flush and allow them to dry.

Preparing for a Finish

Sand the flat surfaces with #120- and #150-grit sandpaper, and round the ends of the tops of the legs and the sharp corners. Use a file or rasp to ease the edges of the leg tops and carefully sand the areas smooth.

The staining process begins with a coat of Olympic "Special Walnut" wood stain, rubbed on heavily with a clean rag. Allow it to penetrate for about 15 minutes, then wipe away the excess. Let it dry for 24 hours.

The second coat (also ragged on and allowed to penetrate for 15 minutes) is of "Dark

Walnut" Watco Danish Oil. Let this coat dry for 24 hours, too, then rag on a coat of shellac over the entire table. When the shellac is completely dry, lightly sand with #400-grit sandpaper. This will knock down any nibs left from the shellac. Finally, rub on a layer of paste wax, allow it to set and dry, then polish the surface to a warm sheen. **PW**

This project is excerpted from "I Can Do That: Woodworking Projects" (Popular Woodworking Books), available at popularwoodworkingshop.com. Glen is a senior editor of this magazine. Contact him at 531-513-2690 x11293 or glen.huey@fwpubs.com.

About This Column

Our "I Can Do That" column features projects that can be completed by any woodworker with a modest (but decent) kit of tools in less than two days of shop time, and using raw materials that are available at any home center. We offer a free online manual in PDF format that explains all the tools and shows you how to perform the basic operations in a step-by-step format. You'll learn to rip with a



jigsaw, crosscut with a miter saw and drill straight with the help of our manual.

Visit ICanDoThat.com to download the free manual.



Squared up. Everything may be in position, but if your table is not square to the flat surface, you will find it extremely difficult to add the finishing pieces to the table.

Free-form Sculpting

With a couple simple techniques you'll augment your design skills and flexibility.

What woodworker hasn't dreamed of wielding sharp gouges and chisels, effortlessly transforming a giant, lifeless chunk of wood into a one-of-a-kind masterpiece? Perhaps even creating a life-sized bust of yourself in exquisitely painful detail. What? Just me? Well maybe so, but there isn't a woodworker out there who wouldn't benefit from adding carving to their toolbox of tricks. While I don't delve too far into the world of artistic carving, I do try to incorporate free-form sculpting into my work whenever possible.

To understand what I mean, think about a situation when you needed to shape something and your normal power tools just could not provide the solution. Perhaps it's a wide cove that none of your router bits is capable of producing. Or maybe you need to make a simple scooped-out chair seat. Should we let the limitations of our everyday power tools limit our design possibilities? No way!

So at some point, you'll be presented with the challenge of creating shapes, curves and accents with little more than a few pencil lines to guide you. Initially, this may sound a little scary since most of us can't even draw a uniform curve on paper (at least not on purpose), let alone create one in wood. But as someone who is admittedly "non-artistic," I found the process to be much easier when I broke it down into a series of steps.

Learning these steps, as well as which tools to use, will give you a sense of freedom and control over your work and help you put the "hand" back into handcrafted.

Online EXTRAS

To watch a video of The Wood Whisperer as he demonstrates these sculpting techniques in his shop, go to:

popularwoodworking.com/dec08



Move beyond linear designs. A couple new techniques with non-traditional tools and you're ready to explore free-form sculpting. And that increases the design possibilities in your woodworking.

So let's take a look at some of my favorite sculpting tools. My arsenal consists of a cabinetmaker's rasp, several card scrapers, a die grinder with various profile bits, a grinder outfitted with a carving blade, a 7" polisher for rough leveling and a random-orbit sander for final smoothing.

There are many ways you can use these tools to arrive at your final goal, and as far as I'm concerned, there are no rules. Just use whatever combination of tools gets you from point A to point B. But in my experience, I've found that certain combinations of tools work very well for specific tasks.

your life miserable in short order.

Whatever the reason, it's good to know how to make a cove of any shape or size by hand. Start by making a simple pattern of the desired profile, then transfer the profile to each end of the board. Then draw lines on both the face and the side of the board that correspond to

CONTINUED ON PAGE 34



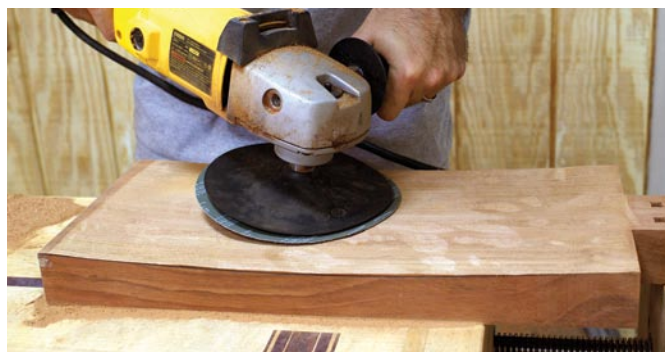
Big coves, no problem. A hand-held die grinder with a ball mill is the tool of choice for creating large coves.

Cove Profiles

There may come a day when your creative designs exceed the capabilities of your router-bit collection. Or perhaps you are working on wood that is prone to tear-out and you just know that your big cove bit is going to make



Let the chips fly. An angle grinder and a carving blade make one powerful combination! Hold the tool close to horizontal to avoid sculpting deep gouges.



Smooth out the rough spots. A polisher makes quick work of leveling the surface.

the top and bottom of the cove and serve as a reminder of the “no carve zone.”

Because there is a significant amount of material in the cove, I suggest making several passes on the table saw to remove the bulk. Once the workpiece is clamped in the bench, it's time to start carving. My tool of choice is an electric die grinder outfitted with a 1" ball mill. Rub the surface with the spinning ball mill from side to side to begin shaping the cove. Try to make the entire length of the cove look uniform from one side to the other and never stay in one place too long. (The kerf cuts from the table saw really help in visualizing your progress.)

Don't forget to continually monitor your overall progress by looking at the template lines on the sides. Once you hit your pencil lines at the sides, the rest of the cove should be done as well. The surface will be relatively rough at this point and will need further smoothing. I usually use a gooseneck scraper or one of the sanding spindles from my oscillating-spindle sander. A dowel wrapped in sandpaper would do the trick, too. Just work the whole cove until the surface is regular and smooth.



Multi-function sander. A great way to clean up a sculpted cove is with a sanding sleeve and rubber spindle from a spindle sander.

Large Curves

Creating large complex curves is another area where hand-sculpting comes in handy (chair seats come to mind). Here is a simple example that establishes the principals of this process. Start by tracing the desired curve onto both edges of a board with a template. In the example shown above, I am just doing a simple curve.

I start removing the bulk of the material with an angle grinder outfitted with a carving blade. Keep in mind that this tool demands your respect in every possible way! A full face shield is recommended.

Take your time with this tool and make very light passes from right to left with the blade in a near-horizontal position. You can carve with the blade in a vertical position, but if you do, you'll most likely create a deep gouge. Again, try to be consistent as you work your way from one side to the other, and try to avoid going right up to the edges at the ends of the curve. (This tool is for rough stock removal only.)

Continually monitor your progress by looking at the template lines on both edges. When you are as close to the lines as you dare, it's time to switch to the polisher.

Outfitting a polisher with a sanding pad makes it quite the formidable leveling tool. Simply make numerous passes from one side of the curve to the other, in a smooth sweeping motion. The flexible pad follows the curve, but not the small hills and valleys created by the carving blade. Eventually, the surface will be consistent and smooth. At this point, I like to do my final smoothing with a random-orbit sander.

Although these are just two very simple examples, you can see the potential power and flexibility these tools and techniques provide.

Most of the tools we use tend to take the human element out of the equation. Whether it's a fence, stop, guide rail or bearing, each seems to stop us from doing what our bodies and reflexes apparently want us to do. Although this makes perfect sense in most cases and is completely necessary, I sometimes feel like I am missing out on something. And that's why these techniques are so gratifying. I can walk into the shop, fire up the tool, stare that wood in face and say, “It's just you and me today, Woody!”

Now don't expect perfection right out of the gate. These techniques take a little practice. But bear this in mind: The human eye is much better at recognizing errors and inconsistencies when viewing straight lines and 90° angles. Curves, on the other hand, are much more forgiving. So just relax and enjoy the process. After a few “man-vs.-wood” bouts, you too will be on the lookout for excuses to include these techniques in many of your projects. **PW**

Marc is a professional woodworker as well as the creator and host of *The Wood Whisperer* (thewoodwhisperer.com). *The Wood Whisperer* (an instructional Internet woodworking show) represents Marc's three passions: woodworking, technology and education.

About This Column

Our “Wood Whisperer” column features woodworking thoughts and ideas, along with shop techniques from Marc Spagnuolo. Each column has a corresponding video related to the techniques or views expressed in the column available at popularwoodworking.com/video.



Veritas Skew Rabbet Planes

How novel: Rabbet planes that actually work well in hardwoods and in cutting across the grain.

Rabbet planes have always been a bit of an odd duck. The best vintage ones are either difficult to find or they have wooden bodies and are difficult to fix to get them functional.

Add to that the fact that the most common rabbet plane ever made – the Stanley No. 78 – isn't well-suited for cutting hardwoods, and it's no wonder that even hard-core hand-tool woodworkers make rabbets on a table saw.

Now Veritas has introduced a pair of rabbet planes that hand-tool woodworkers have been waiting for. In fact, these tools are so good that they might convince a few power-tool woodworkers to give them a try.

The Veritas designers clearly learned a lot of lessons from old designs and avoided every one of the pitfalls of these tools (except one).

Here's what's right: The plane has its cutter skewed at 30°. This makes a cleaner cut overall and pulls the tool's fence tight to the work.

They also improved the tool's fence. Using the same technology from the company's plow plane, the Veritas's fence is incredibly stable and always—always—locks down square. Any-



Veritas Skew Rabbet Planes

Lee Valley Tools ■ 800-871-8158 or
leevalley.com

Street price ■ \$249 ea. or \$449 a pair

For more information, circle #157 on Free Information Card.

one who has used the Stanley No. 78 can now stop cheering and get out a credit card.

The tool's nicker is also improved. You engage the nicker when you are cutting cross-grain rabbets. It scores the work ahead of the blade so that your work doesn't get torn up. The Veritas nicker is easy to sharpen and is fully adjustable. Nickers on old rabbet planes are neither.

The tool's depth stop is also robust and contoured so it won't mark your work.

Veritas also added an improvement that I've not seen on a rabbet plane: blade set screws. These control the position of the blade side to side. Veritas has these set screws on many other tools, and I generally ignore them. But on a rabbet plane, they are welcome.

So what pitfall did they step into? It was an unavoidable one, I'm afraid. Rabbet planes are complex tools that require sensitive and careful adjustments to make them work at all. There are a lot of controls on this tool – even more than you'll find on a bench plane – and they all must be correct to get good results.

So be sure to follow the tool's instruction manual. It's brief, but it's critical to success.

Despite its complexity, I found the tool easy to set up. The iron is accurately ground and

its flat side is lapped dead flat – sharpening the iron was a five-minute job.

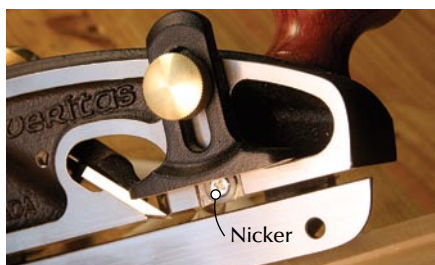
Once I got the blade, nicker, set screws and fence all working in unison, the tool made beautiful spiral shavings – shoot for a thickness of about .008" for best results.

The rear tote of the tool is comfortable to hold, but I didn't use the front knob at all. When I use a rabbet plane, I find it best to relegate my off hand to pressing the fence to the work. So I ended up using my left hand's fingers to press the fence horizontally and my left thumb to press the tool down in front of the mouth.

Veritas is offering left- and right-hand versions of this tool. Do you need both? Perhaps. Having both will allow you to deal with grain reversals in your boards. Most people will buy the one tool that matches their hand dominance and live with some tear-out.

Not me. I want both. I've been cutting rabbets for far too long with a table saw and have a lot of catching up to do.

—Christopher Schwarz



Neat nicker. The round nicker is fully adjustable and easily sharpened.

Titebond Instant Bond CA Glue

If you're a serious woodworker, or a woodworker who sometimes needs to correct small errors somewhere in your shop, you should have a bottle or two of cyanoacrylate (CA) glue. (You may know it as Super Glue.) I always keep a couple bottles close at hand whenever I'm woodworking.

Cyanoacrylate glue has been available for some time, so what's new? New to this type of product is the name Titebond. Franklin International, manufacturer of Titebond glues, has developed a high-quality CA glue, Titebond Instant Bond. Instant Bond is triple-distilled to remove any contaminants, which extends its shelf life to two years.

Instant Bond is a powerful glue that sets in as little as five seconds and fully cures in just 60 seconds. That's just the ticket for hard-to-reach joints, areas that are difficult to get to with clamps, or simply repairs that need to be accomplished in short order. Of course, if five seconds is a bit too long for you to wait, the company developed Instant Bond Activator. This bonding accelerator, specially developed

for Titebond Instant Bond, reduces the setup and cure times by up to 50 percent.

Instant Bond is available in four viscosities for different jobs. The thin viscosity is great for bonding small hairline cracks or to repair loose veneer, while the medium viscosity is used in pen turning. The thick viscosity bonds in 10 seconds and is great for jigs and quick repairs. (I like this product for adding material back onto tenons that were cut too thin. Immediately, I can re-cut tenons to the correct thickness.) And the gel is perfect for MDF or other porous woods and is also simple to use to install door-catch magnets.

Instant Bond was developed specifically for wood and wood products, but its uses are not limited there. Use these products to bond many different materials from acrylic to stainless steel and even granite.

Titebond's CA glue is available in 2 ounce, 4 ounce or 8 ounce bottles. Instant Bond Activator is available in either a 2 ounce or 8 ounce pump spray bottle.

—Glen D. Huey



Instant Bond

Franklin International ■ 800-347-4583 or
titebond.com

Street price ■ \$8-\$40

For more information, circle #158 on Free Information Card.

Amana In-Tech Router Bits

Insert tooling has long been used on the industrial side of woodworking and is now making its way to home-based and small professional woodworkers. One example is Amana Tool's In-Tech Series router bits.

Amana has placed tungsten carbide inserts (small individual cutting knives) on nine 1/4"-shank router bits commonly used in many shops. The company states that these router bits, with insert knives, have superior cutting quality in hardwoods, softwoods, MDF and chipboard. Additionally, Amana professes that these bits will last at least four times longer than brazed router bits.

Unlike sending a brazed bit out for sharpening, or pitching it into a drawer full of dull router bits, with the In-Tech series you simply replace the insert at a cost that's less than a new bit. In fact, straight-sided replacement inserts, such as those for the flush-trim, straight-plunge and rabbeting bits, have two sharpened sides that allow for more than a single change. That's a money-saving idea.

Each replaceable insert has an oversized hole through which a small screw passes, locking the cutting edge to the shank. We are concerned about the fact that there's no indexing

for the inserts—indexing is the way to assure the insert is correctly positioned to the tool. According to Amana, there are bit-specific instructions when changing the inserts.

We have a few In-Tech bits with different profiles in our shop and have found the resulting cut to be equal to most router bits we've brought in before. When we removed and replaced the inserts, we experienced no problem achieving a cut with a matching profile. Of course, we didn't install replacements, but if you plan to change out the inserts, we suggest replacing both cutting edges to guarantee a better profile match and resulting cut.

Are these bits a good deal? First you have to decide if you'll find the need to replace the inserts. I seldom buy a second exact profile router bit unless it's a basic profile. After that, you'll have to compare pricing of the In-Tech router bits to your favorite brand.



In-Tech Series Router Bits

Amana Tool ■ 800-445-0077 or
amanatool.com/intech

Router Bits ■ \$16 - \$52

Replacement inserts ■ \$5 - \$16

For more information, circle #159 on Free Information Card.

We like, and welcome, the idea of insert tooling in the woodshop and look forward to further use of the In-Tech router bits. As for determining the length of time before we see any degradation of the cutting edge, that's going to take a while.

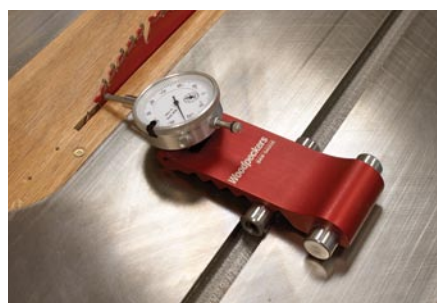
—GH

CONTINUED ON PAGE 40

Woodpeckers Saw Gauge

If you notice a substantial amount of burning as you rip or crosscut with your table saw, you have a problem. Problems with table saws generally fall into two categories: problems with the saw blade or problems with the fence. More often than not, these issues relate to alignment problems.

Either scenario requires you to make fine adjustments. And in the past, at least for me, that meant a dial indicator with all the bars and magnetic bases – magnets that had to be turned on to hold and turned off to be adjusted. Now, that's in the past.

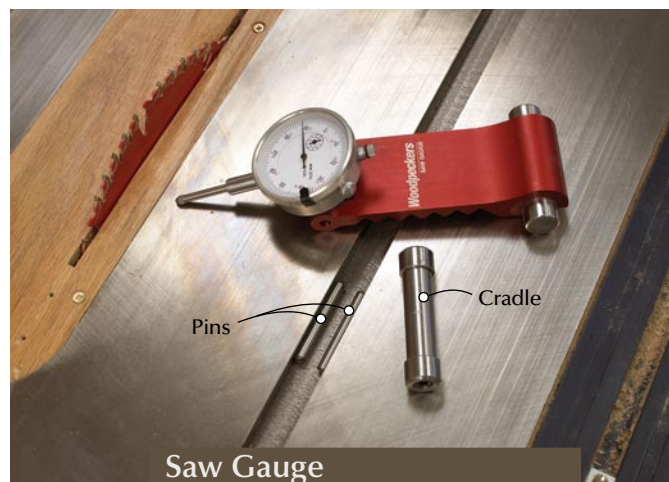


Snappy setup. Tool-free assembly makes this instrument simple to use.

The Saw Gauge, by Woodpeckers, takes the hassle out of the alignment of table saw arbors, blades and fences. Setup of the tool is easy and quick. Place the two small pins against the walls of your miter gauge slot, position the cradle (a larger cylinder) on top of those pins – the cradle actually locks over the pins, then on top of the cradle goes the gauge body, ready to read any small variations. The gauge automatically aligns and adjusts to your miter gauge slot, be it a standard $\frac{3}{4}$ " or something different, as in older saws.

Saw Gauge has a saw-tooth design, a stair step if you will, on the bottom of the tool that allows you to position the gauge body at six different settings to achieve the optimal position of the dial indicator.

Once assembled, the unit slides as one, which makes checking your blade in a couple locations or finding the toe-in or toe-out of your fence very simple and precise.



Saw Gauge

Woodpeckers ■ 800-752-0725 or woodpeck.com

Street price ■ \$99.95

For more information, circle #160 on Free Information Card.

Quality of construction is another nice feature on this tool. The body is anodized aluminum with the remaining parts all steel. And you could remove the dial indicator from the body for additional uses if you desire.

—GH

Triton TC36LS 3.6 Volt Lithium-ion Screwdriver

Tiny Lithium-ion cordless screwdrivers are breeding like feral cats in the *Popular Woodworking* shop these days. This little hex-drive Triton, at just 3.6 volts and less than 1 pound, is the runt of the litter (most of the small drivers on our benches are 12v or 10.8v). But like many runts, this baby is awfully cute, and it's one we're going to want to keep around.

Unlike its slightly larger brethren, the Triton driver doesn't have a removable battery (which means there's no bulky charger of which to keep track). Instead, the cord attaches to the tool, and simply plugs into the wall. The charge time is a bit long at 3-5 hours, but not out of line with other tools of this price. And because of the Li-ion technology, the battery holds the charge when the tool is not in use, so it's ready when you are.

The small pistol grip ($5\frac{3}{8}$ " at the widest point) fits quite comfortably into my child-sized hands, and the forward/reverse switch is a thumb's reach at the top of the tool, though the action on it is a little stiff. Sliding driver tip in and out is literally a snap.

Because of its size, this tool can get into places many drivers can't – it's smaller than the average hand size in our shop – and a magnetic extension piece allows for even longer reaches.

This screwdriver would be a great choice when tightening a few odd screws around the shop or for any jobs that involve an out-of-the-way reach, such as working inside a cabinet. It's also the perfect size to stuff into your pocket (or pocketbook) for any unexpected needs or an installation job.

In addition to the extension piece, the kit comes with 17 common driver tips in assorted sizes, including four flatheads, three Phillips, two Robertsons (square) drives, four hex drives and four Torx drives. And although this Triton shouldn't be your go-to tool for heavy drilling, I easily drilled a couple $\frac{5}{64}$ " and $\frac{3}{32}$ " holes in yellow pine and poplar ... before I snapped my boss' new $\frac{3}{32}$ " quick-change drill bit in jatoba (so much for a complete set of bits in the shop). **PW**

—Megan Fitzpatrick



Triton TC36LS Screwdriver

Triton ■ 888-874-8661 or tritonwoodworking.com

Street price ■ \$36

For more information, circle #161 on Free Information Card.



Online EXTRAS

To watch a video of our testing criteria and procedures, and to read a review of a new saw equipped with a video camera, go to:

popularwoodworking.com/dec08



12" Sliding Compound Miter Saws

BY ROBERT W. LANG

Testing the ultimate crosscut saws.

Thirty years ago, there weren't many options for making wide crosscuts. The machine to use was a radial-arm saw. Expensive, fussy to set up, hardly portable and touted as a "do-it-all" device, the saw's head could turn and twist to make compound-miter cuts in wide material. Repeating a setup for a mating piece, however, took a long time.

Then Delta came out with the Sawbuck, a small saw mounted on rails, supported at the front and back of a rotating table. This was a great leap forward, but was short-lived. Something better was on the eastern horizon.

Hitachi effectively made Delta's tool obsolete with the introduction of the sliding compound-miter saw. This was an instant jobsite favorite, and its most important feature was its accuracy and repeatability.

Makita followed with a 10" version, and since then manufacturers have competed to make saws to make complex miter cuts on larger and larger mouldings, such as crown moulding. The saws in this test are designed to make life easier for the trim carpenter.

In the shop, however, the benefit depends on the types of cuts commonly made. Furniture makers and cabinetmakers can go years without needing to make a compound cut in wide material, and the features of these saws

that allow that could be something paid for but never used.

The Price of Capacity and Accuracy

Because of their complexity, there is some play in the head of even the best saw when it is fully extended. This can lead to cuts in wide flat stock that are rough or out of square. This can be minimized by careful technique.

Bring the blade to operating speed then gently lower the blade and start cuts at the edge of the board nearest you; push back at a pace that doesn't strain the motor. If you move too fast you can flex the carriage and get a less-than-perfect cut. Saws with smaller blades and simpler mechanisms may be a better choice for furniture making or cabinetmaking.

For this test, we compared 12" dual-bevel, sliding compound-miter saws from Bosch, DeWalt, Hitachi, Makita, Milwaukee and Ridgid, ranging in price from about \$550 to \$750. We also scrutinized the new 10" saw from Festool, the Kapex. Our impression of the Kapex is in the sidebar on page 47. We also looked at a prototype of a saw with a video display. A review of that saw is online.

Aside from price, the differences among the saws were mostly in the features or combinations of features.

A good group. Large-capacity sliding compound-miter saws will make nearly any imaginable crosscut. Choosing which one to buy may be a challenge.

12" Sliding Compound Miter Saws



Bosch 5412L

Bosch has put effort into making this saw user-friendly with all of the controls for setting miter and bevel angles located on the front of the saw. The handle is also adjustable, turning to four positions. The sleeves on the sliding bars are adjustable and our test saw didn't require any adjustments.

The laser is mounted on the blade and isn't adjustable. The projected beam moves laterally as the saw is lowered. This doesn't affect the accuracy of the cut, but it is disconcerting to watch it move as the blade is lowered. We got used to it, but prefer a saw-mounted laser that doesn't require a spinning blade to use.

This saw has a large footprint, with a distance of 26¹/₄" from the fence to the wall. The table is large, and features built-in extensions. This might be an advantage on a jobsite, but placed on a permanent bench in the shop it doesn't add much. Dust collection is average and the noise level was in the middle of the group, at 103dB.

The saw head is well-balanced, making adjustments to the bevel angle simple and painless. The miter detents are solid, but overriding them requires pushing a thin piece of steel above the handle into a notch. If you have small hands, or lack hand strength, this can be difficult.

If space isn't an issue, this is a nice saw, solidly made with some unique features. It wasn't our favorite, but if some of these features are important to you, it could be the ideal choice.



DeWalt DW718

This saw is engineered to make a deep cut, allowing the sliding bars to be kept to a minimal length. Space required from the front of the fence to the back of the saw is only 17¹/₄" without the dust bag, increasing to 25¹/₂" with the bag in place.

The dust collection is not very effective. A rubber sleeve behind the blade looks as if it is meant to channel debris, but it narrows the opening, and gets in the way if you install an auxiliary wooden fence. The noise level was 105dB, among the louder saws in the group.

The DeWalt does not come with a laser as standard equipment, but a saw-mounted laser is available as an option. Another option is a saw-mounted light that uses the shadow of the blade for alignment. We liked this option, as it provided good light at the cutline in addition to serving as an alignment aid.

The controls are straightforward, and easy to find and use. Changing the bevel angle does require reaching behind the saw, but the mechanism is well-balanced and dampened. The bearing sleeves are adjustable and the saw was accurate out of the box. Construction is solid, and when changing angles the detents are easy to hit.

Should the detents ever need adjusting, they are in plain sight and adjustments are a matter of loosening a couple screws, moving the head, then tightening the screws. This saw has been on the market for several years, and it is a popular and dependable performer.



Hitachi C12LSH

We've picked on Hitachi before about the space-age trade dress on its newer tools. Some of these tools weren't as good as previous offerings, so we were pleasantly surprised with the quality of this saw. It arrived without needing adjustment, and has some design elements that we really liked.

The sliding bars can be locked at either end, allowing the saw head to move forward along the bars. In this configuration, only 17⁷/₈" was needed from the fence to the wall, the smallest distance of saws in the test with the dust bag in place.

A laser guide is mounted to the saw body, and is easy to adjust to the exact position of the saw kerf. A gooseneck arm at the top of the saw contains a digital readout for the angle of both the miter and bevel settings, in 0.5° increments. There is a fine-adjust knob for tweaking each the two angle settings, although some might question if half a degree is fine enough.

The saw is top-heavy, and adjusting the bevel angle can be a strain. This was also the only saw we tested with independent back fences. This makes squaring the fence to the blade more complicated, but it eliminates the possibility of bending a one-piece fence.

The noise level was high, at 106dB, but the feature-to-cost ratio and the overall quality make this a solid choice. For the money, we consider it a "Best Value." We still don't like the space-cadet appearance, but this is a nice saw, especially when permanently mounted in a small shop.

BOSCH

877-267-2499 or boschtools.com

■ Street price: \$623

DEWALT

800-433-9258 or dewalt.com

■ Street price: \$560

HITACHI

800-706-7337 or hitachipowertools.com

■ Street price: \$574



Makita LS1214FL

This saw is similar in design to Makita's 10" saw, which has been available for more than 10 years. It's a time-tested design and a quality saw. Some of its features are showing age, however, and what was once a category leader is now an average saw. In this category, however, average is very good.

Our only complaint is the indicator for the miter angle. It is on the right side near the fence instead of up front as it is on all the other saws. It isn't visible if you have a piece of stock on the table.

The saw we received needed some minor adjustment to square the fence and reset the bevel stops. Adjustments were straightforward and quick to make, but this was one of only two saws that weren't ready to go on arrival.

The body-mounted laser took a bit longer to adjust than the Hitachi version, but that was still less than a 10-minute job. There is also a worklight mounted on a flexible stem. This was an added convenience, but we preferred the fixed light on the Milwaukee. The Makita was the quietest saw in the test, at 99dB.

The controls for locking in a miter setting and the sliding bars are both at the front of the saw. This is a convenient location, but it takes a while to get used to which is which. With the slide all the way back, the distance from the fence to the wall is 20⁷/₁₆".

The Makita is a popular and reliable tool. The sliding bars are located below the table, giving this saw a low center of gravity and a more positive feeling of control while cutting.



Milwaukee 6955-20

New on the market is this saw from Milwaukee. It is solidly made, and arrived needing no adjustment. The worklight and digital miter setting (to 0.1°) are nice features, as is the dust-collection bag – the only one in the group that was effective. But we wonder why a laser guide is not available. Not all of us think the laser is essential, but it is an option or standard equipment on all the other saws we tested.

The sliding rails on this saw are below the table, keeping the center of gravity low. Changing miter angles is smooth, although the lever to release the detents is out of sight and easy to miss. The addition of a fine-adjustment knob for miter angle setting is a nice addition, and the digital readout reflects changes of one-tenth of a degree.

The direct-drive motor features an electronic speed control, which maintains optimal speed under load. The noise level was on the high side at 104dB, but other saws were louder. The distance from the fence behind the saw is 21¹/₄". The built-in worklight provided good light at the blade. Again, this feature may not appeal to everyone, but in a small garage or basement shop it could be a real benefit.

The combination of unique and useful features and overall quality moved this saw into the "Editor's Choice" position. But the margin of victory is narrow. Most of the other saws were equal in quality of construction and cut of this one. It could almost be considered a photo finish.



Ridgid MS1290LZA

As the lowest-priced saw in our test, the Ridgid is a decent saw and a solid value. It cuts and holds its settings as well as any of the other saws in this group. Some of the features have been "value-engineered," but not to the point of making this saw a regrettable choice. It's on the loud side at 106dB, and doesn't have all the bells and whistles, but it is a good, solid tool.

One of the good features it shares (with the DeWalt and the Bosch) is the ability to adjust the tightness of the bushings on the sliding bars. We did have to adjust the fence to square on the saw we received, but this was a simple, five-minute task.

This saw has a large table in front of the fence, and it also requires a lot of space in back, 26¹/₂" from the fence to the wall if permanently mounted. The additional table area up front doesn't really provide additional support, and this saw has the deepest footprint of the group. The laser guide is blade-mounted, and adjustable.

The detent override is located above a locking lever up front. It looks like a fine-adjustment knob, but isn't labelled, except for arrows pointing up and down. To change a miter angle, this has to be released then manually re-engaged. On all the other saws, moving between the miter detents is a simpler, one-step process.

The dust collection, as with most of the saws we tested, leaves a lot to be desired, and the mechanism for controlling the depth of cut is awkward to use.

MAKITA
800-462-5482 or makita.com

■ Street price: \$659.99

MILWAUKEE
800-729-3878 or milwaukeetool.com

■ Street price: \$689.92

RIDGID
866-539-1710 or ridgid.com

■ Street price: \$549

We have mixed feelings about these saws. Almost all cuts we make with our saws are right angles, in pieces less than 2" thick. We prefer accurate and repeatable square cuts over the ability to cut odd angles on a rare occasion. Digital readouts, lasers and lights are nice, but aren't "must-haves" for us.

Let There Be Light

Except for the Milwaukee, all the saws have a laser available. The laser is built into the saw body on the Hitachi and Makita, and DeWalt offers a body-mounted laser as an option. DeWalt also has an optional LED light that uses the shadow of the blade for alignment. The Bosch and Ridgid have a blade-mounted laser. The saw-mounted lasers work without running the saw, and are useful for setting angles as well as positioning the blade.

The blade-mounted lasers come on as the saw reaches operating speed. This adds a spinning saw blade into the process of lining up cuts, an uncomfortable scenario. Also, the blade-mounted lasers shift as the saw is lowered. You align the laser and mark before lowering the head, then ignore the shifting line. The saw-mounted lasers are helpful but not necessary, and blade-mounted lasers are more of a distraction than a help.

Milwaukee and Makita have built-in lights, which we like. The light on the Milwaukee is behind the blade and illuminates both sides of the cut. The light on the Makita is on a goose-neck arm that can be shifted to either side.

Milwaukee and Hitachi incorporate digital readouts to aid in setting angles. On the Milwaukee the digital display is on the front of the saw table and reads miter angles in increments of 0.1°. Hitachi's display is on a flexible arm above the handle and reads miter and bevel angles in increments of 0.5°.

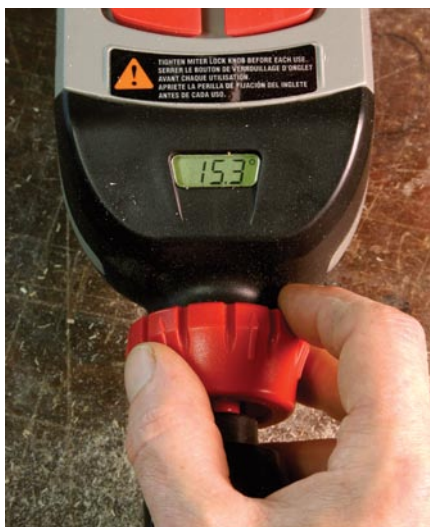
It's cool that the saw does this, but with most cuts made square, or at least in one of the detents, the value of this feature is limited. If you do a lot of trim work, however, and often cut just outside the detents, you might pick one of these saws for the digital readout alone.

Six Saws and a Cloud of Dust

These saws are among the most difficult machines in woodworking to set up for effective dust collection. Most of the manufacturers have made only token efforts in this area, with a small round port at the back of the saw leading to a removable bag. Except for the Milwaukee, a shop vacuum hose can be attached to any of these saws. You don't need to empty the bag,



The shadow knows. DeWalt offers an optional light that uses the shadow of the blade for lining up cuts. It works as well as a laser, and lights the work area.



To a fine degree. Milwaukee adds a digital readout and fine-adjustment knob to set miter angles to 0.1°.

but that doesn't solve the bigger problem.

The Milwaukee saw channels the dust into a larger rectangular port and was the most effective of the saws we tested. It would take some effort to make an adapter to use with a shop vacuum or dust-collection system, but most of the debris lands in the right place.

The complexity of these saws means that each has several levers, locks and knobs to allow repositioning of the saw head in relation to the table. In addition to indexing the saw at preset angles, you can override the detents to cut close to, but not in, the detents.

Bosch put all the controls on the front of the saw, including the bevel release. The others require reaching around behind the saw to tilt the head, which can be awkward. The Milwaukee and Hitachi saws have knobs to fine-tune the miter angle position, a feature that goes well with the digital readouts. Hitachi also has a knob for adjusting the bevel position. With



No spin zone. Laser guides mounted on the saw can be used to set precise angles as well as to align the blade to a line. Blade-mounted lasers require the blade to be spinning to turn them on.



Digital double-play. Hitachi has a digital display and fine adjustment knobs for both miter and bevel angles, reading to 0.5°.

the others, setting a precise angle is a matter of pushing and tapping.

All the saws, except the Hitachi, have one-piece aluminum fences. Adjusting the fence perpendicular to the blade involves loosening several screws, pivoting the fence, then retightening the screws. Adjustments don't take long because the fence is one piece.

If the screws aren't properly tightened, the fence can be bent. If it bends, it is nearly impossible to bend it back—the fence will need to be replaced. The Hitachi has independent fence halves that eliminate the bending problem, but complicate adjustment. DeWalt has a one-piece fence, but it is adjusted to square by repositioning the detent plate.

Little Saws that Need Large Homes

On a jobsite, a miter saw tends to be located in the middle of things. In a shop, equally important is the footprint of the saw. Many of these saws need a lot of room behind for the sliding bars to operate.

DeWalt and Hitachi have the shallowest footprints, requiring 17¹/₄" (with the dust bag removed on the DeWalt), and 17⁷/₈" on the



Front and center. Bosch puts all the controls for setting miter and bevel angles in one convenient location.

Hitachi (dust bag in place), from the front of the fence to a wall behind the saw. The most space is required by the Ridgid, at 26½". The others come in at 26¼" for the Bosch, 21¼" for the Milwaukee, and 20⅞" for the Makita.

Personal preference may make a difference in handle orientation. The DeWalt, Milwaukee and Ridgid saws have horizontal handles, while the Hitachi and Makita have vertical ones. The handle on the Bosch rotates to four positions. For some of our editors this was important; for others it didn't matter.

Personal Preferences

Any of these saws might be ideal for you. Overall quality and accuracy, supplied blades and quality of cuts made were too close for us to pick a clear winner. Our review is also written from the perspective of furniture makers, not finish carpenters. We didn't put much weight on features we rarely, if ever, use.

Choosing the right saw for your shop will likely come down to specific features you value as well as price. If you can live without a laser guide, or don't mind adding an aftermarket, blade-mounted laser, the new Milwaukee is a solid combination of features in a sturdy package. This combination of features, as well as dust collection that actually works, earned it our "Editor's Choice" award by a narrow margin. If the laser is important, the Hitachi is an excellent value. Hitachi's solid construction and combination of features for a relatively low price earn it our "Best Value" award.

There isn't anything wrong with the remaining saws. Our preferences are subjective, we wouldn't argue with other choices, and would likely be happy using the other saws that came in a very close second place. This is a category where performance and quality of all the tools tested were very close. **PW**

Robert is senior editor of this magazine. His latest book is "Drafting & Design for Woodworkers" (Popular Woodworking Books). Contact him at 513-531-2690 x11327 or robert.lang@fwpubs.com.



Consider the back. Most of the saws in the test require a lot of space behind the fence. The DeWalt (with the dust bag removed) and the Hitachi take less room than the others.



FESTOOL Kapex KS120

New on the market is this 10" saw from Festool. Because of its blade size, we didn't include it in this test, even though its capacity rivals larger saws. The other thing that separates the Kapex from the 12" saws is its price; it's roughly twice as much as the most expensive 12" saw we tested.

As might be expected, what you get for your money is what you get when you decide to purchase a BMW or Mercedes instead of a Chevy or Ford – luxury engineering and impeccable workmanship in the finished product. If you insist on having the best and don't mind paying a premium for it, you'll want one. Comparing a Porsche to a Chevy isn't really fair.

The controls on the Kapex are easy to operate, but some of them aren't very intuitive. We resorted to reading the manual to understand how some of the functions were controlled. There is a knob on the operator end of one of the sliding rails for setting bevel angles precisely, but no fine adjustment for setting miters.

This saw was designed to be used with a vacuum instead of a dust bag, and dust collection was better than most of the saws in the test. But when cutting wide stock, a good deal of dust didn't make it to the hose and was left behind.

Cutting capacity was close to that of the 12" saws, and the sliding mechanism was smooth and precise. The Kapex is an extremely accurate, well-made saw, but like an expensive car, it isn't for everybody.

— RL

FESTOOL USA

888-337-8600 or festoolusa.com

■ Street price: \$1,300

Stickley Mantle Clock

BY GLEN D. HUEY



Attention to detail pushes this Stickley design,
and the builder, to another level.

A few years prior to his brothers taking over the furniture business, Gustav Stickley, the grandfather of the Arts & Crafts movement, produced what might at first glance appear to be an ordinary mantle clock. A closer look reveals many remarkable details. It's the details that make this project more than just a box containing a clock movement.

Take a look at where the top of the clock meets the sides. Is Stickley over the top with the number of pins and tails? I guess. But that's a detail that influences the overall look of the clock. Through-tenons that have chamfered ends is another small detail, as is the leaded-glass window that reveals the swinging pendulum. And the 12-sided clock-face opening certainly grabs your attention; it's certainly not as easy to cut as a simple circle. But at the end of the project, you'll have a clock worthy of a sacred spot on your mantle.

Plan Your Dovetails

To be faithful to the original (an example of which recently appraised for \$4,000), I set out to cut a total of 13 pins and tails. I wasn't so lucky. In fact, I had to abandon my 12°-dovetail marking gauge in favor of a 1:8 dovetail ratio. Even then, I only managed to arrive at five tails, four pins and two half-pins. The idea is to leave enough width in the pins to hide the groove for the backboard.

After you've established the baseline of your dovetails, layout begins on the top's face with two $\frac{1}{4}$ " sections that become the half pins, one on each edge of the piece. Squeezed between those smaller sections are nine $\frac{1}{2}$ " spaces. These wider spaces become the full pins and tails.

Place marks on the face to form the sections. This makes the dovetail layout easier. Use a dovetail saddle marker, or a 1:8 layout jig, to transfer the layout and create the appropri-



Measure and mark. Layout on the dovetails begins with accurate sizing. Work from the face to the angled lines on the board's end.

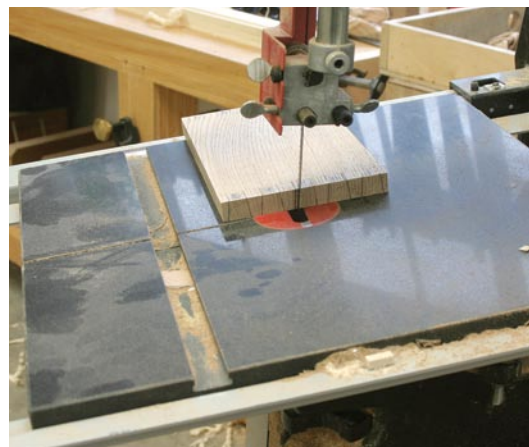
ate angled line—each line receives an opposing angled line. Designate the waste area with scribbled lines to ensure accuracy as you work, then repeat similar steps for the other end to complete the pin layout of the top.

Band Saw is Better

I generally cut my dovetails with a 12° angle. That measurement prevents me from using a band saw for the majority of my work without a jig; on most band saws it's not possible to get a 12° setting left of zero. If you use a 1:8 ratio, or 7° angle, that option is back in play so the band saw is my tool of choice.

Set the band saw table to 7° or align the saw blade with the layout mark as shown (above right). The first setting is easily attained with a simple tilt of the table. Make your cuts on the waste side of the lines. (Take a look at the layout in order to figure which line the angle is set for.) Once that's determined, cut every other line to your baseline. Remember to cut both ends of the top piece with the saw's table positioned at this setting.

Next you have to change the tilt of the band saw table. This time the table must be tilted toward the post of the saw. Set the angle of the table, then make the remaining cuts to delineate the pins and tail sockets. Remove the waste area to form your pins.



Handsaw-free pins. Pin cuts are easy if you use a band saw set at an angle to match your layout lines. Tilt the table once for each pin direction.



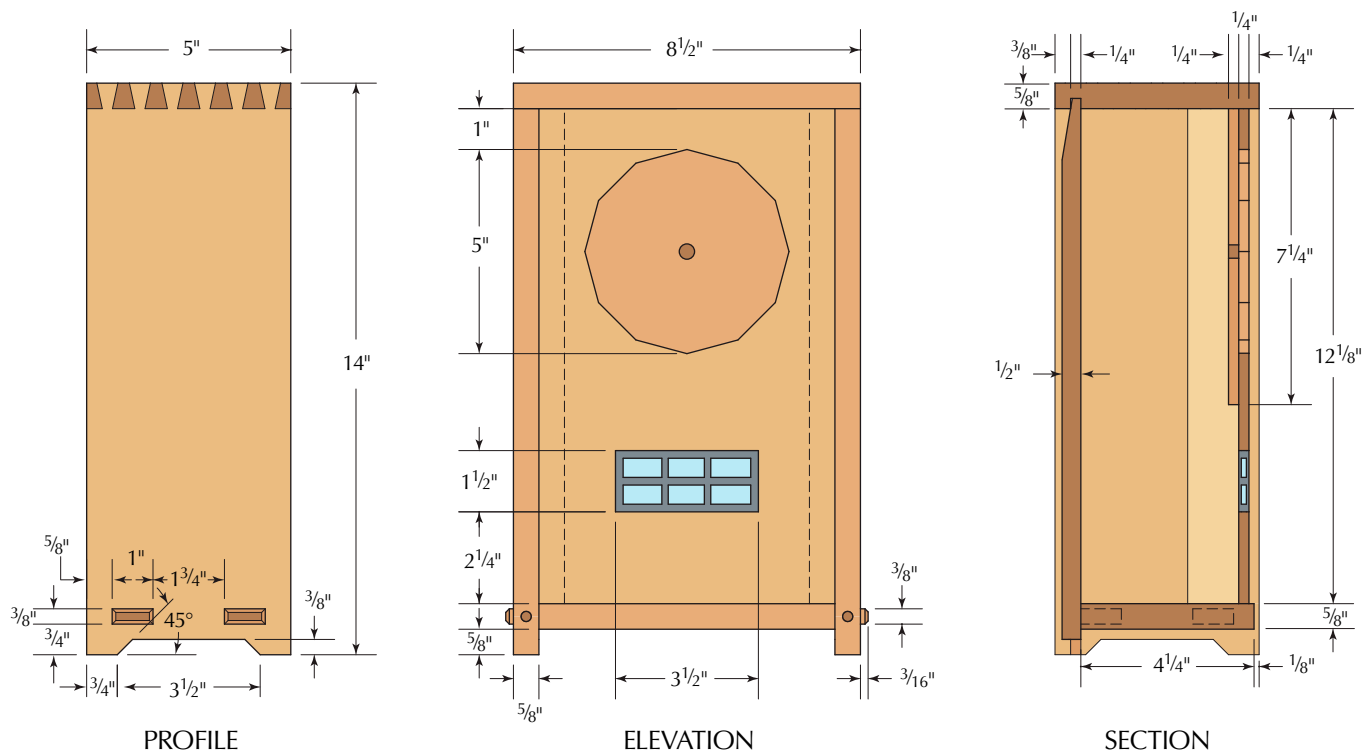
Sharp lines, tight fit. Align the top onto the clock sides, use a sharp pencil to transfer the lines and mark the waste area to be removed. The extra marks assure that you'll waste the correct area.

Transfer the pin layout to the tailboard then remove the waste of the tailboard to form the tails. Set the band saw table back to 90°, then make the cuts along the layout lines on the waste side of the lines. Remove the waste and check the fit. Make any adjustments to achieve a snug, but not a tight, fit. The rule of thumb is: The more dovetails you have and the more dense the wood, the closer to your layout lines you can cut and still achieve a nicely fitted joint.

Easy Mortise for Through-tenons

Once the dovetails are complete and fit, determine the position of the mortises for the through-tenons of the clock bottom. The bottom is $\frac{5}{8}$ " thick, but the tenons are $\frac{3}{8}$ " in thickness. There are a number of methods you can use to create the mortises. You can cut them by hand, use a router and jig or use

A timeless design. Time may stand still for no one, but this striking Gustav Stickley gem will cause a pause when it catches the eye.



a dedicated mortise machine with a $\frac{3}{8}$ " mortise chisel and bit installed (that's the easiest way I've found).

Due to the position of the mortises, you'll need to cut the stock moving front to back, instead of side to side as is normal. Place a scrap piece beneath the side to reduce any blowout as the chisel plunges through the workpiece. Locate the mortise area under the chisel. Align the bit with both sides of the layout and position the fence so the front edge of the chisel is in line with the near edge of the rear mortise. Place a stop-block at the bottom end of the side that's 90° to the fence. You'll also need two spacers, one $\frac{5}{8}$ " thick and one $\frac{1}{4}$ " thick.

Place the side against the fence and the stop-block, then plunge the first hole. Next,

slide a $\frac{5}{8}$ " spacer between the fence and the workpiece. This positions the chisel to cut the opposite end of the rear mortise. Plunge that hole. Replace the thick spacer with a $\frac{1}{4}$ " spacer, which removes the balance of the waste material from that mortise.

To cut the second mortise in the same side, simply flip the workpiece and repeat the same steps. It's best to change the scrap with each new mortise to keep the exiting face crisp. Complete all four mortises, two per side.

The sides are then grooved to accept the clock's back. A $\frac{1}{4}$ " groove is carefully positioned to fit to the dovetail layout. As you can see in the top center photo on the next page, the $\frac{1}{4}$ "-deep groove is aligned with the rear dovetail socket in the clock top and cut with a spiral upcut router bit at a router table. Groove

the top from side to side, but for the sides, a stopped groove terminates before exiting the dovetail.

To complete the milling of the sides, form the feet of the clock using your band saw.

Tenons Complete the Joint

After the tenons are created, the piece is reduced in width at the front and back edges. It's easier to locate and form the tenons with the workpiece the same width as the top and sides.

Begin by forming a full-width tenon on each end of the bottom. I use a two-step approach at my table saw. Make the shoulder cuts with the workpiece flat on the table, then with the workpiece vertical, make the cheek cuts to form the tenons. Look for a snug fit.

Position the clock's bottom (with the $\frac{3}{8}$ " tenons formed and fit to the mortises) onto the clock's sides, then transfer the layout lines to the tenons. Take care to accurately transfer these marks. The tenons should be snug on all sides when fit to the mortises.

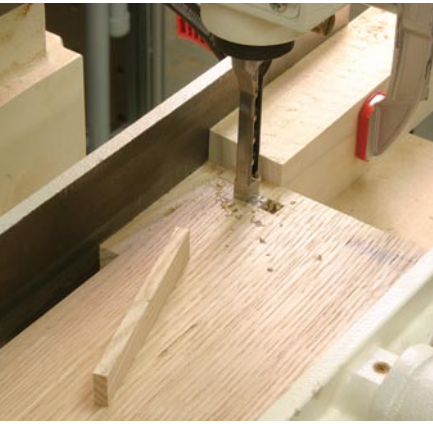
Use a table saw to define the tenons. Match the saw blade height to that of the formed tenons. Use a tall auxiliary fence and clamp the bottom in position to cut the tenons at your layout lines. Be sure to work on the waste side of the tenons.

Remove the end waste areas using a band saw or nibble the material away at your table saw. The center section can be cut and/or nib-

Stickley Mantle Clock

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL	COMMENTS
		T	W	L		
❑ 1	Top	$\frac{5}{8}$	5	$8\frac{1}{2}$	QSWO	
❑ 2	Sides	$\frac{5}{8}$	5	14	QSWO	
❑ 1	Bottom	$\frac{5}{8}$	5*	$8\frac{7}{8}$	QSWO	$\frac{13}{16}$ " tenon both ends
❑ 1	Door	$\frac{3}{8}$	$7\frac{1}{4}$	$12\frac{1}{8}$	QSWO	
❑ 2	Supports	$\frac{5}{8}$	$1\frac{1}{4}$	$12\frac{1}{8}$	QSWO	Rabbeted for dial back
❑ 1	Back	$\frac{1}{2}$	$7\frac{5}{8}$	$13\frac{1}{4}$	QSWO	
❑ 1	Dial back	$\frac{1}{4}$	$7\frac{1}{4}$	$7\frac{1}{4}$	Plywood	

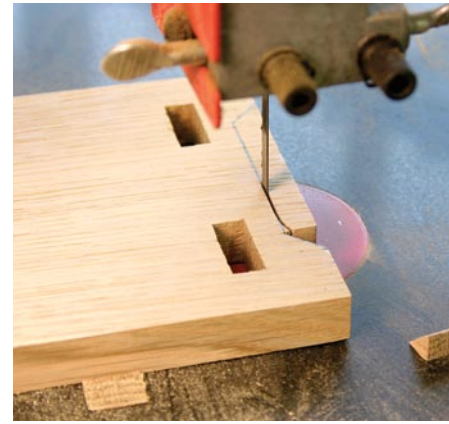
QSWO = quartersawn white oak; *Oversized, will be cut to fit



Spacers make quick work. Once the mortise chisels are positioned to the workpiece, it's a matter of changing spacers to complete the mortises.



Watch that cut. Don't push your groove through the dovetail or it will show from the top.



Stand tall. Simple feet are cut at the bottom edge of the sides. The best tool is a band saw.



Accuracy counts. Mark the tenons on your bottom off the mortises cut into the sides. Be sure to accurately transfer the layout once the edges of the pieces are aligned.



Simple and straight. Tenons made at the table will be straight, which makes for a tight fitting mortise and tenon.



Hybrid woodworking. This sander's table adjusts to 45°. Another way to chamfer the tenon edges is with a miter gauge at a disc sander. No matter which method you use, the ends of the tenons require handwork.

bled, but I find it more efficient to use a chisel to remove the waste. Work partway through the material, then flip the stock and remove the remaining waste. Work with your chisel at a slight angle so you undercut the area. Any material extending beyond the shoulder of the tenon will cause problems when fitting the pieces.

These tenons extend through the clock sides by $\frac{3}{16}$ " and are chamfered on all four edges, with a portion at the center remaining flat. You can use an edge sander or disc sander to chamfer the long portion of each tenon, but the work on the ends of the tenons has to be completed by hand with a rasp due to the fact that you'll nip the corner before you reach the tenon's edge.

Once the tenon work is complete and the fit is accurate, make the cuts to reduce the width of the bottom. The front edge is trimmed $\frac{1}{8}$ " to create an offset at the front of the clock. (Arts & Crafts designers were always looking for

shadow lines.) The back edge of the bottom is trimmed $\frac{5}{8}$ " to allow the clock back to slide past the bottom when slid into the grooves.

The Focus of the Clock

There's no way around the fact that the door of this project is the focal point. The faceted cutout for the dial is a real eye-popper while the art glass is no small feature. The point here is to find and use a very nice piece of lumber for your door.

Assemble the clock – without glue – to get the height and width of your door, then mill the piece to $\frac{3}{8}$ " thick. Affix a paper pattern of the dial cutout to the door front with spray adhesive to begin the work. (The pattern is available as a free download at popularwoodworking.com/dec08.) Find your largest-diameter drill bit, chuck it into a drill press and hog out as much of the center of the cutout area as you can, without cutting beyond the facets. The hole size needs to be at least large enough for a

jigsaw blade to pass through and the more you remove, the easier the jigsaw work.

Secure the door in a vise or at your bench, then use a jigsaw to cut from the center hole to each facet junction. Next, cut close to each facet line without touching the line. As you reach each center-to-facet junction line, the waste falls away, allowing you to line up the next length of cut. A good jigsaw blade is a must.

Now use a rasp to straighten your cuts. Work tightly and accurately to the lines. If you're off even a small amount, the symmetry of the design will visually intensify any inconsistencies.

Online EXTRAS

For information on fuming an Arts & Crafts finish, creating the art-glass insert for the door and a link to find the dial face, go to:

popularwoodworking.com/dec08

Next, lay out the opening for the art glass and again use a jigsaw to hog out the majority of the waste. Fine-tune the opening with your rasp. When these two areas are cut, shaped and finished, use a card scraper to remove the paper from the dial area.

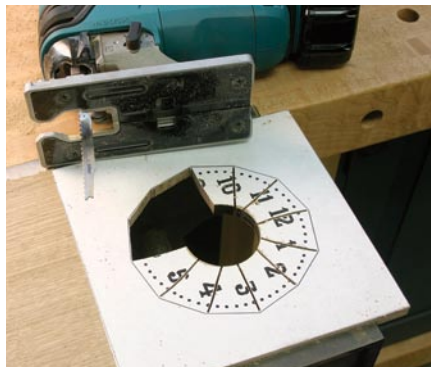
The Door: Hang and Fit

The door's position is slightly back from the front edge of the clock, so it's not possible to install butt hinges as you would normally. The leaf mortise on the case side has to be ramped and the barrel of the hinge is on or at the surface.

Establish the mortise locations according to the plan. Mark both the front edge and rear edge of the door. It's from the front edge of the door that you'll ramp the mortise area. The idea is to create a ramp so the hinge leaf is flush to the surface where the outer edge of the leaf meets the case.



Ramping up a hinge mortise. Installation of the hinges is tricky because the door is slightly recessed into the clock. A ramped mortise allows you to bury the hinge leaf and keep the barrel aligned as needed.



Hour by hour. To remove the waste inside the dial cutout, make cuts from the center out, then trim closely to the 12-sided opening.

To make this ramp, set the inner hinge line with a chisel to a depth equal to the hinge-leaf thickness. At each end of the hinge area, plunge a $\frac{3}{8}$ " chisel into the waste area while it's set at an approximate angle that matches the ramp. All that's left is to create the ramp.

Begin with your chisel resting on the outermost hinge line and slice downward as you move toward the inner layout line. Work slowly until the leaf edge is just flush and the ramp is straight and flat.

Next, install the clock bottom to the hinge side piece. This creates a 90° corner and a place to fit the door. Align the door to the assembled pieces, hold a small gap at the bottom and transfer the hinge location onto the edge of the door.

Because the door thickness matches the length of the hinge leaf, it's possible to cut the recess at a table saw. One method to achieve the necessary depth of cut for the recess is



Raspy detail. Small variations in the faceted edges are magnified when viewed as a whole. Spend some time to bring the edges to your layout lines.

to hold the hinge so the leaves are parallel, measure that thickness, then subtract $\frac{1}{16}$ " (for a reveal) and set the depth of cut at that figure. I think it's best to install the hinges on the clock body and create a test piece to arrive at the accurate depth of cut.

Once the blade is set for the correct depth of cut, add a tall auxiliary fence to your miter gauge, position the door to cut at the transferred marks and make a pass over the blade with the door clamped to the fence. Cut both ends of the recess on the waste side to define the hinge area; nibble away the balance of the material.

Install the door on the hinges. Add the top to the hinge side/bottom assembly. Mark at the tenon shoulder as well as the baseline of your dovetailed top to establish the exact width of the door. Cutting to that line will make the door fit, but it will be far too tight. Take a look at the reveal at the hinge side and adjust your cut to match.



Precise transference. Mark the door-hinge location off the mortises made in the side. Make sure to keep the door aligned as you transfer the layout.



Just like the tenon cuts. Remove the waste from the hinge area on the doors at the table saw. This is the same setup I used to define the tenons for the bottom.



Fit tight or fit right. There's a fine line between your door fitting exactly and fitting sloppy. Make the piece fit, then angle the back edge with a block plane. If the gap needs to be enlarged, a simple pass or two with a sanding block should do the trick.

Finally, turn a door knob from matching hardwood. Form a $\frac{3}{8}$ " tenon on the end of the knob to fit a $\frac{3}{8}$ " hole drilled into the door. A small amount of glue secures the knob in place.

Finishing Construction

After you've assembled all the parts of the clock and fit the door to the case, it's time to finalize construction. You have to add supports for the door and dial back, and make then install a backboard.

The two supports pull double duty. First, they act as a stop for the door and second, they hold the plywood dial back. Mill the material for these supports according to the cut sheet. At the table saw, raise the blade height to match the thickness of your plywood dial back. Set the fence to cut at the $7\frac{1}{4}$ " mark. Use your

miter gauge with the auxiliary fence to cut a small notch into each support. Make the first cut with the end of the support tight to the fence, then pull away from the fence making a number of cuts until you've removed about $\frac{3}{4}$ " or more of waste.

Raise the blade to just below its full height. In this position, the cut will be more vertical and the pressure applied from the blade helps hold the stock to the table. Position the fence to rip the area for the dial back, then make the second cut.

The supports are added to the interior of the clock sides, just behind the door. To figure the placement, hold a square to the door and hinge side. Draw a line up both edges of the door. Add a thin bead of glue along the support's length, then attach the support just behind that line with a few small brads.

At this time, if everything is checked and fits, assemble the clock for the last time. Add glue to the dovetails and slip the parts together. I choose not to add glue around the tenons so as not to have any glue squeeze-out to clean up. Besides, the front edge of the tenons gets pegged through the face edge of the sides, which can also be completed as you assemble the clock. And don't forget to cut and fit the plywood dial back. It attaches to the supports with four small screws.

The back on my clock speaks volumes of the builder. Ordinarily, this back would be a piece that's $\frac{1}{4}$ " in thickness. But because I usually build pieces from the 18th and early 19th centuries, I found myself making this piece as I would a drawer bottom in Queen Anne furniture. If you choose to copy my project,

Supplies

Woodcraft

800-225-1153 or
woodcraft.com

- 1 ■ standard quartz movement
#3722X, \$15.99
(includes 4802X hands)
- 1 ■ rare earth magnets
#128473, \$5.99

Rockler

800-279-4441 or
rockler.com

- 1 ■ narrow cabinet hinge
#32908, \$11.49

Clock Prints

513-309-4666 or
clockprints.com

- 1 ■ clock face
#AC9 PWW, \$14.99

Prices correct at time of publication.

mill the back to size and thickness and set up at the table saw to complete the piece.

Set the fence (with a height extension added) spaced $\frac{3}{16}$ " from the blade, just as a tooth passes below the table's surface. Raise the blade so you can just slide the panel between the blade and the fence. Use a push stick to make the cuts, as shown on the next page. The first cut is at the end grain, while the other two cuts are along the long-grain edges. This results in a near-perfect fit of a backboard into a $\frac{1}{4}$ " groove.

If you choose to make the piece traditionally, mill the back to size and thickness the part to just slip into the groove.



The first of two steps. Form a notch in the supports that will eventually accept the dial back. A number of passes over the saw blade will carve out an area that makes finishing the rabbet a breeze.



The second of two steps. The support rabbets are finished when you rip the material up to and including the notch. A small amount of waste needs to be cleared prior to the addition of the dial back.



Where to position the supports. Hold the door closed and tight to a square, then mark the edges of the door. Use a folded business card to position the supports behind those lines.

Finish-sand the entire project to #120 grit. There's no need sand go any further unless you plan to use a different finishing method.

The door is held in a closed position with a pair of rare-earth magnets, one in the door and one in a support. After the finish is complete, drill a hole in the support that's sized to accept your magnet. Cut off a small brad, then install the brad into the center of the hole. Close the door onto the brad a few times to mark the location for the second magnet. Install the magnets with a drop or two of thick cyanoacrylate glue and make sure to keep the polarity of the magnets in the correct orientation.

I turned to our resident Arts & Crafts expert, Senior Editor Robert W. Lang, for his help on the finish. He suggested this piece is the perfect size to fume, as was done on

period pieces. Visit popularwoodworking.com/dec08 for additional information about fuming quartersawn white oak.

Also there, you'll find information on the paper dial (clockprints.com created a custom design for us that matches the original in most details). And you'll find information about the art-glass insert for the door.

This project was a venture into Arts & Crafts detail and the finish had me fuming, thanks to Mr. Lang. But the end result sits proudly on my mantle. I'll bet your results will be equally as impressive. **PW**

Glen is a senior editor of this magazine, a published author and the host of the Woodworker's Edge DVD series. Contact him at 531-513-2690 x11293 or glen.huey@fwpubs.com.



Pegged joint. The mortise-and-tenon joint is held together with a dowel that extends well into the first tenon. I made this matching-hardwood dowel by driving the stock through a series of graduated holes in a dowel plate until I reached the 1/4" diameter.



Know your period. I found myself stuck in the 18th century when I made the clock back. If you're positioned differently, you might just want to mill your stock to a 1/4" thickness and do away with the bevels.

Fuming the finish.

Fuming the clock in a clear tub allowed us to see the difference in the way the wood changed. We pulled the door and back out after two hours. The clock case stayed put for another 16 hours.

Remarkably, the color achieved was nearly identical.



A trick to install magnets. A brad driven into the center of a hole sized for a magnet will locate a second hole location by simply closing the door.

2008 BEST NEW TOOLS



The Winners:

Bosch
Bridge City Tools
Byrd Tool
Colt
Delta
Festool
Gramercy
Jet
Makita
Powermatic
Veritas

Before I started working at this magazine, I saw tools as things that came in boxes. But during the last 12 years, my view has changed. I now see tools as triumphs of marketing, engineering or both.

After you meet the people who make and sell your tools, you never look at the tools the same way again. I know the guy who designed my jack plane, and the man who came up with the idea for SawStop. Because we know these people, you might think that we cut them a lot of slack when selecting the winners of our Best New Tools award each year.

Nope. Today we wrapped up our selection process, and we spent most of that time ripping apart the candidates, exploring what we didn't like about them. It's a bit like telling your spouse that you don't like the way she gets her hair cut. But we have to do this. Not only for you, but for the engineers and marketing people who conceive of these tools, figure out how to make them and successfully bring them to market.

We owe it to these people to select the tools that are like nothing that anyone has ever made (such as the Jointmaker Pro). Or tools that have innovative features that revive an established form (such as the new Festool router). Or tools that take an old idea and use it to make a new tool that works better than we could have imagined (such as the Veritas skew rabbet planes and the Bosch jigsaw blades).

These tools might be manufactured of steel, glass-filled nylon and brass, but they really are made of guts, gray matter and gumption.

— Christopher Schwarz, editor

COLT *MaxiCut Forstner Bits*

It's taken more than 125 years, but it looks like the Germans have perfected the Forstner bit. The new Colt MaxiCut bits are virtually uncloggable and cut rapidly and cleanly through tough materials, even exotic woods. What more could you want?

The genius in these bits is that the cutting lip is designed to bust up the chips as they are severed. So you don't get big disc-shaped chips, which clog the works. Instead you get ribbon-like shavings, which eject easily, even from deep holes.

We tried to overfeed this bit, and we failed. Bravo to Colt. These bits cost a little more, but we think they're worth it.



COLT
■ Available this fall from specialty stores

POWERMATIC *18" Band Saw*

If you've ever been to an automotive show, you know that those cars come fully loaded and tricked out with every option and good idea the manufacturer has to offer. And that's exactly what it felt like when Powermatic unveiled its new 18" monster band saw at the International Woodworking Fair in Atlanta.

The saw is overbuilt in every way you can imagine. The only plastic on the saw is the switch's cover. The cast wheels are beefy enough for a car. The saw's independently adjusted guides are planted on a rock-solid post. And the whole thing is powered by a 5-horsepower motor.

In addition to the cast iron, Powermatic added some sweet amenities: An intuitive blade-release mechanism, a clever way to tilt the saw's table both ways quickly, and a T-square fence that works like a Biesemeyer. The whole package is extremely well thought out with everything that you both want and need in a saw.

Priced at about \$4,000, it's at the upper end of the market, but it will be the last band saw you ever buy.



POWERMATIC
■ 800-274-6848 ■ powermatic.com

DELTA MACHINERY *U.S.-made Unisaw*

The biggest news in woodworking machinery this year was the redesigned Delta Unisaw. With a new look, new features and a new factory (in the United States), skeptical but excited woodworkers were clamoring for a first look at the saw.

After looking over the saw, we think Delta is delivering on its promise to build a new and better Unisaw in the United States. Here's what we saw:

■ **Better controls.** Delta has put both the bevel and the blade-height mechanisms in the front of the machine, where they belong.

■ **Better safety equipment.** Delta added a riving knife and removable blade cover, which everyone is adding these days. Delta also made it as simple as possible to add and remove the guard. Now there's little reason to leave the guard off your saw.

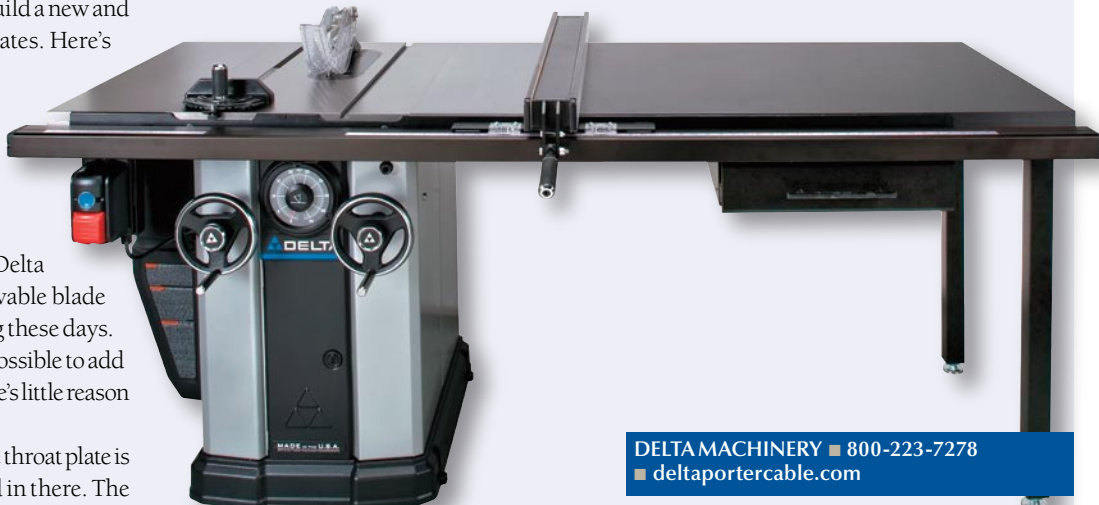
■ **Smart improvements.** The throat plate is bigger so you can get your hand in there. The

arbor locks so you can remove the blade with one wrench. The arbor nut is one piece instead of two (and there's a convenient front door on the saw in case you drop it). And there's more cast iron table in front of the blade.

■ **Better dust collection.** Now there are two

ports to keep your saw cleared of debris.

As long-time Unisaw users, we cannot wait to get our hands on the new model, which will be assembled in Tennessee from parts from all over the country (more details on this later). Welcome home Unisaw!



DELTA MACHINERY ■ 800-223-7278
■ deltaportercable.com

BRIDGE CITY *Jointmaker Pro*

When I saw the Bridge City Jointmaker Pro for the first time, it was hard to figure out exactly what it was. Was it a hand-powered table saw with a sliding table? An upside-down hand-powered miter saw? A precision joinery jig for a Japanese handsaw? It turns out that the Jointmaker Pro is all those things and more.

At its heart, the Jointmaker Pro is a precision sliding table and an adjustable Japanese-tooth blade. How you combine those two features can create surprising results.

It can simply be a precision crosscutting machine that makes the cleanest crosscuts

you have ever seen. It can make glass-smooth miters. Dovetails. Precision veneer for inlay. All without a power cord or more than a whisper of noise.

When the table saw was first invented, I'm sure its inventors were unable to imagine all the things that could be done with it. The Jointmaker Pro is like that. Every time we stepped up to the tool, we thought of something else new and different that could be done with the Jointmaker Pro with great precision.

The tool is made to exacting standards from high-quality and durable materials. The base model costs \$1,095.



BRIDGE CITY TOOLS
■ 800-253-3332 ■ bridgecitytools.com

FESTOOL *OF2200 Plunge Router*

Lots of people want to sell you plans for the "ultimate" router table. But wouldn't you rather own the ultimate router?

Now you can.

Festool's engineers pulled out all the stops when they designed the 15-amp OF2200

router. Let's begin at the collet, which is where you spend most of your time and frustration with a router. Festool has a ratcheting collet. Press a button to lock the collet, then use a single wrench to tighten or loosen the bit using the efficient ratcheting mechanism.

Don't you hate changing the baseplates on your routers? We do. Festool fixes this frustration with bases that clip on and off the tool in a second. No more odd screwdrivers or fasteners to lose.

Having different bases for big and little bits allows you to actually collect dust with the router, thanks also to the tool's spring-loaded retractable shroud.

Adjusting your plunge depth is fast, intuitive and precise. And the plunge lock is right where you want it (on the left handle).

Festool just forced the plunge router to evolve again. Now watch everyone else try to keep up.



FESTOOL USA
■ 888-337-8600 ■ festoolusa.com

MAKITA *10.8v Lithium-ion Compact Drill-Driver*

For years we've been railing against high-voltage cordless drills (36 volts? Give us a break! Actually, give us a broken wrist!). So we used to tell woodworkers to buy 9.6-volt drills, instead.

Now—thank goodness—the world is changing. Manufacturers are using new battery technology to make smaller and more powerful tools instead of making bigger tools that mimic corded tools.

Our favorite of the new crop is the Makita 10.8-volt Lithium-ion compact driver, the DF030D. It has the right set of features for woodworking. It's small (of course), about 7" high and 6" long. And it delivers a powerful punch—195 in./lbs. of torque.

But what we really like is the tool's two-speed gearbox (0-350 and 0-1,300 rpm) and its 18-position clutch. These are the two features you need to drive screws and drill bits effectively.

The drill features a 1/4" hex-head chuck. Some woodworkers prefer a standard chuck, but I've become fond of this sort of tooling because you can switch quickly from drilling to driving.

Makita also makes a pint-size impact driver in this format that you might be interested in. Though we prefer the standard drill/drivers in our shop, many woodworkers like the extra driving power provided by an impact driver. If this describes you, then check out Makita's TD090D. It's also a high-quality, compact tool.



MAKITA
■ 800-462-5482 ■ makita.com

JET *Resaw Band Saw*

Many woodworkers who buy a 14" cast-frame band saw modify the machine by adding an accessory riser-block kit. This about doubles the maximum height of the material the saw can accommodate. But the cost of this modification is that the saw's frame loses some of its rigidity – a critical feature for a precision setup.

Jet Tools solved this problem by creating an entirely new 14" cast iron frame for its JWB-14 ProDX saw (710116K) that gives you 12" of resaw capacity right out of the box – without losing rigidity. This new frame casting is significantly beefier than on standard band saws and helps ensure a smooth cut in very thick materials. Jet officials demonstrated the saw for us this summer, and we were very impressed with the whole package.

At \$899 the saw is a good deal with a quick blade-release mechanism, high-tension spring, 1¹/₄-hp motor and a rack-and-pinion blade-guide post.

If you want a 14" cast iron saw to use for resawing, we think this machine should be your top choice.

JET TOOLS
■ 800-274-6848 ■ woodworking.jettools.com



BOSCH *Xtra-clean Jigsaw Blades for Wood*

Most woodworkers separate jigsaw blades into two categories: sharp and charred. Now there's a third kind of jigsaw blade: the Xtra-clean blade from Bosch.

When we first started using these blades, we were skeptical. Now my fellow editors are hoarding them in their toolboxes. Thanks to some very clever tooth geometry, these blades cut cleaner than any jigsaw blade we have ever used – hands down. Senior Editor Robert W. Lang used them to cut lap dovetails when building his workbench and the joints went together right from the saw. Throw your old blades out and get some Xtra-clean ones. Enough said.



BOSCH
■ 877-267-2499 ■ boschtools.com

JET OSC Drum Sander

Drum sanders are great for leveling glued-up panels and surfacing figured woods, but they have their downsides. A little dried glue on your panel can gum up and ruin your sandpaper (an expensive problem). Also, changing grits a lot to get to your final finish can be time-consuming.

Jet Tools has introduced a new 22" open-end drum sander (the 22-44 OSC) that remedies both of these problems. Unlike other drum sanders, the head can be set to oscillate back and forth by 1" as it spins. This oscillation (a patented design) increases the life of your sanding belt, decreases the chance of it getting gummed up and leaves a superior finish, even at coarse grits.

Jet officials demonstrated the sander for us with #80-grit paper loaded on the machine's single drum. With the oscillation function turned off, the sanding scratches were clearly visible. With the oscillation turned on, the scratches were dramatically reduced. You could get away with a lot fewer grits with this machine.

Priced right above \$2,000, this is a serious machine with lots of impressive features (it automatically adjusts your feed rate). If you would like to sand less and you work a lot with panels, the Jet is an ideal machine.



JET TOOLS
■ 800-274-6848 ■ woodworking.jettools.com

GRAMERCY

Crosscut Carcase Saw

The carcase saw is one of the three essential backsaws when cutting joints by hand (you'll also want a dovetail and tenon saw). The carcase saw is useful for all manner of precision crosscuts, from simply getting a board to the exact length to cutting high-tolerance tenon shoulders. You need a good one.

The new Gramercy Tools carcase saw stands up against the other premium brands and has some extra features that we like. The saw is exceptionally smooth-cutting, thanks to its hand-filed and hand-set teeth. Plus the saw has a bit more fleam than others, which also contributes to its smoothness. ("Fleam" is the bevel on the front of each saw tooth.)

The saw's blade is a little longer than most at 12", and it has a blade that tapers in width from heel to toe, like old saws. And it's quite lightweight (12.6 ounces), which makes it easy to wield. I was impressed by the prototype, which I used during the summer; the first production models are even nicer. I particularly like the tool's delicate and traditional look (and the crisp etch on its blade).

The market for premium backsaws has been getting fierce, with several new boutique makers entering the fray this year (and more

to come). The Gramercy is definitely not an also-ran. Its distinct set of features have launched it into the very top tier of makers and it deserves your careful consideration.



TOOLS FOR WORKING WOOD
■ 800-426-4613 ■ toolsforworkingwood.com

VERITAS

Skew Rabbet Planes

Veritas continues to fill out the line of essential planes that woodworkers need to do joinery by hand. Last year, Veritas released its excellent plow plane. This year, the company hit a home run with its skew rabbet planes.

These planes come in right- and left-hand versions (having both allows you to work with varying grain directions). And the tools have every detail and adjustment you need to make clean rabbets both with and across the grain.

The tool's iron is skewed, which pulls the tool into the cut and results in cleaner cuts overall. The fence uses router-collet technology to ensure the fence locks square. And the cross-grain nicker is fully adjustable and easy to sharpen.

In use, the plane is comfortable to hold and easy to wield. I had the tool making crisp rabbets in less than 25 minutes out of the box (and that included sharpening). That's saying something for rabbet planes, which are complex tools.

If you like cutting joints by hand (or you perhaps want to learn), a rabbeting plane is essential. And you can't do better than the Veritas.

Need more proof? Then check out our full review of this tool in the Tool Test column of this issue on page 36.



LEE VALLEY TOOLS
■ 800-267-8735 ■ leevalley.com

BYRD TOOL

Shelix Cutterheads for Portable Planers

Byrd Tool makes amazing spiral cutterheads for machinery that are quiet, clear the chips efficiently and leave a fantastic surface, even in difficult woods. The cutterhead technology—called Shelix—also allows you to use small carbide inserts that you can easily replace if you hit a nail. Plus, the carbide lasts a long time.

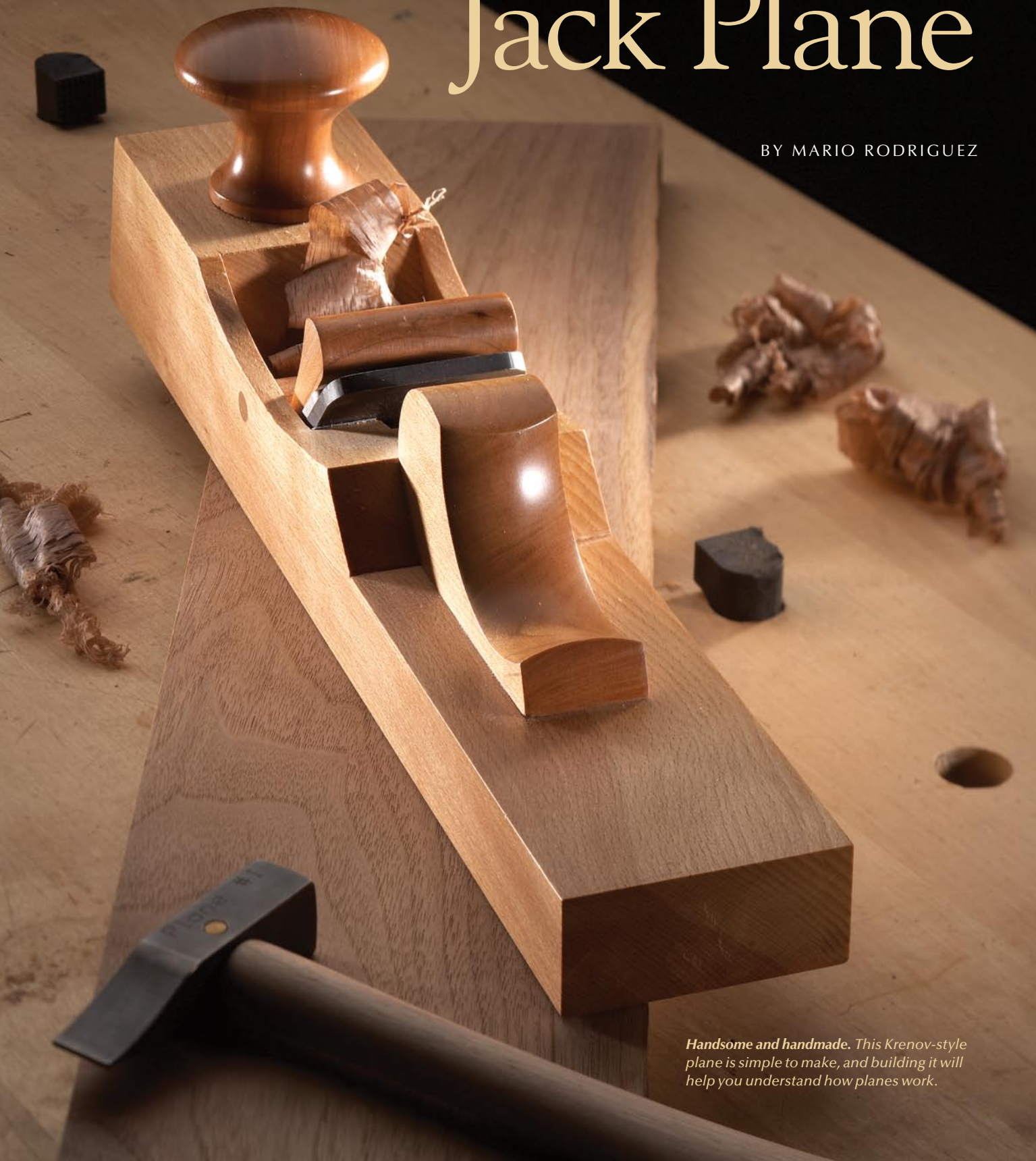
Until now, these cutterheads were available only for bigger machines. Now Byrd Tool has begun making aftermarket Shelix heads for some portable planers, including the DeWalt 13" DW735. And others are in the works, including Ridgid and Delta planers. At about \$410 for a Shelix replacement head, it might be better to update your existing planer than replace it. **PW**



BYRD TOOL
■ 800-441-2973 ■ byrdtool.com

Build a Wooden Jack Plane

BY MARIO RODRIGUEZ



Handsome and handmade. This Krenov-style plane is simple to make, and building it will help you understand how planes work.

Making your own tool helps you understand how and why it works, and what to do if it doesn't.

Making a plane is a unique wood-working experience that shouldn't be missed. It's a way to develop a deep knowledge of how a plane works – and why one might not. The experience also provides the opportunity to customize one of the most useful tools in your collection. Another advantage is that you get to create a tool best suited to your particular work and methods.

For this article, I built a jack/panel plane that's 15" long with a 2"-wide blade. A plane of this size can be used for final finishing of a wood surface, sort of like an English panel plane. And at 15", it isn't too long. The extra weight and girth enable it to overcome chatter and better deal with tricky grain and any cross-grain planing. It's not a size commonly used for smoothing by American woodworkers, but the panel plane has always been popular in England.

I don't normally use a plane of this size, but I've found this one easy to use and extremely effective. I almost have to resist the temptation to grab for it whenever I need a plane and it's quickly becoming one of my favorites.

I chose beech for the body. It's a traditional wood for planes that works easily, holds up well and acquires a nice appearance and patina over time. For contrast, I made the rear handle, front tote and wedge out of cherry.

Design Roots

This type of plane is commonly known as a "Krenov-style" plane. It's similar to some Japanese planes in that the wedge, which holds the blade to the bed, presses against a slender cross bar that spans the throat of the plane. Traditional European planes have abutments cut into the sides (cheeks) of the plane, which hold the wedge in place. So instead of being carved from a single, solid piece, the body is sliced lengthwise into three parts: the cheeks (or sides) and the center block (which is eventually cut into the breast and the bed), then glued back together. This type of laminated construction eliminates the tedious and often difficult task of carving out the throat from a single piece of wood. The illustrations on

page 63 show the cutting and laminating process.

I chose a Krenov-style blade assembly by Ron Hock (hockblades.com) that was specially designed for students of the woodworking program at the College of the Redwoods. It's shorter than a traditional blade assembly, but it's much thicker. The design and high quality of this blade assembly is ideally suited for this type of plane.

Milling and Shaping

I pulled a nice chunk of red beech, roughly 16" long from my stash of stock. After milling it to 2³/₄" x 3¹/₈", I ripped it horizontally in half to establish the "razee" shape. A razee is a traditional European plane, with a distinctive body profile. The razee cut lowers the back end of the plane, changing the plane's center of gravity and providing more control by locating the handhold directly behind the blade. According to John M. Whelan, author of "The Wooden Plane" (Astragal Press), the razee shape "directs the thrust of the plane more in line with the motion of the blade, and decreases frictional drag." I get it.

For a slight change of pace, from a tra-

ditional plane tote, cut and shape the rear handhold. I designed a stubby but comfortable shape that provides a firm and effective grip. I wanted something low-slung like the plane itself, but with an attractive flourish. Make sure the handhold height and placement won't interfere with the removal or adjustment of the blade assembly.

For the handhold, choose a piece 1¹/₄" thick x 1³/₄" wide. Leave it long for easier handling and shaping. First, cut the end at 45° to fit against the razee cut. Then cut the outline of the handhold on the band saw. Next, working from a centerline, use a rasp to achieve a smooth and flowing shape. Follow that with #220-grit sandpaper to gently round and soften any hard edges.

Consider the handhold an ornament – so have some fun with it. When the handhold is sanded smooth, cut it free and sand the tail end.

After completing the razee cut on the plane body, smooth the two halves on the jointer, then cut the back end of the upper half to a 45° angle. Place the upper half upon the lower half of the block to mark the exact position of the mortise for the handhold.

A Well-Placed Mortise

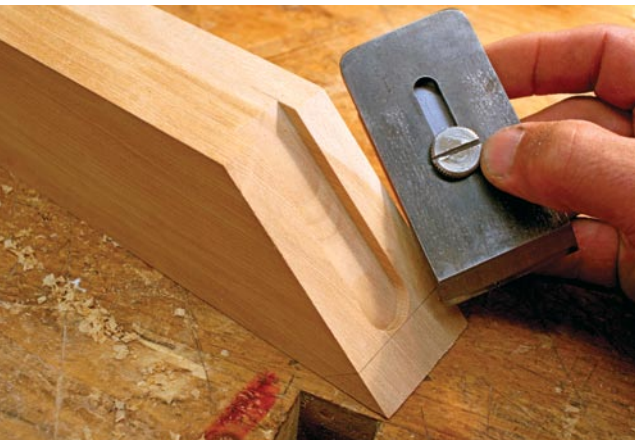
The ³/₈" handhold mortise should be centered on the block and positioned about ¹/₄" behind



Solid combination. The Hock blade assembly was designed for this type of plane. It has a thick cutter and cap iron.



Hold on before gluing. The handhold and plane body are mortised before regluing the body.



Room for the screw. A shallow slot, routed into the bed, accommodates the blade-assembly screw.



Critical location. Carefully measure and mark for the cross bar.

the end of the upper half of the plane body. The mortise is shallow and not very wide, so it can be milled on a router table.

Now glue the two halves of the body back together. When the glue has dried, square the block again. Then lay out the vertical rips that will separate the cheeks from the center section. Before ripping the block, drill holes for registration dowels at the front and back of the plane block. These allow you to register the parts throughout the building process.

The cheeks (sides) of the plane should be rough cut to $\frac{3}{8}$ " thickness. The center portion of the body (to be cut into the breast and the bed sections) should measure $2\frac{1}{8}$ " wide. Next, clean up the mating surfaces of these parts for a tight seam. For glue-up, the thick-

ness of the cheeks should measure $\frac{5}{16}$ ". The center section should measure $2\frac{1}{16}$ " – that's $\frac{1}{16}$ " greater than the width of the blade.

Lay out the center section for the bed and breast sections and make the bed cut to 45° on the chop saw. After checking the bed cut for square, rout a slot into the face of the bed to accommodate the blade-assembly screw. This operation can be performed on a router table.

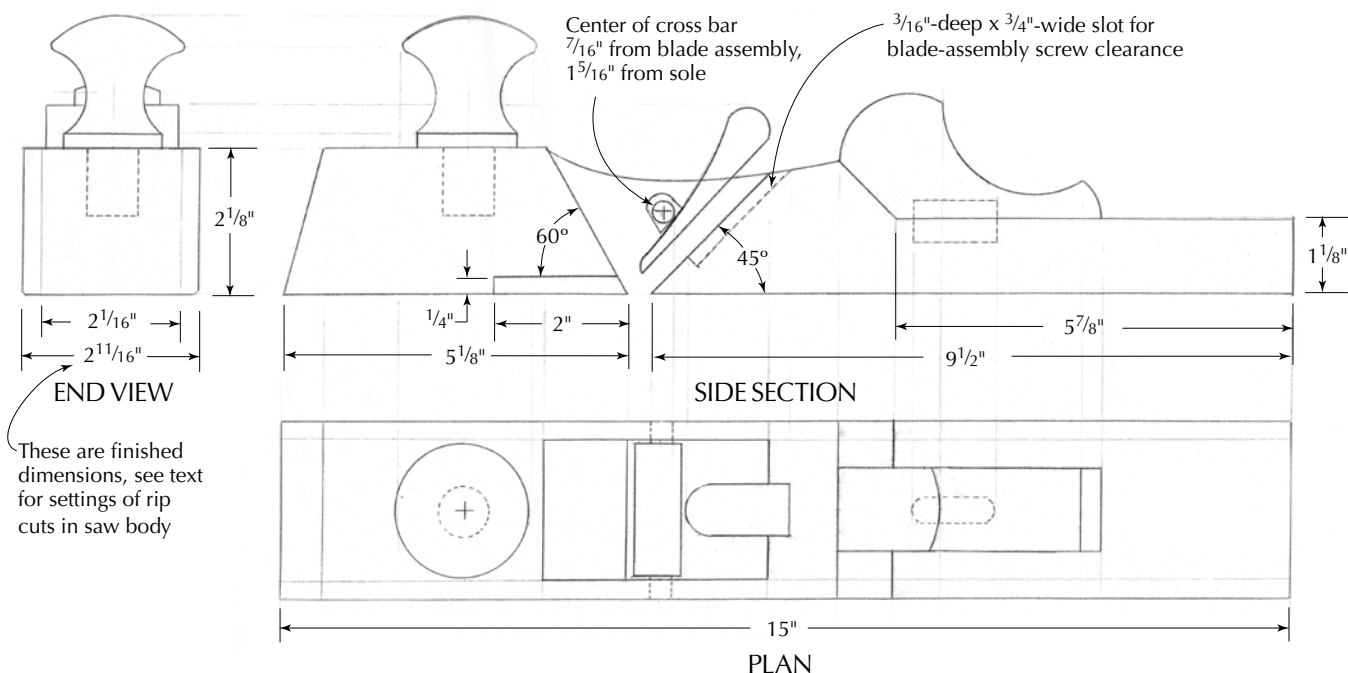
Mouth and Cross Bar

Set one of the cheeks on the bench and place the 45° bed section against it, followed by the blade assembly. Carefully mark the edge of the plane blade onto the inside of the cheek. This mark indicates the location of the mouth

opening. Don't worry that the mouth will be too small. As the plane is dressed and flattened, the mouth will probably widen. And if it's still too small, it can always be opened up. It's much harder to reduce the size of the mouth after the plane is finished.

With the blade assembly in place on the bed, measure $\frac{7}{16}$ " from the blade assembly and $1\frac{5}{16}$ " from the sole. This point will be the center of the cross-bar hole. Now place both cheeks together (secured by the registration dowels), back them with a scrap block, and drill a hole with a $\frac{5}{16}$ " brad-point bit through both pieces.

The placement of the cross bar is critical to the smooth operation of the plane. If it's placed too high in the throat, the pressure





Save your place. Drill both holes for the cross bar at one time on the drill press.



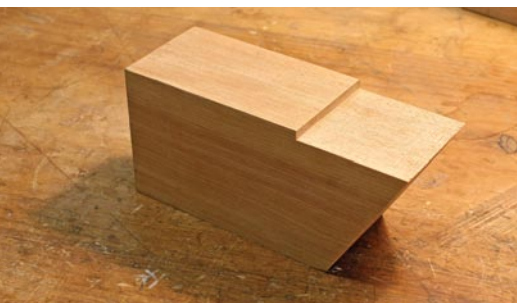
Turned tenons, planed radius. The cross bar features turned tenons; the center section has a flat side to secure the wedge, with the opposite edge rounded to help clear shavings.

applied by the wedge may be insufficient to prevent chatter. And if the bar is too low (and close to the mouth), shavings may become trapped, causing the plane to choke (jam with shavings).

To make the cross bar, start with a straight-grained, clean piece of wood, measuring $\frac{1}{2}$ " square x 3" long. Carefully locate the center at each end and mount between centers on the lathe. Using a narrow parting tool, mark out the center section of the cross bar at $2\frac{1}{16}$ " (to match the width of the body) and turn $\frac{5}{16}$ "-diameter tenons on each end.

When the lathe work is completed, check the fit of the tenons in the cross-bar holes drilled through the cheeks. The pin should pivot nicely. Then use a block plane to round over the top of the bar. With a rounded top, shavings will more easily clear the throat. After shaping with a plane, sand the cross bar with #220-grit sandpaper.

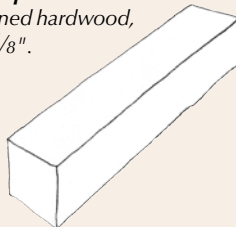
Place the breast section in position on the cheek to mark the mouth opening onto the breast section. Next, cut the breast section to a 60° angle at that line. You might want to cut it a little fat to ensure a tight mouth opening.



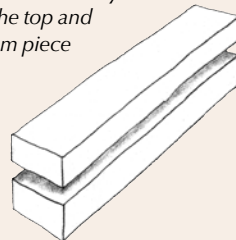
Ready for wear. The rabbeted breast (upside down), can now be measured for the fill-in piece.

Laminated Plane from a Block of Wood

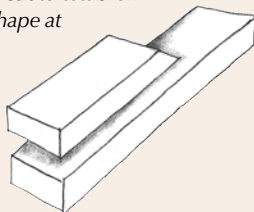
1 Begin with a square block of well-seasoned hardwood, milled to $2\frac{3}{4}$ " x $3\frac{1}{8}$ ".



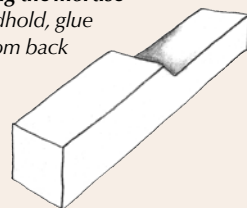
2 Rip the blank horizontally to establish the top and bottom. The bottom piece will be $\frac{1}{8}$ " thick.



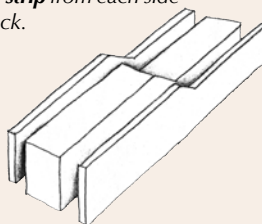
3 Make a 45° cut to establish the razee shape at the back.



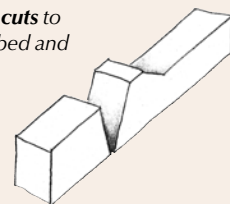
4 After making the mortise for the handhold, glue the top and bottom back together.



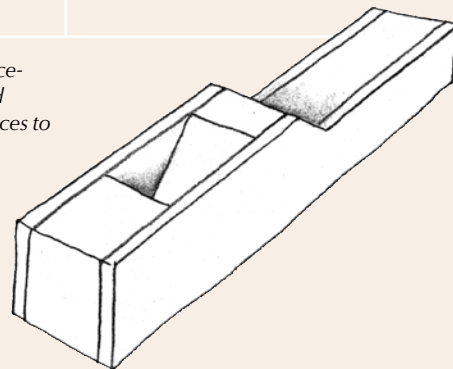
5 Rip a $\frac{3}{8}$ " strip from each side of the block.



6 Make angled cuts to establish the bed and breast.

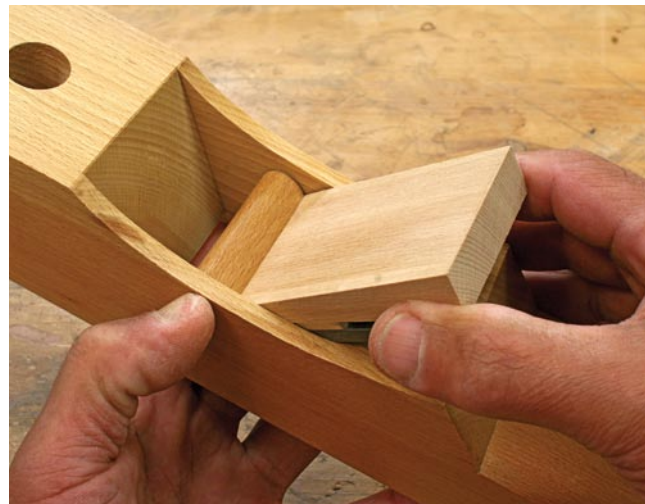


7 After making a rabbet for the replaceable block in front of the mouth and making the cross bar, dress the center pieces to $2\frac{1}{16}$ " wide, then glue the sides back on.





Now you're ready. Before assembly of the plane body, make a final check to ensure that all the parts are aligned and ready to put permanently together.



This is a keeper. Fit the rough wedge to securely hold the iron assembly between the bed and the cross bar.

Now the breast section can be rabbeted to accept a fill-in piece in front of the blade. This operation can be performed on the table saw by making multiple passes until a clean rabbet is achieved to a $\frac{1}{4}$ " depth. Choose any hard-wearing wood, such as oak, hickory or rosewood for the fill-in piece. For the plane pictured in this article, I chose paduak, an attractive, blood-red, hard-wearing wood.

Tight, Replaceable Mouth

There are two reasons for a fill-in piece in front of the mouth: First, planes are subjected to the hardest wear at the head of the mouth. If that area is worn and depressed, proper blade adjustment can be difficult. Fitting that portion of the sole with a hard-wearing piece of wood will ensure longer, more precise service from the plane. Second, as you build your plane, you will likely joint or flatten the sole several times, each time slightly increasing the size of the mouth. By using a fill-in piece during the last stages, you can better control the eventual size of the mouth opening.

Before gluing, assemble, register and clamp the parts of the body to make sure everything fits and lines up. Perform this last check on a flat surface, making sure there are no discrepancies between the various parts, or unsightly seams. After a dry run, remove the clamps.

Carefully apply yellow glue to all the mating surfaces while watching for any squeeze-out in the throat cavity. Be careful not to glue the cross-bar tenons to the cheeks. The cross bar should pivot freely to better engage the wedge when setting the blade.

Use a generous number of clamps to ensure a tight, solid job. And keep a damp cloth handy

to mop up any excess glue. Cleaning up will be easier at glue-up. If the squeeze-out is left to dry, it will require deft manipulation of sharp tools in tight corners to clean it up.

Clean, Square and Fit

After removing the clamps, pass the sole of the plane over a jointer set for a very light cut. Then square the sides to the sole. It's not essential for the sides to be square to the sole, but it's a nice touch and will allow you to use the plane with a shooting board.

Cut the plane to final height and cut the curve above the escapement on the band saw.

Final cleanup of these surfaces can be done with a block plane and spokeshave, then sandpaper, up to #220 grit.

Cut an oversized wedge and plane it down to fit between the cross bar and the blade assembly. It should securely hold the blade assembly to the bed and put the plane under tension. With the blade retracted, but securely held in place by the wedge, flatten the sole of the plane. I recommend two strips of #100-grit sandpaper, temporarily glued end to end with spray adhesive onto a jointer table as a good leveling surface. Rub the plane across the sandpaper until the sole is flat.



Dead flat. Flatten the sole on the jointer table by rubbing the completed plane over sandpaper glued to the bed.



Watch your mouth. Carefully measure and fit the fill-in piece to ensure a tight mouth.



A simple solution. Sandpaper shims can be used to fine-tune the mouth opening if it is larger than desired.

With the sole flat, advance the blade until it protrudes slightly from the sole. Now fit the fill-in piece. One end of your fill-in piece should be cut to 60°, the other should be square. Place the fill-in piece into the void. Set the fill-in piece against the blade's edge, mark the other end against the sole, and cut the fill-in piece to length.

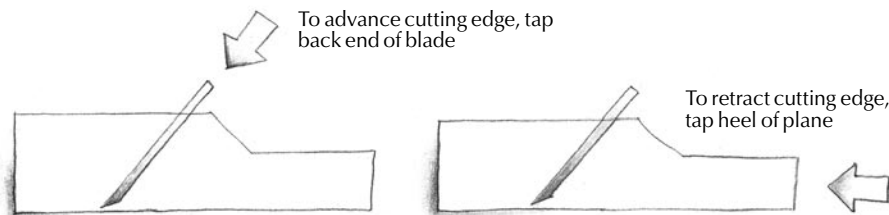
When you're satisfied with the fit, glue and clamp the fill-in piece. When dry, carefully plane it flush to the sole.

Now sand the sole dead-flat on the jointer infeed table again. Then advance the blade until it protrudes slightly. The mouth opening should be barely visible.

I worked as carefully as possible and the mouth still turned out a little larger than I had planned. If the mouth opening on your plane is slightly larger than desired, don't worry; glue a couple sandpaper shims to the bed. The shims will raise the blade assembly from the bed slightly to effectively close the mouth.

The Knob, the Wedge and the Test

To make the knob, choose an attractive block, measuring 2½" square and about 4" long. Chuck it between centers and turn it round. The knob should be turned to a pattern that will provide a comfortable grip and shouldn't



Where to tap. Depth of cut is controlled with light hammer taps. Tap the back of the iron to lower the blade; tap the back of the plane body to retract the blade.

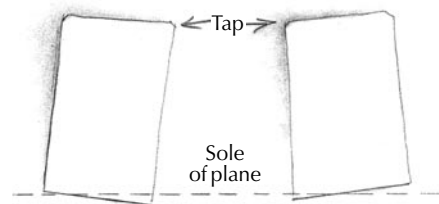
have any hard edges or extreme contours—and avoid turning any delicate details that might be damaged while using the plane. Next, turn the tenon end of the knob to ¾" diameter. I used a ¾" open wrench to precisely size the tenon. After final shaping on the lathe, sand the knob with #220-grit sandpaper.

The wedge should extend far enough down the throat to hold the blade assembly in place and prevent any chatter. However, it should not extend so far that the plane will choke.

Shaping the wedge is a matter of personal taste. Just be sure to round and relieve the back end (providing easy access to the blade). Make sure to also gently round over the tapered end of the wedge.

Sand all the flat, accessible surfaces of the plane. When everything is sanded, glue on the front knob and the handhold. The last step is to spray a light coat of satin lacquer. When the lacquer dries, rub out the finish and wax.

Set the blade shy of the mouth opening and press the wedge snugly into place. Using a small hammer, gently tap the back of the blade until it just protrudes from the mouth. Make sure it projects evenly across the mouth to ensure uniform shavings and avoid plane tracks on your work. Now tap the wedge



Setting the edge. The lateral position of the blade is also controlled by tapping the top of the iron on the low side to set the edge parallel with the mouth.

lightly to secure the blade.

If the blade's edge isn't parallel with the mouth, tap the side of the projecting corner to adjust the cutting edge. To remove or retract the blade, grab the thick end of the wedge and carefully twist it from side to side. Or you can take hold of the blade assembly and wedge while you tap the back end of the plane. Always perform this operation over your benchtop. Sometimes too vigorous a tap will unexpectedly release the blade and wedge, sending the plane flying. **PW**

Mario Rodriguez has been a woodworker, teacher and author for more than 30 years. He currently teaches at the Philadelphia Furniture Workshop. Detailed information about the school's classes is available online at philadelphiafurnitureworkshop.com.

Supplies

Hock Tools
888 282-5233 or hocktools.com

■ 2" plane iron assembly
#PI200, \$52

Price correct at time of publication.

Shaker Nesting Trays

While not traditional, this form echoes the look of iconic Shaker box tops.

BY JOHN WILSON



I have never seen an oval tray at a Shaker village, but these examples are certainly in the Shaker style. Trays are an extension of a well-known object of Shaker craft (the nesting sets of oval boxes) and possess utility, simplicity and economy of construction. Not much more is needed to qualify for the label “Shaker.” Let’s take each of these qualities to see what it means.

Shaker Tray Design

Shaker oval boxes (see *Popular Woodworking*, August 2003, issue #135) are associated with the work of the craftsmen of the Shaker community, along with ladder-back chairs with the web-taped seats, and peg-rails set into the plastered walls of their dwellings. “Icon” is a word that comes to mind – something that represents a larger body of work and that most would associate with the time and place of the makers.

The oval boxes have enjoyed a revival in the past quarter-century, as craftsmen learn that the best wood boxes are something that can be made with few special tools, and that the form has a universal appeal. Boxes, after all, need no explanation, and their nesting feature appeals to the child in all of us.

Just as oval boxes come in a range of sizes, from one that fits the palm of your hand to ones large enough to be furniture, their lids can be made in a similar range of sizes on their own to serve as trays. When made in a set, trays display their nested sizes – something not evident in the closed boxes.

As mentioned above, these trays possess real utility. Small trays are used as desk organizers to hold office objects, or pocket change and contents on a bureau. Larger trays serve wherever and whenever needed.

Handy and useful, plain and elegant at the same time.

A graceful nest. A set of Shaker-style trays in graduated sizes are elegant and lovely in their simplicity.

Easy Construction Methods

But what of their construction? Does their making entail special techniques and tools? Are they time consuming? What skills are assumed in the hands of the maker? What does “economy of construction” mean? Let’s start with the last first. Economy of construction means that the materials used, and the effort and time required, are all less than what would be expected of other construction methods to make a similar object, for example a rectangular dovetailed dining tray. An oval anything has no corner joints. The single act of bending encompasses the object. Herein is the simplicity and the economy of the tray.

What skills are required? Not many beyond what working with wood in a modest way assumes. Probably the most important step is the introduction to bending because water and wood don’t seem to mix in the experience of most woodworkers. When bending is not part of one’s lexicon, doing it is surrounded with mystery. But bending is really quite simple. Wood in the tree has lots of water – in fact more than half its weight is from water. It is not only living as annular rings are added, it is strong and flexible. Wood is dried to create dimensioned boards for shop use, and in the process wood loses flexibility. This means that green wood is bendable, and in fact your tray could be made directly from a band cut from a freshly felled tree.

Dry wood can be soaked for bending. How long to soak it depends on water temperature.

Cold-water soaking takes hours; near-boiling water can do the job in 10 or 20 minutes.

Pick Your Tray Sizes

Serving trays are made in a range of sizes. I have given seven examples to choose from in the dimension chart below. You can make one or all seven, or a set of three, which for some reason seems to bespeak completeness. Let’s just say three look good on display. If I were to choose, the three would be the #7-#9-#11, or the #8-#9-#10. (The numbers assigned to the trays derive from the numbers commonly used for oval boxes, the trays being in many ways similar to the lid of one of the boxes.)

Making an Ellipse

Today many people prefer a computer and printer to make an ellipse. Yet for hundreds of years a string, two nails and a pencil served as the way to generate this shape. It still serves the shop well today. On the paper used for a pattern, or directly on the foam board used in construction, lay out the major and minor axis of the ellipse. Two positions along the major axis are found by swinging an arc with a compass, the center of which is the end of the minor axis, and its radius being half the major axis. (Did I lose you here? Just look at the drawings on page 68 for help.)

Next you will need a string tied in a loop, two small nails and a pencil. The two nails are driven into the points you marked on the major axis. The size of the loop is one that goes

Oval Tray Sizes

With this set of dimensions and the techniques outlined in the article, you can generate all your ellipses and the parts for any of the seven sizes.

OVAL NUMBER*	MAJOR & MINOR AXIS**	BAND SIZE†	LENGTH TO DOUBLE TACK LINE ‡	FINGER LENGTH ‡
#6	7 ⁵ / ₈ " x 11"	1/8" x 1 ¹ / ₈ " x 36"	2 ⁵ / ₈ "	2 ⁷ / ₁₆ "
#7	8 ³ / ₄ " x 12 ¹ / ₂ "	1/8" x 1 ³ / ₁₆ " x 40 ¹ / ₂ "	2 ¹³ / ₁₆ "	2 ⁹ / ₁₆ "
#8	9 ⁷ / ₈ " x 14 ¹ / ₄ "	1/8" x 1 ¹ / ₄ " x 45"	3"	2 ¹¹ / ₁₆ "
#9	11 ¹ / ₈ " x 16"	1/8" x 1 ⁵ / ₁₆ " x 51"	3 ³ / ₁₆ "	2 ¹³ / ₁₆ "
#10	12 ³ / ₈ " x 17 ³ / ₄ "	1/8" x 1 ³ / ₈ " x 56"	3 ³ / ₈ "	2 ⁷ / ₈ "
#11	13 ⁵ / ₈ " x 19 ³ / ₄ "	1/8" x 1 ³ / ₈ " x 61"	3 ⁹ / ₁₆ "	3"
#12	14 ¹⁵ / ₁₆ " x 21 ³ / ₄ "	1/8" x 1 ³ / ₈ " x 67"	3 ³ / ₄ "	3 ¹ / ₈ "

* Corresponds to the number in a nest of oval boxes sizes.

** The string and two nails method can be used to generate the ellipse for each size.

† Cut band stock on table saw from any straight-grained wood (hardwoods provide better strength and bending qualities than softwoods).

‡ The characteristic finger pattern of Shaker bent-wood projects is achieved by knowing where to locate the copper tacks and the length of the curved sides of the finger.

from a nail at the far end to the opposite end of the major axis. The string itself should not stretch, and be similar in size to the carpenter's chalkline. Then, holding the pencil inside the loop so the loop is held taut throughout the drawing, inscribe an ellipse that will touch the end points of the two axes.

Materials for Your Tray

The form, or core, used for making the tray is 1" foam board used in home construction. It is called polystyrene rigid foam board and comes in a variety of thicknesses from 1/2" to 3". The 1" thickness is just right for bending and drying your tray band. In fact, it is just right for the string and nail method of making an ellipse. Once you have drawn the ellipse, it can be cut out using a band saw, scroll saw or jigsaw, and sanded up to the pencil line using sandpaper on a wood block. (Note: while the actual size of your ellipse can vary, the band lengths given in the table presume that they

will be within $\pm 1/8$ " of the major and minor dimensions given.)

The tray bands are cut on a table saw using a zero-clearance insert to eliminate the gap between the blade and the table. This is made of wood about 1/4" thick and the shape of your metal insert. Clamp the insert to the table saw. Turn on the motor, raise the blade into the wood insert and, presto, you have a zero-clearance adapter.

The woods for tray bands are most often maple, cherry or walnut, but most any straight-grained wood will work. If necessary, softwood can be used. As long as the wood grain is straight, tray bands 1/8" thick and 1 3/8" wide can be cut on the table saw to provide bending stock.

Preparing the Band for Soaking

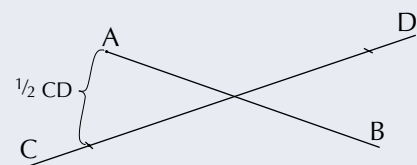
The finger-shaped end is characteristic of Shaker boxes. It is not only assumed as part of the icon associated with Shaker work, it

is functional. The narrow point is where the final copper tack will hold down the band, and it is the point your finger holds down while tacking the line of tacks. The shape is curved on both sides back from the tip and along the prescribed length (see chart on page 67), with the edges slightly beveled.

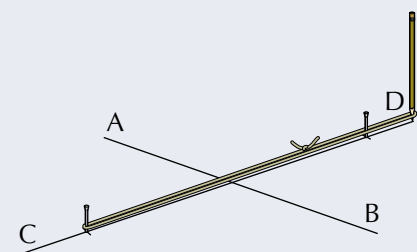
Follow the pattern for the finger end of the band that also gives the shape and the location of the 1/16" pilot holes for copper tacks. Cut the profile on a band saw or scroll saw, with the final shape trimmed with a knife. Wetting the finger end in water for a minute or two will ease the knife trimming.

Beginners often make beveled edges 45° or more, but bevels should be a slight 10°. This bevel is trimmed at the finger's end as well. The band is also thinned slightly at the finger ending. I want to underscore "slightly" here to be sure you know that this is not the feathering treatment given to the other end of the band. The amount is no more than half

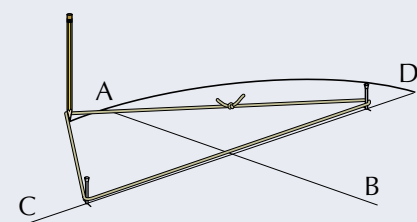
Drawing an Ellipse



- 1** *A-B = Minor axis. C-D = Major axis. Locate point for nails from A being 1/2 CD.*



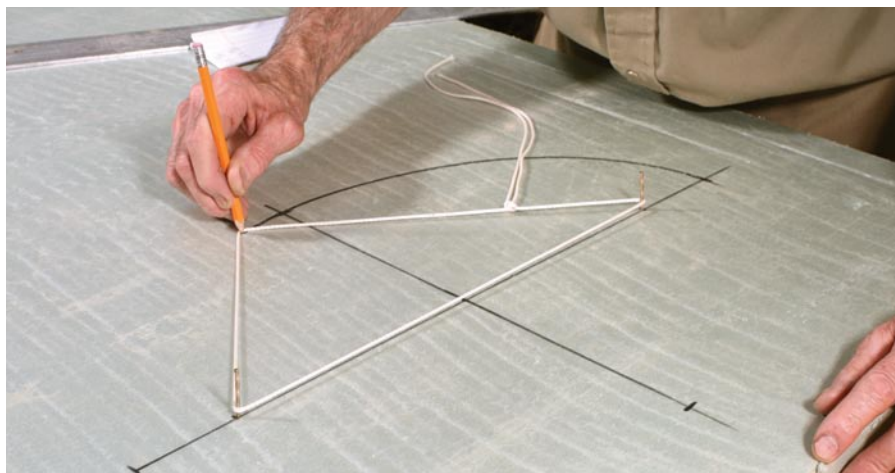
- 2** *Drive nails (2) where 1/2 CD intersects major axis. Tie off string so pencil is at end of major axis – use non-stretching string.*



- 3** *Swing oval with pencil inside string to complete your ellipse.*



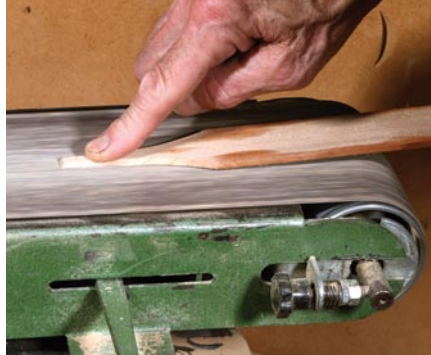
Push stick at the ready. Cut 1/8" tray bands from a straight-grained strip of wood 1 3/8" wide. The use of a zero-clearance table saw insert prevents the thin band from dropping below the table level. Keep push sticks handy!



String and nail. Trace an ellipse directly on 1" polystyrene rigid foam board used in home construction. This form will be used both for bending and holding the wet band until its dry.



All trim. After cutting the profile of the finger and drilling $\frac{1}{16}$ " holes for tacks, the edges are trimmed with a sharp knife.



Gently now. The tip is slightly sanded to help it be flexible. Only sand the last $1\frac{1}{2}$ " of length, and taper only half the thickness at the end. Be careful to leave $\frac{1}{16}$ " thickness.



Feathered. The inside square end is feathered to give a smooth inside curve to the tray. Here the sanding tapers back $2\frac{1}{2}$ " to 3" and removes thickness to almost nothing at the end.

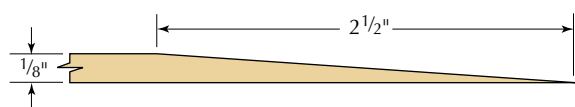
the thickness at the tip, and goes back no more than to the middle tack hole.

This accomplishes two things: The finger end wraps more easily and tacks tightly to the band, and the end looks a touch more graceful and not so chunky. Small things to be sure, but quality lies in the details. But please, don't overdo the amount of sanding.

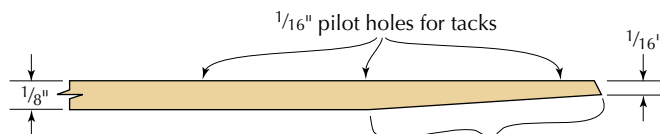
The band ends need preparation before going into the hot water for soaking. The end on the inside of the tray is feathered back a distance of $2\frac{1}{2}$ " to provide a blended ending. This can be done with a block plane or a belt sander. In either case, feathering is a straight ramp ending with just the touch of thickness at the end to prevent it from being ragged.

Bending and Tacking

The finished band needs its double tack line centered on the minor axis of the ellipse. To find where to start the bending, place a mark on the core that's to the right of the minor axis line and is the same length as the finger. This is the starting mark when bending. With this mark, you are ready to soak your band for 10



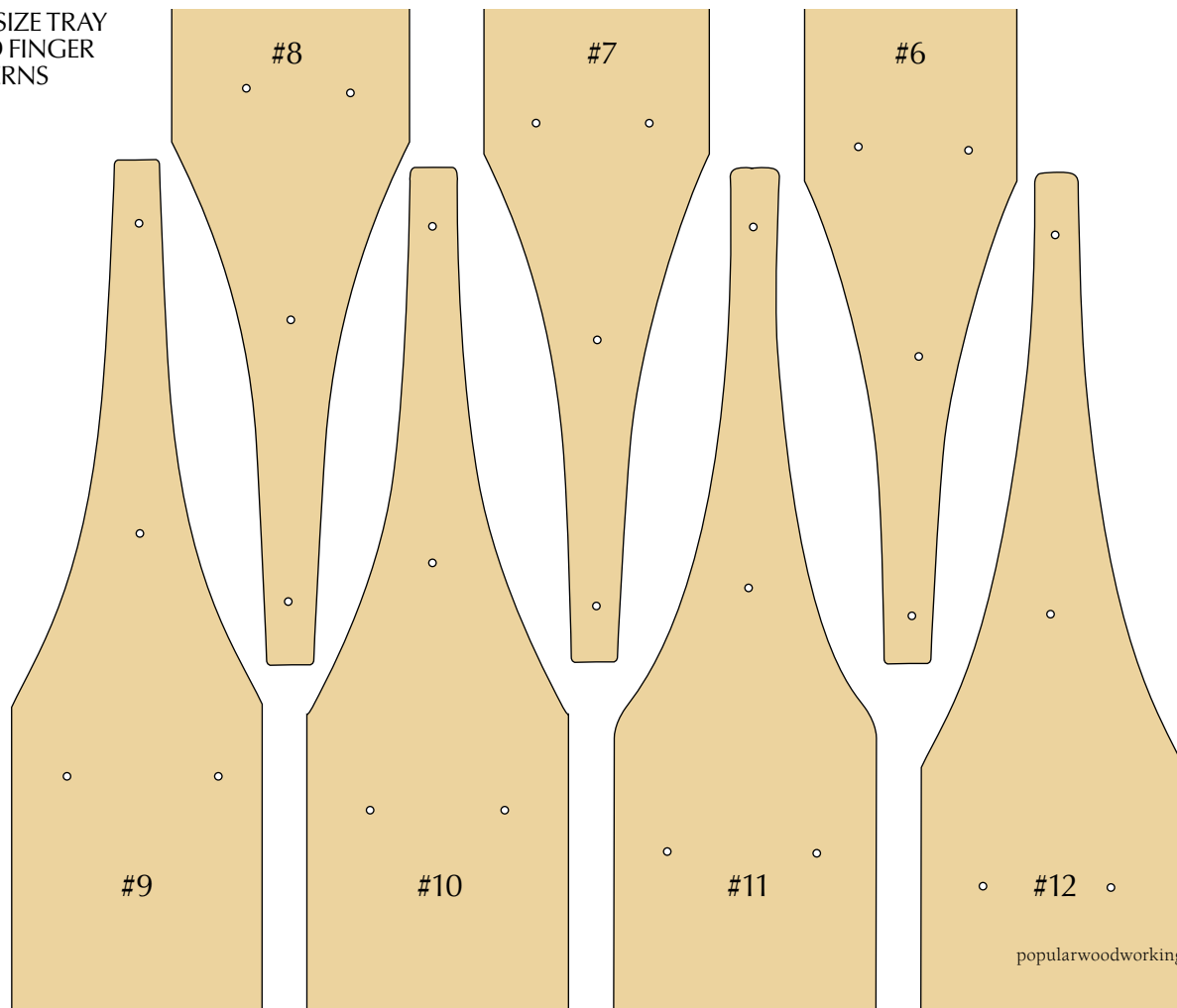
FEATHERED END OF BAND



FINGER END OF BAND

Sand slightly

FULL-SIZE TRAY BAND FINGER PATTERNS





A nice hot bath.
Bands need to soak to make them flexible for bending. Hot water is heated in a 6' length of rain gutter. A hot plate provides the heat. Wood blocks under each end give stability to the long tray.

to 20 minutes in hot water above 180° F.

You have several options for a soaking tray. With the bands long and narrow, a length of eaves trough (a gutter) works well. The end caps on eaves trough are secured with pop rivets and goop in a tube called gutter sealer. Regular construction adhesive would probably work as well, if that's what you have on hand. Any of these will resist the hot water. I have also used a length of PVC pipe with an end cap cemented on. Boiling water can be poured in, or straight tap water used if you wait hours to allow for sufficient limberness to happen. With the indulgence of other members of the household, you can also soak bands in the bath tub.

When it's soaked, wrap the band around the foam core, observing the start mark and ending with the main tack line centered. As soon as you have it tightly wrapped, make a pencil mark across the lap to record the circumference. Remove the core by opening the band slightly, then return to the lap mark.

What comes next is the tacking of the lap and the use of the foam core as a drying form. The economy of construction is seen here again in the use of the ellipse foam board for drying as well as bending. To be a good snug drying form, you should slightly reduce the size of your bent band. So, before tacking the lap, go past your lap mark by $\frac{1}{8}$ ".

The lap is secured with #2½ copper tacks. These tacks go into $\frac{1}{16}$ " pilot holes drilled in the finger layout and are clinched through the lapped band. They hit a steel pipe anvil, which J-hooks the tip on the inside for a very tight hold that belies the appearance of these tiny tacks. As soon as the band is tacked, return the band to the foam core to dry overnight. There will be some shrinkage in the band

that would be a problem if a solid-wood core were used, and by problem I mean locking up permanently on the wood form! The beauty of the foam board is its flexibility, making it able to pop out when dry.

Fitting the Bottom Board

The second stage in tray construction is fitting a bottom board. In picking a suitable material, consider the fact that there is no room within the oval tray band for seasonal expansion and contraction. Therefore some kind of plywood will be used because of its stability. For this project I have used five-ply 6mm birch plywood, which sometimes is referred to as Baltic birch after the region from which it comes.

A no-nonsense, work-every-time method for fitting the bottom board is this. (1) Decide which direction you want the finger to point (normally right) and lay the band on your plywood. (2) Use a mechanical pencil for accuracy

and trace the inside of the band. (3) Cut out the oval, staying just outside the line. (4) Sand the edges of the board with a 2° bevel on your disc sander and leave half a pencil mark showing all around. (5) If you miss step four and go too far, wipe yellow glue into the crack and sand immediately to deposit sanding dust on the wet glue line. It's a perfect fit every time, and a means of making it even if you are still learning your edge-sanding technique!

Wood Pegs Hold the Bottom

With the oval board fit, the edge of the band needs to be sanded flush with the bottom. When this is done, $\frac{5}{64}$ " holes are drilled $\frac{1}{2}$ " deep around the perimeter. Space them 2" to 3" apart. Wood pegs are made by cutting toothpicks in half. You can cut a whole box at once before this step, but be careful to hold the box securely together so the band saw will not scatter the pegs. No glue is needed for this



Wrap it up. The 1" foam core is used as a bending form. The start mark is found by marking the length of the finger pattern for each size tray on the foam core as you can see. When the wrap is done, the main tack line will fall on the centerline.



Mark it. Record your tight wrap by a pencil mark. Remove the band from the foam core, and use this mark as a reference for sizing the tray. By going $\frac{1}{8}$ " past the mark when tacking, the resulting size will fit snugly back on the form.

(or any other steps in the project) if you tap the peg securely in the hole. A diagonal cutter is just right for tapping and snipping pegs. Sand the pegs flush and you are done.

Finishing

Finishing is up to you. Milk paint or flat latex paint will provide a traditional look. Sand the

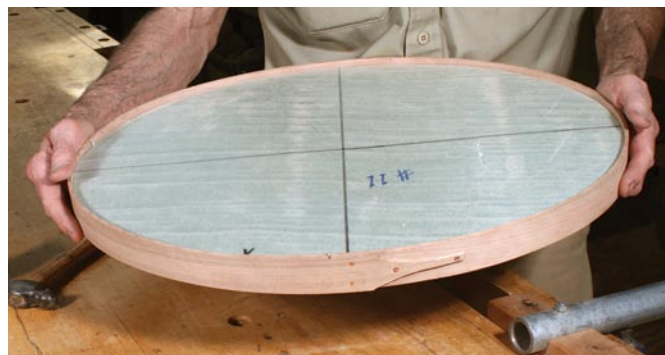
copper tack heads bright and lightly sand the edges of the fingers to accent their shape (if you paint). Then apply a coat of dark furniture wax to give an aged patina to your paint. My standard finish is a clear coat of polyurethane varnish. The cherry bands contrast nicely with the birch bottom so I leave them unstained. No matter what finish you choose, everyone

will be delighted with the effect of serving food and drinks on an oval tray. **PW**

John runs The Home Shop in Charlotte, Mich., which supplies wood, copper tacks and other critical supplies for the Shaker oval boxmaker. He also offers classes on a wide variety of woodworking topics, including a new class on making these Shaker-style trays, on Jan. 17, 2009. Contact him at shakerovalbox.com or 517-543-5325.



No glue needed. Small copper tacks are used to secure the lap. No glue is necessary; the tacks clinch to the underside as they hit the pipe anvil. You will appreciate the slightly thinned end that makes tacking easier.



Back again. Return the tacked band to the foam core for drying. Normal drying time is 24 hours. In a pinch you can shorten this to an hour or two with help holding the ellipse when tracing the bottom board, since wood not fully dry doesn't hold its new shape well.



Accuracy is key. Use a mechanical pencil for achieving an accurate line. Be sure to hold the band in contact with the plywood all the way around. The "helping hand" here is a piece of iron anvil.



Scrap jig. Sand up to the pencil line after sawing the ellipse. The edge is slightly beveled, about 2°, to give a tight fit. Raise the disc sanding table to achieve this. If your sander stops at 0°, you can tape a scrap of 1/8" band stock to the outside edge of your disc table.



Peg holes. Drill holes every 2" to 3" around the edge of the tray for wood pegs. Here a 1/16" x 1/2" wood shim is taped to the edge of the bench to guide the 5/64" drill bit, which is extended 1" from the chuck.



Cut to fit. A diagonal cutter serves to tap the wood pegs securely into the 1/2"-deep holes. Then snip the surplus length.



These once-standard tools have a place in the modern shop.

Drawknives

When the last grains of sand run through my hourglass, I know how I want to check out. I want to drop on the shop floor in the middle of a project. The mortician will have to pry my woodworking machines out of the cold dead fingers of my left hand. He will then have to pry my hand tools out of the cold dead fingers of my right. The last two tools he will wrest from my grasp will be my drawknife and my wooden spokeshave. I am so dependent on these two tools, that I am sure when that final moment comes, they will be in my hands.

Early records show that a drawknife and a spokeshave were in every woodworker's kit. In fact, these guys often owned more than one. Why? These are two of woodworking's most useful tools. Today's woodworkers will benefit as much from them as did the old guys. I am writing about the two tools together because that is how they are often used – together.

As its name implies, the drawknife is a knife that is used on the pull stroke. Using two hands provides a lot more control. Pull-

ing with arm, shoulder, back and leg muscles places a great deal of force behind the blade. An experienced user can slice a shaving as thick as his thumb, or cut one as fine as a human hair. This means a drawknife can accomplish quick stock removal, fine work and everything in between.

Old Tools Abound

The problem for today's woodworker is to find a good drawknife. Those sold in stores and catalogs will not generally work. The reason is simple. The tool is supposed to be a knife, but toolmakers insist on grinding their drawknives like a chisel. A 45° bevel won't work any better on a drawknife than it would on a pocketknife.

Happily, our predecessors bought scads of drawknives back when toolmakers still knew what they were doing, and many of them are still around. You should have no trouble finding a good knife on eBay or from old-tool dealer web sites. Look for one with tight handles, that has not been beat, or ground down to

nothing. Drawknives were made with cutting edges more than a foot long or as short as 4". An 8" to 10" knife is the right size for most work.

Get a Grip on your Drawknife

When choosing a knife, don't be tempted by the ones with folding handles. They look nice, but leave them for the collectors. The extra length created by the hinge places the handle too far away from the edge. You sacrifice control. Drop handles cause a similar problem. They lower your hands out of the plane of the cut, sacrificing power.

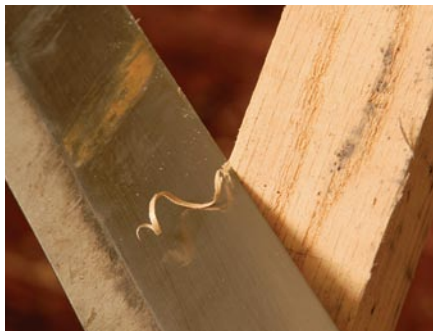
A drawknife's handles are misleading. They suggest that you hold a drawknife like you did the handle bars on your tricycle. In fact, how

Traditional tools. Drawknives and spokeshaves used to be standard in any toolbox – often in multiple sizes. And they're still useful today. As the name implies, the drawknife (pictured above) is used on the pull stroke. A spokeshave (shown at right) is usually pushed, but on straight-grained wood can be pulled.

you hold a knife is a function of the work, and a straight grip on the handles is only one of many possibilities. A drawknife is frequently used on end grain. Then, you have to choke up on the control handle (the right hand if you are right handed). Sometimes I hold the blade vertical, then my right hand holds the handle with an overhand grip. The important point is to not get locked into a misperception and be limited by it.

I tell students that a drawknife is a slicing tool, not a two-handled hatchet. This means you do not use it by hacking. My analogy is a butcher cutting meat. He starts close to the handle and makes a slicing stroke that ends with the point of the blade. The result is a clean, easy cut. So too with a drawknife. Start the cut close to your control hand. Lift the blade ever so slightly to create some clearance behind the cutting edge and to engage it. As you pull the knife, make a slicing cut that ends up at the far end of the blade. The closer you are to end grain, the shorter the radius of the slicing arc.

Besides an easy, glassy smooth cut, using the knife this way has other benefits. By slic-



A versatile tool. Taking a hair's breadth off a workpiece is quick work for a drawknife – as is heavy stock removal, and anything in between.

ing, you distribute the cutting action along the entire cutting edge, and it will stay sharp longer. Pulling directly toward yourself, or hacking as with a hatchet, places the wear all in one spot on the blade. This area becomes dull faster, and you will eventually develop a hollow in the cutting edge.

Once you understand how a drawknife cuts, you will understand the flaw behind a common misconception. Some woodworkers hold the knife upside down. This position – with the bezel down – changes the cutting



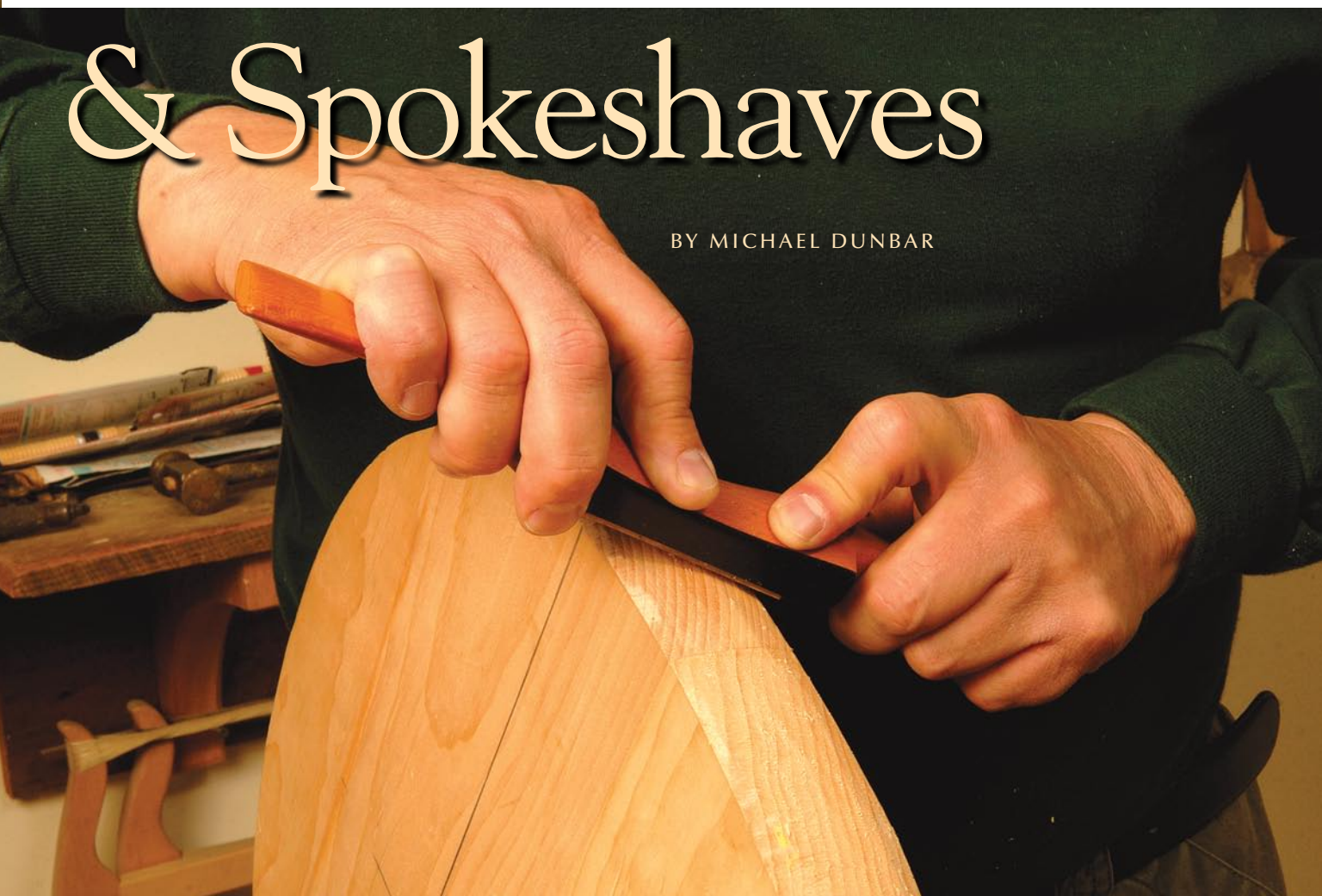
Bad grind. The modern drawknife on top in the picture above is ground with a chisel edge, which severely limits its usefulness. Look for one with a knife edge (they're easy to find on eBay and on old-tool web sites).

action. You have created a high-angle cut that will not slice. To better understand, imagine paring with a chisel. You place the bezel up, raise the handle slightly to create clearance, and cut with a slicing action. Consider what kind of cut you will get if you try to pare with the bezel down, and how much control you will have in this position.

The guys who use a drawknife this way argue they have more control. They mistake

& Spokeshaves

BY MICHAEL DUNBAR





Get a grip. There are many different ways to grip a drawknife, depending on your goal. How you hold the knife is a function of your work.

a limited cut for control. In accepting the limited cut they sacrifice the drawknife's most important feature: its ability to remove wood fast. Furthermore, the higher cutting angle will not cut as cleanly and it creates more friction, which dulls the edge faster. I liken using a drawknife upside down to training wheels on a bike. If you only know how to ride with training wheels, you mistake them for control because you don't fall. Better to take a few spills and learn how to really ride. Then, you truly have control.

Sharpening

A drawknife will eventually need to be sharpened. In fact, if you buy an old one, it will need some work before you can use it. Never grind a knife-edge tool. I sharpen my knives with sandpaper adhered to a wooden block. A drawknife edge is a special case, in that it is only one half a knife. The bottom of the blade is flat, as on a chisel-edge tool. That is where I begin. Hold the block, or the stone, flat on the surface and work back and forth. Be very careful not to raise the block, as this will round the edge, aggravating the very condition you are trying to correct.

Next, work the bezel, or upper surface of the edge. This surface is curved like your pocket knife. If you work only the cutting edge, you will gradually increase the angle and reduce the tool's ability to slice easily and cleanly. So while honing this surface, be sure to gradually lower the block so you are dressing the entire curve, rather than just the edge. In other words, do not just sharpen the blade. You also have to maintain the curve's original shape.

Work the lower surface and the upper curve through several grits. It is not neces-



Unclean cut. If you hold the knife upside down, the angle of the blade is higher and you're likely to get a crumply shaving and rough surface.



Flat bottom. Although the blade should be ground with a knife edge, the back of the drawknife should be flat, like a chisel.



Dress all surfaces. Make sure you dress the entire curve on the front of the blade to maintain its original shape. Don't just dress the edge, or the angle will gradually increase.

sary to create an edge as sharp as on a chisel or plane blade, but it causes no harm.

A word of safety about drawknives: The tool has an open, unprotected cutting edge. I hang mine on a wall. This protects the tool and me. If you store the tool in a drawer or tool box, wrap or cover the edge. Otherwise, it can give you a real nasty bite when you reach in for the tool.

Spokeshave

The spokeshave usually cleans up after the drawknife and brings your work down to the line. The tool will create a finished surface, or one that requires only a light sanding. The difference in the two tools is that while the drawknife can also make fine cuts, the spokeshave cannot do heavy jobs. It is a lightweight tool intended for fine work.

When I use the term "spokeshave" I am referring to the type with a wooden body. While the metal-bodied version has the same name, it works in a very different way, and



Material difference. The difference is more than material between a wood-bodied and metal-bodied spokeshave. Notice the difference in cutting angles – when assembled, the wooden body’s blade is close to parallel with the sole.

nowhere near as well. Take a minute to look at the two tools. The wooden shave’s cutter is close to parallel with the sole and the bezel is placed up. It is the same configuration as the drawknife. The metal version’s cutter is bedded at 45°, with its bezel down, in the same configuration as a plane and a drawknife used upside down. The wooden version’s cutting angle is much lower, making it a true shave. This lower cutting angle is the reason the tool works so well on end grain, and cuts so effortlessly with the grain.

While you may have to hunt to find a good drawknife, wooden-bodied spokeshaves are readily available. They are not mass produced and do not show up in catalogs. Rather, they are made by individual tool makers, and have to be purchased from their web sites. Most of these shaves are as good as any shaves made in the past. My shaves were all made by Dave Wachnicki of Dave’s Shaves.

There is another advantage in dealing with these individual makers. In the past, common-grade shaves were made of beech. Best grade were boxwood. Neither is a particularly pretty wood. Today’s shave makers work with highly figured woods, and their shaves can be spectacular. If you own a small piece of really special wood, they are happy to make it into a shave for you.

Materials Matter

Some catalogs sell low-angled shaves with metal bodies. I do not like these. Chatter is a spokeshave user’s biggest problem. A wooden body absorbs shock better than metal and reduces the tendency to chatter. I prefer to stick with wood.

Like drawknives, shaves were once part of every woodworker’s kit. Having a wooden body and a lightweight cutter, fewer of them have survived. Of those that have, a large percentage are worn out. Because shaves wear quickly, I strongly recommend you not use an old shave. Put it on display as an artifact, but spare it. You’ll be real happy with a new one.

While you can manage very well with just one drawknife, you will find that the more familiar you become with wooden shaves, the more of them you will want to own. I have about a dozen. It is more efficient to dedicate a shave for a certain job. The more jobs, the more shaves.

Spokeshave Setup

Unlike a drawknife, you have to set up a spokeshave. Most of today’s shaves have a top adjustment, which allows you to set the tool without removing the cutter. Adjustment is usually made by turning a small Allen screw. If not, you will have to examine the tool to see how it is adjusted. The trick in setup is to cock the blade so it is higher on one side than the other. In this configuration, you have every setting you need. When you want to take a very light cut, move to the shallow side of the blade. To

make a deep cut, move to the deep end. Much of your work will be done with the medium setting in the middle.

The drawknife is designed to be pulled. A spokeshave can be pushed or pulled, depending on the job. However, 90 percent of the time, the tool is pushed. The only time it can be effectively pulled is when whittling very straight-grained wood. An example would be Windsor chair spindles.

A shave is a very lightweight tool. Unlike a much heavier bench plane, gravity is not giving you any assistance. You provide all the force needed to engage the cutting edge. Without sufficient pressure, the tool will either skate or chatter. When pulling a shave, the tool is controlled by your wrists, and any downward pressure is provided by your shoulders, way out at the far ends of your extended arms. This is sufficient when whittling, as little weight is required to engage the cutting edge.

However, most of the work you do with a shave is shaping, which involves cutting across grain. In this case, the muscles involved in pulling a shave are inadequate. When you push a shave, you can apply weight from your upper body down onto the tool. It is your weight that keeps the edge engaged and cutting.



Multiples. It’s hard to stop at just one spokeshave; multiples allow you to dedicate specific tools to specific jobs.



Tricky setup. Set the blade so that it’s a bit higher on one side; that way, by moving the tool left and right, you have every setting you need without changing the tool’s setup.



Proper stroke. A spokeshave is, 90 percent of the time, used on the push stroke. However, if you have a straight-grained workpiece such as a chair spindle, it can be pulled effectively.

Proper Handling

Like the drawknife, the spokeshave's body seems to suggest you grip it in your hands by the handles. In reality, you pinch a spokeshave in the center of its stock with your fingers. The only difference in your grip when whittling and shaping is the position of your thumb. When pushing, place the thumb of your control hand low on the stock, close to the cutter. Your thumb provides forward force behind the cutter, while your shoulders provide weight over it. The result is a clean cut with little or no chatter.

A spokeshave's low cutting angle can make it a challenge for the first-time user to engage the cutting edge. Use this trick: Lay the tool on the flat of its blade. Rock it forward until it is now resting on its cutting edge and the sole's front corner. That's the placement. You're ready to cut.



In a pinch. The handles suggest that one grip the shave by the handles. However, more control is gained by pinching it in the center.



Training. Set the shave flat on your work, then place your thumb in the curve to slightly increase the angle; that's the correct angle for use.



Cheap sharpening jig. A piece of sandpaper stuck on a small piece of wood is perfect for removing any rounding in the blade. But this is a time consuming method.

Like all other edge tools, a spokeshave works best when its cutter is slightly askew, rather than being worked straight on. When you work end grain, all the downward force you can muster still may not prevent chatter. Try increasing the amount of skew. If this doesn't work, try skewing the blade in the other direction. In woods with a pronounced difference in early and late wood, such as pine and oak, what appears as chatter may actually be washboarding. The edge cuts easily through the softer growth and rides up over the harder. Each pass makes the situation worse. When you skew the blade in the other direction you run the cutter across several layers of growth and the hard part of several annual rings is shaved along with the softer.

Sharpening

A spokeshave cutter is small, so it sharpens pretty readily. The problem is that being small, it's hard to hold. I start by lapping the flat bottom. Check the edge in good light to be sure



Hollow grind. Cutters with hollow-ground bottoms make sharpening fast – only two narrow strips of metal have to be dressed rather than the entire blade surface.

you have removed even the most microscopic rounding caused by wear. Now, hone the bezel. I use a piece of fine sandpaper adhered to a strip of wood about the size of a tongue depressor. The problem is to avoid changing the bezel angle with repeated honings.

This is a lot of work to do with a small strip of wood. I recently acquired a Work Sharp. This system has made the process a piece of cake. It quickly flattens the cutter and dresses the bezel. I repeat the procedure through several papers and my shave will cut translucent end-grain shavings.

I have refitted most of my shaves with hollow ground cutters from Woodjoy Tools. These cutters have a hollow bottom that speeds up sharpening even more. I only have to flatten two narrow strips of steel, rather than the entire surface. **PW**

A chairmaker since 1971, Mike is the founder of The Windsor Institute in Hampton, N.H. For information on the school, and to read Mike's blog, visit thewindsorinstitute.com.



Work Sharp. A more expensive – but easier-to-handle – blade sharpening method is the Work Sharp.

Shop-made Mortise Jig

You don't need fancy tools or a special machine to create a traditional joint.

Reproduction furniture is my main focus in woodworking, so I think one of the most important construction joints is a mortise-and-tenon joint – and not simply the use of a stub tenon, but a full-blown tenon that ranges between 1" and 1 1/4" in length depending on the project and if there's adequate depth in the material.

Due to the number of these joints I make, I have a dedicated mortising machine. But if you need to create a mortise and tenon and you don't have a dedicated machine to use, whip up this simple jig from a few scraps of wood and use a plunge router, a properly sized guide bushing and an upcut-spiral router bit. (You can use a straight router bit, but an upcut bit lifts waste material out of the mortise, so it makes a cleaner cut.)

Make a Slot for a Guide Bushing

The first step in building this jig is to create a slot in a piece of 1/2" plywood to guide the bit's location as you plunge into the workpiece – plywood's stability makes it a better choice. Don't create a slot that matches the router bit size; you need to match the slot to the guide bushing's outside diameter.

Select a bushing with a diameter that's larger than the router bit. For standard 3/4" material, I use a 3/4"-outside-diameter bushing for two reasons; this diameter is a standard drill bit size and the slot matches the thickness of the stock with which I'm working. When working with 3/4" material, select a plywood scrap that's about 3 3/4" wide and at least 12" long, then establish a centerline. Chuck a 3/4" drill bit into a drill press.

To determine the length needed for your specific mortise when using a 3/4"-outside-diameter bushing and a 1/4" router bit, add 1/2" to the finished length of your required mortise. The additional opening allows for



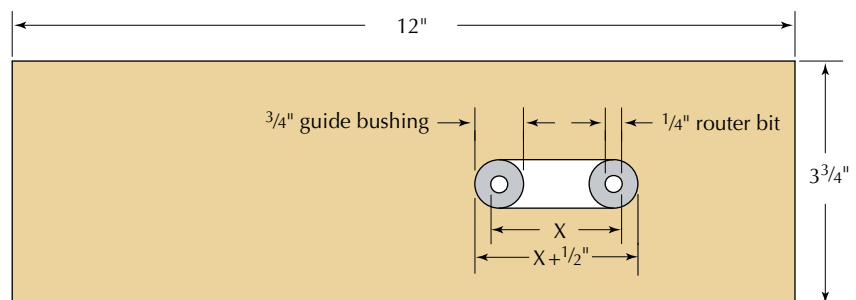
Job-specific tooling. A mortise-and-tenon joint is one of the strongest, most useful joints in woodworking. With scraps from the waste bin, you can create a jig that does the job and is simple to use.

the differences between the router bit and the guide bushing.

Next, lay out the final measurements on the centerline of the plywood. Position a fence so the center point of the drill bit aligns with the centerline on your plywood. Drill the two

end holes first, making sure to position the outside diameter of the bit's cut with the outside location of the layout.

Once the ends are established, remove the additional waste with your drill bit while keeping the workpiece tight to the fence. When



MORTISE JIG

finished, the slot has smooth sides. (You can touch up the sides with a rasp or file if you need to.)

Two Side Pieces Complete the Jig

For step two, position two additional scrap pieces on either face of the material to be mortised while holding one end of each piece flush with the end of the workpiece. Next, clamp the three pieces into a bench vise. These scraps or side pieces should be nearly as long as the slotted top piece of the jig.

The key to building this jig straight and centered is in the final step. Lay out the mortise on your workpiece; I find it best to do the layout work using the overall length of the slot, keeping in mind that my finished mortise will be $\frac{1}{2}$ " shorter. Position the plywood piece on the three pieces in your vise, align the slot with the layout lines at the top and bottom, and with the edges of the workpiece looking side to side. Once you've got the slotted piece properly positioned, add a couple clamps to hold everything in place.

Attach the slotted top to the two side pieces with #8 x $1\frac{1}{4}$ " screws – two screws per side. Counterbore the holes for the screws. This is not the time to split or crack the side pieces. Pull the assembly from your vise and remove the workpiece. The fit should be snug so it will take some muscle to remove the workpiece from the jig.



You choose the length. The overall length of your mortise is determined by the slot cut into the jig's top. Make sure to compensate for differences between the bushing and router bit.

Plunge a Mortise

Set up your router with the guide bushing and a $2\frac{1}{2}$ "-long router bit. You're now ready to work. A bit this long allows you to plunge a mortise just over $1\frac{1}{4}$ " in depth into the workpiece after passing the jig's $\frac{1}{2}$ "-plywood top.

Match the jig's opening to the layout lines on your workpiece and clamp the two together in a vise or with other clamps. Zero out the router bit by plunging down (with the power off and the router unplugged) until the bit touches the workpiece, then lock the plunge mechanism. Use the router's depth stop to set the plunge depth.

The base of the router sits securely on top of the jig and the bushing, which fits snugly in the

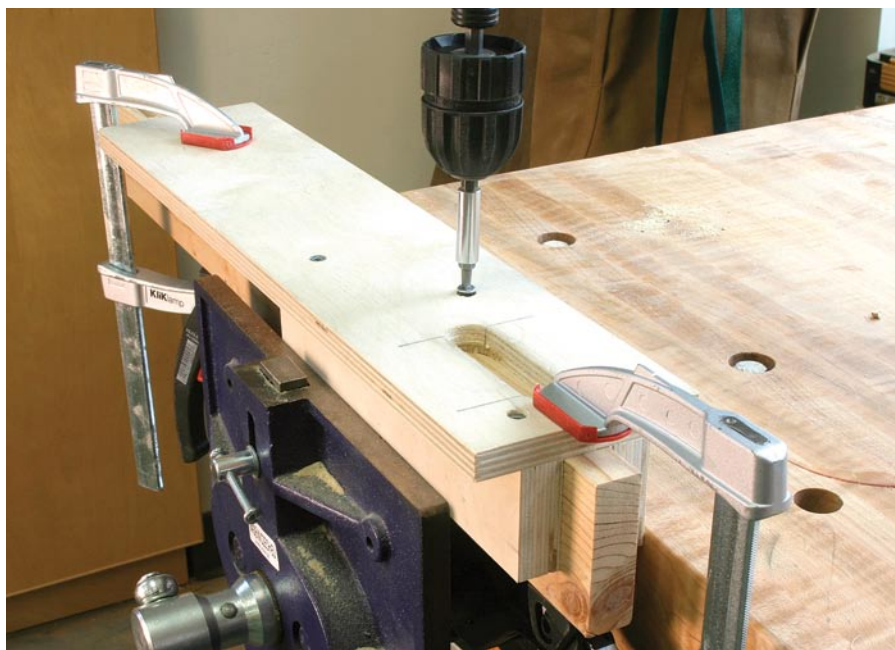
slot, adds to the overall stability. To create the mortise, release the locked plunge mechanism and pull the router setup tight to one of the ends. With the bit standing above the workpiece, start the router and hold tightly against the slot's end as you plunge to full depth.

Allow the router bit to retract from the hole, slide the router to the opposite end and plunge a second hole. To remove the material for the balance of the mortise, repeat the plunge action, each time positioning the router setup over an unexcavated area.

Once most of the waste is removed and no section remains that bridges the two sides of your mortise, return to one end of the slot, plunge to the bottom of the mortise and make a pass along the entire length to clean and straighten the sides. Make it a point to travel the length while holding the bushing firm to one side, then make a return pass holding tight to the opposite side. The result might be slightly wider than the $\frac{1}{4}$ " router bit, but because you make the mortise section of the joint first then match the tenon, this won't be an issue.

This jig is easy to build and can be used repeatedly with consistent results. The only decision you'll need to make is should you round your tenons to match the mortise, square the mortise ends to match the tenons or create tenons with wiggle room – not snug to the mortise's rounded ends. I always opt for wiggle room. **PW**

Glen is a senior editor of this magazine, a published author and the host of the Woodworker's Edge DVD series. Contact him at 531-513-2690 x11293 or glen.huey@fwpubs.com.



Everything held securely. Once the parts of the jig are positioned around the piece to be mortised, add screws through the top to complete the jig.



Two finishing passes. Once the plunging cuts are completed, finish the mortise with a pass along both faces of the slot. This last step smooths and cleans the slot.

How to Brush a Finish

Putting some sense back into a simple task.

For most people, the first experience brushing comes with oil or latex paint, or with alkyd or polyurethane varnish. Each of these coatings is relatively easy to brush.

Paint is easy because it doesn't have to go on perfectly; brush marks and other minor flaws are expected and accepted. Varnishes are easy because they dry slowly, so there's plenty of time to spread them out evenly and get the brush strokes lined up with the grain.

Polyurethane varnish is the finish most widely brushed by amateur woodworkers, and it is the finish that is almost always used in instructions on how to brush. (See "The 7 Myths of Polyurethane" in the finishing section at popularwoodworking.com.) There are countless articles, several videos and even segments of television ads that describe or demonstrate how to brush varnish.

For a reason I don't understand, almost all of these instructions suggest or show brushing slowly, several at the incredibly slow speed of eight seconds per foot. (Try it; I'll bet you can't brush this slow the first time).

There was even a recent TV ad from a major finish supplier that showed brushing the entire width of a tabletop only 1' in from the end of



Brush differences. Brushes differ in their ability to keep their bristles from falling out, in the amount of finish they can carry and in their comfort. More expensive brushes, such as the oxhair brush (top), don't reduce brush marks noticeably over the very cheap chip brush (middle), or the foam brush (bottom). The finishes themselves differ in how well they flatten out.

the boards (to be followed presumably by the next foot, which would leave a distinct overlap) instead of using long strokes running the length of the top.

Though this method is counterintuitive, and most people will figure out very quickly that it produces unacceptable results, the authority presented by TV and a brand-name company can't help but lead some people astray. (For example, a senior salesman from a major paintbrush manufacturer came to my shop once and used this method while we were trying out different brushes.)

Though it's also somewhat counterintuitive, many instructions suggest brushing across the grain, or diagonal to it, before lining up the brush strokes with the grain. Other instructions caution against shaking the finish, or even stirring it, because this will introduce air bubbles.

Brushing is very simple, actually intuitively simple. It shouldn't require a magazine article like this one to put common sense back into the process.

The Basic Rule

The most critical rule for achieving good results, and the rule you almost never see, is to watch what you're doing in a reflected light. This rule holds for spraying just as it does for brushing.

You can see what's happening in a reflection, and you can't see if there isn't one. As long as you see a problem as it occurs (usually a run, sag, drip or bubbles), it is usually easy to fix simply by brushing back over the surface.

Bristles or other trash that may have fallen into the finish are also easy to spot in a reflected light, and they're easy to remove with the tip of the brush or a small tool such as a toothpick.



Reflected light. When there's no light reflected in the surface (left), you can't see problems as they develop. Move your head to pick up a reflection from some light source so you can see what's happening—for example, the runs and sags in this finish (right). Once you see a problem, it's usually easy to fix, most often by brushing back over the surface.

The damage done to the finish can then be repaired by brushing back over.

The Procedure

No matter which finish you're using, the procedure for brushing is the same. The only difference is you have less time with faster-drying finishes, such as shellac and water-based finish.

On any given object, begin by brushing the least important parts first. This way, any overlapping will occur on less-seen parts. Tabletops, chair seats and backs, and cabinet doors should be brushed last.

Be especially careful of runs and sags on vertical surfaces. Watch the surface in a reflected light as you brush, and brush the finish back out flat if it begins to sag. If you've applied too much finish to get it to hold to the surface, use your brush to transfer some of the finish to another part or remove the excess finish by dragging the brush bristles over the lip of a can or jar.

It doesn't make any difference in which direction you brush—with the grain or across it. Brushing across the grain doesn't help the finish get into the pores; it soaks in quite well by capillary action.

Whichever direction you brush to begin with, however, be sure to brush back over and line up the brush strokes with the grain if possible. It will help disguise the brush marks and knock off most of the bubbles, if there are any.

Lining up brush strokes may not be possible on turnings and other irregular surfaces. But light doesn't reflect evenly off these surfaces, so brush marks don't stand out anyway.

Flat horizontal surfaces are the most critical because people will see flaws easily in reflected light. To brush a large, flat surface such as a tabletop, lift your loaded brush out of the finish container (the original can, or a glass, metal or plastic container into which you've poured some of the finish) and deposit the finish onto the center of the area you intend to brush.

Then stretch the finish out side to side all the way to both ends. If there's not enough to reach both ends, add some finish from the container. You'll quickly get the feel for how much finish, or how many brush loads, you need to deposit to make it to both ends.

There's no reason to drag your brush over the edge of the container or tap the brush

against the inside unless you want to reduce the amount of finish you're transferring or you want to reduce the chance of finish dripping off the brush. Removing a part of the finish from the brush just slows you down on large surfaces. (You can even pour some of the finish onto the surface, then spread the puddle from end to end to really speed things up.)

Don't worry about creating bubbles. There's no way to avoid them because they're mostly caused by the turbulence created by the brush movement (the same as underwater bubbles created by the turbulence from a propeller), not by shaking or stirring.

Bubbles in a wet finish film aren't a problem anyway as long as they pop out before the finish dries. Most will pop out as you line up the brush strokes end to end.

To line up the strokes, bring your brush down onto the surface near one end in an airplane-landing motion and move the brush quickly across and off the other end. Brush back and forth across the surface in this manner in a width no larger than you can manage before the finish begins to set up.

You can work on a much wider area with varnish than with shellac or water-based finish.

If you drag your brush over an edge as you land it on the surface, quickly spread out the runs and drips, or wipe them off with a clean cloth.

With one section covered and the brush strokes lined up, deposit some more finish in the center of the next section and begin stretching out the finish end to end. Work this newly applied finish back into the previously



Depositing finish.

Unless you have a reason to remove some of the finish from your brush, there's no point in dragging it over the lip of the container or tapping it against the sides. The most efficient method of transferring finish to a large surface is simply to deposit a brush load onto the work.



Stretching finish.

Once you have some finish transferred to the work, stretch it end to end. If you need more finish to reach the ends, add more. It's best to pour some finish into another container from the original, so if you should introduce some dirt you won't have contaminated your entire supply.



Sand between coats.

No matter which finish you're brushing, it's almost always best to sand between coats to remove dust nibs. In most cases #320- or #400-grit sandpaper works well.

applied finish before it begins to set up.

Once a finish stiffens, brushing over it will drag it and leave severe brush marks. Here's where working fast is critical when using faster drying finishes. Working fast enough so previous strokes are still wet is called "keeping a wet edge."

Continue working across the surface, being careful not to drip on the finish you've just applied. To avoid doing this, hold or place the container of finish so you aren't swinging the brush over finished areas.

You can work from the near side to the far, or the far to the near. It doesn't make any difference.

It's almost always wise to sand between coats to remove dust nibs and other minor

problems. Unless they are severe, use stearted #320-grit sandpaper or #400-grit Norton 3X or 3M Sandblaster sandpaper. These sandpapers are widely available at home centers and paint stores.

Brushes and Brush Marks

Cheap brushes are often blamed for brush marks, so most instructions encourage you to spend more and buy a better quality brush.

I've tried dozens of times over the last 20 years to confirm that it's the quality of the brush that is responsible for the severity of brush marks, and I've never succeeded. It always comes down to the product itself being responsible. Some brands of varnish or water-based finish lay down level better than others.

In an effort to learn more about brushes and their possible role in causing brush marks, I once visited a large paintbrush manufacturer. The marketing director, plant manager and the technicians who designed the brushes all told me they didn't know how to make a brush that wouldn't leave brush marks.

They designed brushes to hold more paint or finish and to release it more evenly over the longest distance (both critical for painting large surfaces).

This confirmed what all my trials had told me. More expensive brushes feel better to use, shed bristles less and usually hold more finish. But expensive brushes don't reduce brush marks.

Neither do foam brushes, for that matter. There's no reason you can't substitute a cheap, disposable foam brush for an expensive bristle brush if brush marks are your only concern.

Choosing a Brush

I find bristle brushes much more enjoyable to use, however, and choosing one is pretty easy. It comes down to paying enough to get a brush that doesn't shed bristles (about \$6 to \$8 for a 2"-wide brush).

Keep in mind that natural ("China") bristles lose their spring in water, so you should choose a synthetic (nylon or polyester) brush if you are brushing a water-based finish. Either type of brush can be used with varnish and shellac.

Cleaning Brushes

If you brush finishes every day, you can wrap your brush in plastic wrap or hang it overnight in the thinner for the finish. Otherwise, you should clean your brush if it is of good quality.

Clean water-based finish in the same manner as latex paint. Hold the brush under a faucet for a minute or two while spreading and massaging the bristles with your fingers. Then wash the bristles thoroughly with soap and water until you get suds.

Dishwater detergent is usually handy and is perfectly adequate.

Clean shellac by scrunching the bristles against the bottom of a jar that contains a couple inches of a mixture of about one-third household ammonia and two-thirds hot water. Then wash with soap and water.

Cleaning shellac with ammonia and water is much faster and more effective than cleaning with alcohol.

Clean alkyd or polyurethane varnish by first rinsing (scrunching) the brush in several inches of mineral spirits (paint thinner). Do this once and then at least one more time in clean mineral spirits.

Then rinse the brush in lacquer thinner or "brush cleaner." You can use either of these for all the rinsings, but they are more expensive. Then wash in soap and water, usually two or three times until you get suds.

The purpose of the lacquer thinner or brush cleaner is to remove the oily mineral spirits so it takes fewer washings to get suds.

Finally, with the brush clean, return it to the holder it came in or wrap it in paper. This will ensure the bristles dry out straight and stay clean. You can use masking tape or a rubber band to hold the wrapping closed. **PW**



Storing brushes. If you are using a brush almost every day, you can store it by hanging the brush in the solvent for the finish or by wrapping the brush in plastic wrap. Notice the holes in the brush handle for suspending it in different-sized jars. You shouldn't let the bristles rest on the bottom for any length of time or they will adopt a permanent curved shape.



Washing a brush. After a couple of rinses in the solvent for the finish (and in lacquer thinner or brush cleaner for a varnish brush) wash the brush under a faucet. Wash until you get a lot of suds to indicate that the bristles are clean.



Storing clean brushes. When the bristles are clean, shake out the water and return the brush to the holder it came in or wrap the brush in paper so the bristles dry straight and stay clean. You can use a rubber band or masking tape to secure the paper.

Bob is author of "Understanding Wood Finishing" and a contributing editor to Popular Woodworking.

Sharpeners' Anonymous

A 12-step program for regrowing forearm hair.

I head through the main doors, down the stairs to the basement, arriving at the third door on the right. Like everyone else, I grab a cup of coffee before finding a seat. By the time the clock gets close to 7 p.m., the entire group is sitting.

It is an eclectic group; the appearances are varied. The people range in age from 20 to more than 75. I am dressed in the business clothes I wore to work. One fellow is wearing overalls. The group is mainly men, but there are at least a couple women here, too. There does seem to be one common trait among this group: Each person has one arm that is completely free of hair below the elbow.

As the leader of this meeting, I start with a generic prayer.

Following this, I take the lead and say, "Hi, my name is Jeff, and I throw money into sharpening."

I receive a communal response, "Hi Jeff!" Then, I continue sharing.

"I started with oilstones when I was a kid. Nothing big, just playing around with my Case "XX" pocket knife. It was fun. Eventually, I got into diamond stones. It was so gradual I didn't seem to notice that I just kept moving to finer and finer grits. I was happy. I was getting good results. However, I kept thinking there was something else out there. One day a friend asked if I wanted to try his Japanese waterstones, and within a week I was using a #1,000, #4,000 and #8,000. I even had a Nagura."

"Thanks, Jeff."

"Hi, my name is Ed, and I'm a sandpaper sharpener."

"Hi, Ed."

"Like everybody else, I never saw the sharpening obsession coming. I thought I

knew what sharp was. Who needs to shave the hair on the back of his hand with a chisel? Or so I thought. My experimentation didn't venture out too much, because I landed on sandpaper pretty early. I was watching a Marc Adams video and he went through the process. At first I thought it was neat just to watch.



Eventually, I brought it into my own shop. When I first started woodworking I never expected to have a piece of float glass and a spray bottle, but now I feel like I can't work without them."

"Thanks, Ed."

"My name is Glen, and I'm addicted to power sharpening."

"Hi, Glen."

"I got my first Tormek in 1995. I have every attachment. Even though my Tormek still runs, I bought the Jet two years ago just to

do my own side-by-side comparison. I also own a LapSharp and the Lee Valley Mk. II system. Earlier this year I bought the Work Sharp machine. I get good results with all of them, yet each leaves me feeling hollow ... like there is a keener edge still to be found. I don't know how, but someday I'm going to beat this thing."

"Thanks, Glen."

A few more share their struggles with diamond paste, leather strops and other vices. Others tell of the victims that have been hurt by their struggles with sharpening.

Tears well up in the eyes of Carol as she describes ruining the temper on a plane blade through the cavalier use of a traditional high-speed grinder. Dylan cries when he describes ignorantly using David Charlesworth's ruler trick on an entire set of socket chisels.

I remind the group that we walk the path day by day, and regardless of what the world says, there is no shame in using a file to break the corners of a plane blade.

Soon, it is time for us to go. As our departure ritual requires, we recite our prayer together.

"God, grant me the serenity to accept the things I cannot change. The courage to change the things I can. And the wisdom to know the difference between the two. Regrow the hair that I have shaved off my arm, and by your grace may I never sink so low as to embrace a honing guide ... unless it is one of the new ones that costs over a hundred bucks. Amen." **PW**

Jeff spends a lot of time writing his new blog at jeffskiver.blogspot.com. In his spare time, he heads for the woodshop.