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OCTOBER 2005
ISSUE #150

POPULAR Woodworking

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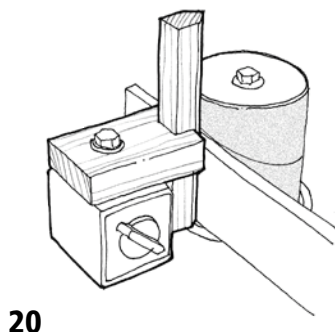
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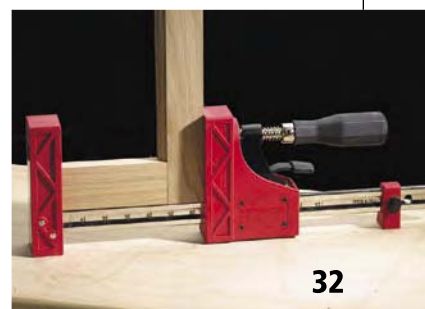
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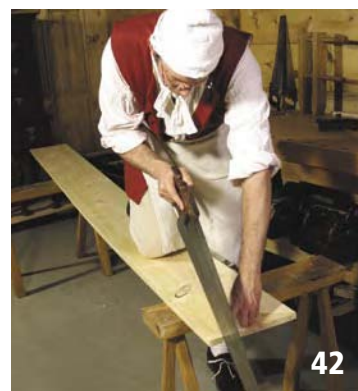
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Popular Woodworking (ISSN 0884-8823, USPS 752-250) is published seven times a year in February, April, June, August, October, November and December by F+W Publications Inc. Editorial and advertising offices are located at 4700 E. Galbraith Road, Cincinnati, Ohio 45236; tel.: 513-531-2222. Unsolicited manuscripts, photographs and artwork should include ample postage on a self-addressed, stamped envelope (SASE); otherwise they will not be returned. Subscription rates: A year's subscription (seven issues) is \$28; outside of U.S. add \$7/year • Canadian Publications Mail Agreement No. 40025316. Canadian return address: 2744 Edna St., Windsor, ON N8Y 1V2 • Copyright 2005 by Popular Woodworking. Periodicals postage paid at Cincinnati, Ohio, and additional mailing offices. Postmaster: Send all address changes to Popular Woodworking, P.O. Box 420235, Palm Coast, FL 32142-0235 Canada GST Reg. # R122594716 • Produced and printed in the U.S.A.



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Throughout the years master cabinetmaker Frank Klausz has taught thousands of woodworkers how to quickly and easily hand cut dovetails. His secret? Stop measuring.

Cover photo by Al Parrish

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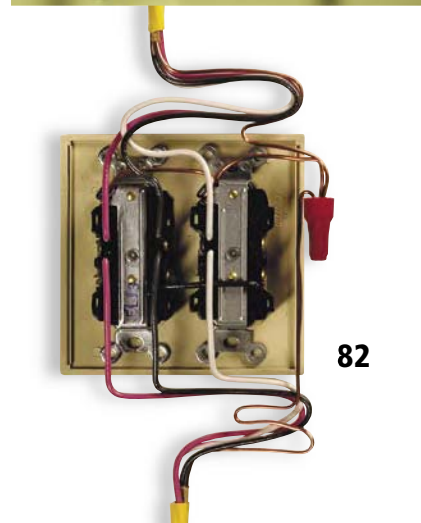
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POPULAR Woodworking®

October 2005, Vol. 25, No. 5

popwood.com

Editorial Offices 513-531-2690

Editor & Publisher **Steve Shanesy**
ext. 1238 • steve.shanesy@fwpubs.com

Art Director **Linda Watts**
ext. 1396 • linda.watts@fwpubs.com

Executive Editor **Christopher Schwarz**
ext. 1407 • chris.schwarz@fwpubs.com

Senior Editor **David Thiel**
ext. 1255 • david.thiel@fwpubs.com

Senior Editor **Robert W. Lang**
ext. 1327 • robert.lang@fwpubs.com

Managing Editor **Kara Gebhart Uhl**
ext. 1348 • kara.uhl@fwpubs.com

Assistant Designer **Susan L. Smith**
ext. 1058 • susan.l.smith@fwpubs.com

Project Illustrator **John Hutchinson**

Photographer **Al Parrish**

Contributing Editors

**Nick Engler, Bob Flexner, Glen Huey,
Don McConnell, Troy Sexton**

F+W PUBLICATIONS INC.

William F. Reilly, *Chairman*

Stephen J. Kent, *President*

Mark F. Arnett, *Executive Vice President & CFO*

Barbara Schmitz, *VP, Manufacturing*

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MAGAZINE GROUP

William R. Reed, *President*

Susan DuBois, *VP, Consumer Marketing*

Matt Friedersdorf, *Director of Finance*

Mark Fleetwood, *Group Circulation Manager*

Cristy Malcolm, *Newsstand Sales Supervisor*

PRODUCTION

Vicki Whitford, *Production Manager*

Debbie Thomas, *Production Coordinator*

ADVERTISING

Don Schroder, *Advertising Director*

331 N. Arch St., Allentown, PA 18104

Tel. 610-821-4425; Fax 610-821-7884

d.schroder@verizon.net

Advertising Production Coordinator

Krista Morel, Tel. 513-531-2690 ext. 1311

krista.morel@fwpubs.com

SUBSCRIPTION SERVICES: Subscription inquiries,
orders and address changes can be made at
popwood.com (click on "Customer Service FAQs").

Or by mail: **Popular Woodworking**, P.O. Box 420235,
Palm Coast, FL 32142-0235.

Or call toll-free 877-860-9140 or 386-246-3369.

Include your address with all inquiries.

Allow 6 to 8 weeks for delivery.

NEWSSTAND DISTRIBUTION: Curtis Circulation Co.,
730 River Road, New Milford, NJ 07646

ATTENTION RETAILERS:

To carry *Popular Woodworking* in your store, call 800-894-4656
or write Magazine Retail Sales, P.O. Box 5014, Iola, WI 54945-5014.

Back issues are available. Call 800-258-0929 for pricing or visit our
web site at popwood.com. Send check or money order to: *Popular
Woodworking* Back Issues, F+W Publications Products, 700 E. State
St., Iola, WI 54990. Please specify publication, month and year.

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. Safety First!

To Every Season Turn, Turn, Turn

One aspect of woodworking that never occurred to me when I discovered this life-long passion at age 30 was how it would continue to have something new to offer as my age, interests, and someday, I'm sure, physical abilities change. But now in my mid-50s, where over my shoulder I see the horizon where the sun rises, as well as straight ahead where it will just as surely set, I can more fully appreciate how wonderful it is that this abiding interest can continuously evolve.

I'm sure my experiences are familiar to many woodworkers. My early years in the woodshop produced the sorts of things a growing family needs, such as cabinets to rehab a kitchen and bath, a highchair for a small child, toy chests, beds, desks and bookshelves. As a young man, long days in the shop weren't tiring at all, no matter how strenuous the work. Tossing around sheets of plywood or manhandling heavy boards didn't get a second thought. There were no aching muscles or sore back the next day.

Then, as the kids grew, and outgrew their "children's" furniture, I entered what might be called the replacement and discovery phase. Just as the family matured so did my woodworking skills and interests. Early projects found their way to the attic. My home and family deserved better work than my early efforts, most of which was now a bit embarrassing for a woodworker who'd by now spent thousands of hours in his shop.

Good design became important and my eye sharpened to produce work that simply looked more refined. Making replacement pieces provided the opportunity to express a more mature sense of design and an evolving personal style. The focus in the shop changed from the building process to refining the design. "No" design from the early days begot Shaker style, which begot American colonial. Years later, in a complete turnaround, contemporary, mid-century modern was my

direction, fueled in part by a new interest in welding, and combining metal and wood in furniture. No doubt, the only description for our home furnishings today is "eclectic."

These days our home is on its second, and more or less final, round of replacement. The next home, a smaller one suited to a smaller family, may become a whole new phase. That remains to be seen.

In the meantime, woodworking for me has morphed into an entirely new and immensely pleasurable phase, lathe work. And it's a phase that suits a body that just doesn't seem to be as strong as it once was. Turning can be a deeply satisfying pursuit. Unlike "flat work," turning allows me to start and finish most pieces in a single session at the lathe thus providing instant gratification. "Failed" pieces are chucked into the firewood pile with little, if any, regret.

Of course, at age 56, this body isn't spent yet, and cabinet and furniture work still brings its joys. But I must admit that a recent, fairly large, built-in cabinet project reminded me of some muscles I had long since taken for granted. The string of weekends and evenings required to complete it left me longing for a session with my lathe.

As I look ahead, it's not hard to imagine the rewards woodworking will continue to provide throughout my life. After all, I see my father, now in his mid-80s with the limitations that age brings, in his woodshop several days a week, finding enjoyment there and still reaping the satisfactions we woodworkers are so fortunate to experience.

Be grateful your chosen hobby offers so many avenues of rewarding pursuit that can change with the seasons of your life. **PW**

Steve Shanesy

Steve Shanesy
Editor & Publisher

CONTRIBUTORS

FRANK KLAUSZ

In woodworking circles the name Frank Klausz practically is synonymous with hand-cut dovetails. For many years Klausz has taught countless woodworkers how to



cut their first dovetails via seminars, videos and articles (such as the one on page 46). He is one of the most recognized craftsmen of our age and rightfully so. At the age of 14 Klausz entered the

Hungarian trade school system, earned his journeyman cabinetmaker certificate and later became a master. Klausz's apprenticeship was tougher than most because of time spent working for an exceptionally strict master – his father. When not teaching Klausz is building fine furniture reproductions in his New Jersey-based shop.

BRUCE D. WEDLOCK

In high school Bruce D. Wedlock elected to take shop class in lieu of early European history much to the chagrin of the social studies department head. She went to Wed-



lock's dad (who was the principal) and said shop class was a bad precedent for college-bound students. Wedlock's dad said his son could do what he wanted and so Wedlock did. In

1952 Wedlock began studying electrical engineering at Massachusetts Institute of Technology (MIT), received his doctorate and then taught at MIT until he retired in 2000. Today he finally has a shop of his own where he enjoys building Shaker and 18th-century furniture. To learn how he wired his shop for 240 volts, turn to page 82.

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Where Do You Get Your Good Plywood?

Finding Quality Plywood a Problem

In every picture I see, the quality of the plywood being used for projects in your magazine is superior to anything I have ever seen in Home Depot or Lowe's. The number of plies is greater and the finish is better than my choices. All I can get is oak or occasionally "paraply" from somewhere in South America. What kills me is that I see your "better" plywood being used for jigs – I would love to use it for some of my better projects! I know I can't afford to ask Home Depot for an entire bundle of the stuff, but maybe there is a different or better way – can you tell me the name of what you use and how to get it?

Michael Prather
Pace, Florida

I doubt you'll ever find quality plywood at the major home-center retailers. It's just not their market. You should check your Yellow Pages under "hardwood plywood" and "hardwood lumber." Most areas have at least one company that deals in better lumber and plywood. They will sell to consumers and cabinet shops. If you don't find a source there, contact your local woodworking club or call a cabinet shop and ask them where to buy. Another alternative: Order by phone long distance. I completed a rather large project recently that required 10 sheets of maple-faced plywood and birch for the interiors. I ordered it from Steve Wall Lumber (800-633-4062 or walllumber.com) in North Carolina. It was shipped common carrier. Even though the shipping costs extra, the total price was still quite a bit less than prices here in Cincinnati. And it was good material that arrived in good condition.

— Steve Shanesy, editor and publisher

How to Sharpen a Curved-edge Blade Using a Jig that has a Wide Roller

I really enjoyed the article about sharpening a curved blade by David Charlesworth ("Learn-

ing Curves," August 2005). His techniques would have worked well on my old side-clamp honing guide, but I have a honing guide that has a 2"-wide roller. The roller offers great support for wide blades but it's almost too stable. I tried for a while to put a camber on a blade without much success – until I found a solution. I took a 2"- to 3"-long piece of black electrical tape and wrapped it around the middle of the guide's roller. The tape increased the center diameter of the roller by about $\frac{1}{32}$ ", allowing me to put a nice camber on the edge of my blade while giving me sufficient support to sharpen the center of the blade flat.

Dave Brown
Germantown, Maryland

What Happens to Abram's Projects?

I recently received the August 2005 issue of *Popular Woodworking* and have just finished the very interesting article on Norm Abram. What a guy! Anyway, I wonder if you can tell us what happens to the projects he builds—all 800 or so of them (17 years times 26 episodes times two copies of each project less some that took two episodes to complete)?

John Fleming
Lancaster, Massachusetts

continued on page 14

WRITE TO US

Popular Woodworking welcomes letters from readers with comments about the magazine or woodworking in general. We try to respond to all correspondence. Published letters may be edited for length or style. All letters become the property of *Popular Woodworking*. How to send your letter:

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LETTERS

continued from page 12

Norm Abram keeps projects to monitor them as they age and he uses them. Typically Abram and Russ Morash, creator, director and executive producer of the show, will each take a project home. Abram says he's even started to do theme rooms. For example, his daughter's room is filled with mahogany furniture. Shop projects are used in *The New Yankee Workshop*. Morash often uses the second shop projects in his personal woodshop. Many of the outdoor projects can be seen on the grounds of the workshop. Projects are never sold and the Adirondack chair (see our August 2005 issue) was the first to be given away in a contest.

—Kara Gebhart Uhl, managing editor

But What is the Proper Way to Store a Straightedge to Keep it True?

Recently I purchased the Veritas steel straightedge. I felt good about my choice when I subsequently read your review in the April 2005 issue referring to it as “the deal of the year.” I got a little nervous, though, when I read your comment about straightedges going “out of true when stored improperly.” I have it lying flat on a firm, flat surface. Should it be hung up?

Randall Warren

Coon Rapids, Minnesota

Either hung up or fully supported on a firm, flat surface will do nicely. Many machinists treat their straightedges like a holy relic by wrapping them in rust-retardant paper and placing them in a special box to protect them. There is some merit to this approach. Our Starrett straightedge is now slightly banana-shaped because some thoughtless person stored it propped up on one end and unsupported. It bent under its own weight and is now completely worthless. And the steel straightedges are susceptible to corrosion, so do wipe it down after use. PW

—Christopher Schwarz, executive editor

CORRECTIONS

In the “Sawbench & Shop Stool” article (June 2005), the hardwood blocks for the feet should be 4" long, not 4' long as stated in the Construction Steps on page 43.

In the “Farewell Fractions – Hello Bob” Out of the Woodwork column (June 2005), the example in the second to last paragraph should be 4', 8" and 10 bob, which is equal to “four-foot eight and $\frac{13}{32}$ nds,” not “four-foot eight and $\frac{17}{32}$ nds” as stated.

How to Properly Cut A Clean Keyhole

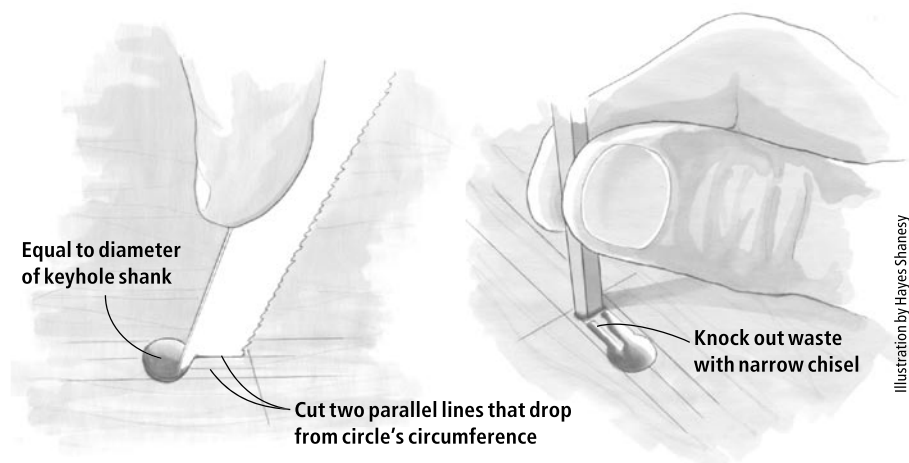


Illustration by Hayes Shanesy

What is the Best Method for Cutting a Keyhole Without an Escutcheon?

I have yet to be able to cut a decent-looking keyhole. Usually this doesn't matter because the outside of the hole is covered by an escutcheon. However I am now involved in a project where the "escutcheons" are shop-made inlay and flush to the front face of the drawers, and a clean-looking keyhole is essential. Can you suggest a good way to accomplish this?

Bill Jordan
Andalusia, Alabama

I've done only a dozen of these, so I always struggle myself. The first time I did it I looked up the procedure in Charles Hayward's "The Complete Book of Woodwork" (Drake). It works.

1. Measure the diameter of the keyhole's circular shank. Drill a hole that diameter.
 2. Measure the width and length of the square section of the keyhole on your lock. Scribe that dimension on your work using a knife. Score the lines several times to make the mark deep.
 3. With a keyhole saw (I use a Japanese version), define the two parallel lines that drop from the circle's circumference.
 4. Knock out the waste with a chisel.
- If you have a lot of these to do, you might consider making an oversized router template, and use a template guide and very small straight bit.
- Christopher Schwarz, executive editor

How Can I Replenish the Oils in an Antique That's Been Outside?

Our pastor is retiring and some time ago he had mentioned wanting a small pew to put on his porch. I have found one but it has been sitting on a covered porch subject to wind and weather – in particular, the sun. Most of the finish is gone.

The problem is the wood is very dry. How do I replenish the natural oils in the wood and what kind of finish should I use given where the pew will be placed?

Byron "Bud" DeLong
Ocqueoc, Michigan
continued on page 19

WRITE TO US

Every day we get questions from readers on all subjects about their woodworking. Some are letters; many are e-mail messages. 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. In addition to the hundreds we answer privately every month, we want to share the best questions here with readers.

Send your questions via e-mail to popwood@fwpubs.com or by mail to:
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Common hardwoods don't contain "natural" oils. Only a few exotics such as teak and rosewood contain oil, and these oils cause problems for gluing and finishing. They don't need to be replaced. Wood contains water, and the expansion caused by exposure to moisture, and shrinkage accelerated by the sun, has likely caused splitting.

If the wood is splitting, you can't do much about it. Just paint or finish over the splits. Only if you paint should you try to fill the splits. Filling the splits will look awful under a clear finish.

I would imagine that the wood is gray, at least the parts that were exposed to the sun. When you get all the old finish removed, sand the wood lightly. Then apply oxalic acid, a wood bleach you can buy in crystal form at home centers and paint stores. Dissolve the crystals in hot water to saturation. Let the solution cool, then brush it onto the entire piece. After the solution dries, hose off all the crystals. Be careful to not breathe them. Oxalic acid is mildly toxic and will cause coughing and choking.

When the wood is clean and dry, sand it smooth. Then finish it in any way you want. Three or four coats of boat varnish, available from marinas (jamestowndistributors.com, for example) will be the most effective clear finish for resisting damage from the sun. (Wax will offer no resistance to either moisture or sunlight.) Paint is best, however. It totally blocks sunlight.

— Bob Flexner, contributing editor

How Do You Calculate the Board Footage From a Materials List?

I recently bought plans for a curio cabinet. And while the plans contain a cutting list, there's no shopping list. Fortunately when I build projects from your magazine, sometimes a shopping list as well as a cutting list is supplied. Is there a simple way to find out how much material you will need for a project, when it is not given?

Eddie Dunlap
East Elmhurst, New York

Calculating board feet needed for any project is as much art as it is science. In theory, if you multiply the thickness of each piece (figuring $\frac{3}{4}$ " thickness as 1") times the width, times the length, times the number of pieces, you will have the cubic volume of the parts. Do this for every part, and you will have the total volume of material for the finished parts. A board foot is a measure of volume, equal to 144 cubic inches. If you divide the volume from

your calculations by 144 you will know the board feet in the finished parts.

The problem with this method is that it doesn't take into account any waste factor. Hardwood is sold in random widths and lengths, so until you look at individual boards, and decide which parts will come from which board, you can't be sure how much material you will need.

It can be tedious to work through the list. What I usually do is go through it quickly by

rounding up to the next whole number. When all of this calculating is completed, I add a factor for waste, somewhere between 15 percent and 40 percent of the total.

The alternative is to take your list with you to the lumberyard, and as you pull boards, figure which parts can come from each piece of lumber. Some people go so far as to mark them out with chalk, or put Post-it notes on the boards. **PW**

— Robert W. Lang, senior editor



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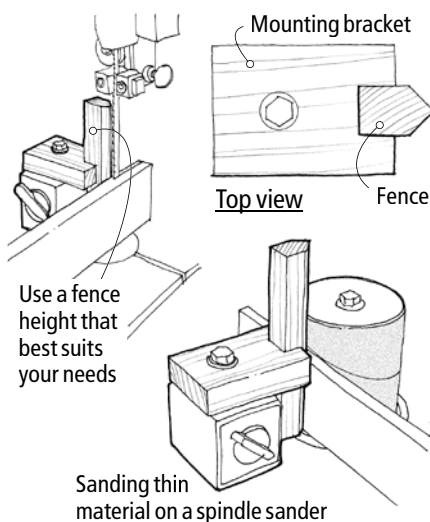
Powerful Magnetic Single-point Fence

THE WINNER:

I prefer to resaw on the band saw using a single-point fence, but have been frustrated trying to clamp a fence to my saw table, with its webbing on the underside. To avoid clamps, I decided to make a magnetic fence, but discovered that small rare-earth magnets, while strong, are not sufficient for this purpose. Instead, I turned to the magnetic base that holds the dial indicator I use for checking the accuracy of my table saw and other machines (\$20 from Lee Valley; 800-871-8158 or leevalley.com; #88N31.02). These commonly available bases include a mounting post that threads into a hole in the base. Removing the post allows you to bolt on a simple shop-made fence assembly as shown in the illustration above.

The fence assembly consists of nothing more than a hardwood strip of a fence glued into a mortise in the mounting bracket. The fence is jointed straight, then chamfered on both faces to create a narrow bearing edge. After bolting the mounting bracket to the base, glue the fence in place, making sure to square it to the table surface.

In use, the fence is carefully located on



a cast-iron machine table and easily locked in place by rotating the on/off switch on the base. With the magnet on, you can't budge the base, short of smacking it with a mallet. After resawing at the band saw, I use the fence on my spindle sander to smooth the pieces to an accurate final thickness. Of course, different sized fences can be made to suit various woodworking operations.

Bruce D. Wedlock
North Reading, Massachusetts
continued on page 22

CASH AND PRIZES FOR YOUR TRICKS AND TIPS!

Each issue we publish useful woodworking tips from our readers. Next issue's winner receives this terrific set of three specialty planes from Veritas, including a large and medium shoulder plane, and a bullnose plane. These planes are perfect for fine-tuning a variety of woodworking joints including rabbets and tenons. This set of quality joinery planes is valued at more than \$400.

Runners-up each receive a check for \$75. 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*. Unfortunately we are unable to return original photographs. 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.



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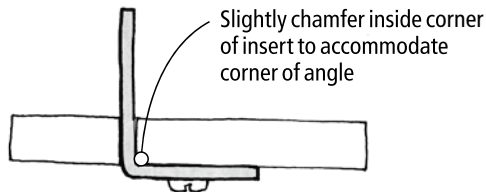
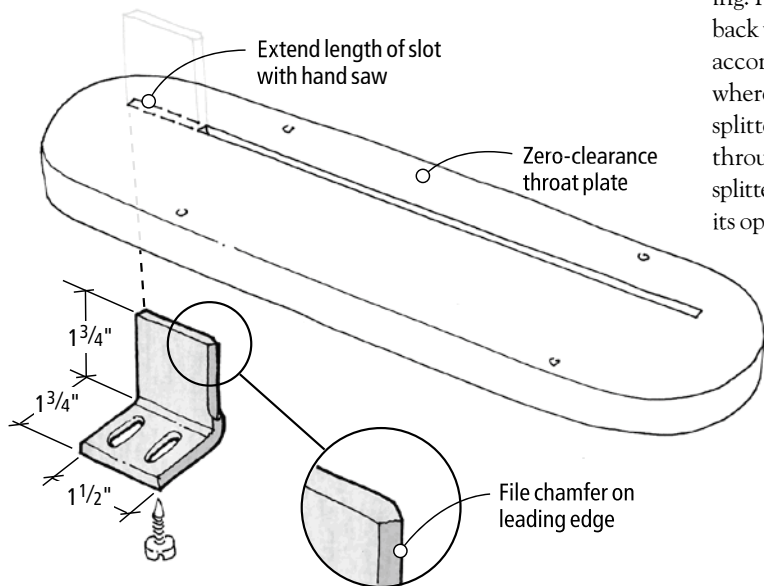
An Easy-to-use, Shop-made Splitter

Like many woodworkers, I found the stock splitter that came with my table saw to be troublesome to remove and reattach when necessary. So I made a simple splitter from $\frac{1}{8}$ "-thick flat aluminum stock that I attached to a shop-made, zero-clearance throat plate. I use this setup for most of my sawing operations, replacing it with a splitterless throat

plate when necessary to make dados and other non-through cuts.

To make the splitter, I drilled and filed the screw slots, then bent the aluminum into an "L"-shape in a vise. I filed the vertical leg to $\frac{3}{32}$ " thick to use with my thin-kerf blade, then filed a chamfer on each side of the leading edge for easy entry into the workpiece during sawing. I used a Japanese ryoba handsaw (any small handsaw without a back will work) to extend the length of the insert plate's blade slot to accommodate the splitter. I slightly chamfered the insert plate slot where the interior corner of the splitter would meet it, to allow the splitter to pull down tightly. I then attached the splitter with screws through the elongated slots, which allow precise alignment. For the splitter to work properly, it's important that your insert plate fits within its opening without side-to-side movement.

*Dan Locaputo
Cincinnati, Ohio*



TRICKS OF THE TRADE

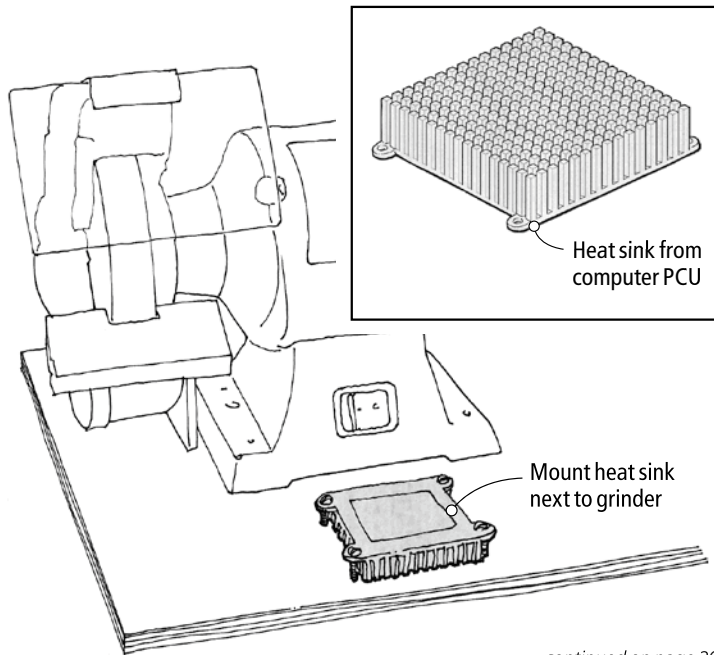
continued from page 22

Dry Cooling for Sharpening

In Leonard Lee's "The Complete Guide to Sharpening" (The Taunton Press), he warns against plunging a hot tool into water when sharpening on a bench grinder. This quenching can cause minute fractures in the thin metal at the edge, compromising its sharpness. However, if you don't cool overheated metal, it can turn blue and distempered, losing its ability to hold an edge for even a short time. So what to do?

Oddly enough, the world of computers offers a solution. Many discarded computer circuit boards incorporate a heat sink used to keep the computer chips cool. A heat sink is made of a special alloy and design that dissipates heat very quickly. It's easy to identify because it's usually the biggest component on a circuit board. It generally has a grid of "fingers" on one side, and a flat face on the other. Sometimes a fan is attached to it. In any case, the sink is usually easy to detach by removing a few screws. I mount the heat sink flat-side up next to my grinder. When a tool gets hot from sharpening, I lay it on the sink, and in a few moments it's cool enough to continue to use.

*Bob Ward
Eugene, Oregon*



continued on page 26

TRICKS OF THE TRADE

continued from page 24

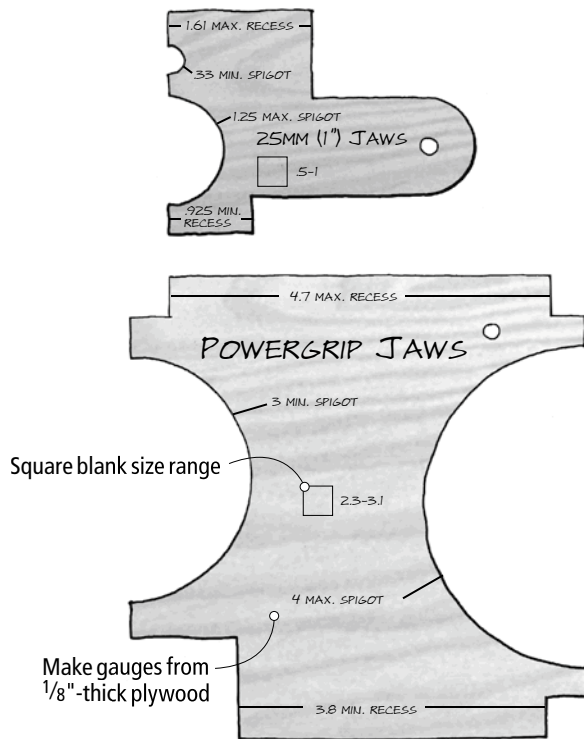
Lathe Chuck Gauges Eliminate Guesswork

One of my great frustrations when I took up the wood lathe was turning the correct size spigot or recess on a workpiece to match the various jaws on my chucks. I have two chucks and several sets of jaws. I often installed the wrong jaws by mistake, or made the spigot or recess the wrong size. Plus, it was difficult to figure out which chuck and jaw combination was appropriate for gripping a square turning blank.

To eliminate this aggravation, I decided to make myself a “go/no-go” gauge for each set of jaws I own. Each gauge quickly shows the minimum and maximum spigot and recess diameters, as well as the range of square blanks the setup will accommodate. I cut the gauges from $\frac{1}{8}$ "-thick hardwood plywood, and used a fine-tip marker to note the measurements, color-coding the spigot-diameter measurements with a red marker and the recesses with blue. To prevent the ink from wicking into the wood, I first sanded and sealed the wood with shellac before top-coating it with wipe-on urethane.

I designed my gauges on a CAD program, printing them out full size, but you could easily lay them out to size using a ruler, compass and square. Obviously, designs can be made to suit any brand of chuck. I glued the patterns to the plywood, then cut them out with a scroll saw and smoothed the curves with a spindle sander. A small hanger hole allows me to chain my gauges together near my lathe.

*Kenneth Glasscock
Conway, Arkansas*



continued on page 28

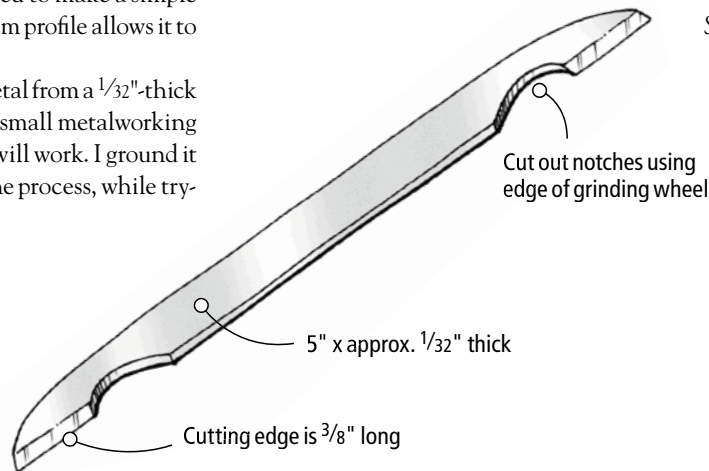
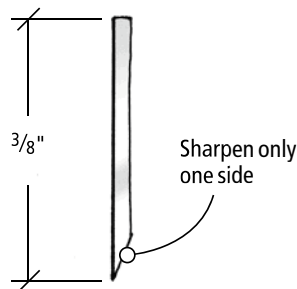
A Dovetail Marking Knife

When transferring the shape of tails onto the pinboard of a dovetail joint, I like the accuracy gained by using a chisel-sharpened knife. As opposed to a double-beveled knife edge – which requires leaning the blade into the junction of the tailboard and pinboard – the flat side of a chisel-sharpened knife can be placed against the workpiece edge being traced, reducing the chance of error. However, it requires a right-handed and a left-handed knife. I decided to make a simple two-ended knife to do the job efficiently. The slim profile allows it to get into even the tightest spots.

For the blade blank, I cut a 5"-long piece of metal from a $\frac{1}{32}$ "-thick discarded industrial hacksaw blade I got from a small metalworking shop. However, any heavy-duty hacksaw blade will work. I ground it down to a width of $\frac{3}{8}$ ", removing the teeth in the process, while try-

ing not to overheat the material. I radiused the ends on the grinder, then undercut behind each $\frac{3}{8}$ "-long cutting edge using the corner of the grinding wheel. I used emery cloth to break the sharp edges in the center for a more comfortable grip, but you could wrap it with electrical tape instead. After grinding a bevel on the same face of each end, I honed each bevel on the edges of waterstones.

*John Bush
Seattle, Washington*



TRICKS OF THE TRADE

continued from page 28

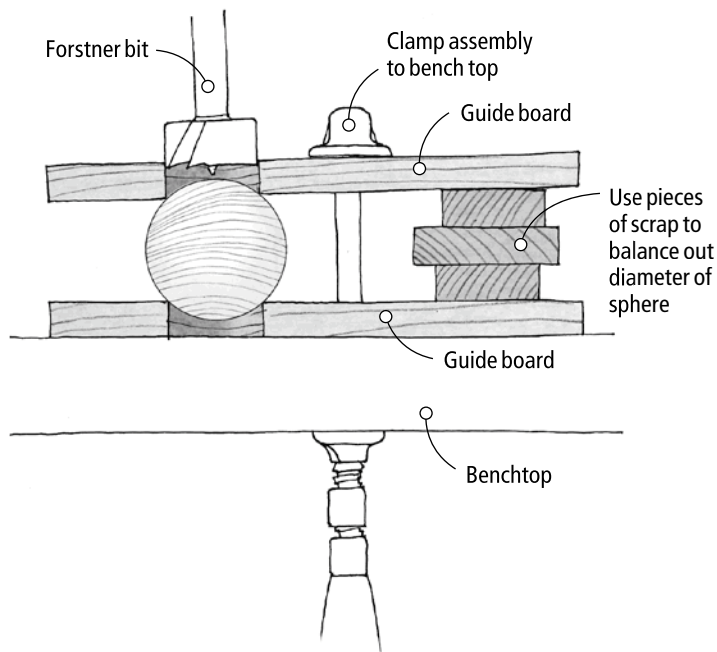
Drill Spheres Easily

I recently installed a bench vise, but was disappointed by the skimpy plastic caps on the ends of the wooden dowel handle. I decided to upgrade them using a couple 2"-diameter wooden balls that I bought. Fitting the balls onto the dowels proved surprisingly simple with the aid of a setup that is so simple it hardly deserves to be called a jig.

First, I outfitted my drill press with a Forstner bit of the same diameter as the dowel, then drilled a hole through two short lengths of scrap, offsetting the holes toward one end. I then trapped the ball between the two holes, shimming between the non-drilled ends of the scrap to orient the two pieces roughly parallel to each other while clamped to my benchtop. Now I was able to bore a hole in each ball using the same Forstner bit in a hand-held drill, guided by the holes in the scrap.

The beauty of this setup is that the scrap guide pieces really don't need to be clamped parallel to each other or square to the benchtop, as the exaggerated angles in the drawing show. As long as the ball is seated firmly between the guide holes, the drill will travel through the ball's axis. For best long-grain glue strength, I made sure to bore the hole in the direction of the ball's grain. **PW**

*Philip Roe
Ann Arbor, Michigan*



Jet Parallel Jaw Clamps

When Jet announced its new line of parallel jaw clamps, I asked if they would be less expensive. Company officials said, "No, but they'll be better." I was skeptical, but the company proved good to its word.

The clamps offer accurate parallel clamping along the length of the jaw, with plenty of clamping power for any woodworking task. As for durability, we drop-tested the clamps from bench height a number of times, aiming for the more fragile corners. We scuffed the plastic, but didn't crack one.

The clamping jaws (a non-marring resin) are oversized and they've added a scale to the beefy steel I-beam bar that gives you a rough idea of how far the clamps need to be opened for the project at hand, which is handy. The oversized pads also give you nearly $\frac{3}{4}$ " on either side of the bar making it possible to glue up panels using the edge of the jaw while still maintaining a solid parallel grip.

The more significant upgrade is a Slide-Glide Trigger that holds the clamping jaw in place on the bar even when the clamp is in a

vertical position. The jaw won't slide down without releasing the trigger, which is nice.

Jet also added an oversized handle that makes gripping and tightening the handle comfortable and easy.

The clamps also function as spreaders and have a moveable stand to hold the clamp's bar horizontal when clamping smaller objects.

Another feature is the threaded inserts in the movable stand and the stationary jaw. These tie in with bench dog accessories that let you mount the clamps to your bench for easier panel glue-ups.

We're looking forward to testing these clamps over time, but we're impressed with the quality and upgraded features.

—David Thiel

For more information, circle #182 on Free Information Card.



SPECIFICATIONS

Jet Parallel Clamp

List prices: \$33 - \$70

Sizes: 12", 24", 31", 40", 50", 60", 82", 98"

Jaw size: $1\frac{3}{4}$ " x 6" (4" depth)

Stated clamping pressure: 1,000 lbs.

Performance: ●●●●●

Price range: \$\$\$\$

Jet Tool: 800-274-6848 or

wmhtoolgroup.com

Lee Valley Mk.II Honing Guide is Near Perfect

Allow me to skip to the bottom line here and say that the Veritas Mk.II Honing Guide is the most thoughtful, accurate and well-made honing guide for sharpening chisels and straight plane irons I've ever used. If you like honing guides, you'll be thrilled by this one. If you don't like them, this one might convert you.

Its true genius lies in the fact that you have complete control over the exact angle you're sharpening at. The registration jig, which hitches to the front of the guide while you're setting the blade, allows you to set sharpening angles anywhere from 10° (for back-bevels) all the way up to 54° (for wild-grained woods). And the jig measures off the unbeveled face of the chisel or plane iron. Other jigs register off the beveled face, which complicates setting your angles with thick plane blades in particular. The Veritas nullifies this problem and makes sharpening to any angle a repeatable process.

Another advantage of the registration jig is that it also squares the tool in the honing guide, and it does this quite well. I found that the jig could easily secure and sharpen almost

any tool, from narrow triangular chisels to scraper plane irons.

Other nice features include the fact that you can raise the roller up 1° or 2° to add a quick micro-bevel to an edge. And the honing guide is comfortable to hold.

At first glance, the whole rig looks quite complex, but I actually found it intuitive to use and went right to work without even reading the guide's manual (I did read the manual eventually; it's short and sweet).

My only wish is that the guide could be used to sharpen a camber on plane irons using finger-point pressure. The roller is just too wide and always creates a straight edge. There are ways around this (wrapping a narrow piece of tape around the roller's midsection; placing a $\frac{1}{2}$ "-wide piece of cardboard on the stone), though you might want to keep your cheap side-clamp honing guide for touching up smoothing plane irons. Otherwise, this guide is just what I've always wanted a sharpening jig to be.

—Christopher Schwarz

For more information, circle #179 on Free Information Card.



SPECIFICATIONS

Veritas Mk.II Honing Guide

Street price: \$48.50 (#05M09.01)

Max blade size: $1\frac{5}{32}$ " thick, $2\frac{7}{8}$ " wide

Roller width: 2"

Performance: ●●●●●

Price range: \$\$\$

Lee Valley Tools: 800-871-8158 or

leevalley.com

Shop Fox W1724 15" Planer with Spiral Cutterhead

In our February 2005 issue we tested 15" planers and, honestly, we missed one. The Shop Fox W1724 should have been in the test.

The W1724 stands out as one of the new spiral cutterhead models. This planer uses three disposable, high-speed steel knives mounted in a spiral pattern. Of the spiral head variations available, this design provides a quality cut, is quiet, less expensive and it's easy to change and set the knives.

In testing the noise level we had a 79 decibel (dB) reading without wood running through and a 90 dB reading when running wood. That gave us a dB variance of 11, which puts it fairly in the middle of the machines tested, but with a very quiet no-load level.

We tested the motor's amperage draw (7.42 amps no-load/10.6 amps under load, 3.18-amp variance) and rpms (5,080 rpms no load/4,990 rpms under load, 90-rpm variance). These results fell in the middle of the pack, as well.

We ran ash boards through the planer to test cut performance. The snipe was next to negligible, but it occurred about 2³/₄" in from the end, which is pretty deep.

The construction of the machine was

good, with decent fit and finish. One regret is that the motor is mounted above the cutterhead. While the spiral knives make changing and adjusting the knives easier, the motor location complicates things.

In our prior test we gave our Editor's Choice award to the Powermatic, which is similar to the Shop Fox, with both using the same spiral-knife configuration. Differences include the under-mounted motor, solid tables, integral mobile base and digital height readout on the Powermatic. The Powermatic's noise and rpm variance specs were better than those of the Shop Fox, but the W1724 is \$500 less.

The Shop Fox W1724 is a good planer, but a stripped-down version of the Powermatic. While we're a little tardy, we're awarding the Shop Fox W1724 a Best Value award in the 15" planer category.



SPECIFICATIONS

Shop Fox W1724 15" Planer

Street price: \$1,099

Motor: 3 hp, 220V, single-phase, 5,000 rpm

Capacity: 14⁷/₈"-wide x 6¹/₈"-high

Cutterhead: Spiral, 3 helical HSS blades

Max. depth of cut: 1/8"

Min. stock thickness: 3/16"

Shipping weight: 560 lbs.

Performance: ●●●●○

Price range: \$\$\$

Woodstock International: 800-840-8420

or woodstockinternational.com

Veritas Scrub Plane Can Blaze Through a Board

Though I own a powered jointer and planer, I always keep a scrub plane close by. It's good for dressing boards that are too wide for my powered equipment, or for adding a scalloped texture to the surfaces of rustic pieces.

Some woodworkers make their own scrub planes from vintage planes by filing open the mouth and grinding a severe curve to the blade, but I've always preferred the real thing. Scrub planes are simpler, have a thicker iron and are built specifically for the task.

With a couple winding sticks you can quickly true a board's face with this tool. Even 1/8"-thick shavings are no problem. Interestingly, there's evidence that this tool was designed for the home job site—to reduce boards in width, not in thickness. (Stanley's 1923 catalog backs this up.) Most modern-day woodworkers, however, use this tool to plane face grain, and it does do that task well.

Veritas's new version of the scrub plane is solid, well-made and comfortable to use. At 3 pounds and 1 ounce, it's substantially heavier

than the Lie-Nielsen version and Stanley's discontinued model (both are 2¹/₂ pounds). The extra weight helps the tool plow through knots. I found the extra weight more tiring only during long sessions.

Another new feature on the Veritas is the addition of two setscrews to keep the blade centered in the mouth when you slam into knots. Even with the setscrews backed off the blade always stayed put, so you might not actually need this feature.

The ductile iron body and 3/16"-thick blade ensure that this tool is nigh indestructible. I found the fit and finish to be excellent. Veritas continues to improve on this front with every tool. And the price is very reasonable.

My only quibble with the Veritas is that the rear handle is a bit chunky for my taste, though that can be remedied quickly and easily with a rasp. All in all, the Veritas scrub plane is a tool you'll turn to more than you might imagine.

—CS

For more information, circle #181 on Free Information Card.



SPECIFICATIONS

Veritas Scrub Plane

Street price: \$99 (#05P35.01)

to \$119 (#05P35.02)

Blade: High carbon (\$99) or A2 (\$119)

Body length: 11"

Performance: ●●●●○

Price range: \$\$\$

Lee Valley Tools: 800-871-8158 or

leevalley.com

JessEm Miter Gauge: Worth the Money

A high price tag brings high expectations and the JessEm Mite-R-Excel lives up to its price. Thoughtfully engineered and nicely made, the gauge uses a pair of brass pins to lock in angle adjustments in $1/2^\circ$ increments. I found this system easy to use, reliable and deadly accurate. The gauge can also be used without the pins; a vernier scale allows manual adjustments to $1/10^\circ$. All of the other parts were solid, smooth and precise. In use, it slid easily, was well balanced and felt solid without being too heavy.

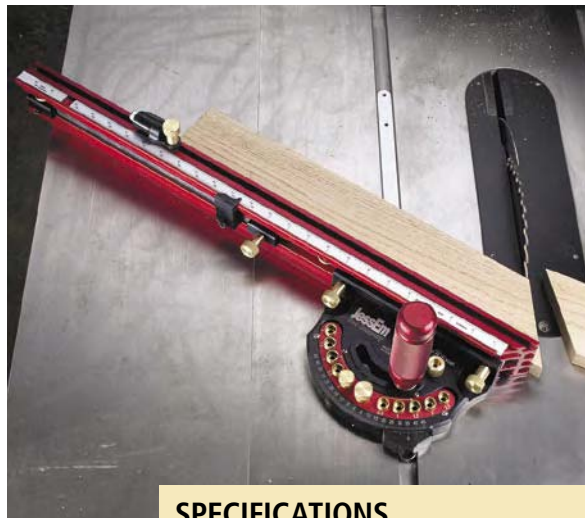
Less obvious features were also well executed. Adjusting the fit of the bar to the slots in the saw table is done from above, taking far less time than expected. The stop and scale on the extruded aluminum fence were easy to adjust and use. The scale can be recalibrated quickly if you move the position of the fence. The fence also extends to 36" giving you enough room to cut a table or a bench leg. Devices with a shorter reach really aren't of much value if you can't use them to make

common-sized furniture or cabinet parts.

All of the knobs and adjustments worked well, and there was a solid feeling of quality in every part. There was no detectable play in the stop, and the stop is close enough to the fence to allow it to be used with small parts that could slide under the stop in other systems.

This gauge stands out from the crowd because there aren't any compromises to be made or quirks to work around. Similar devices I have used have left me wondering if they were worth the price. The JessEm, on the other hand, seems like a bargain. The shortcomings we have seen with similar gauges have been overcome. I could pick this gauge up and use it with confidence. **PW** — Robert W. Lang

For more information, circle #178 on Free Information Card.



SPECIFICATIONS

JessEm Mite-R-Excel

Street price: \$220

Length capacity: Extends to 36"

Accuracy: (+/-) $1/10^\circ$

Performance: ●●●●●

Price range: \$\$\$\$

JessEm Tool Company: 866-272-7492 or
jesssem.com

A Better Table for a Drill Press

Hold and guide your work like never before with this fixture that will (finally) fix your drill press.

There probably isn't any machine more ignored in my shop than my drill press. Even though I use it constantly for one thing or another, the last significant upgrade it saw was a slab of leftover plywood and a simple, but workable, fence. Even after swearing to myself (and at the machine) on numerous occasions that I would come up with something better, I'd still haul out a clamp and screw gun to hold down some odd setup.

Most times I'm drilling a hole located from an edge and end, or a series of holes along an edge. The hole diameters need to be precise, but usually their relation to an edge doesn't require extraordinary precision. More and more often, I'm trying to hold down some elaborate fixture positioning an odd-shaped part.

Similar to many woodworkers, I often wondered why drill presses couldn't be more like mills and less like drills on a stick. What if I could go to my drill press and set hole locations without marking the part? What if it had a slotted top so I could mount fixtures anywhere? Isn't there a better alternative than a router-table-style fence?

As these ideas fermented in my mind, it wasn't until a catalog with the prominently featured slot-wall-cutting bit arrived that things took off. In a matter of minutes the T-slot table was born.

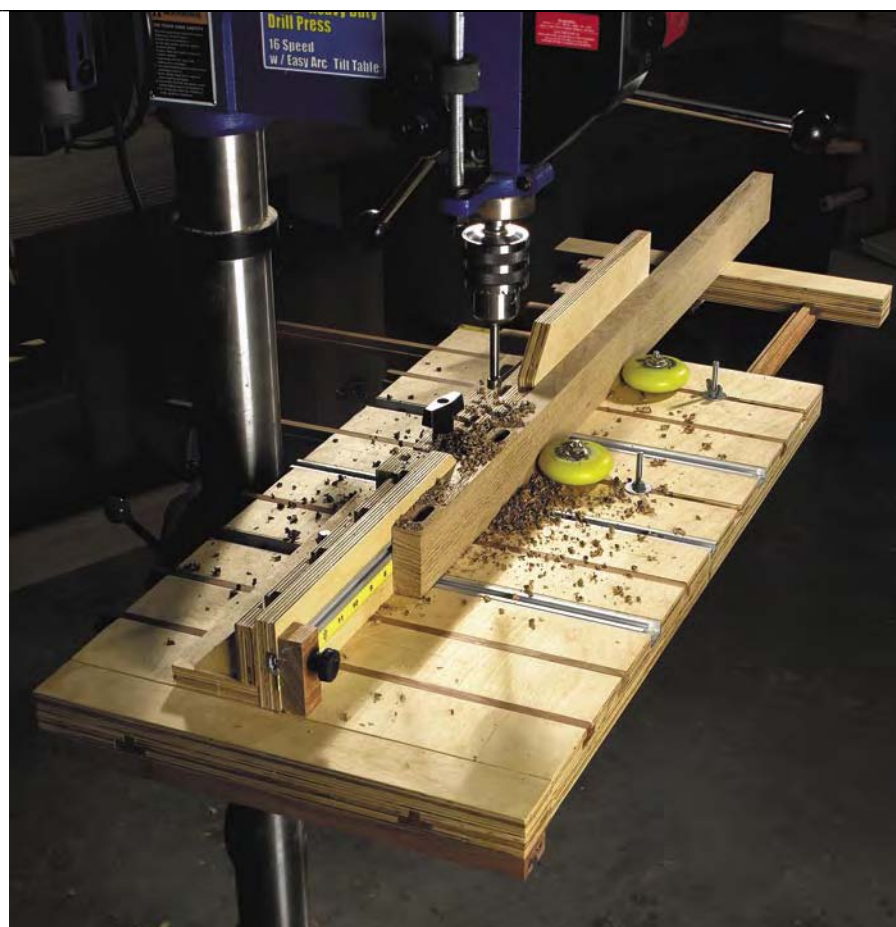


Photo by Al Parrish

On the T-slot table everything moves on an X/Y axis and all the scales are built into the table. T-track extrusions guide the fence to act as an independent table. Work can be clamped to the fence assembly and moved. Only one conveniently located knob is needed to lock down the fence. A row of slots on the back of the fence holds clamps for one-handed tightening of work. The large T-slots in the table hold a variety of fixtures and stops. Filled with wood strips, they keep out the dust and debris, and are self cleaning. Extensions on either end pull out to nearly double the table width, which is a handy feature.

Despite its somewhat overwhelming appearance, it is easy to build. The brunt of the work requires basic router skills and a couple quick jigs.

Making the Table

Everything for the T-slot table can be cut out of a 24" x 60" piece of birch plywood (or two

pieces of 24" x 30" birch plywood). Rip and crosscut the plywood to the sizes given in the cutting list, to start.

The upper table has three dados that hold the center T-slot extrusion and the two channel extrusions that guide the fence. I used a router to make all the dado and T-slots on the plywood table.

The first dado cut goes directly down the centerline of the table from front to back. Measure and mark 15" to the center of the table. Using an edge guide, set up your router to cut a 3/4"-wide by 3/8"-deep dado down the centerline of the table, front to back.

The next two dados hold dado channel extrusions. Measure 9" in from one end of the table and mark the centerline for the first dado. Using a router guide, make a 1" x 1/2"-deep dado from front to back. I didn't have a 1" bit so I made the dado in two passes using a 3/4" bit, offsetting the cut by 1/4" for the second pass.

The other dado holds the second channel extrusion. It must be parallel to the first 1" dado. The dados are cut 12" apart, centerline to centerline. Parallelism is more important than the exact 12" spacing. Measure accurately, but don't panic if the spacing is a hair

by Eric Hedberg

Eric is a writer and woodworker in St. Paul, Minnesota. When he isn't designing creative woodworking jigs, he actually takes time to work on the projects they were meant for.

off. A guide template that rides in the first 1" dado is preferable. Using a guide such as this also allows you to flip the guide around and use the dado you just cut as a guide to recut the previous dado. This will make sure your dados are parallel and eliminates future problems with the fence guides binding.

However, if you don't have such a guide, another option would be to carefully set up a router guide using the first dado as your reference point (again, maintaining the parallelism) as shown below, then cut the second 1" x 1/2"-deep dado front to back.

You're now ready to cut the 36" channel extrusion in half and install the channels into the two 1"-wide slots.

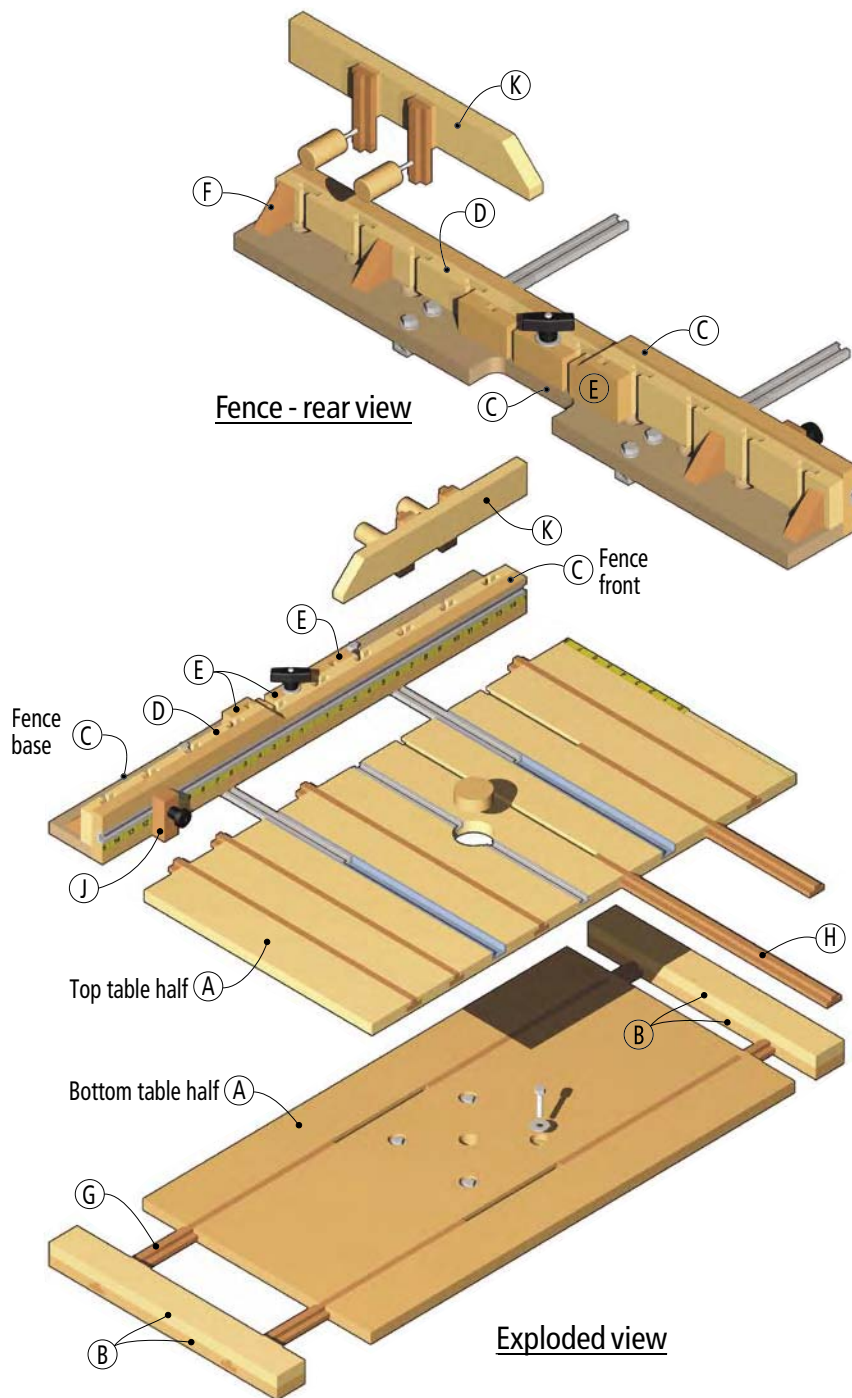
While you have the router set for a straight cut, readjust the depth and cut a shallow rabbet on the right edge to inset an adhesive scale flush with the surface. My scale was 1/2" wide x 1/16" thick; yours may differ.



After making my centered 3/4" x 3/8"-deep dado, I cut both the side 1" x 1/2"-deep dados using two passes with the same bit.



The second 1" dado must be parallel to the first, so if you use a router guide as shown here, measure carefully from the first dado to align the cut.



T-SLOT DRILL PRESS TABLE

	LETTER	NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL	COMMENTS
				T	W	L		
<input type="checkbox"/>	A	2	Table halves	3/4	16	30	Plywood	
<input type="checkbox"/>	B	4	Table extensions	3/4	2	16	Plywood	
<input type="checkbox"/>	C	2	Fence front & base	3/4	3	30	Plywood	
<input type="checkbox"/>	D	1	Clamp holder	3/4	2	30	Plywood	
<input type="checkbox"/>	E	3	Spacers	3/4	2	2 5/8	Plywood	
<input type="checkbox"/>	F	4	Fence braces	3/4	2	2	Plywood	Cut diagonally
<input type="checkbox"/>	G	4	Extension arms	1/2	1	16 3/4	Solid wood	
<input type="checkbox"/>	H	6	T-slot fillers	1/2	1	17	Solid wood	
<input type="checkbox"/>	J	1	Fence stop	3/4	1	2 1/2	Solid wood	
<input type="checkbox"/>	K	1	Tall fence	3/4	2	13	Solid wood	

The T-slots

Cut the T-slots using a jig similar to that in the photo below. It cuts the T-slots 3" on center from the previously cut 1" channels. Carefully set the depth of the bit to $\frac{5}{8}$ " and then cut T-slots on both sides of the channels. Cut the remaining two T-slots on the ends of the table, 3" from the adjoining T-slot by modifying your jig or using a router fence. Don't forget to recheck the bit depth.

T-slots on the Lower Table

Clamp the lower table extensions to each side of the table. The slots start 3" in from the long edges. With your router set, rout a T-slot end-to-end, parallel to each long side through the table and extensions.

Slotted Clamp Holder

Because I cut my table out of 60"-wide stock, I was able to make my clamp holder in one piece. If you cut yours out of smaller stock, you may need to put together sections. I cut my slots on my router table using a scrap wood fence and pin to control spacing, just like cutting finger joints on a table saw or router.

T-slot Fillers

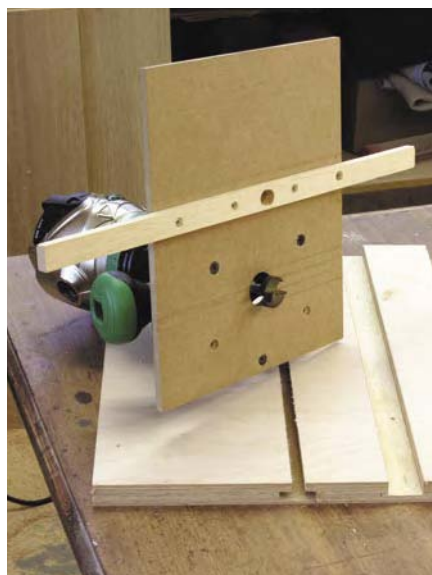
T-shaped strips fill the slots not in use and also serve as the supports for the table extensions. Just about any wood will work. I used some cherry leftovers that I had lying around. I cut mine with the same slot-cutting bit I used for the top, mounted in my router table. Any suitable method will work. Make them a nice

sliding fit. The same T-fillers will work to add accessories to the drill press table.

Making the Fence

Dado the channels for the T-track and measuring scales. Before cutting the fence profile I used screws to temporarily attach the clamp holder to the fence front. On the fence base, mark the exact center and drill holes as shown in the illustration for the guides, T-nuts and fence lock. Install the T-nuts.

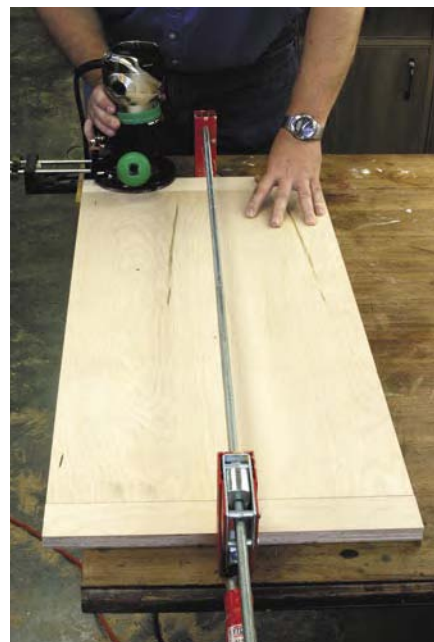
Assemble the fence with the front perpendicular to the base. Add blocking and spacers



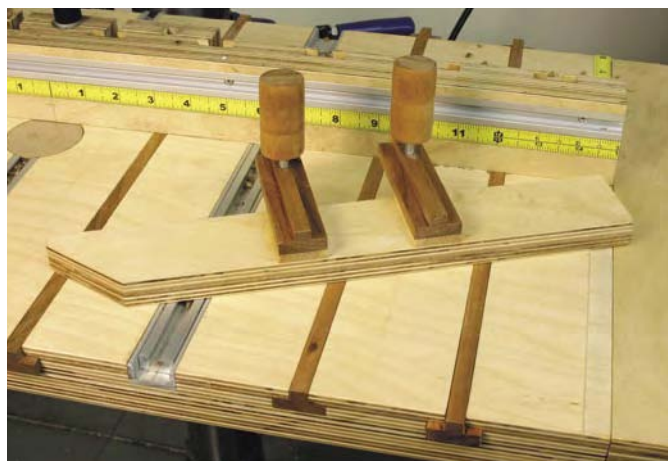
My jig to guide the T-slot cutter is simply an auxiliary base plate for the router and a $\frac{3}{4}$ " x $\frac{3}{8}$ " strip to guide in the 1" slots.

(see illustration on page 39). Cut 30" from the 48" T-track and install on the face.

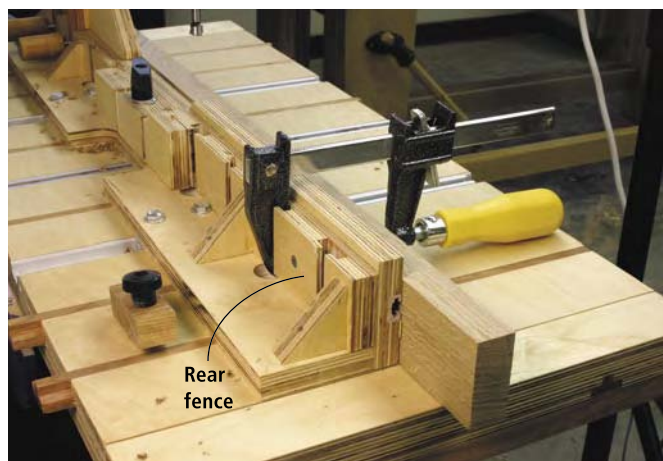
Cut the 24" piece of T-track in half to make guides for the fence. Securely attach one of the T-track guides to the fence with bolts and sliding T-nuts. The extrusion should protrude about 9" from the front of the face. Make sure the track is perfectly perpendicular to the fence face.



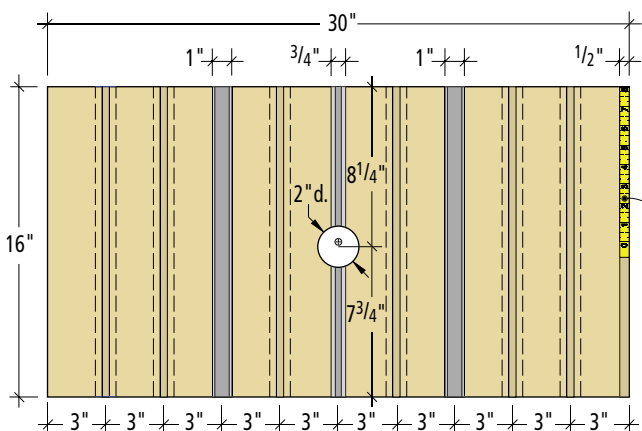
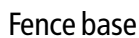
Clamp the end extensions to the lower table in the center to run the T-slots for the extension tables. If you have to move the clamp between cuts you might shift the location and mess up the smooth operation of the extensions.



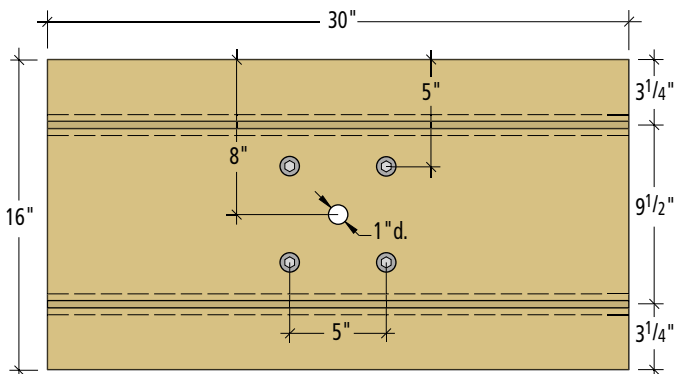
For working with taller objects, a taller fence (part K) is handy. By utilizing the T-slots in the rear fence, I easily adapted an auxiliary fence to slip into place on the right or left side of the table.



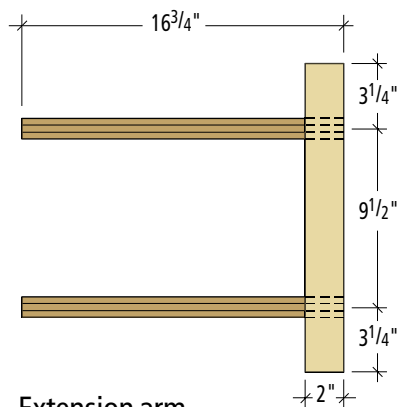
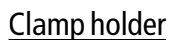
The fence can be simplified to the basic base, front and triangular braces, but I added the T-slotted rear fence to make it easy to attach a clamp to the fence. The T-slot lets the head of the F-style clamp slide into place, and holds it there.



Top table half



Bottom table half



NOTE: H = hardware.
See Supplies box
on the next page for
more information.

Mounting the Table

When you use a drill press with an auxiliary table, the area under the bit invariably becomes perforated. So I included a replaceable section under the bit. This isn't a new idea, but I've added tricks that make mine better.

It's nearly impossible to find $\frac{3}{4}$ " plywood that's actually $\frac{3}{4}$ ", so I use two discs to match the "thinner" plywood.

Before mounting the table to the drill press, use a $2\frac{1}{4}$ " hole saw to cut two medium-density fiberboard (MDF) plugs from scrap material. One should be $\frac{3}{16}$ " thick and the other $\frac{1}{2}$ " thick. These two discs, used together, add up to $\frac{11}{16}$ ", which is much more likely to be the thickness of your plywood.

Next, mark diagonals across the lower table to locate the center. Use a brad-point bit in the drill press to center the table and clamp it in position. Mark appropriate locations for bolts. Drill holes and counterbores for the bolts and re-center the table. Affix it with carriage bolts that lie flush or just below the top of the lower table.

Now it's time to attach the two table halves. Remove the extruded channels from the upper table and lay it on top of the lower table. Move it back $\frac{1}{4}$ " from the front edge of the lower table and clamp it into position.

Many drill press tables will use square table inserts, while I prefer a round insert because it collects less dust (no corners!). One concern with a round insert is if it was exactly centered in under the bit, the disc could get caught on the bit and spin. By making the replaceable center eccentric (drill through the disc off center), it cannot spin (an old engineer's trick).

Install a $2\frac{1}{8}$ " holesaw (lock-installing size) and drill through the first table until the saw edge just touches the lower table. Remove the plug. Move the top table to realign it perfectly with the lower table and re-clamp.

I used two $\frac{1}{4}$ " dowels to keep the upper and lower table pieces aligned. They have no structural purpose and I placed them in the dados because the track covers them up. I didn't permanently glue the table pieces together as I have commitment issues.

From the bottom, use screws to hold the upper and lower table together taking care not to drill through any of the T-slots. Apply a little glue to the bottom of the $\frac{3}{16}$ "-thick plug and drop it into the hole. After it has



The two-plug system brings the insert flush to the table surface. Also notice the offset location (the through hole is where the bit will drill) to keep the discs from spinning.

set, put a 1" bit into the press and drill a hole through the plug and lower table. You will see that the center of the plug does not match the center of the hole.

Putting it all Together

Reinstall the guide channels. Put the fence on the table and install the second T-track, and adjust to ensure smooth operation.

Drop the $\frac{1}{2}$ " MDF plug into the table and cut T-track from the leftover 18" piece to fit from the back and front up to the edge of the plug. Install the T-track with screws. Next, using the center "groove" on the extrusion, locate the center of the fence and transfer a line to the front and top.

Cut six pieces of T-slot filler stock to length (+ $\frac{3}{4}$ ") to fit the table and slide into position. Next cut the four $16\frac{3}{4}$ " pieces of T-slot filler stock for the extension guides. Glue the T-shaped stock into the extension pieces and attach the top piece.

Adhere the scales to the fence and table, connect the lock-down knob and bolt on the fence, and you are set to go.

Jigs, Fixtures, etc.

The large T-slots require custom T-bolts. I make mine by using scraps of the T-filler strips. I drill a $\frac{3}{16}$ " hole through the center and then thread with a $\frac{1}{4}$ -20 tap. A countersink on the back lets me thread a $\frac{1}{4}$ -20 flathead stove bolt through to make a rock-solid T-bolt.

Your fixture is ready, but I'm sure you'll continue to work on it, as I have. I've come up with a number of "add-ons" to improve the



Roller guides are only one of the accessories you can add to your drill press table.

usefulness of the table, such as a pair of roller blade wheels to serve as a rolling clamp for stock. And with all the T-slots available on the jig, there are lots of places to attach any kind of accessory you can dream up. **PW**

SUPPLIES

Lee Valley

800-871-8158 or leevalley.com

- 1 • slot-wall bit
#16J60.61, \$16.50
- 1 • $\frac{3}{4}$ " x 36" slot extrusion (H1)
#12K79.07, \$10.50
- 1 • 48" T-slot extrusion (H2)
#12K79.02, \$12.50
- 1 • 24" T-slot extrusion (H3)
#12K79.01, \$6.50
- 2 • left-to-right adhesive scale (H4)
#06K17.02, \$2.50
- 1 • right-to-left adhesive scale (H5)
#06K17.01, \$2.50
- 4 • $\frac{1}{4}$ -20 sliding T-nuts
#05J21.15, \$2.00 for 10

Rockler

800-279-4441 or rockler.com

- 1 • $\frac{5}{16}$ -18 x $1\frac{1}{2}$ " T-slot bolt (H6)
#83311, \$.99
- 1 • $\frac{5}{16}$ -18 x $2\frac{1}{2}$ " T-slot bolt
#33939, \$1.19
- 1 • 2" T-knob (H7)
#71514, \$.99
- 1 • 1" round knob (H8)
#34121, \$1.39

The Secrets to Sawing Fast

The traditional hand saw (when wielded correctly) can size all your stock. Here's a basic primer.

Hand saws were used to make some of the finest furniture ever built. They are very clearly capable of producing accurate cuts. Hand saws require little shop space, and produce little appreciable noise or dust.

These facts conspire to allow work in environments or at hours otherwise inhospitable to modern means. Please don't underestimate the advantage of working outside, late at night, in the living room or kitchen, etc. Likewise, the elimination of the table saw—or even the reduction of its use—frees up precious workshop floor space, allowing room for other tools, workbenches, finishing areas, etc.

So it appears in advantage after advantage that hand saws are effective if not superior tools. Clearly only 220-volt speed stands in their way of becoming the one essential tool in every woodworker's shop.

In this, the fourth article in our Arts and Mysteries series, we'll investigate the secret tricks period woodworkers used to saw quickly. Let's begin by examining basic technique:

How to Rip Efficiently

Ripping at the horse is performed using one or more sawhorses. Boards can be placed across two horses (typically 20" to 24" high), or supported by the broad top of a single horse. Because ripping is defined as sawing along the grain, the cut is started at one end of the board. The cut is started with the finer, heavily raked teeth, at the toe of the rip saw. Using the knuckle of your thumb or forefinger to steady the blade, draw the saw backwards to create a small nick. Use very light strokes for the first cuts. Don't allow the full weight of the saw to rest against the board. These first



Ripping at the horse is surprisingly fast and effective. Here (dressed in the traditional garb I wear at Pennsbury Manor) I'm using the more heavily raked teeth at the toe of the saw to help start the cut.

motions can be very short, using just the fine teeth at the toe.

Once the saw starts cutting, full strokes can be used. The saw should be held more vertical than horizontal, say 45° to 60° with

respect to the board's face. Don't force the saw into the cut as if it's a knife. Let the saw's weight provide the force for the cut. Relax your grip. Focus on placing your effort behind the teeth. These strokes are performed with the arm only. The shoulders must remain fixed, as twisting moves the hand sideways. The hand should move from armpit to full extension, in a nice straight line. In time, this motion will become second nature.

To correct a wayward cut, lower the angle the saw makes with the board. The saw will

by Adam Cherubini

Adam makes reproduction furniture using the tools and techniques of the 18th century. He demonstrates his craft at Pennsbury Manor in Bucks County, Pennsylvania, on Historic Trades Days. You can contact him at adam.cherubini@verizon.net.

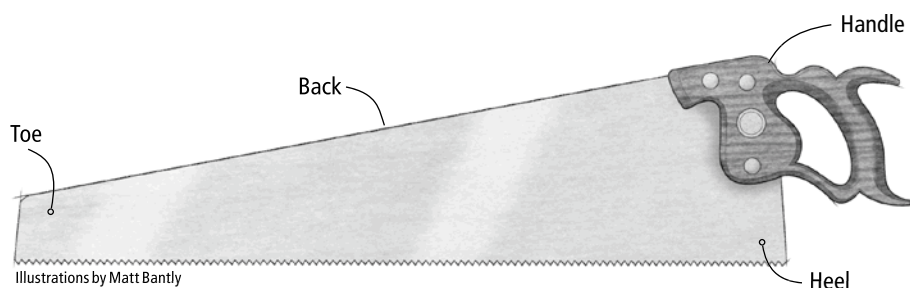
Photos by the author

now ride in a much longer kerf. Push the heel of the saw sideways, ever so slightly back to the line with each passing stroke. The effort of sawing will likely be increased as the blade is forced into a curved shape. If the effort becomes too great or the mis-cut too severe, return the saw to the previously straighter section, and lay it down. Lay a new kerf through the mis-cut area. See the photo on page 44 for more details.

If the cut is not perpendicular through the thickness, there's no way to fix it during the saw cut. Resist the temptation to twist the saw or bend it sideways to correct. This won't help. This must be fixed later with a hand plane, but then nearly all long rip saw cuts must be cleaned up regardless of the tool that does the ripping. Next time, leave a little extra room to the line. Leaving a little extra beyond the line is no great sin in rip sawing. The planing goes so quickly, one can't honestly say it's a waste of time, only a waste of wood.

Crosscutting Wide Boards and Panels

Because crosscuts are often related to the long edge (often perpendicular) they are typically performed after ripping and edge planing is finished. The resulting cut is often the finish



Hand saw anatomy

cut (not like a rough cut with a rip). Moreover, planing end grain is difficult. For these reasons, extra care should be taken to produce a straight and square crosscut.

Depending on the length of the resulting scrap or offcut, crosscutting is performed either using the bench hook or using a pair of sawhorses. The line to be cut should be carefully knifed across the face of the board. A square mark is then knifed through the thickness with the try square. Make this mark on the far edge of the board (where the cut is about to begin).

Drawing the saw back slowly at a 45° angle to the work, nick the far corner. Begin the saw cut with light, careful strokes. Advance on

both lines (across the face and through the thickness) simultaneously. This is a critical skill worth practicing, as it will be later used for all crosscuts and many joinery operations, including dovetailing. When the cut through the thickness is complete, lay the saw down and advance the cut only on the face line, using the existing kerf to guide the saw. Maintain this relatively low angle (maybe 30°) until a sizable kerf is created. With a good-sized slit to guide your saw, begin incrementally raising the angle as you saw through the stock. Your saw should make a 45° angle when you reach the end of the cut. As always, make sure the scrap is well supported before finishing the cut.

GOOD GRIPS



All hand saws are held in a similar manner. Three fingers and the thumb grip the handle lightly. The index finger points, laying along the side of the handle or blade.



Most rip saws with closed or ring-type handles have enough room for four fingers. These handles allow a two-handed grip. You can pass the thumb of the offhand through the space not used by your dominant hand's forefinger. The other fingers wrap over the top of the handle. You will likely find the handle has been specially designed to permit this grip.



The overhand grip, while it looks uncomfortable, is highly effective. I find it is especially helpful when sawing thick stock as it limits the number of teeth in the kerf and keeps the kerf free of tooth-clogging sawdust.



Try to limit the amount of motion in your upper body when ripping or crosscutting.

Picking Up Speed

I find a sharp saw cuts faster than a dull one (not hard to believe). Sharpening a saw isn't as difficult as honing a plane iron, though it takes about the same amount of time to learn and perform. Selecting the right saw for the job (see "Good Saws" on page 45) is a major contributor to sawing speed. In general, saws with lower rakes cut faster. Even faster than a low rake is a saw with no rake or negative rake (forward-swept teeth). Handles that focus all effort behind the teeth seem more efficient to me and thus make sawing faster. Of course, these benefits come at some price. But generally, learning more about how saw teeth work, and optimizing your saws for your work, is an important first step to learning to saw faster (and a topic worthy of another article).

In addition to a good saw, good technique makes a significant contribution to speed. With proper technique and practice, you'll be able to rip 4'-long 4/4 stock in a few minutes. The ripped edge will need to be planed to achieve a straight, square edge, but that process goes quickly and would be performed regardless of the voltage of the saw used. But



Correct a miscut by lowering the angle as shown above. This angle puts more of the saw in the kerf. We see this philosophy again and again in the period shop. Long tools make straight cuts.

good saws and technique can take you only so far. There is a limit to the speed achievable. I believe that limit is still far below the reasonable expectations of modern craftsmen.

Before we reject our hand saws it may be helpful to look back in history (as is our custom in this column) to see what we might learn from 18th-century craftsmen.

Eighteenth-century account books indicate craftsmen sometimes purchased lumber in “scantlen.” This may provide some explanation for pre-industrial woodworkers’ productivity. Scantlen was a term used to describe boards purchased at some desired dimensions straight from the mill. Craftsmen could purchase stock in the sizes they needed to limit the amount of sawing required in-house. Mills at the time, not unlike modern lumberyards, had specialized machinery and personnel that could dimension lumber faster than individual shops. Some 18th-century mills in Philadelphia advertised that they had lumber sized for certain industries in stock and ready for immediate delivery. Surely this was done in response to a demand from area craftsmen who found such a service cost-effective.

Modern period woodworkers rely heavily on project plans made from extant pieces. Unfortunately the original builders’ plans are lost. It could be that the plans were drawn on scrap wood that later fueled the shop’s heating system. Or perhaps we have failed to recognize their plans simply because their plans don’t look like plans we use today. Artists generally don’t care if their canvas is 12” tall or 200”. Beauty isn’t contained in these numbers. The proportions are what we see, not inches. Period craftsmen may have worked parametrically, using existing stock to define key dimensions. In this way, they could use their materials more efficiently, limit the labor required and work directly to the desires of their customers.

Now you know a secret I’ve spent years learning. If you don’t understand this mystery, unplug your table saw and start relying on your hand saw. After you’ve learned to sharpen and use it correctly, you too will find clever ways to keep it hanging from the nail in the wall. No saw can cut as fast as that. **PW**

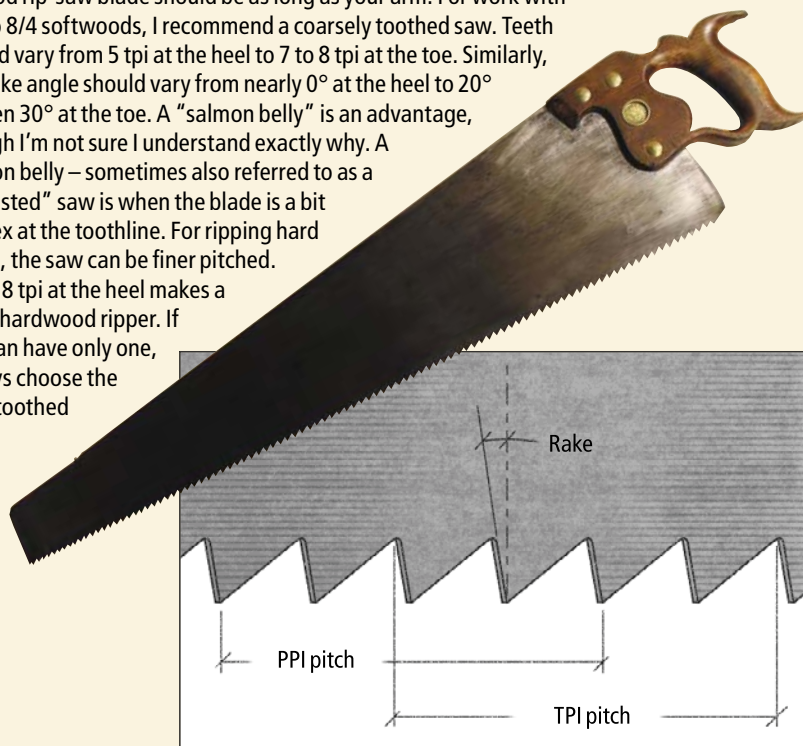
Coming next issue: Adam Cherubini explains why a hatchet is an essential woodworking tool, shows you how to use one and spins another woodworking mystery for you to ponder.

GOOD SAWS

Choosing the right saw for the job at hand is an important first hurdle.

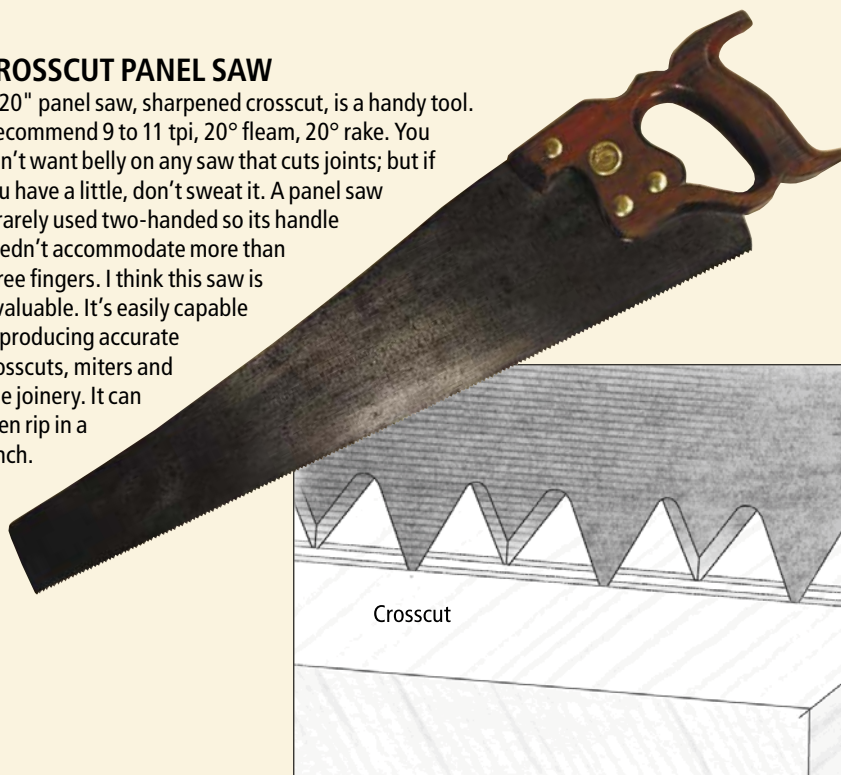
RIP SAW

A good rip-saw blade should be as long as your arm. For work with 4/4 to 8/4 softwoods, I recommend a coarsely toothed saw. Teeth should vary from 5 tpi at the heel to 7 to 8 tpi at the toe. Similarly, the rake angle should vary from nearly 0° at the heel to 20° or even 30° at the toe. A “salmon belly” is an advantage, though I’m not sure I understand exactly why. A salmon belly – sometimes also referred to as a “breasted” saw is when the blade is a bit convex at the toothline. For ripping hard wood, the saw can be finer pitched. Six to 8 tpi at the heel makes a good hardwood ripper. If you can have only one, always choose the finer toothed saw.



CROSSCUT PANEL SAW

A 20” panel saw, sharpened crosscut, is a handy tool. I recommend 9 to 11 tpi, 20° fleam, 20° rake. You don’t want belly on any saw that cuts joints; but if you have a little, don’t sweat it. A panel saw is rarely used two-handed so its handle needn’t accommodate more than three fingers. I think this saw is invaluable. It’s easily capable of producing accurate crosscuts, miters and fine joinery. It can even rip in a pinch.



Frank Klausz's FINAL WORD ON DOVETAILS

Stop measuring and simply learn
how to saw straight.

The dovetail is an ancient joint widely used in cathedrals, barns and Egyptian furniture. It is the right joint for many items including fine furniture, carcasses, drawers and jewelry boxes. They are all dovetailed together.

I was only 27 years old when I came to this country in 1968 from my native Hungary. Although I had a piece of paper that said “master cabinetmaker,” I was still very eager to learn more about my trade.

Where I came from I was happy if I could carry a white-haired master’s tool chest to the job site because I knew I would learn a thing or two that day working with him. Now I am that white-haired master with 45 years of experience in the trade.

In the early 1970s I went to a lot of seminars. Some were on dovetailing with well-known teachers in the woodworking world. Some cut the tails first; others cut the pins first. They used tools that I didn’t own, such as a dovetail marker. They measured the size of the pins and tails, which is completely different from my method. The more I studied, the more confused I became. I decided to find the best way to cut tight dovetails quickly.

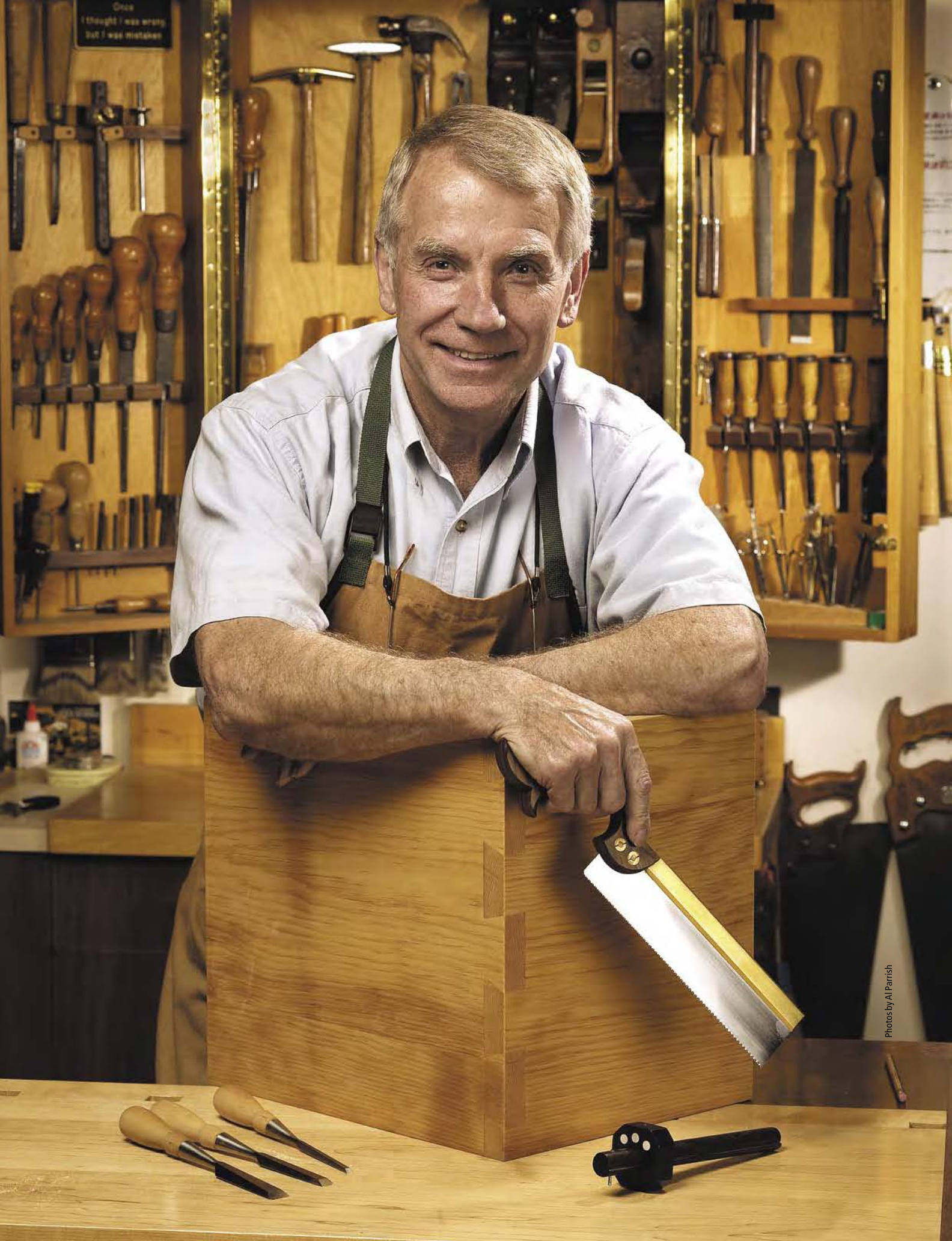
A Search for the Best Method

I owned an antique restoration shop. I had a chance to study a lot of antiques from around the world. Each time a piece of furniture came to the shop, the first thing I looked at was the dovetails. I studied hundreds of them and made tracings of dozens of unusual pieces. I tried to find an answer for my methods. I learned in Hungary, I worked in Vienna, and I was looking for someone from a different part of the world than Eastern Europe to do dovetails. I found Hector, from Guatemala, a master cabinetmaker.

“This is great, Central America!” I said. I asked him to make me dovetails. He said, “You cabinetmaker, you make dovetail.” We had a language problem. I had a hard time explaining to him my intentions. I replied, “I know how to cut dovetails, I want to see how you do it.” “OK,” he said. He grabbed some chisels, a dovetail saw, a marking gauge, some scrap wood, set up the marking gauge to the thickness of the wood, marked the wood, clamped it into a vise and started cutting. He cut the pins, chiseled the pins; from the pins he marked the tails, chiseled the tails and put it together. “How is

by Frank Klausz

Educated in the Hungarian trade school system, Frank is a master cabinetmaker, author and owner of Frank’s Cabinet Shop in Pluckemin, New Jersey, which specializes in fine furniture reproductions and custom architectural fixtures. He also teaches woodworking. For more information, visit frankklausz.com.



Photos by Al Parrish

that?" he asked. I was as happy as can be! "That is exactly the way I do it," I replied.

After my experience with Hector, and my 10 years of researching dovetail techniques, I came to the conclusion that Grandpa wasn't a bad craftsman at all and my father taught me well.

Later on, I wrote some articles for different magazines and I made some videos – one of them is "Dovetail a Drawer with Frank Klausz." Before I knew it, I was teaching the craft throughout America. I taught hundreds of people how to dovetail. A lesson took plus or minus one hour with a 99 percent student success rate (let's face it, some of us are born with two left hands).

Anyone Can Do It

If you already know how to do dovetails, and are happy with your method, I am happy for you and don't mean to change your ways. If you are a beginner or learning about new methods, you can do it my way. I know you can do it!

CUT DOVETAILS EASILY ON BIGGER BOARDS

When cutting dovetails on a wider board, use the same method as I describe in this article. You have to divide the remaining space after your third cut in half and half again, or $\frac{1}{3}$. With practice it will come naturally. The thicker the wood, the bigger the pins and tails. For example, a 1"-thick board for a blanket chest should have 1" to $1\frac{1}{2}$ " tails. It both looks good and is very strong. When I was an apprentice watching my father work, I asked him, "How can you do this so fast?" He replied, "Don't worry, after 10 to 15 years you will be a good beginner yourself." —FK

How do you know how to write? You learned in school. You made a whole row of a's. You made a whole row of b's. Before you knew it, you were writing words and sentences. That's how I learned to do dovetails. In school, I cut a whole row of straight cuts without marking, checked it often with a square, and improved the next row. In the next lesson, I cut angles approximately 10° to 15° , all to the left, the next row all to the right, and before I knew it, I was cutting dovetails.

Companies sell router bits from 7° to 18° , so the angle you use is a personal choice. The strongest dovetails have equal-sized pins and tails, like machine-made drawers. Pope John Paul II's coffin had approximately 3" pins and 3" tails. The choices are endless.

Cutting Dovetails My Way

So how do you make dovetails my way? Make yourself a cheat sheet (see the drawing above) or look at some dovetails to copy. Get some scrap wood. Mill them to the same size: $3\frac{1}{2}$ " to 4" wide, $\frac{1}{2}$ " thick and cut them 5" to 6" long. Mill five, 10 pieces, whatever it takes. Set up your marking gauge exactly to the thickness of the wood. Mark the face of the wood. Clamp it into your bench vise, and start cutting with your dovetail saw. (I hope you already practiced your rows of straight and angled cuts.)

Every dovetail starts with a half pin. On the other side is another half pin. Cut them. Next to the half pin you need a full tail. Cut it. Cut the remaining distance in half with the same angle, turn it around, make two more cuts and you're done. Cut only pins, and cut as many as you need until you are pleased.

There's no marking involved – use your eyesight and judgment, and use the thickness of the wood for the width of the tails by judging distances. Make them to your

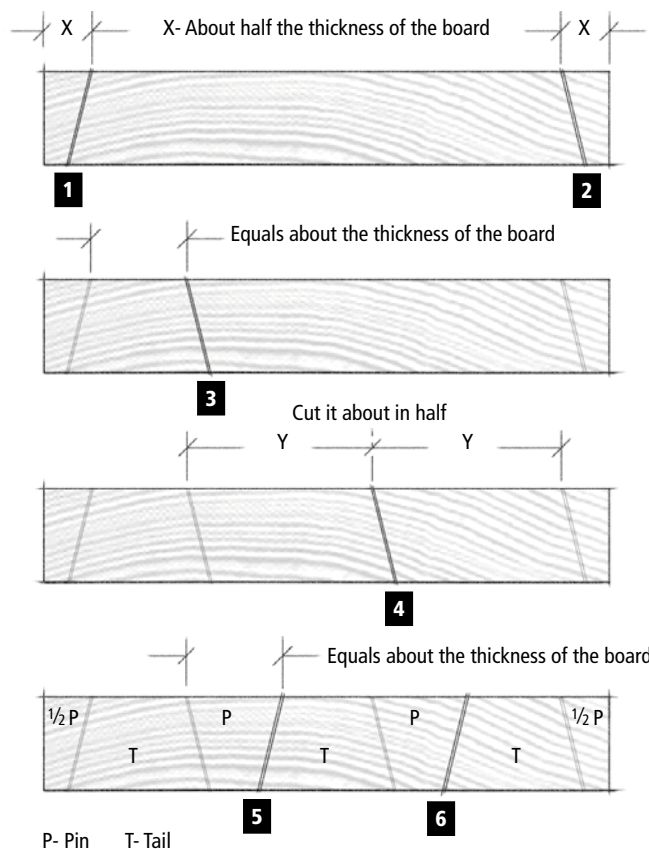


Illustration by Matt Bantley

liking. My pins are a little smaller than the tails. That's the way I like them. You may make them the same way or you may make small pins such as ones found in English furniture. They are all good. You are cutting hand-cut dovetails; there should be some variation. Hand-cut dovetails have character and Mrs. Jones likes that.

Once you're happy with your pins, chisel the pins. Put the chisel on the marking gauge line and tap it. Take out a little "V" cut. Now chisel deeper, taking out chips. Undercut just a very little. Flip the piece over and do the same on the other side.

Next, use your pins to make the tails. Hold all three sides even with the edge and the end. With a sharp pencil, mark it from the inside. Here is the hard part: When you cut the pins a little this way or a little that way, it doesn't matter because you're making a

template. But when you cut the tails, you have to be accurate and cut that pencil line in half. To understand which side of the pencil line you are cutting, you have to mark the half pins and pins with an "X." That will be your waste. When you chisel out your waste, the "X" will become sawdust and chips. Cut off your half pins; chisel your tails (you are chiseling out the space for the pins).

Here comes the fun part: Try fitting it together. If it doesn't fit, try to find out why, but don't fix it. Cut your next piece. You may have to go closer to the line if it is too tight or leave more of the line on to make it tighter. Make a new one using the same pins until you are happy with a snug fit.

You are ready to make a jewelry box for your mother-in-law. Good luck trying, I am sure you can do it! Happy woodworking. **PW**

CUTTING DOVETAILS THE KLAUSZ WAY



1

Set up the marking gauge exactly to the thickness of the wood.



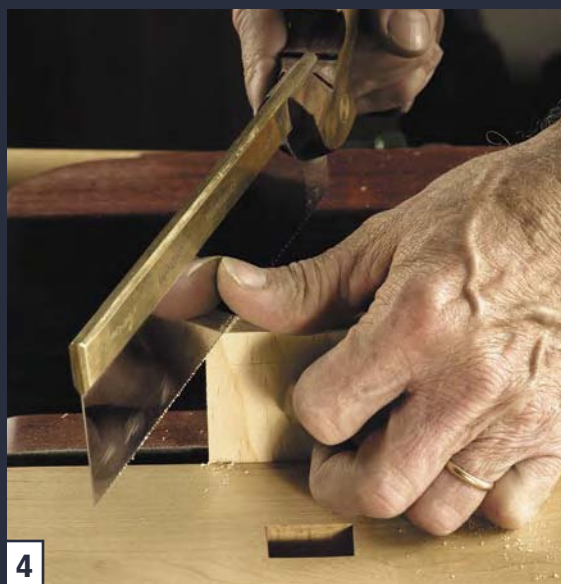
2

Next, mark the wood.



3

Cut a half pin.



4

Cut another half pin.



5

Cut a tail.



6

Divide the distance in half between the two saw kerfs and cut it.



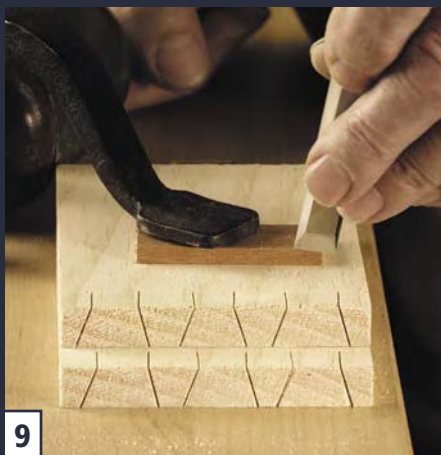
7

Go back to your first angle and cut another pin.



8

Cut one more pin. You're done cutting pins.



9

Put the chisel into the marking gauge line and tap it.



10

Do the same on all the tails.



11

Tilt the chisel forward to take out a little piece.



12

Put the chisel back up and tap it more. Undercut a little bit, approximately 2°.



13

With a smaller chisel, chisel into the corners. Chisel about halfway.



14

Flip your stock and chisel from the other side.



15

From the pins, mark the tails. Hold the pin board flush on the outside and on the edges.



16

Mark your waste (the bits of wood you will be cutting out) with an "X."



17

Line up your saw with the pencil line. Use your thumb for a guide and cut on the "X" side.



18

Here you can see what it looks like to leave the lines on the tails.



19

Cut off the half pin. The saw kerf should be outside of the marking gauge line.



20

Chisel the tails the same way you chiseled the pins.



21

With the edge of your chisel, push out your waste.



22

If you did everything right, it should easily tap together.



23

Here you can see the finished practice piece.

Dovetails, THE POPE'S COFFIN AND THE UNIDENTIFIED CRAFTSMAN

A quest to find the builder of this famous project.

The morning after Pope John Paul II's funeral, John Darrow, Frank Klausz's finisher, asked Klausz, "Did you see the pope's coffin?" Klausz hadn't. "It has big, big pins and tails, just like you do them!" Darrow said.

Using pictures of the coffin to determine scale, Klausz made a replica pine corner. Then he examined the joinery in the pictures using a magnifying loop. "It was easy to tell nobody measured or used angle gauges," Klausz says.

Finding out who built the highly publicized coffin should have been easy, but it wasn't.

The quest first led to the editor of the Catholic magazine *America*. He said to contact the United States Conference of Catholic Bishops who said to contact the Vatican Embassy in Washington D.C. who said to contact the Vatican press office who said they don't handle requests "for such small details." Several other publications and an organizer of a funeral fair in Poland didn't respond.

Several Vatican experts did research for us and found nothing. The Catholic News Service also couldn't provide detailed information.

Two experts who were in Rome asked several people in the city but no one knew anything. Rev. Steven M. Avella said Archbishop Stanislaw Dziwisz, "the pope's dear friend and personal secretary" knows but doesn't respond to these types of requests.

Wendy J. Reardon, author of "The Deaths of the Popes" (McFarland & Co.) and part-time teacher of exotic dancing (yes, exotic dancing) suggested contacting Alan Howard who runs St. Peter's Basilica's web site. "He's got some powerful friends in St. Peter's, so perhaps he can ask them," Reardon said. Howard gave us the address of Archbishop Piero Marini, who planned the pope's funeral. John-Peter Pham, author of "Heirs of the Fisherman: Behind the Scenes of Papal Death and Succession" (Oxford University Press) also suggested we contact Marini. So we sent a letter to Vatican City.

Surprisingly Marini sent a letter back. After translating its few sentences we learned this: The coffin was built in Vatican City.



Pallbearers carry Pope John Paul II's cypress, dovetailed coffin into the Basilica during his funeral in the center of St. Peter's Square at the Vatican April 8, 2005. Note the coffin's large pins and tails.

While this news was welcome, the lack of further information was unfortunate. So the quest took some alternate paths. Travel writer Rick Steve's consulting department was unable to provide information about Vatican woodshops. Brian Boggs, a chairmaker in Berea, Ky., provided contact information for Thom Price, a gondola maker in Venice who didn't respond.

But Mark Marsay, a London, England-based refinisher and tool restorer with family in Italy recalled hearing that the coffin was made by Vatican Museums' restorers and conservators. He also didn't think it was a solo effort. But he couldn't confirm anything.

Our quest ended when we called Vatican Museums: Our deadline had approached and no one on the other line spoke English.

Although much remains unknown, we did uncover some interesting facts and suspicions:

- The cypress coffin was adorned with a carving of a cross and the letter "M," which stood for "Mary, the mother of Jesus."
- Along with the pope's body a sealed lead tube called a rogito containing a sack of bronze and silver Vatican medals, and a brief biography written in Latin were placed in the coffin.
- The pope was buried in three coffins. The innermost cypress coffin was placed inside a zinc coffin, which was placed inside another wood coffin (some sources say the wood is elm; others say it's walnut or oak).

• Charles Garnette, an Indiana-based woodworker who plans to build a replica of the cypress coffin, surmised from pictures that the wood is about 1" thick. Garnette says there is speculation by Vatican historians that the cypress was recycled wood, perhaps old door planks. He also believes the coffin actually was built in 1981, when Pope John Paul was shot.

Still, it's too bad we don't know who built the coffin. Such skill and dovetail methodology deserve recognition and exploration.

— Kara Gebhart Uhl



Pope John Paul II's outermost coffin is taken to the grottos beneath St. Peter's Basilica at the Vatican.

WOODWORKING ESSENTIALS

BY DAVID THIEL

CHAPTER

1

Casework Construction: Beginning Principles

To open our seven-part series on casework construction it's probably smart to include the definition of casework. "Webster's Dictionary" (Random House Value Publishing) gives it a one-word definition: cabinetwork. I think that's both a little too complicated and simplistic at the same time. Casework is making boxes. Whether for cabinets, bookcases, nightstands or storage boxes for all your old *Popular Woodworking* magazines, casework is making boxes.

Casework can be as simple as two sides, a top, bottom, back and a door (such as a medicine cabinet). Or it can be a box on a stand with more boxes inside and another box on top of it with doors (such as the entertainment center shown at right).

In this series we'll be discussing casework design, joinery, construction, accessorizing and more. But before we get too deep, let's start with some common definitions so that we're all talking the same language.

Casework Parts

Casework can be called cabinetwork, carcase construction and a variety of other things. Similarly, the parts that make up a piece of casework furniture have many different definitions depending on country of origin and who the builder is.

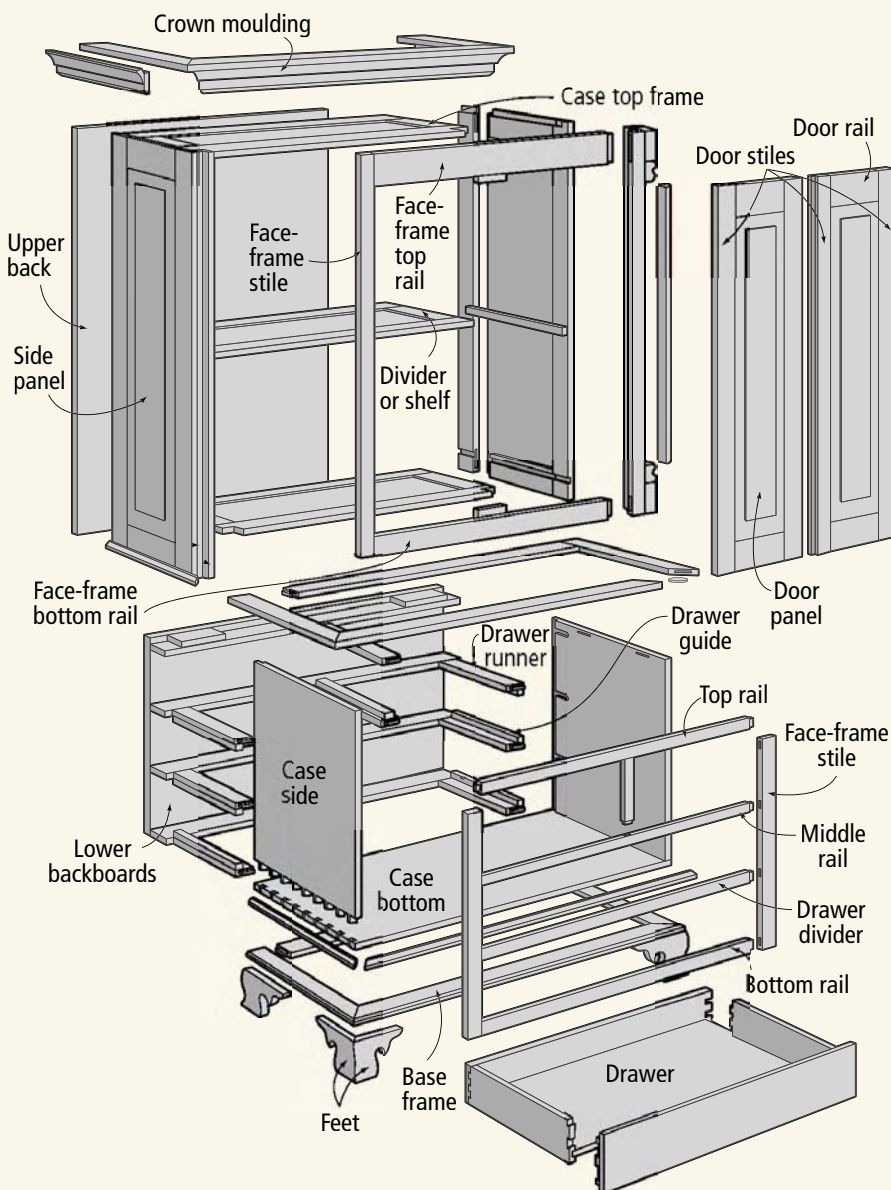


Illustration by Len Churchill

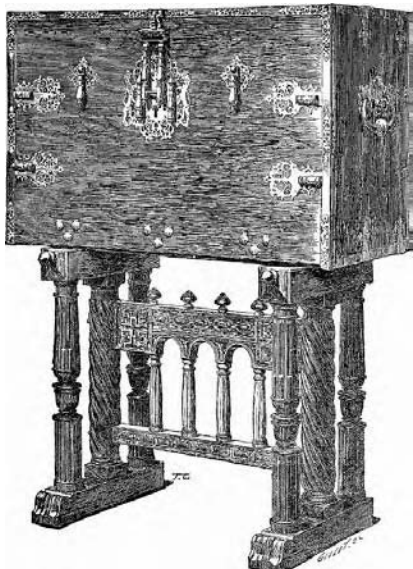
The History of Case Furniture

The history of case furniture actually needs to start with chests that first appeared in Egypt more than 4,000 years ago. The boxes were made from boards joined together at the corners and were used to carry heavy loads when traveling. Around 1,500 B.C. chests found in Egyptian tombs showed improved joinery skills with the introduction of frame-and-panel construction. The interiors often were divided for storage of jewelry and other valuables used in the burial process.

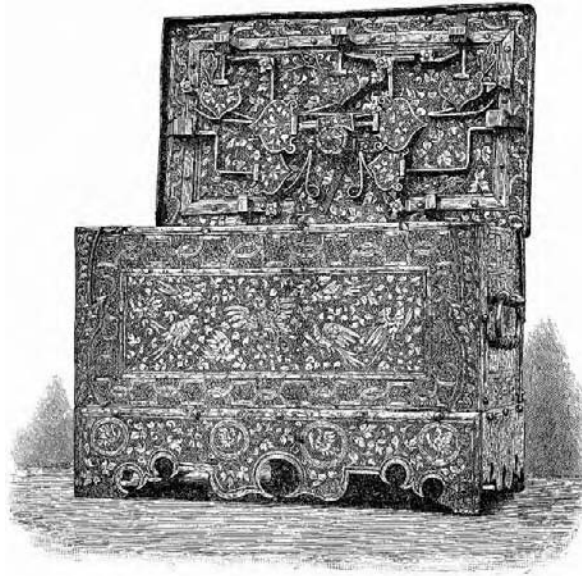
In time, legs were added to boxes used by the Egyptians and these pieces became the first rudimentary case furniture. They were used to store linens, jewelry and toiletries. The next evolution of casework (adding shelves and doors) didn't appear for quite a while.

Furniture designed for holding household goods, what we would call cupboards, didn't appear until late in the Greek and Roman eras. They were still not considered valuable furniture, and were often built using rough wood and crude joinery.

This construction trend continued into the early Middle Ages when the cupboard, known as the press, was often vividly painted to disguise its generally crude joinery. Presses began changing and improving in the Gothic era as more attention was paid to the construction and decoration of the pieces. The form began



This is a Spanish, 17th-century wooden coffer with wrought-iron mounts and a falling flap, on carved stand. (Basically, it's a fancy box.)



This is a 16th-century coffer fort (a coffer fort is bigger than a coffer). The decoration is bitten in with acids so as to present the appearance of its being damascened, and the complicated lock, shown on the inside of the lid, is characteristic of these safeguards for valuable documents at a time when the modern burglar-proof safe had not been thought of.

to change as well, with specific purposes being assigned to the furniture. It was during this period that the armoire and wardrobe furniture styles came into fashion.

True cabinetry started in Italy in the 16th century and the concept quickly spread across the continent. When it came to decorating these cabinets, architecture heavily influenced the designs, much of it classical in nature. During the 17th and 18th centuries, cabinets were the most important and elaborate pieces of furniture made. Because of the time, effort and skill required to create these pieces, the profession of cabinetmaker became synonymous with particularly fine furniture.

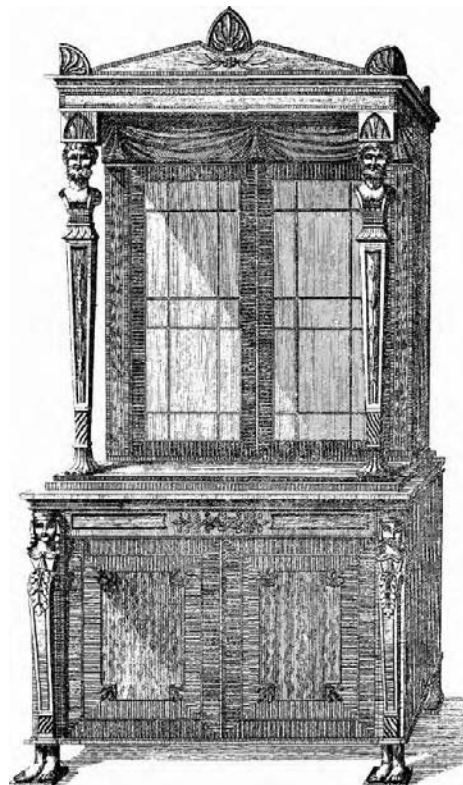
The next evolution for casework was the addition of divided storage. Cabinet pieces with drawers became very popular in America in the mid-17th century. Chests were often filled with drawers (usually four) and were referred to as "cases of drawers." Doors and drawers were soon blended together in pieces to offer a variety in storage options.

And that brings us up to the furniture design that most of us consider traditional case furniture. However, during the mid-20th century, there was a change in case construction that continues to affect the type of furniture we have in our homes – frameless construction.

It's widely accepted that the origin of frameless cabinetry can be traced back to the post-World War II reconstruction effort in Germany. The need for quick, inexpensive furniture

using a minimum of materials led to the 32mm assembly-line construction of case pieces. New hardware made it possible to build cabinets without face frames, revolutionizing 20th-century furniture design.

—DT



This bookcase design was published in "The Cabinet Maker and Upholsterer's Drawing Book" by Thomas Sheraton in 1793.

So that we're speaking the same language, I'm going to define the parts of a typical casework piece; and though you might use a different name, we'll refer to them as discussed here throughout the series. Not all of these pieces will occur in every casework piece, but they could. It's similar to the options on your car.

■ Sides

All casework pieces will have at least two sides and sometimes more if there are upper and lower sections. They can be simple slabs of solid wood or plywood, or frame-and-panel construction.

■ Bottom

As with the sides, this one's almost a given. There may be specialty situations where a bottom isn't required, but because most casework is designed as storage, having a place to rest your stored items is a good thing.

■ Dividers

These parts can be either horizontal or vertical surfaces. Because they separate the main casework box into smaller sections they're known as dividers. They can be the full depth of the case piece, or they can be partial depth as when dividing drawer sections where the division is important from the front view, but it's not necessary to be full-depth.

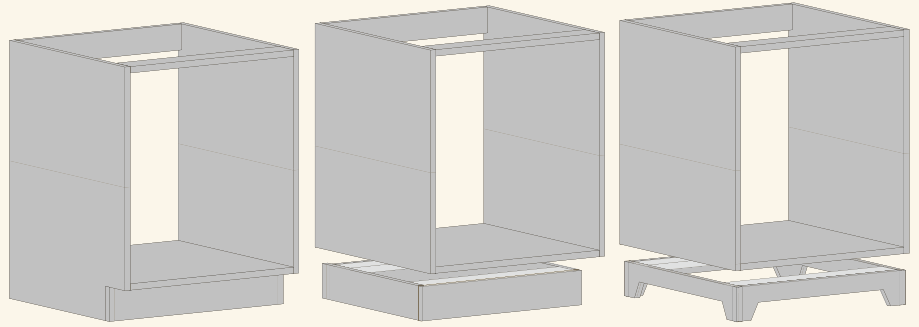
■ Top

This part can be many things. In the case of a nightstand, the top will be a finished, visible piece. But the top doesn't need to be an integral component for strength in the casework piece and can simply be attached to the finished box. In other cases (such as entertainment units) the top is structural and while it's visible from the inside, it won't be seen from above because of the project's height.

■ Back

This isn't a given, though most pieces will have a back. Some open storage units or bookcases won't, and that adds some difficulties in keeping the box square. Maintaining squareness is the true function of the back. It also makes the piece look more finished.

Backs can be of different thicknesses (more than any other piece in casework), can be solid lumber or plywood and can include joinery of its own, including a frame-and-panel back.



Here are three very traditional casework bases: The version on the left allows the notched sides of the case to run to the floor and a kick plate is added to the front to complete the base. The middle version is a separate base (a box on its own) that is screwed to the cabinet. The case on the right is a similar separate base, but the base is trimmed to make the case appear to have feet.

■ Frame

This is more of a style consideration that we'll look at in later chapters, but it belongs in a parts definition list. Just as with a back, some casework relies on a rigid frame at the front of the piece to add strength and support. If a frame isn't used, that strength needs to come from somewhere else.

Two parts that need defining within the frame are the rails and stiles. The vertical members of a frame are the stiles and the horizontal members are the rails.

■ Base

A base isn't necessary for hanging cabinets or portable casework, but it's pretty common on casework that will sit on the floor. The base can be a separate construction that attaches to the main case, or it can be built into the construction. A third option is a base that is more similar to feet than a base.

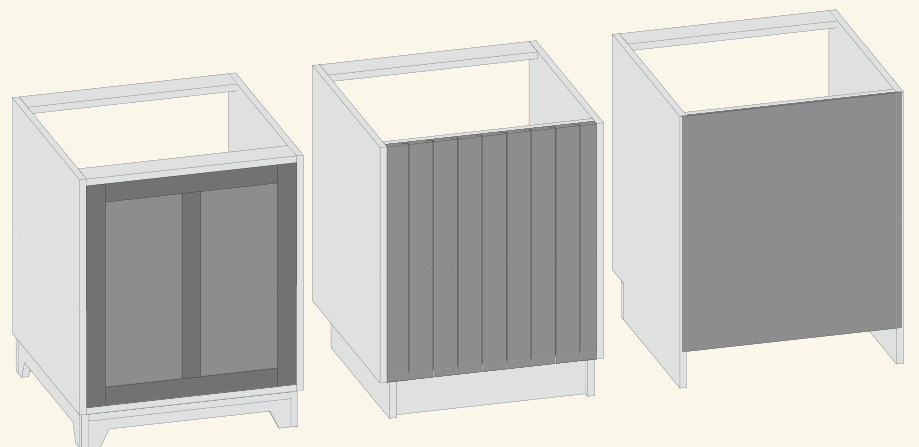
One of the great advantages to a separate base is the ability to level just the base, then add the cabinet in place after. It's a lot easier to adjust a small base than an entire cabinet. It also makes moving the casework more manageable and easier to fit through doorways.

■ Crown

This part is a finishing touch for many casework pieces. The crown is usually attached to the central case piece at the top and projects beyond the body of the cabinet. It's also possible that the crown could be a separate construction (for transportation ease) that's attached to the case, similar to the separate base.

■ Shelves

Because most casework is about storage, maximizing the space is important. The shelves can be simple, utilitarian (and hidden), or they can be built in as part of the visual design.



The three backs shown above vary in complexity from left to right. The back on the left is of frame-and-panel construction, adding great stability, but also more time. The middle version is a shiplapped back with each solid-wood board rabbeted to interlock. The far right version shows a simple, but still effective, 1/4" plywood back.

■ Drawers

These offer more storage. The drawers are simply boxes (without a top) within other boxes.

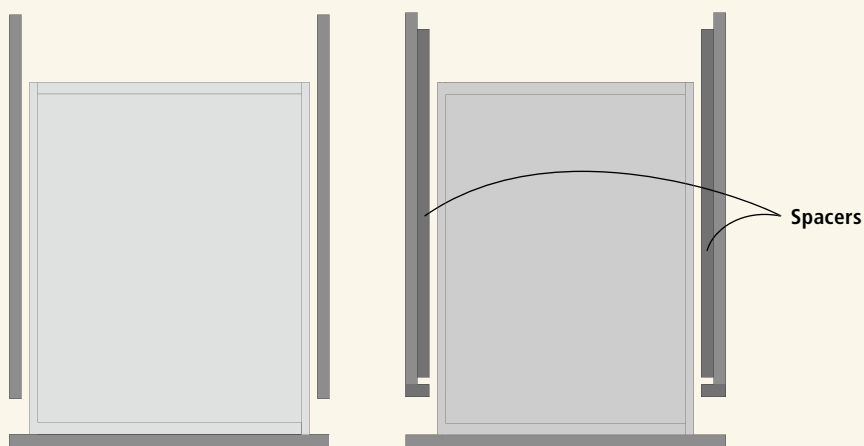
■ Doors

These are simply a way to make the storage neat and to dress up the casework. Doors can be a single piece of wood, or they can be an assembly of several pieces. A panel door (raised or flat) will be made of at least five pieces: two vertical members (stiles, just as with cabinet frame members), two horizontal members (rails) and the panel itself. We'll talk at length about the concerns and applications of shelves, drawers and doors in later chapters.

These are the basic parts that make up most casework. There are lots of other parts that we'll discuss as we get into joinery and construction.

Casework Styles

Casework style needs to be addressed from two directions: function and form. Function is the consideration of how the cases will be used – what storage is



Beyond appearance, one significant difference between frameless (left) and frame cabinetry is the available drawer space. On the frameless cabinet the drawer only needs 1/2" spacing on either side to handle standard drawer slides. With frame cabinets, spacers need to be added to bring the drawer slides clear of the frame, reducing the interior drawer space by 1 1/2".

required, whether doors and drawers will be added and how casework will be installed. Form is simply the way the finished piece will look. That's not so simple a topic as it covers the balance, proportions, materials, mouldings and even the finish applied to the piece.

■ Function

In the larger concept, casework can be built using a front frame (sometimes called a face frame) or as a frameless construction. As I mentioned earlier,

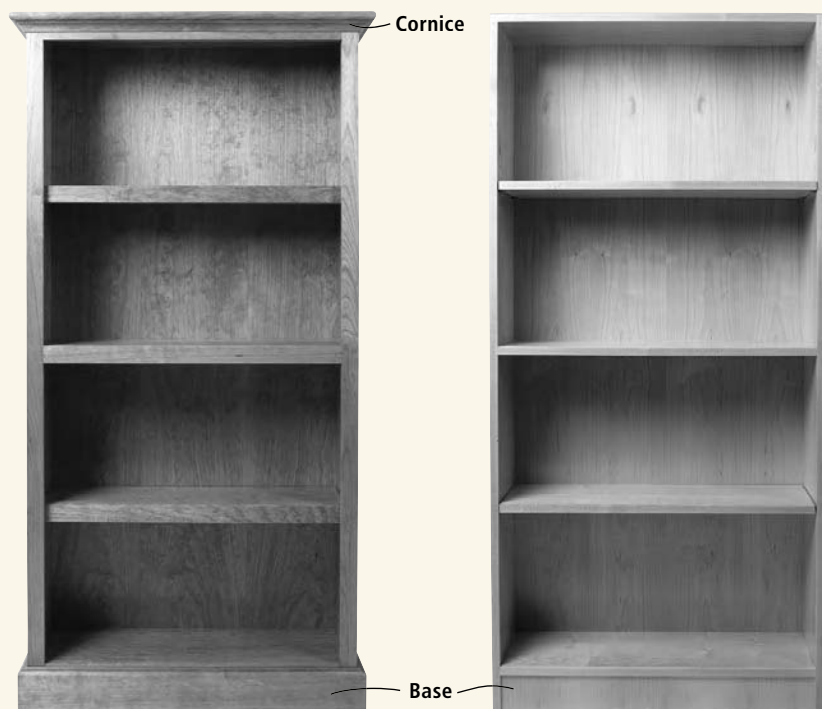
the frame is useful in keeping the case square and adds strength. The frame can also make the project more complicated. Because the width of the frame extends in past the edge of the sides it interferes with the storage space. Drawers that are mounted inside a frame case can't be as wide as the case itself. There are also issues of how the drawers are attached to the case to compensate for the spacing added by the frame.

Another strong reason for using a frame design is that it makes it easy to use plywood for the case sides, top and bottom. You don't want the plywood edge showing at the front of the cabinet, so adding a solid-wood frame will automatically cover all the raw plywood edges without any workaround, such as iron-on edge tape.

Frameless casework lacks a face frame. This allows full use of the interior space, but the case is not resistant to racking forces. Frameless cabinets are often built into a space that allows the strength of the building's walls (and other cabinets) to support the casework. Also, many cabinetmakers will use a thicker back (5/8" to 3/4") for a frameless cabinet to add rigidity. More substantial joinery also can add greater strength to a frameless cabinet, but this will add time and effort to the construction process.

And yes, you can still use plywood for the case members in a frameless cabinet. But if you do, you'll have to add either veneer tape or a thin, flush-fitting solid edge to the fronts of the members to hide the plywood core.

I'm stepping into the design area here



Shown here are two nearly identical bookcases – the version on the left has a face frame, while the version on the right is frameless. These two case pieces are also a good example of different base and cornice options for similar case pieces.

for a second to mention that after determining the type of case construction you intend to use, you'll need to take the door and drawer look and construction into consideration at the same time. Doors and drawers can be built as inset, full overlay, partial overlay and lipped (again something we'll discuss in depth later in the series). How the doors and drawers will look and fit will affect the way you build your cases and what dividers (and what divider dimensions) will be required for the project.

Beyond how the drawers and doors will look, they play an important part in making sure the storage needs are being adequately met by the functional design of your casework. For example, make sure your silverware drawer will actually hold all the silverware. Almost as bad, don't make the drawers so large that they become dumping places that can't be easily sorted or divided.

How the boxes are arranged is also dictated by function. Casework encompasses chests, cupboards, cabinets, wardrobes, secretaries and more. In addition, the basic chest can be arranged to suit specific needs. And a chest can be a chest of drawers, a chest-on-chest design, a chest on frame, or a chest on stand. All of these permutations allow the casework to match the storage needs. Whether drawers (large, small, deep or shallow), shelving (open or closed) or large undivided space as with a wardrobe, it's all in how you break up the space.

As a last concept in casework function, stop a minute to consider how the piece you're planning will be installed.

If it's an entertainment center headed for the second floor, make sure you can get it there. By designing case pieces in, well, pieces, you'll make it easier to move (physically, considering both weight and negotiating corners) and install. And the beauty of building with boxes is that once the pieces are put together, no one will know how many pieces there are!

■ Form

Beyond function, casework style can be varied and eclectic to match every taste. The style can be as elaborate as a Louis XIV bombé chest of drawers or as simple as the clean, Scandinavian lines of IKEA furniture.

No matter what your preference in style, remember the adage that form follows function. That's an adage you must keep in mind. It's important first to make sure the cabinetry meets your storage needs. Then you can make it look like anything you'd wish.

As you might imagine, this is a huge topic and one that's too big to discuss in an overview. In fact there are some very good books covering design in depth. I've listed some of our favorites (on the last page of this chapter) that will help you develop your own sense of style.

Dealing with Stress

As mentioned already, some of the decisions as to what style of casework to use for a particular project depend on the use of the case. Weight, stresses and even what will be stored will help define what construction techniques best fit the needs.

A bookcase is a perfect example. There are the concerns of the physi-

cal size of the books to be stored. The shelves have to be deep enough to adequately support your largest book. But you have to worry about weight as well. Books get heavy quickly and you need to make sure the shelves are not too long or they will sag under the weight.

The construction of the bookcase and of the shelves comes into the equation here. If you're building a bookcase with a substantial back you can help support the shelves from the center of the span. But if it's a 1/4"-thick plywood back, or there's no back at all, the shelves need to provide all the support.

You can beef-up the shelves by adding a brace underneath the shelf, but that will also reduce the storage space, so there's a balance to be met.

And if you've opted for no back, there's the concern of racking (twisting the case out of square from side-to-side) once weight is added. Without proper structural bracing, or attaching the bookcase to the wall, the whole thing can collapse like a deck of cards.

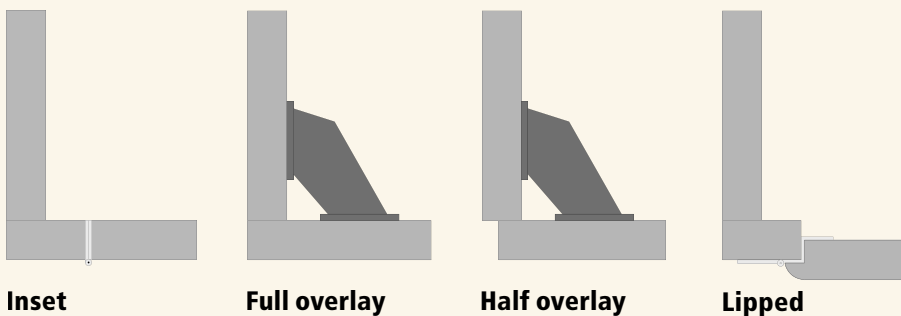
Another way to rack a cabinet is by attaching it to a wall that isn't square. The case can take on the shape of the wall when attached. Also, a case piece can rack because of an uneven floor. Levelling the cabinet upon installation can correct this, but anticipating the problem in your design will make it possible to shim the cabinet to adjust for level without being visible.

Racking not only changes the look of the cabinet, but will also affect the way doors and drawers fit, open and close. So we're back to making sure the case piece is built in a manner that will support the weight and adapt to the location without affecting the function.

One more stress to consider briefly here: wood movement. When wood reacts to changes in humidity, it shrinks or contracts. If you're using solid wood in your case piece, these changes need to be considered. This is mostly a concern with doors and drawers, but we'll get into that in detail later.

On the Move

The stresses mentioned above are mostly concerns of built-in case pieces. But if



Inset

Full overlay

Half overlay

Lipped

The style of door or drawer front you choose for your casework will affect the way the case is designed and built. It will also impact the hardware you use (European or traditional) and you'll need to consider the hardware installation in the process as well.

your case piece happens to be a mobile filing cabinet, or a kitchen island on wheels, there are more stresses to consider. Moving one of these mobile case pieces racks the box in multiple dimensions, not just from side-to-side.

With a file cabinet you can still use a back and frame to control the stress. But with the kitchen island, there's a very good chance you'd like to be able to access storage from more than one side of the island and that takes away some of your bracing. Adding strong frames

on both sides, or adding interior bracing (such as dividers that define the drawer spaces), will tame the stress.

One other "mobile" thought: While you probably know enough to purchase wheels that will be adequate for the weight of the case, how those wheels are mounted is important. If the bottom of the case is simply nailed between the sides and the wheels are attached only to the bottom, the weight of the case will cause that joint to fail. Sure the bottom and wheels will still be standing, but the sides will be sitting on the floor. Carefully planning ahead for such construction concerns will lead to a successful project.

Cornices, Plinths and More

Once the shape and size of your box is determined, and you've considered the storage needs for

your case piece, it's time to have a little fun adding some creative aspects.

Throughout the centuries the concepts of dressing up a box have run the gamut from simple to sublime. The most common details to adjust have been cornices and plinths. These parts of furniture actually derive their names from architecture that was originally parts of columns. Both are horizontal decorative additions, with the cornice occurring at the top of the structure (what we would often call a crown on a piece of furniture today) and the plinth refers to the decorative horizontal addition at the base of the structure.

With cornices, or crowns, the detail is up to the woodworker and can be as simple as a large cove crown (at right), or as elaborate as a bonnet top with even more creative detailing (at right). The odd part about the cornice is that it serves no pur-



Photo by Bronze Photography

Here are a couple good examples of mobile case pieces. The mobile kitchen island above is an open construction, but the box in the center adds cross-connecting strength to keep the island rigid while mobile, otherwise the motion would rack the drawers and they wouldn't work properly. The tool cabinet at right is designed to carry a substantial amount of weight with tools stored in the open upper section as well as in the drawers. The case is enclosed except for the front, and the upper section's dividers are built into the case construction to add strength.



Photo by Al Parrish



Shown here are three similar case pieces with upper and lower sections. Each has a different treatment for the cornice, waist and base. All are reproductions in the 18th-century North American style, but each carries the maker's individual touch. The cornice and base pieces are highlighted here. Even though there are similarities, each has subtle design changes to make the piece unique.

pose (no matter how large) other than dressing up the case furniture.

The plinth, what we'd most commonly call the base, can also be simple or elaborate. The detailing on this section can take the form of feet (as mentioned earlier), but that still leaves lots of room for personal expression as shown on the three case pieces above.

But that's certainly not the end of the decorative opportunities. Because we're dealing with boxes arranged with other boxes, sometimes that transition from one box to another is an opportunity for decorative detail. In particular, when an upper and lower case piece (such as the secretaries above) changes dimensions, some transitional detail is helpful. This is referred to as the waist of the cabinet and often waist moulding is used to smooth out that transition (see the next page). Essentially an inverted crown moulding (as the upper case should always be smaller than the lower case) the waist moulding can also be simple or elaborate.

But the decorative opportunities don't end here. The doors and drawers themselves will add ample opportunity to continue adding to the boxes. The doors can be dramatically figured panels set in frames, or they can be glass doors to allow the items inside (whether rare books or family crystal) visible to all. Even the glass panels can add to the decoration as shown above.

And we haven't even approached the concept of carvings, columns, appliques inlay or marquetry.

This series may be all about the intricacies of building boxes, but there's nothing

simple or boring about boxes. They're the cornerstone of most of our furniture, so we'll make sure you get the right information to build perfect casework for your home. **PW**

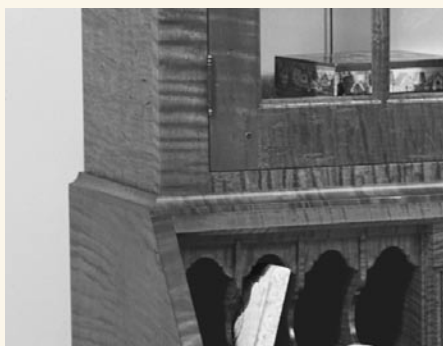


Photo by Lonnie Bird

This classic bonnet top by Lonnie Bird dramatically enhances the look of the basic box, which in this case is a tall clock.



Both of these glass doors are in nearly identical secretaries, but the pattern of mullions on the left offers a simple approach, while the Chippendale design on the right is more refined.



The two waist mouldings shown here help smooth the transition between the upper and lower case pieces. These waist mouldings also help align the upper case and hold it in place on the lower case. The example on the right is obviously doing more alignment than smoothing the transition.

Deeper Thoughts on Design

For more reading on designing furniture, we recommend the following:

- "The Woodworker's Guide to Furniture Design" (Popular Woodworking Books) by Garth Graves
- "Designing Furniture (New Best of Fine Woodworking Series) by Fine Woodworking magazine (The Taunton Press)

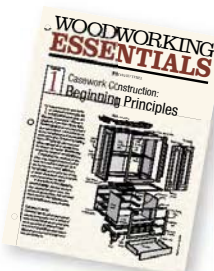
- "Furniture By Design: Lessons in Craftsmanship from a Master Woodworker" (Blackburn Books) by Graham Blackburn
- "Illustrated Cabinetmaking: How to Design and Construct Furniture That Works" (Reader's Digest Association) by Bill Hylton
- "Design Your Own Furniture: From Concept to Completion" (Popular Woodworking Books) by Jim Stack

Everything you need to know about case construction!

Building cases (from jewelry boxes to kitchens) is the basis of all woodworking. This series will give you the details you need to design, build and outfit your next project.

Chapter 1 Beginning Principles

A look at the history, parts and stresses involved in case construction.



IN FUTURE ISSUES

Chapter 2 Wood Selection and Prep

How to choose the best wood for your project and make sure it's ready to use.



Chapter 3 Case Joinery

Learn the best way to put all the pieces together – from simple to sublime.



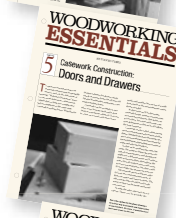
Chapter 4 Smart Case Assembly

Knowing what joint to use is only half the battle. Making the assembly easy and safe is the other half.



Chapter 5 Doors & Drawers

Doors and drawers make your casework efficient and attractive storage.



Chapter 6 Cabinet Hardware

From drawer slides to door pulls, learn how to add the best to your project.



Chapter 7 Special Applications

Whether it's an entertainment unit, or a closet rehab, we give you what you need.



Build an Oil Wicke

Help your hand planes glide effortlessly with lubrication from a continental bench accessory.

In the countless dark and dreary woodworking shops around Europe, before modern times and machines turned them into icons of days gone by, craftsmen made every minute count. After all, this was about putting bread on the table and anything that would make life easier was sorely welcome.

Chances are, shortly after man put a plane to wood he discovered that lubricating the plane's sole was a good thing. The effort of pushing or pulling the plane over the surface became easier and thus better. One can only imagine the oils people tried, and the results. Olive oil would go rancid, while others left a sticky mess and damaged the workpiece. Eventually, it was discovered that one particular oil was a better choice. Raw linseed oil, courtesy of the seeds of the flax plant, turned out to be a leading contender because it was readily available and cheap. Applying the oil to the plane is where the oil wicke, or plane wick, proved itself. Using materials readily available, a benchtop wicke can be made in a short time and will provide months of service with nary a thought.

Making Planing Easier

Even today there's a need for this simple device. Once you use one, you'll be convinced of its value. The way an oiled plane glides over a surface is truly remarkable in the ease of work. Also, a plane is less likely to "chatter" through the abrupt starts and stops caused by excess friction between the work surface and the plane.

Building an Oil Wicke

Constructing this inexpensive device simply requires materials on hand and should take less than two hours. You'll need a block of wood, a tin can, a couple old socks and a piece of sandpaper.

Find a suitable piece of wood that's about 8" long, 3" high and 5" wide. Basically, you want to end up with an oil wicke that has enough stability to stay put as you slide the plane over it. Take a little time to add a personal touch to the block. After all, any woodworker who sees it will ask about and examine it. A bit of detail provides an attractive touch.

by Samuel Peterson

Samuel is a traditional woodworker who enjoys building period furniture the old way. His varied interests are brought out in the sometimes obscure topics he writes about.

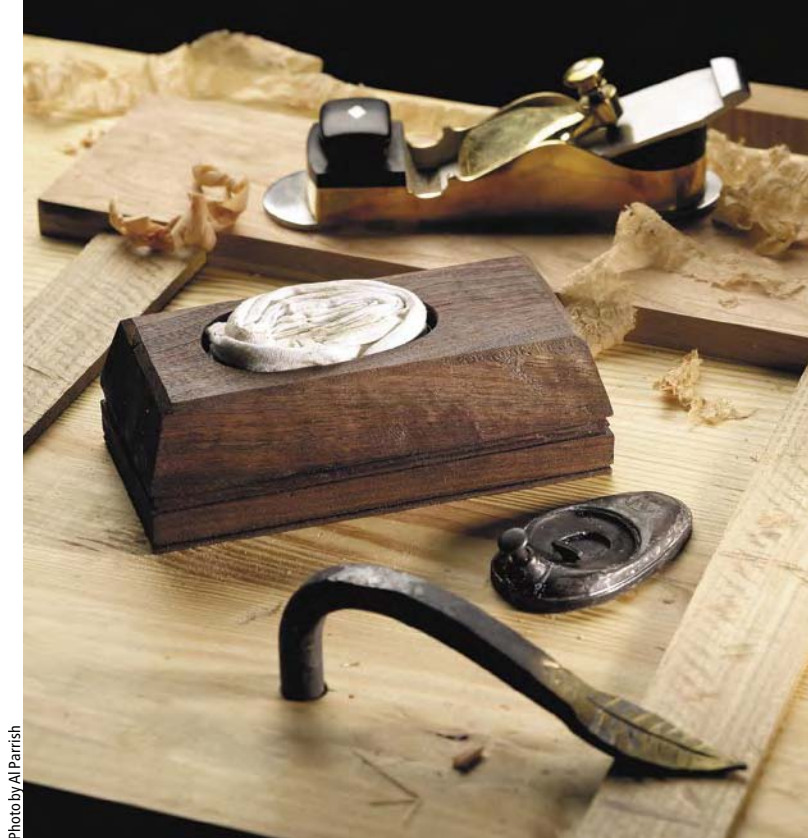


Photo by Al Parrish

Take the time to personalize your oil wicke. For my tin can I bought an old Kayes oil can from my favorite Scottish tool source, Andy Stephens (toolbazaar.co.uk). You can see the can's lid in the photo above.

Next, wash out an empty tin can and trace the outline onto the block of wood. Excavate the hole. I drill $\frac{3}{4}$ " holes with a Forstner bit and then work out the waste with chisels. A $2\frac{1}{2}$ "-deep hole allows for a good reserve of oil. Once the can fits, trim it so that the cut portion of the can rests below the surface of the wood. Sand the inside of the opening so that no sharp edges are left. Attach sandpaper to the bottom of the block, so that it stays put while in use.

Two socks rolled up and tightly packed into the can, slightly proud, complete the construction.

Today we have many oils to choose from. Some people prefer mineral oil, but the old standby is raw linseed oil. Never use boiled linseed oil because of the possibility of spontaneous combustion. Pour enough oil in so that the top of the wicke will give off a slight amount. You don't want it to be

extremely wet at the top. With the wicke tightly packed and loaded, it's now ready to use.

Before planing, and after every five or 10 strokes, pull the plane backwards on the oil wicke. If it doesn't have the desired effect, put more oil in the wicke. **PW**

BUILT-IN OILING DEVICES:

Ever wonder about that "hang hole" in your metal plane? That hole just in front of or under the front knob that everyone assumes was used to hang a plane from a wall? Guess what: This might have been the distribution point for an aftermarket self-oiler in your front knob. These oilers were short-lived gizmos that soon proved to be more trouble than they were worth. Many were sold, but few remain so the next time you find a plane with an extra hole take a moment and see if the knob was designed to be filled with oil.

—SP

Prairie-style **COFFEE TABLE**

An anachronism in its time, this
table now fits perfectly in our homes.

by David Thiel

Comments or questions? Contact David at 513-531-2690 ext. 1255
or david.thiel@fwpubs.com.



Frank Lloyd Wright would probably be dismayed to see a coffee table built in his Prairie furniture style. In fact he and his fellow early 20th-century designers all would have been disturbed by the concept of a coffee table. Eating or drinking in the living room? Unheard of! That type of informality in furniture is a product of the latter half of the 20th century.

But, there is a fine, old Russian proverb that says necessity is the mother of invention. And so I offer you the Prairie-style coffee table. At least it'll keep my kids from leaving plates, glasses and remote controls on the floor.

This project is an adaptation of a number of Wright's pieces, utilizing applied moulding to a generally simple design. The shelf is placed high on the legs and extends beyond the base to match the wide and low look of Wright's Prairie-style buildings and furniture.

The construction is simple, with the most complicated joint being a mortise-and-tenon attachment on the legs, which I've simplified even further for you.

Ground-up Construction

I started building the table at the base with the four legs. For a larger table I would have used a mitered or lock-mitered leg to make sure the dramatic grain commonly found in quartersawn white oak was visible on all four sides of the legs. But for a table this small, the work really didn't justify the benefit, so I started with 2" x 2" white oak turning blanks, choosing the straightest grain possible.

With the legs cut to length, the first step is to mark the mortise locations and then make the mortise holes. Traditionally it makes sense to make the mortises and then fit the tenon to the mortise.

Because I'm short-circuiting the tenon process by using part of the stretcher as the tenon, I needed to make the mortise match the tenon this time. The photo below shows the details.

The next step is assembling the stretchers. This is where the fun starts. The two stretchers are of an I-beam design, with a top and bottom that are horizontal, and a middle piece that is oriented vertically. The top and bottom stretcher pieces are 9 $\frac{1}{2}$ " long, which is the actual size of the space between the legs. The middle stretcher is 11" long. When the three pieces are assembled, the middle piece extends $\frac{3}{4}$ " on either side, creating the tenons.

It's important that the stretchers fit tight against the legs, so I assembled the stretchers while they were in place in the legs. Before you do that, though, sand all the pieces, because it's next to impossible to sand inside the channel once the stretcher is assembled. By squaring the

stretchers to the legs while assembling, everything fits tight without a lot of extra fitting.

The other part of the support structure on the table is the shelf. Traditionally this would be positioned much lower, but the Wright design dictates a higher shelf. Useless you say? Posh! It's the perfect height for hiding the remotes and

the TV Guide. Maybe they won't all end up stuck in the couch cushions if they have a proper home.

The shelf is attached to the legs using dowels. I used only one dowel per leg on the version shown at left. Because it's such a small table and the top is attached to the legs as well, one dowel is likely adequate for a small-scale table.



The lower stretchers tie into mortises cut in each of the four legs. I made the mortises $\frac{1}{2}$ " wide so I wouldn't have to cut tenon cheeks on the stretchers. Unfortunately I only had a $\frac{3}{8}$ "-wide mortising chisel, so I overlapped the mortise cuts to achieve a snug $\frac{1}{2}$ "-wide mortise.



With the mortises cut, it was time to assemble the three-piece stretchers. To ensure a square fit, I first squared the center stretcher piece while it was fit into the mortise. Remember, no glue at this point!



With the center stretcher square, it's simple to pin the upper and lower stretchers in place, maintaining the square relationship and forming the tenons on the stretchers simultaneously.

At this point, leave the stretchers and shelf separate from the legs. We still have some detailing to do on the legs themselves before assembling the base.

There are two moulding details on the leg – a lower “foot” and a small upper strip. The upper

piece is simply $\frac{1}{4}$ " x $\frac{1}{2}$ " material mitered around the perimeter of the leg. The lower moulding is $\frac{1}{4}$ " x 2" material that has a $\frac{1}{8}$ " x $\frac{1}{4}$ "-wide groove cut into the length, $\frac{1}{2}$ " down from the top. I cut the groove in two passes on the table saw on a long strip before mitering the pieces to length.

Wright's Prairie designs, I looked at the mouldings and thought, "Wow, that's simple! All you do is miter the pieces and nail them on!" Well, that is the process, but it's not as simple as it seems. While fitting a single miter isn't too awkward, getting four miters to align perfectly around a leg is darn tricky. In fact, this step turned



out to be the most difficult part of the project.

I started out assuming that I could simply use my miter saw and a stop block to cut the pieces. But working with such small pieces is actually a little scary. Your fingers are too close to the blade. A table saw could work as well, if you have a sled that works with the blade either tilted or beveled to 45°. But, again, the small pieces and the concern of tear-out make it a task not for the faint of heart.

Instead, I relied on a slower method, but one that proved more reliable. After rough-cutting the moulding pieces to length (using a clamping jig on the miter saw). I hand-fit each piece using a small disk sander with the table set to a 45° angle.

Tiny Nails

After fitting the pieces to the legs, it's a good time to sand all the pieces before attaching the mouldings. It's just easier to get

in the corners this way. Then it really is as simple as adding a little glue and nailing them in place. Actually, I pinned the pieces in place using a 23-gauge pneumatic pinner. I love this tool. The pins are so small that the hole looks like a freckle on the wood. The holes are easily filled, or you can actually be a little lazy and let the stain cover up the hole.

One tip when using a pinner (or nailer) like this: Rather than drive all the pins straight into the piece, angle the pins toward one another. While it's unlikely the pins will fail, this will add extra strength to help keep the moulding from ever pulling loose.

Start with the lower moulding, setting the leg upright on your work surface as you attach the pieces. This helps to make sure you have a flat bottom to the leg and helps align the pieces at the miters.

The next step is the upper mouldings. You'll need to add some location lines to the legs to orient these mouldings. Measure down 2³/₄" from the top of the leg to the top of the mouldings.

Base Assembly

At this point you're ready to assemble the base. Work with two of the legs flat on your work platform, with the mortises fac-

The shelf is dowelled into the legs to make assembly simple. A dowelling jig makes this even easier. Locate the dowel holes on the legs 4³/₄" down from the top of the legs and centered. The locations on the shelves are 4¹/₄" in from the ends and centered on the thickness of the shelf.



After running the 1/8"-deep x 1/4" groove in the lower mouldings using the table saw, they were ready to miter and hand-fit on a sanding disk. This is the tricky part, so take your time. Then glue and pin the pieces in place.

PRAIRIE-STYLE COFFEE TABLE

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL	COMMENTS
		T	W	L		
❑ 1	Top	5/8	22	38	White oak	
❑ 2	Top spacers	1/4	13/4	21 1/2	White oak	MBE
❑ 2	Top spacers	1/4	13/4	37 1/2	White oak	MBE
❑ 2	Top doublings	5/8	2	38	White oak	MBE
❑ 2	Top doublings	5/8	2	22	White oak	MBE
❑ 1	Shelf	5/8	9 1/2	30	White oak	
❑ 4	Legs	2	2	14	White oak	
❑ 4	Stretchers	1 1/2	1 1/2	9 1/2	White oak	
❑ 2	Stretchers	1 1/2	1	11	White oak	3/4 TBE
❑ 32	Leg mouldings	1/4	1 1/2	2 1/2	White oak	MBE
❑ 32	Leg mouldings	1/4	2	2 1/2	White oak	MBE

*MBE=miters both ends; TBE=tenons both ends



The same mitering technique is used to fit and then attach the upper mouldings on the legs. Remember that part of the leg is hidden behind the top's built-up edge, so locate the moulding 2³/₄" down from the top of the legs.



The spacers required to create the $\frac{1}{4}$ " x $\frac{1}{4}$ " shadow line are mitered and held $\frac{1}{4}$ " in from the edges, then pinned in place (no glue). The pieces don't need to be $1\frac{3}{4}$ " wide. My scrap was narrow, but no one will know.



The doubling pieces work the same as the spacers, but they're held flush to the top piece. A square works well to orient the pieces before pinning through the spacers into the top.

ing up. Add glue to the one set of dowels and tenons, and attach the shelf and two stretchers to the legs. Then add glue to the remaining dowels and mortises, and attach the other two legs.

At this point, stand the base up and allow the legs to sit flat on the work platform. Then clamp across the legs to hold everything together while the glue dries. Use a square to double check the angle of the legs to the shelf while clamping the base. Set this aside to dry and turn to the top.

Doubling the Top

Part of the look of the top is achieved by recessing a piece of $\frac{1}{4}$ "-thick material between two thicker pieces, leaving a $\frac{1}{4}$ " x $\frac{1}{4}$ " channel that creates a delicate shadow line on the top's edge.

One of the other benefits of this process is making the top look more substantial without adding too much weight.

Start with the main top glued-up and trimmed to finished size. The spacer and doubling material also are solid white oak, cut to width and thickness as given.

Now flip the top upside down and mark the corners $\frac{1}{4}$ " in from each edge. By holding the spacer pieces at this offset you will create the recess for the shadow line.

A note here on wood movement: Because the top is solid wood, it will move across the width with seasonal changes in humidity. If you attach the spacers and doubling across the ends of the top with glue, they will likely break or shift with this movement. Because of this, I didn't use glue and simply pinned the pieces in place. I used a few extra pins, but because of how thin the pins are, they're more likely to bend slightly with the wood movement, rather than tear the top apart.

Attach the spacers, mitering the corners. I used $\frac{1}{2}$ " pins at this point, holding the pieces $\frac{1}{4}$ " in all the way around the top.

The doubling is next and it's important to align the doubling flush to the top piece for a good look. I used a square against the table to align the doubling, then used $1\frac{1}{8}$ " pins to nail through the doubling and the spacer into the top.

Attaching the Top

I attached the top to the legs using figure-eight-shaped fasteners that are recessed into the tops of the legs – not just recessed, but also given a little extra space so the fasteners can swivel on the screws in the legs. This solves the wood-movement problem at this joint,

allowing the top to expand with changes in humidity without affecting the base.

Drill a hole matching the diameter of the fastener, just to the depth of the thickness of the fastener. Then widen the hole to allow that fastener to swivel.

After attaching all four fasteners to the legs, flip the top over, center the base on the top and attach the base. Remember the top is only $\frac{5}{8}$ "-thick, so don't use screws that are too long!

The Wright Finish

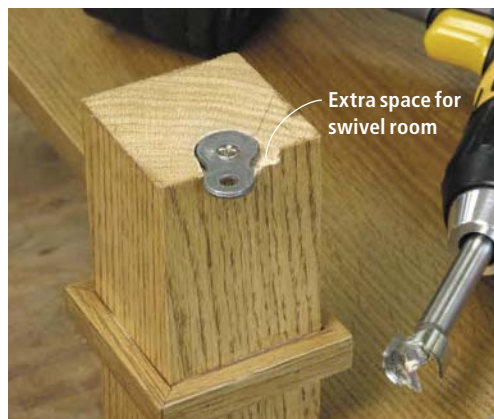
Unlike many of his contemporaries in the early 20th century, Wright didn't stress too much about the finish on his Prairie furniture. While Gustav Stickley preferred a rather dark, heavy

finish on many of his pieces, Wright settled instead on a pleasant, lighter mocha finish for his Prairie furniture pieces.


I found an off-the-shelf stain that adequately matched that philosophy. I wiped on a coat of Olympic Colonial Oak gel stain (available from Lowe's), then wiped off the excess to leave an even, warm-brown color.

A few quick coats of spray lacquer in a can (Deft semi-gloss Clear Wood finish in a spray can from Lowe's), sanding lightly with #320-grit paper between coats, and the table was finished.

While Wright might not approve of the application I've chosen for his design, I think he'd be happy with the way it looks. Now where is that remote? **PW**



I used figure-eight fasteners (Rockler, #21650, 800-279-4441 or rockler.com) to attach the top. These allow the top to move without affecting the base.



Shiplapped Cabinet Backs

Easy to make, shiplapped backs add a decorative element to cabinet interiors.

by Scott Gibson

*Scott, author of "The Workshop," (Taunton Press)
is a writer and woodworker in Steep Falls, Maine.*

Inexpensive and dimensionally stable, plywood is a nearly ideal material for the back of a cabinet. For large kitchen cabinets and built-ins, plywood also adds strength and rigidity to the cabinet box, especially when it's glued in place. But plywood doesn't contribute very much aesthetically when the inside of a cabinet will be on display. To open a finely made wall cabinet and come face to face with a plywood backing is a little deflating. It works, yes, but it could have been so much more.

Shiplapped solid lumber is one alternative that's a lot more agreeable to look at. A back made

this way consists of a series of individual boards whose edges meet in overlapping L-shaped profiles. While a shiplapped back isn't as strong as plywood, it offers many more design possibilities. Widths of individual boards can be uniform or varied, for example, and they can be given a decorative edge profile or made in a wood that contrasts with the rest of the cabinet. Even the narrow vertical lines of a very simple shiplapped back become an interesting visual element in a cabinet interior.

Rabbets in Cabinet Sides Conceal the Back

Shiplapped boards are let into rabbets cut in the back of the case. The rabbets should be slightly deeper than the thickness of the pieces that will be used to make the back. Because mating edges of shiplapped boards are milled to about half their original thickness, there's a practical limit to how thin the back pieces can actually be. At the same time, there's no need to make the back very thick because it's not adding much structurally to the cabinet and added bulk only means unnecessary weight and a slight loss of interior space.

For very small cabinets, back pieces about $\frac{1}{4}$ " thick are enough. That leaves overlapping edges at about $\frac{1}{8}$ " thick, which is thick enough to do the job but it's also not using up any more material than you really need. For larger cabinets, boards $\frac{3}{8}$ " to $\frac{1}{2}$ " thick make more sense. They'll seem more substantial and will be less likely to bow.

As to the width of the rabbet, it's a good idea to have as much meat as possible to support the back pieces without making the lip too thin and prone to splitting. For $\frac{3}{4}$ " material, a rabbet about $\frac{1}{2}$ " wide is about right.

There are many ways to cut rabbets into the cabinet, and the decision rests partly on how the cabinet is made. The purpose of the rabbet is to conceal the edge of

the back, but if the top and bottom of the cabinet won't be seen the easiest approach is to cut rabbets in the sides of the case only. Top and bottom case pieces can be made narrower than the sides by the depth of the rabbet allowing the back pieces to extend the full height of the case. This creates a wider area for nailing or screwing on the back while simplifying construction.



A back made from cherry would be a pleasant surprise inside a simple white pine wall cabinet. All of the back pieces in this cabinet were cut from a single piece of 2"-thick scrap.



To mark the rabbet location, you can use a top or bottom piece to mark the inside of the cabinet side. The mark represents the height of the dado blade.



When the top and bottom of the case won't readily be seen, the top and bottom cabinet pieces can be made narrower than the sides allowing the back pieces to run the full height of the case.

When the back must be completely housed in a rabbet, there are still several choices. If the case is joined at the corners with a miter, the rabbets can be cut quickly with a dado blade on a table saw. For dovetailed cases, you can add a miter before the first dovetail pin and, again, run off the rabbets with a dado. (Although you can cut a stopped rabbet in dovetailed pieces with a plunge router before assembling the case, it leaves a weak area on the corners that's susceptible to breaking.) It's also possible to cut the rabbets after the case has been glued up by using a bearing-guided rabbeting bit and a router table. Corners are cleaned up with a chisel. All of these methods work.

Sizing Back Pieces

Solid lumber changes dimensionally as the amount of moisture in the air rises and falls seasonally. Movement is more pronounced across the grain than it is in length or thickness, but unless the relative humidity remains absolutely unchanged you can count on at least a little bit of wood movement. Flat-sawn wood moves more in width than quartersawn material (changes in length are too small to worry about).

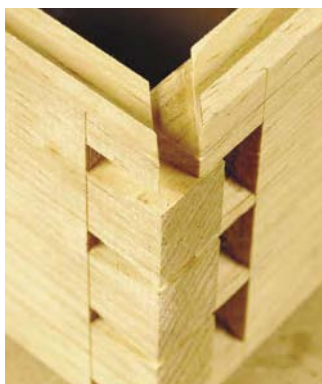
Wood movement is the reason that solid backs can't be glued into a case. Using shiplapped boards skirts the problem because the narrow gaps left between individual boards is enough to accommodate seasonal movement. The greater

number of boards that make up the back, the smaller the gaps can be because you're spreading the total loss and gain in width over a greater number of spaces.

If you have an accurate moisture meter, know the range of relative humidity in your area and really like math, you can calculate exactly how much the width of each board will change with a simple formula that Bruce Hoadley includes in his book "Understanding Wood" (The Taunton Press). There are lots of variables: the species of wood, how much its moisture content is likely to change from summer to a heated environment in the winter and whether the board is flat-sawn or quartersawn. A flat-

sawn cherry board 18" wide, for instance, will change in width by nearly $\frac{1}{2}$ " if its moisture content fluctuated between 5 percent (during the winter in a central-heat environment) and 15 percent (a muggy summer day). If you made a cabinet back with four pieces of this material, gaps of about $\frac{3}{32}$ " should be enough to handle the winter-to-summer expansion.

Most of us probably won't go as far as to try and calculate the change to the third decimal place. If you start with kiln-dried material and you're mindful of the conditions in your shop at the time of construction, you can make an educated guess about how much room to leave at the sides and between boards. In winter,



Adding a miter to the corner of a dovetailed case allows you to cut the rabbet for the cabinet back easily on a table saw with a dado blade.



A rabbet for the back can be cut after the case is glued up with a bearing-guided rabbeting bit and a router table.



The router will leave rounded corners that can be squared up with a chisel. Alternately, shape the corners of the corresponding back pieces to fit.



Before cutting the shiplap profile into the edges of the back pieces, try the table saw or router table setup on a piece of scrap first.



Shiplaps can be run off in a single pass.

when the relative humidity is low, boards should be gapped farther apart than in the summer. When in doubt, leave a little more room than you think you'll need. The beauty of the shiplapped joint is its flexibility.

Make and Install the Back

There's a lot of room for creativity when making up the back pieces. Shiplapped joints can be cut with a dado and table saw, a router or they can be cut by hand with a rabbeting plane. I think the easiest method for cutting shiplapped joints is with a dado, but someone with a good router table might disagree. Whichever approach you take, making the initial cut on a machine and finishing up with a

rabbeting plane is quick and leaves a very good finish.

In sizing the individual pieces for a back, you'll need to add the amount of overlap for each piece to the total width it must span. The width of the shiplap depends on the gap between boards. If you've decided the gap between boards should be $\frac{1}{8}$ ", for example, the shiplap should probably be at least $\frac{1}{4}$ " wide but there's no harm in making it a bit wider. Laying out the pieces on a full-scale drawing helps minimize confusion.

It's also a good idea to mill up a little extra material when you're making the pieces so you can test your machine setups on scrap. I would cut the shiplap with a single pass over a dado set to cut

halfway through the thickness of the board. Then remove saw marks with a rabbeting plane. When you're finished, the boards should fit together flat. The edges can be left square, chamfered with a block plane or run over a beading bit on a router table to add a decorative detail.

It will make it a little easier to finish the inside of the cabinet if you apply finish first and install the back later. If you install the back pieces before applying any finish, inside edges where the joints overlap should be finished so seasonal wood movement doesn't expose raw wood later.

Back pieces are attached at top and bottom. If pieces on each end are narrow, you can also fasten

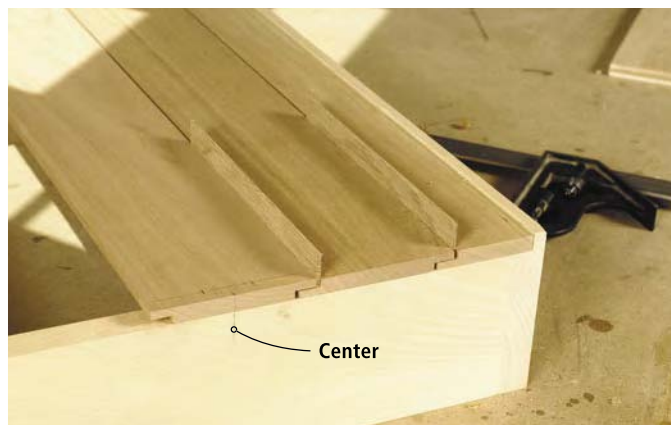
them to the rabbets cut in the sides of the case, making the cabinet somewhat stronger. But fasteners should be installed so they allow the boards to move without cupping or, worse, pushing the sides of the case apart. Either screws or brads can be used, but be careful when setting fasteners to avoid splitting the wood at the rabbet or popping a fastener through the side of the case. Drilling pilot holes is always a good idea unless both the back and the case are made with a very soft wood such as white pine. At top and bottom, two fasteners about 1" apart in the center of each board should keep them firmly in place. If you use fasteners along the edges, place one roughly every 4". **PW**



A rabbeting plane will remove any milling marks left from the dado and fine-tune the fit between adjacent boards. Each shiplap should end as one-half the thickness of the board.



Chamfering the edges of the back boards with a block plane is a simple way of adding an attractive detail to the back.



One way of laying out the back pieces is to start in the middle of the cabinet and work toward the outside edges. Spacers keep the reveal between the boards consistent.



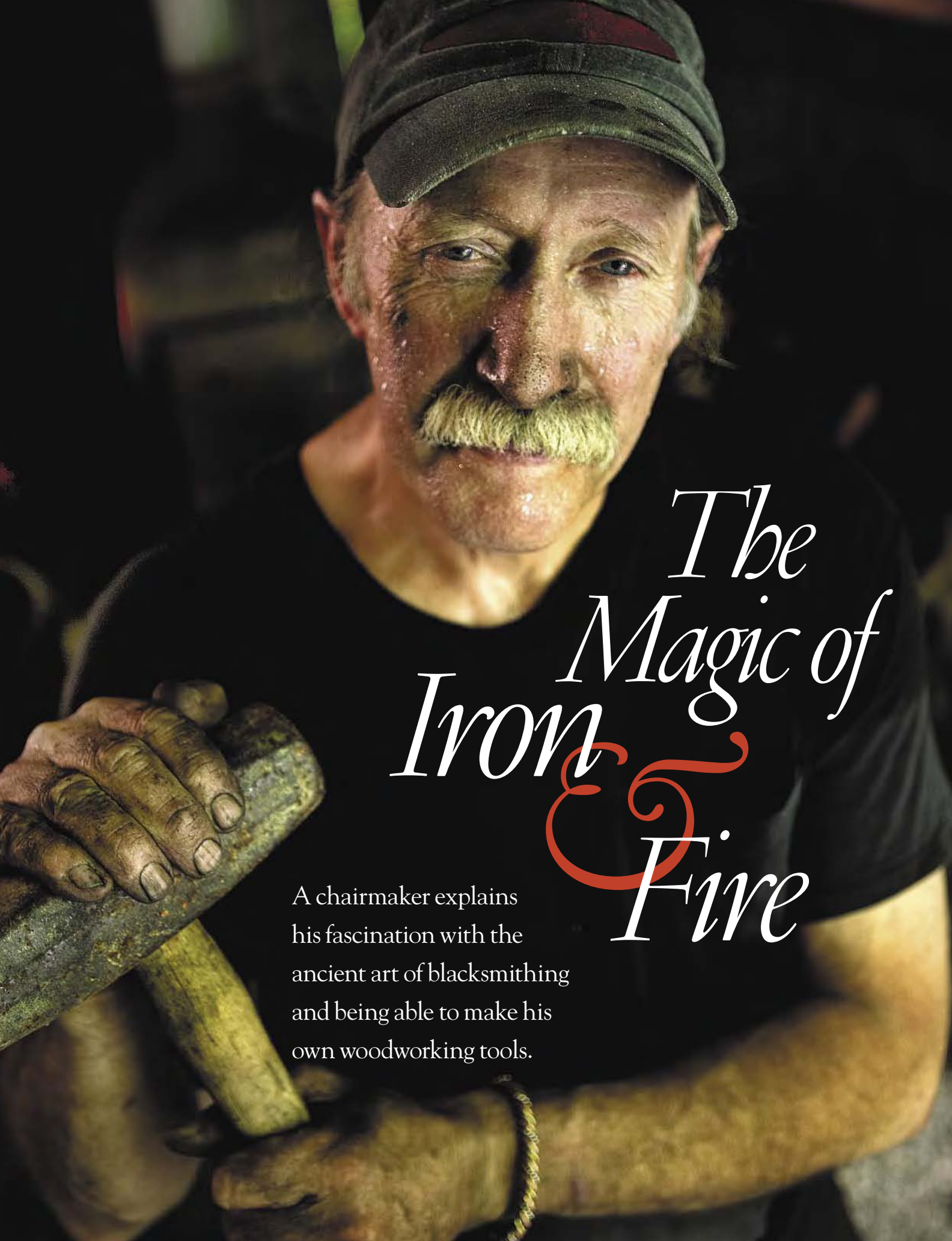
Drilling a pilot hole for 16-gauge brads will help prevent splits in these cherry back boards. The white pine case is soft enough to handle the nails without pilot holes. If screws are used, a full-depth pilot and countersink would be smart.



Two fasteners about 1" apart adequately hold each board in place.



If boards used at each edge are narrow, they can be fastened directly to the rabbets cut in the sides of the case. This would help to strengthen larger cases but probably isn't necessary in small ones.



The Magic of Iron & Fire

A chairmaker explains
his fascination with the
ancient art of blacksmithing
and being able to make his
own woodworking tools.

It was April of 1986, and I'd just arrived at a craft show up a long dirt road, an hour's drive into the redwood-covered mountains of Northern California. I was setting up my treadle lathe – the traditional tool of the bodger or rural British chairmaker – when I realized that I'd left some critical pieces of the lathe back home. I didn't relish the idea of a two-hour trip out and back, but I needed the parts to do my demonstration.

As if out of nowhere, another demonstrator at the show, Jon Soini, a blacksmith of Finnish descent, piped up, "Don't worry, just sit tight – we'll make the parts." In less time than it would have taken to get home – let alone back – Soini had handforged four bolts, nuts and the lathe's centers. My lathe was up and running. I thought to myself, "I've got to get into this."

As it turned out, Soini's dream was to build a wooden boat. With my training as a joiner and years of chairmaking experiences, I agreed to teach him all I knew about working wood in exchange for his teaching me what he knew of blacksmithing. For the next six years, we'd get together every Wednesday and Saturday (sauna days, not coincidentally) and pound steel at an anvil. Initially I was his striker – a laborer who wields a sledge – while Soini handled the tongs, manipulating the glowing steel on the anvil, presenting the proper face to the hammer, and patiently coaching me all the while. Gradually I learned the skills of the smith and began making my own tools (see "Blacksmithing at a Glance" on the next page for an overview of the toolmaking process). When Soini and his family moved up to the maritime community of Port Townsend, Wash. (Soini did build his boat, a 22-foot Seabright skiff), I put together my

own modest smithy out next to my chairmaking workshop. I've since moved to Paint Lick, Ky., and these days I spend about a third of my time making chairs, a third blacksmithing and a third teaching about and demonstrating the crafts of the bodger.

Forging in Wales

For me, the primary lure of the fire is being able to make any tool I need or being able to reshape existing tools to suit my needs as a chairmaker. The attraction goes deeper, though. I was infected, you might say, at an early age.

As a lad growing up in the village of Llandrindod Wells, in the foothills of the granite mountains of northern Wales, I'd often find myself pausing at the door of the forge. In the harsh Welsh winters, the warmth and glow of the forge was a welcome stop on the way to and from school. The forge was a magnet not only to us lads, but also to the gents who sat around reading the newspaper and conducting important village business

in that dim, otherworldly, orange glow. But watching the sparks fly and the steel take shape before our eyes was the real reason we stopped by. It was magic then, and it's magic still, this transforming of raw iron or steel into recognizable objects of utility.

The Self-sufficient Bodger

My path back to the forge was somewhat circuitous. After coming to America in the early 1960s and trying my hand as a farmer outside of Truth or Consequences, New Mexico, I moved to northern California. There I began making stools and bowls on a treadle lathe. I soon became interested in the bodgers and their chairs as well as in the other rural crafts of 19th-century England. I began making these simple, elegant country chairs – the predecessors of the American Windsors – but soon found that many of the tools used to make them were no longer available. When I met Soini, I knew I'd come full circle.

Being able to make my own

tools – froes, drawknives, spoke-shaves, travishers, inshaves and turning tools primarily – freed me. All of a sudden, I was making my own tools from old truck leaf springs and the like, using these tools to make an elegant chair from logs I pulled out of the firewood pile, and then taking the scrap from the chairmaking and making charcoal for the forge. The independence is exhilarating.

That's another thing the rural Welshman in me likes – that the tools and technology of the blacksmith aren't, or don't need to be anyway, terribly sophisticated. As with any craft or hobby, you can spend a fortune just getting set up, or you can spend next to nothing and get on with it. That's my way – if I can put something together for nothing, I'm a happy man.

My forge is an old riveter's forge that I found on a farm and rebuilt. My furnace is homemade from firebrick, a section of an old water heater and off-the-shelf plumbing parts. The whole thing cost \$60. I've forged tools with a charcoal fire in a barbecue grill and a bellows made from a discarded ammunition box. Leaf springs, axles, rake tines – these are all the raw materials I need to make a hammer, knife or chisel. This ability to use what's on hand has been the gift of the smith in every country of the world ever since man accidentally discovered iron by building a fire where the earth was rich in iron ore.

Woodworkers don't need to make their own tools, but it can be an enriching experience. In addition to being able to make my own tools, hardware and other steel fittings, gaining an understanding of the properties of another material has helped me understand wood – my primary material – in much the same way that learning a second language improves the understanding of your own. **PW**

by Don Weber

Don is a bodger, blacksmith and writer in Paint Lick, Kentucky. He also teaches bodging and blacksmithing at his shop and across the country. For more information, visit handcraftwoodworks.com.



Photos by Al Parrish

BLACKSMITHING AT A GLANCE

Blacksmithing is a hasty sport. Unlike woodworking, where you can step back and contemplate a cabinet's lines or run your hands over a planed surface to check its smoothness, working with hot iron means moving fast. You've only seconds before the malleable, bright orange steel has faded nearly to black, and any further hammering is likely to impart stress fractures. Back into the fire it must go.

At forging temperature, from about 920° F to 2,200° F (distinguished by a bright orange to yellow color), steel has great plasticity. It can be cut, flattened, thickened, bent and tapered (see the photos below for a brief overview of the making of a holdfast).

To the uninitiated, probably the most mysterious aspect of the smiths' art is the discerning of steel's temperature by its color. There is

no exact method of knowing the heat of the steel in the fire, and for the actual forging it's not that critical. When the orange has faded, and the steel begins to resist the blows of the hammer, it's time to put it back in the fire. A blacksmith quickly develops an eye and a feel for his material.

Perhaps the only exactitude comes about when heat treating, which is actually a three-step process. As a result of all the heating and hammering, steel becomes hard and brittle and may develop internal stresses. So the first step is to anneal it. This is done by bringing the steel up to a good forging temperature, then plunging it into a container of vermiculite, lime or wood ash so it can cool slowly, relieving any internal stresses. Any grinding to shape should be done now (once the steel has cooled) while the steel is relatively soft.

The next step is hardening. I do this by bringing the steel to just above its critical

You can easily make handsome, functional tools from scrap. I've made froes, Welsh spoon carving knives, a bruz (for cutting beads on the lathe), travishers, spoke-shaves, turning chisels and gouges, drawknives and other tools. Today I'm making a couple holdfasts for a traditional woodworking bench.



Here I'm heating the steel. A charcoal forge (this one's an old riveter's forge) is the simplest, cheapest way of bringing steel up to forging temperature. I keep the fire as concentrated as possible for the work I'm doing and feed charcoal into the fire as necessary to keep it going.



Steel can be cut easily when it's hot. To trim the shaft of this holdfast I first heat the section that will be cut (above). I then pound this section over the edge of a cut-off hardy installed in my anvil.

temperature – 1,350° F for the ordinary high-carbon steel that I use. You might think that it would be hard to tell precisely when steel reaches a particular temperature, but something interesting happens there. The carbon atoms migrate to the core of the iron molecule, and the steel loses its magnetism. I hold a magnet with a set of tongs and check the glowing steel frequently until, suddenly, there's no pull. Then it's back into the oil bath to quench the heat again, freezing the crystalline structure of the steel. The magnet is a sure indicator that the critical temperature has been reached, but an experienced smith will trust his eye. The Japanese compare the color of the steel at this

critical temperature to that of a ripe persimmon or the color of the harvest moon over Mt. Fuji.

Hardening the steel leaves it too brittle for use, so the final step is tempering. Some of the hardness must be sacrificed to make the tools less brittle or tougher. I do this by heating the tool after polishing it, until there's just a hint of the color of straw at the business end. I've done this in two ways. By inserting the tool into the

forge backwards, cutting end out, I can watch the color creep up the tool, toward the cutting end. I've also held tools in the furnace, above the flames, until the residual quenching oil reaches its flash point, bursts into flame and dances across the tool. Either way, when I've reached temperature, I plunge the tool back into the oil, then let it cool. Now all that remains is to hone the tool and put a handle on it. —DW



4 Steel can be made thinner. This technique, known as drawing out, allows the smith to take a piece of $\frac{3}{8}$ "-thick steel, and thin it down to $\frac{1}{8}$ " or less. Here I'm drawing out the pad of the holdfast.



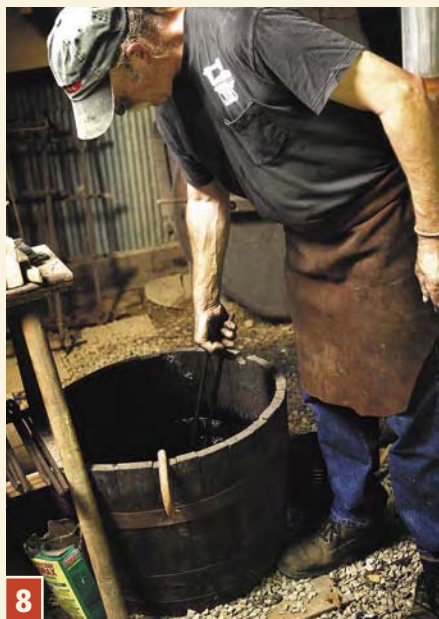
5 Sections of steel can also be made thicker. Here you can see I'm pounding the end of the shaft of the holdfast, which will thicken it where it bends at a right angle.



6 Steel can be bent, twisted and contorted. When it's hot, it's a plastic material, capable of being shaped into almost any form. Here I'm bending the holdfast into its optimal shape.



7 It's important to inspect for symmetry. Here I check to see that the pad of the holdfast is in line with the shaft.



8 When working with hot iron, a quick quench in a barrel of water (as I'm doing in the picture above) makes it safe to handle.



9 Grinding finishes the tool. If this were a cutting tool, I would then harden and temper the edge. But that step is unnecessary with a holdfast.



Photo by Al Parrish

Most of the time when a piece of wood has a bend or a curve, it means trouble: Your stock is warped or bowed. But sometimes a bent part can add an interesting design element. The curved supports in these shelves transform what might be plain and ordinary into an interesting and contemporary design.

I usually like to keep things simple, which to me means using as few parts as possible. But when it comes to curved parts, such as the supports for these shelves, I form the curves by gluing together several thin strips rather than steam bending one piece of wood. This technique of bent lamination is faster and the results are more predictable than steam bending.

With steam bending, you need a boiler, a steam box and a way to quickly clamp a scalding-hot piece of wood to a form. Then you need to wait several days for the part to dry. With bent lamination you need only a form and a way to clamp the thin strips of wood to it. You don't need to wait an hour or more for the wood to get ready to bend and you don't need to race like a madman to get a hot piece of wood clamped in place. Once the glue is thoroughly dry, the parts are ready to use.

The techniques I used to build these shelves can be employed many different ways. Table aprons and chair backs are common uses for curved parts. Once the shape and size of the curve is determined, you build a form for gluing, and decide what thickness of strips to use to make the curved parts.



Instead of making a giant compass, I draw the curve by bending a thin strip of wood across the layout marks. Finish nails hold the shape while I mark the curve with a pencil.



After smoothing the first piece, rough-cut parts are then added to the form. A flush-trimming bit is used in the router to make identical curves for the bending form.

Make an Educated Guess

I like to use the thickest strips possible to minimize the number of parts and glue lines. The more strips in the lamination however, the stronger it will be, and the likelihood of the curve springing back away from the form will be minimized.

To get the finished thickness of $\frac{3}{4}$ ", I could use four strips $\frac{3}{16}$ " thick, six strips $\frac{1}{8}$ " thick, eight

strips $\frac{3}{32}$ " thick or a dozen pieces $\frac{1}{16}$ " thick. It all depends on what wood is used and how tight the radius of the curve is.

I make a good guess at a thickness, and resaw a piece of the material to that size. I then bend the piece to roughly the curve I want. If it's difficult to bend, or I hear any popping or cracking noises as I make the bend, I try again with a slightly thinner piece. For this project, which uses ash, I started at $\frac{3}{16}$ " thickness but ultimately decided to use $\frac{1}{8}$ " for the strips to make the shelf supports.

The next step is to build the form used for bending the curved parts. The shelf supports finish at 2" wide, but the laminations are glued together at $2\frac{1}{2}$ ". The extra width means I don't have to worry about keeping all of the edges perfectly lined up during gluing. After the glue has dried overnight, I can get a clean edge on the jointer, and achieve the final width by ripping the part on the table saw. One more light cut on the jointer will remove any saw

Bent Laminations

Make curved forms without getting steamed.

by Robert W. Lang

Comments or questions? Contact Bob at 513-531-2690 ext. 1327
or robert.lang@fwpubs.com



Resawing strips on the band saw is safer and less wasteful than using the table saw. I cut them a little thicker than necessary, clean up the saw marks, and bring them to final thickness with the planer.



Thin pieces can be sent through the planer on a sled, a piece of $\frac{3}{4}$ "-thick MDF that extends past the feed rollers and is clamped to the planer bed.



Polyurethane glue can be messy as it cures. I use a thin bead of glue and spread it out with a putty knife to avoid this.

marks. A few quick swipes with a card scraper leave the edges ready for finishing.

To get the $2\frac{1}{4}$ " thickness for the form, I used three layers of $\frac{3}{4}$ "-thick birch plywood cut to the inside radius of the curve, and a fourth piece as a base plate. It doesn't matter what the form is made from; I used material that was left over from another project. I would have used particleboard or medium-density fiberboard (MDF) if I had found a piece of that first.

The radius is $56\frac{11}{16}$ ", which would require a long trammel to draw and cut the curve. Instead, I simply marked the end points and centerline of the curve, and marked off the 4" rise at the center. I then drove a 4d finish nail at each of these points, and bent a thin strip of wood across them.

It takes three hands to bend and mark the curve. If you don't have someone to help you, drive finishing nails at an angle close to the points used to define the curve. With the midpoint inside the nail, and the ends outside, the thin piece will hold its shape. You can bend the nails to position it exactly where you want it. I cut the curve on the band saw, being careful to saw just outside the pencil line. Then I used #80-grit sandpaper wrapped on a block of wood to get the curved edge smooth.

The First Part is the Pattern

The first layer of the pattern is the only one that requires this much work. The remaining pattern pieces can be marked by tracing the first one. After cutting them slightly oversize, they are attached to the first piece with half-a-dozen $\#8 \times 1\frac{1}{4}$ " screws, and the edges are trimmed with a flush-cutting bit in the router.

After attaching the base plate, the surfaces of the form were given a couple coats of paste wax to keep glue from sticking to them.

Now make the strips for the laminations. They can be ripped on the table saw, but it can be dangerous to work with parts that thin, and nearly half of the material will be lost to the saw kerf. By using the band saw, the operation is much safer and less material is wasted. I cut the strips to $\frac{3}{16}$ " and took them down to the finished thickness of $\frac{1}{8}$ " by sending them through the thickness planer. I clamped a piece of scrap MDF to the planer bed to carry the thin pieces. Because the ash I used was straight grained, I didn't worry about the edge grain matching, and cut all the strips I needed from $\frac{4}{4}$ stock.

In addition to cutting the strips wider than they need to be, I also cut the strips about 6" longer. When you glue six pieces together at a time, they can slide around some, and each layer is slightly shorter than the layer next to it. It's easier to leave them long and trim them when you're done.

Get Ready to Glue

Before attempting a glue-up, I made a dry run to make sure my clamping method would work, and that everything I needed was at hand. To form a fair curve, pressure must be evenly applied. This means a lot of clamps placed closely together. During the dry run I determined that 4" or 5" apart was a good spacing.

Typically I use yellow glue for most of my woodworking but bent lamination isn't a standard process. The wood wants to straighten back out, and yellow glue is somewhat flexible after it's dry. A glue that dries more rigidly should be used. Epoxy, plastic resin and reactive polyurethane all dry to a rigid line. I chose to use polyurethane (Gorilla Glue) because it doesn't need to be mixed before using.

I laid the strips out in order, and put a thin bead of glue down

the middle of each strip. I then used a putty knife to spread out the bead evenly across each strip. I stacked the strips back up, and placed them in the form. I started clamping in the center, and worked out to the ends, alternating right and left.

Each lamination was left in the clamps for four hours to dry. After removing the bent part from the form, I scraped off the excess glue. After the last part was removed from the form, I waited another 24 hours to be sure that the glue was fully cured before moving on to the next step.

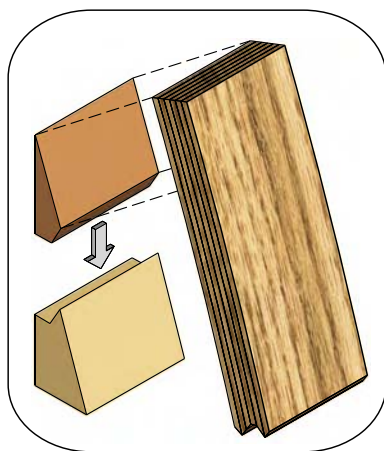
I cleaned up one edge of each curved piece on the jointer. I then carefully ripped each part to $\frac{1}{32}$ " over the finished width on the table saw. This can be done safely by keeping the part flat against



Starting at the center and working out to each end, clamps are placed every 4" to 5" around the form.



After scraping off the excess glue, one edge is evened up on the jointer. Make sure to keep the curve in contact with the fence on the outfeed side of the cutterhead.

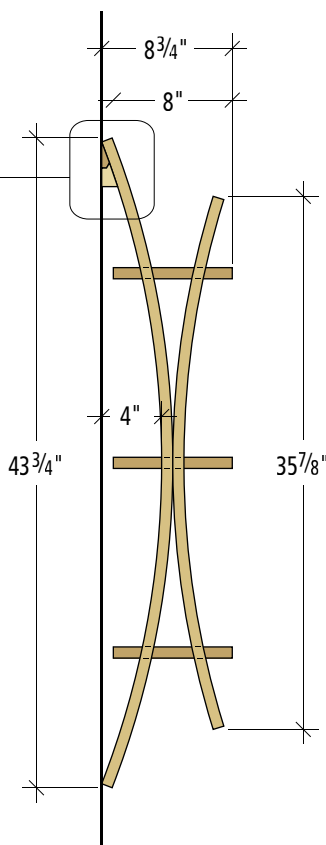


Hanging blocks

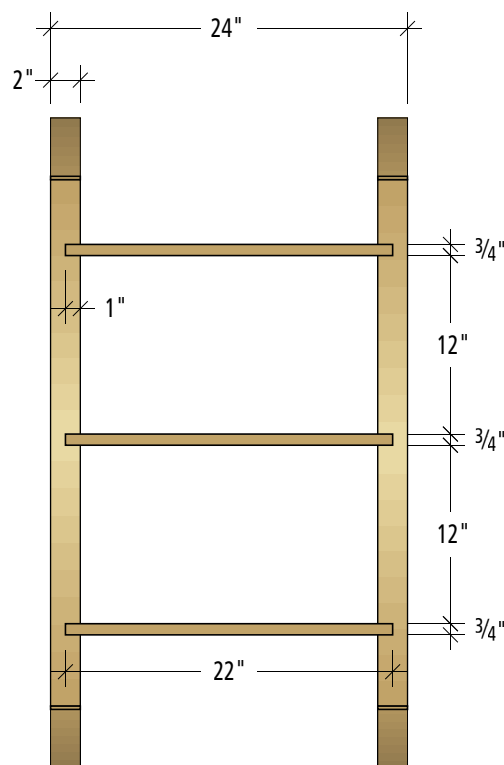
BENT-LAMINATION WALL SHELF

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL	COMMENTS
		T	W	L		
❑ 2	Rear supports	$\frac{3}{4}$	$2\frac{1}{2}$ *	54*	Ash	From 12 $\frac{1}{8}$ " pieces
❑ 2	Front supports	$\frac{3}{4}$	$2\frac{1}{2}$ *	54*	Ash	From 12 $\frac{1}{8}$ " pieces
❑ 3	Shelves	$\frac{3}{4}$	8	22	Ash	
❑ 4	Hanging blocks	1	$1\frac{1}{2}$	$1\frac{3}{4}$	Ash	Cut from larger block

*Sizes reflect overage for trimming



Profile



Elevation

the table and tight against the fence at the infeed edge of the saw blade. After this cut, I returned to the jointer and removed the saw marks with one pass over the machine's cutterhead.

Form Does Double Duty

To make the $\frac{3}{4}$ "-wide x 1"-deep notches in the supports, I put them back in the gluing jig. I added spacers below them to keep the top of each piece flush with the top of the jig. I added guide strips to the form to guide my router when cutting the notches. To prevent making two lefts and no rights, I didn't trim the ends to their final lengths until all the $\frac{3}{4}$ " notches

were cut and the pairs of curves were glued together.

I marked the center 2" of each piece and planed a flat in this area with my block plane. I clamped pairs of curves together, using scraps of wood to keep the notches aligned and in the same plane. After the glue had dried overnight, I marked the ends of the uprights from locations marked on the bending form and trimmed the ends with a handsaw.

I used my smoothing plane to fine-tune the fit of the shelves to the notches. I scraped all of the parts and then hand-sanded them with #220 grit before assembly. The ends of the shelves slide into

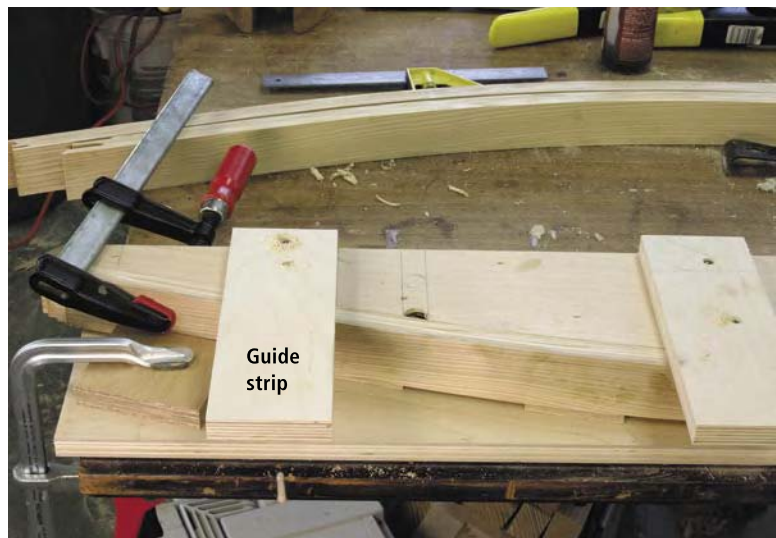
the notches and are simply glued and clamped.

It's a bit of a challenge to keep everything lined up during assembly. I started the shelves in the notches before brushing in glue.

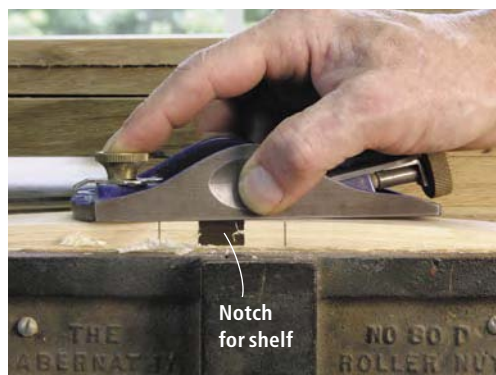
To keep the shelves aligned while clamping, I placed $\frac{3}{4}$ "-thick sticks on my bench to support the back edges. This is the distance from the wall in the finished shelf. I also made sure that the ends of



The other edge is ripped on the table saw, maintaining contact with the table on the infeed side of the saw blade.



Use layout lines on the top of the bending form to attach guide strips for the router. Working from the center, I also established lines for the ends of the supports. Then I notched the curved parts for the shelves with the router.



With the finished part back in the jig, I lay out a 2"-long flat at the center of each curved piece and then plane it by hand. Check the fit by measuring the space between the two parts at the shelf locations.



The ends of the shelves fit in the notches. Adjust the fit with a few swipes with a smoothing plane. Mark the support locations on the bottom of the shelves to keep the parts in line during assembly.

the back uprights were flat on the surface of the bench.

After a final handsanding with #280 grit, I finished the shelves with three coats of lacquer sprayed from an aerosol can.

Curved parts aren't hard to make, and can be both structural and visually interesting. The ability to make them adds to the skills that make a well-rounded woodworker. **PW**



Line up the shelves in the notches, then brush glue on all surfaces of the joint.



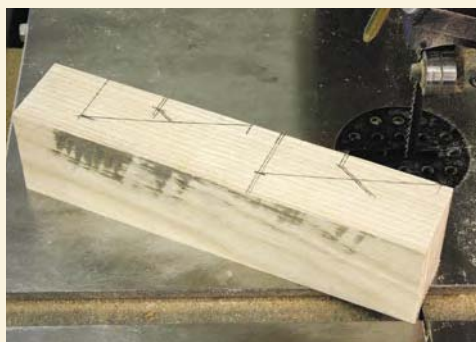
Sticks to support shelves

Assemble the shelves on a flat surface, making sure the ends are flat on the table. Square sticks keep the backs of the shelves in position.

HANGING THE SHELVES

To hang the shelves, I made two small blocks to fit behind the top of the back uprights. The dimensions of the blocks aren't critical, but they need to fit neatly together, and be tight against the inside of the curved support. I started with blocks larger than I needed so that I could cut them to shape while keeping my fingers a safe distance from the band saw blade. After cutting the blocks to shape I fit the curved edge to the back of the shelf support.

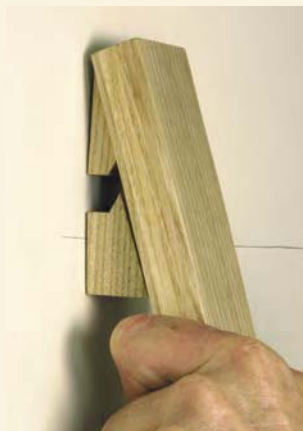
These can be fastened to a wall with Zip-it anchors (available from your local home center) after drawing a level line on the wall. The matching half of the hanger is glued to the back of each of the curved uprights. To hang the shelf on the wall, it is simply dropped in place on the hangers. **—RL**



Lay out the hanging blocks on a piece of wood big enough to let you cut them safely on the band saw.



Cut the curve first, then make two short cuts to form the interlocking joint. The last cut frees the hanger from the block.



The bottom half of the hanging cleat is attached to the wall forming a hook.



The other half of the hanger is glued to the back of the shelf support, letting the shelves hang nearly invisibly.

Efficient Shop

Every article I've seen describing the wiring of a shop for both 120 volts and 240V uses separate cables for each voltage, which is a significant waste of time, effort and cable. Here I describe how a single cable can be used to provide both 120V and 240V service to a single two-gang wall box.

For many home woodworkers this wiring method is an easier, less expensive way to add 240V service to an existing 120V shop.

I describe only the connection scheme, and appropriate plugs and receptacles here. You should consult one of the many home wiring books carried at home centers for basic wiring instructions. I strongly suggest those inexperienced with electrical wiring practices (or those who aren't up-to-date on their local electrical codes) to contact a licensed electrician instead of attempting this on their own. Wiring requires a certain expertise.

The key to this system is the same technique employed for wiring an electric dryer or range, which uses a single cable to provide both 240V for the heating elements and 120V for the lights and motor: a three-wire-plus-ground cable. Using dedicated 240V circuits for heavy-current machines such as cabinet saws, planers, shapers, etc. is a very conservative approach for a one-man shop where only one heavy machine is in use at a time.

In my shop I employ a single 20-amp circuit to feed all the 120V and 240V machinery, plus a 240V, 20-amp, two-conductor cable to feed the central dust collector. The use of a two-wire cable is permissible for 240V circuits if you color the white wire with a black or red magic marker at the connection points to indicate it is "hot." A second

by Bruce D. Wedlock

Bruce is a registered professional electrical engineer, an author of electrical engineering textbooks and a retired lecturer from the Massachusetts Institute of Technology. He practices woodworking in North Reading, Massachusetts. He can be reached at wedlock@alum.mit.edu.



FIGURE A: Here are 240 volt (right) and 120V (left), 20-amp receptacles.

Wiring

A single cable provides
120-volt and 240V service.

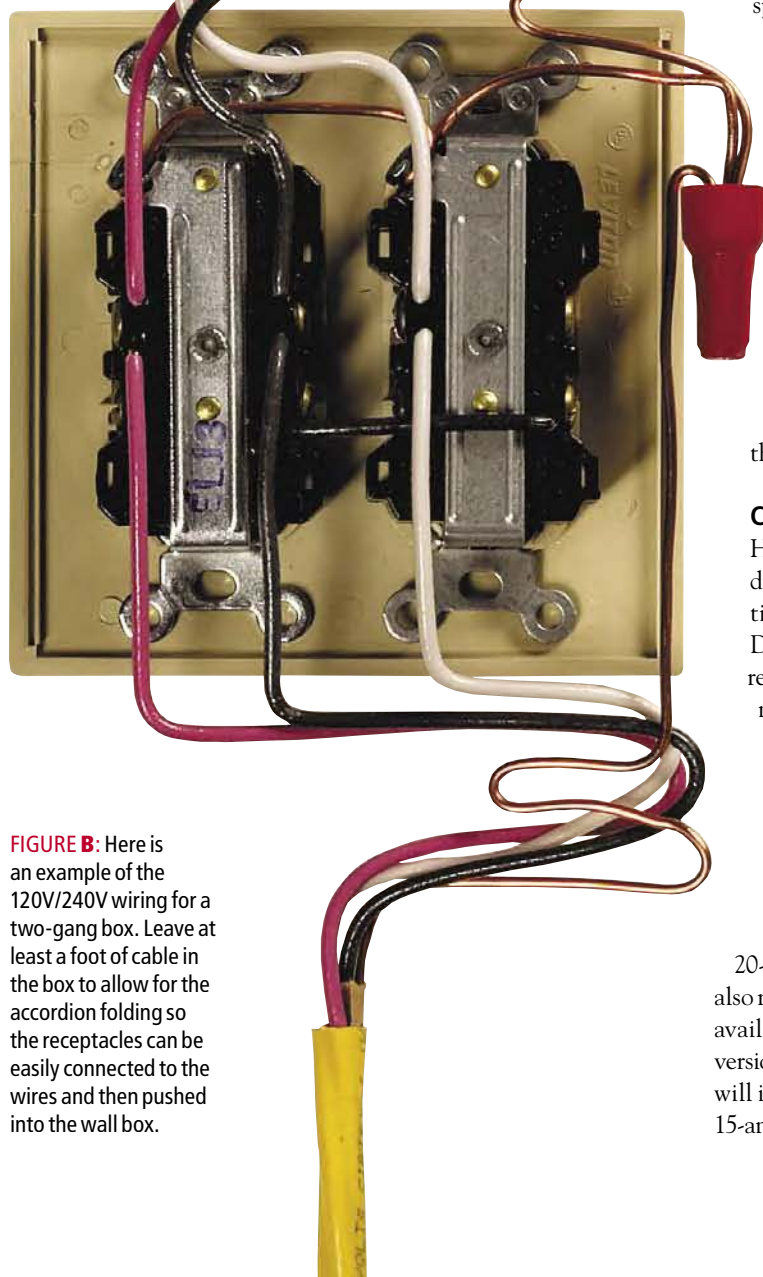


FIGURE B: Here is an example of the 120V/240V wiring for a two-gang box. Leave at least a foot of cable in the box to allow for the accordion folding so the receptacles can be easily connected to the wires and then pushed into the wall box.

three-wire cable provides dual 120V 20-amp circuits to round out the shop installation. These principles can be extended to multiple machine circuits, including automating the dust collector. (See “Easy Automatic Dust Control” on page 85.)

If the 120V receptacles are located in an unfinished space (garage or basement), the National Electric Code requires ground fault circuit interrupter (GFCI) protection. You should check with your town’s wiring inspector to see if your specific shop space requires GFCI receptacles. If it does, you will need a GFCI receptacle for each 120V outlet. If GFCI-protected 120V circuits are required, it may be more economical to run separate, conventional two-conductor circuits; one for 240V and one for 120V. The 120V circuit can then be protected with a single GFCI breaker and employ conventional receptacles. In that case you may want to use separate wall boxes for each voltage to reduce the wiring load in a box.

Component Selection

Heavy-duty commercial, “spec” or industrial-grade duplex receptacles should be used for shop applications; avoid residential or contractor grade units. Duplex receptacles rated for 20 amps at 125V are readily available. But 250V, 20-amp receptacles commonly found at home centers only have single outlets.

Duplex 250V, 20-amp receptacles are available, but you will probably have to go to an electrical supply house to obtain them.

Duplex receptacles provide twice as many outlet connections with no extra work so are well worth the effort to locate. Like clamps, you can’t have too many outlets. The Leviton No. 5462 is a duplex 250V, 20-amp receptacle available in brown or ivory. You will also need 250V male plugs for your machines. These are available at home centers, and come in 15- and 20-amp versions, which have different pin shapes, but either plug will insert into a 20-amp receptacle. I recommend the 15-amp plug for maximum flexibility. You might also want

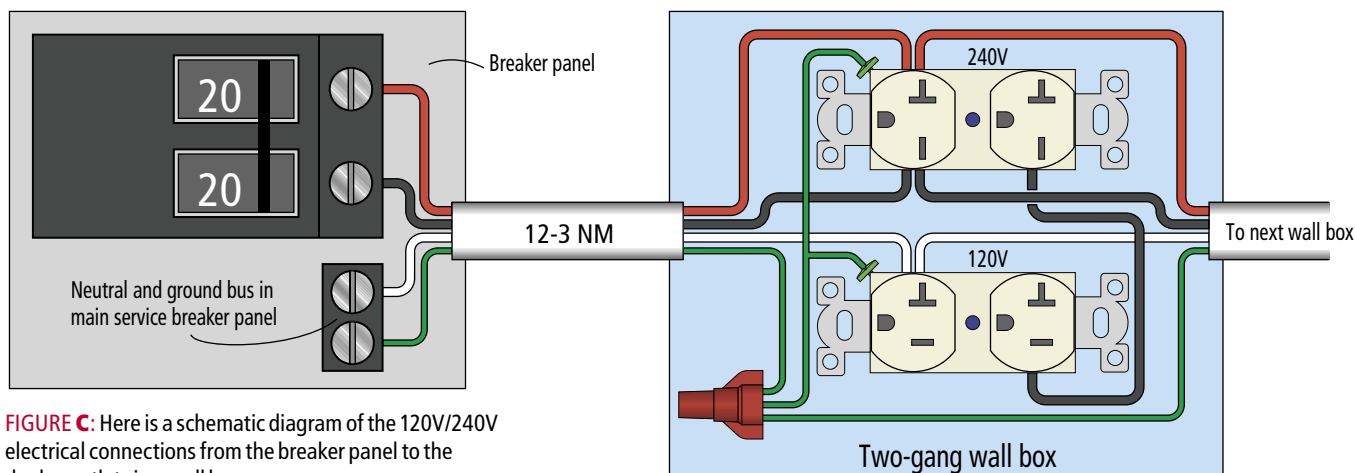


FIGURE C: Here is a schematic diagram of the 120V/240V electrical connections from the breaker panel to the duplex outlets in a wall box.

to purchase a matching 15-amp female connector and 14-gauge rubber covered cable to make a 240V extension cord. This cable should be two wires plus ground.

When buying receptacles, be sure to obtain units that can be backwired. It will greatly simplify your installation work. Backwiring means that you simply strip off a $\frac{1}{2}$ " length of insulation, insert the bare wire into a hole in the back of the receptacle and fasten it by tightening the corresponding screw. This is much easier than wrapping the bare wire around the screws, especially when making multiple connections in a wall box. Note: Early versions of backwired receptacles made the connection by spring pressure only. This type has been discontinued and is illegal for 20 amps in some locations. Be sure your backwired receptacles clamp the wire by tightening screws.

I find the two-gang PVC box most convenient for housing receptacles, but get the $2\frac{3}{4}$ "-deep model. The shallow boxes won't hold the necessary wire and heavy-duty receptacles. These boxes are available for new work (when the studs are accessible) and old work (where sheetrock covers the studs). The latter are easily secured to the sheetrock surrounding the hole

cut for the box. If you're working with conduit, again get a deep box combination. A $2\frac{1}{4}$ " box with a $\frac{1}{2}$ " cover will handle the receptacles and wiring.

Wiring a Wall Box For Machines

For 120V/240V shop applications I use three-wire 12-gauge nonmetallic (NM) sheathed cable, which is suitable for 20-amp circuits, and common-trip, two-pole, 20-amp circuit breakers. The cable actually contains four conductors: three insulated, colored red, black and white, plus a bare copper ground conductor. The white conductor is called the "neutral" while the bare copper wire is called the "ground."

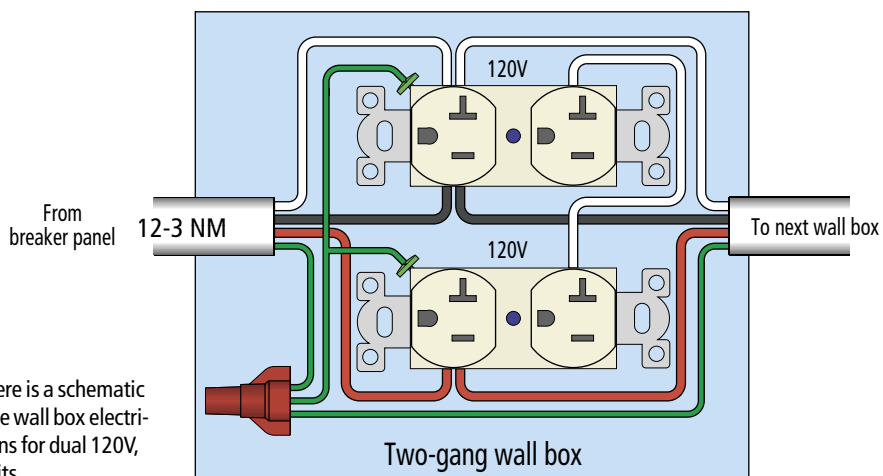


FIGURE D: Here is a schematic diagram of the wall box electrical connections for dual 120V, 20-amp circuits.

All neutral and ground conductors are connected to the neutral bus bar in the main service breaker panel. The red and black conductors are connected to the circuit breaker terminals and carry the "live" voltages. A connection between the red and black conductors supplies 240V; a connection between the white and either the red or black conductor will provide 120V. So this single cable carries both voltages to the wall box receptacles.

In my shop, the wiring is all concealed behind walls, so NM cable is appropriate. If your shop has exposed wall wiring, use metal or plastic conduit on the exposed walls where the wiring is subject to physical damage.

The 120V/240V wall box connections are illustrated in Figure C, shown above. I prefer to make the through connections between the input and output cables in a backwired connection clamped by a single screw. The pigtail to feed the 120V receptacle's brass screw is backwired to the remaining screw on the black side of the 240V receptacle. Note: The white or neutral wire is only used for the 120V outlets and must always be connected to the silver screw. A photograph of the actual wiring is shown in Figure B, on page 83.

Ground connections are not backwired; they are made to the green, hexagonal screws, and must be wrapped clockwise around the screw head. The three ground

wires in the box are finally connected using a wire nut. When making these pigtail connections between the receptacles, you will find it convenient to temporarily attach the receptacles to the wall cover plate to hold them in the proper relationship while fastening these wires.

Additional 120V Circuits

It is good practice to have additional 120V circuits in your shop. Lights should never be on the same circuit as machines or they will dim when machines start. If you use appliances such as glue pots, hot plates, coffee pots, etc., which can be in continuous operation, they should also have a separate 120V circuit. These might be on when machines are also in use, leading to a tripped breaker if not on a separate circuit.

The good news is that if you add a 120V circuit, the use of 12-3 NM cable will permit two independent 20-amp circuits in one 4" wall box as illustrated in Figure D (at left). The connections at the breaker box are the same.

For safety, you must use common-trip, two-pole, 20-amp breakers to ensure all power to a wall box is off when the breaker is off. In the wall box, the neutral white wires are connected to the silver screws on the receptacles, and the black and red wires to the respective brass screws. The ground connections are the same. Again, this connection will not operate with GFCI protection unless each receptacle is GFCI. **PW**

Special thanks to Greg Hyland, who served as technical editor for this article. President of Cincinnati-based Cooper Electric, Hyland has been in the electrical trade for 35 years and holds Electrical Contractor licenses in Ohio and Kentucky, as well as Master Electrician licensed in five local jurisdictions.

EASY AUTOMATIC DUST CONTROL

When I installed my central dust collection system, I wanted automatic control. Turn on a machine and the collector comes on; turn off the machine and the collector goes off. No extra wiring, no klutzy strings and no "garage door opener" to misplace. The answer is a \$50 unit called the Automater (R.F. St. Louis 800-526-0602 or search eBay.com for "Automater"). It's the size of a deck of cards and neatly installs in a two-gang 2 1/4" metal handy box connected to your breaker panel with a nipple.

The Automater provides an adjustable turn-on delay to stagger the starting current surges of the machine and collector motors, plus a turn-off delay to clear the ducts. For a central dust collector installation you want the Model DC-2400. The schematic wiring diagram for the Automater is shown in Figure E (below). Note that the white wire from the 12-2 NM cable connected to the dust collector breaker has been colored black to indicate it is hot. A similar coloring is made in the connection box at the collector.

The Automater senses the current in the red machine conductor. When 3.5 amps is detected, it activates the dust collector by closing the T4 and T5 switch contacts. Hence, whenever a machine connected to the red conductor is turned on, the collector comes on after a few-second adjustable delay. When the machine is turned off, the collector stops after a similar delay. The commercial-grade SPST (single pole, single throw) switch wired to the T4 and T5 contacts permits the dust collector to be turned on manually without running a machine. This switch can be located at any convenient location in the shop. Connect to the Automater with 12-2 NM cable with white lead colored black.

The 120V/240V connection shown in Figure C (at left) used the black conductor to feed the 120V receptacle. However, if instead the red conductor were used to feed the 120V receptacle, then any tool plugged into that 120V outlet drawing a 3.5-amp current will also turn on the dust collector. So by feeding your 120V router table and chop saw outlets, for example, from the red conductor, they will also automatically control the dust collector.

The deciding factor whether or not a 120V receptacle connection controls the collector is whether it is fed from the red or black conductor. A single 120V duplex receptacle can also have it both ways. If the small tab between the two brass screws is broken off, then one 120V outlet can be connected to the black wire (no control) and the other connected to the red wire (control).

The single-cable connection scheme I've described can be expanded to larger shops by adding additional 20-amp breakers and woodworking machinery circuits. Automated dust collection will require a separate Automater for each breaker circuit with all the T4 and T5 switch terminals connected together, respectively. In that way whenever any machine is on, the dust collector will operate.

The Automater will also work with 240V three-phase machines. One only needs to feed one of the machine conductors through the T1 and T2 sensing contacts and connect either of the remaining machine conductors to the T3 terminal. When a machine is turned on, the T4 and T5 switch contacts will close. However, if the dust collector is also three-phase, an auxiliary relay will be needed to switch the collector's power. **—BW**

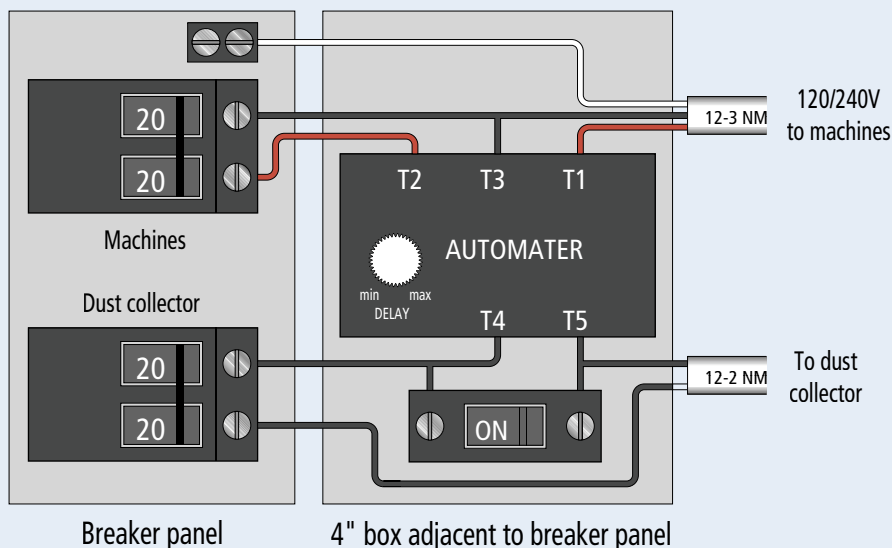


FIGURE E: Shown here is a schematic of connections for automatic dust collector control. Note the white 12-2 NM conductor has been colored black to identify both conductors as hot. The ground wiring is omitted for clarity.



Photo by Al Parrish

SawStop CABINET SAW

What we like (and dislike) about this revolutionary machine.

A safe table saw – that’s the holy grail of woodworking machinery, and that’s how many woodworkers view the SawStop cabinet saw. We’ve spent the last three months using the SawStop cabinet saw in our shop daily. We’re impressed, but we also have some improvements to suggest.

But first, let’s look at the con-

cept behind the SawStop safety system. An electrical signal is passed through the blade and this signal is monitored for changes in conductivity. Wood and humans have significantly different electrical conductivity signals, and the SawStop system is able to recognize this difference.

The system doesn’t react when wood touches the blade. However, when a person contacts the blade, the system reacts dramatically.

The brake (a block of aluminum called a brake pawl) is

launched by a spring into the sawblade’s teeth. The blade’s teeth cut into the pawl and bind, stopping the blade in about 1/200th of a second. At the same time the motor stops and the blade drops below the table. No other saw on the market has this safety feature.

First Impressions

The saw came into our shop in good shape; so setting it up went quickly. The saw was well aligned and didn’t need much adjustment before our first use.

There were a couple features that we were fond of right out of the crate. The blade-height adjustment was smooth and free of backlash, which made it easy to make small height adjustments.

The riving knife is a feature that our entire staff thinks was overdue on an American table saw. In fact, we all agreed that this one feature is probably a more important safety feature than the SawStop mechanism.

The oversized paddle switch is convenient, but the staff had mixed experiences with its location. Some liked being able to turn off the saw by pushing their leg forward. Others found that it was located so close to the table’s edge that it was accidentally turned off during a cut too frequently.

SPECIFICATIONS

SawStop Cabinet Saw

Street price: \$2,995 (as tested)

Motor: 3 hp, 230V, 1 ph.

(tested) (5 hp opt.)

Weight: 640 lbs.

Performance: ●●●●○

Price range: \$\$\$\$

SawStop: 866-SAWSTOP
or sawstop.com

by the Popular Woodworking staff

Comments or questions? Contact David Thiel at 513-531-2690 ext. 1255
or david.thiel@fwpubs.com.

Looking a Little Deeper

After a couple of weeks of use we noticed some things on the saw that were slightly disappointing in a saw costing nearly \$3,000.

The rip fence is offered as an option and is priced about the same as a Biesemeyer fence. But it fell short of the Biesemeyer fence's high quality. Our initial fence had some sloppiness and a bow in the face. The manufacturer admitted some manufacturing difficulties and replaced the fence with a better version.

When setting the fence, we found the cursor nearly unreadable, and we pulled the cursor off our Powermatic 66 to replace it about a half an hour after the saw was put in service. The scale on the fence rail was also hard to read, with all of the fractional lines the same length. We also replaced this. Again, after speaking with the manufacturer, we were told that the scale was already being replaced for future shipments.

The saw has a two-wrench system for holding the arbor to change blades and that's a good idea. But the wrench openings were slightly oversized, chewing up the nut after a short period.

The opening in the tabletop to reach the blade has plenty of room to the left of the blade (where you never put your hand) and not enough on the right.

That space is also the main access to change out the SawStop's cartridge. It's necessary to switch cartridges every time you switch between a dado set and a regular blade, and we found that changing the cartridge didn't take too long after a couple swaps. We did find that one of the two posts that the cartridge mounts on isn't visible from above. To get the cartridge started you have to do it by feel, or crawl under the outfeed table.

We tested a 3-horsepower model of the SawStop cabinet

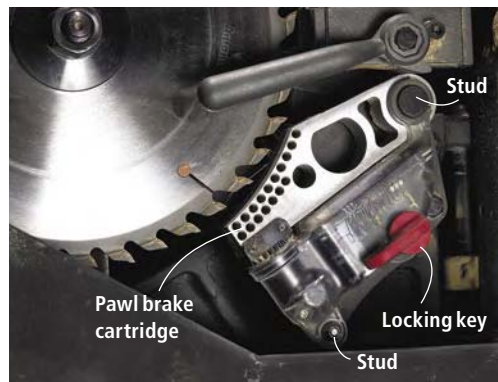


Photo by Al Parrish

The pawl brake cartridge is shown here in place in the saw. The mechanism mounts over two studs and is held in place with a locking key. Changing out the cartridge (a wider pawl brake is required when using a dado set) is easier than we anticipated.

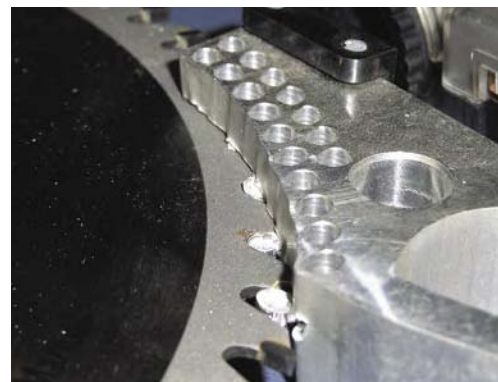


Photo by Brad Staggs

Here you can see the results of a standard test of the saw. A hot dog (used to simulate a digit) was laid flat on a board and pushed quickly into the spinning blade. The pawl brake cartridge functioned perfectly here, stopping the blade very quickly, and only nicking the hot dog.

saw (5 hp also is available), and were at first disappointed because the motor felt underpowered. Another chat with the manufacturer identified a problem with the belt. Once replaced, the saw performed like a 3 hp Unisaw.

The blade is shrouded to improve dust collection (which it does). A door is mounted on the right side of the shroud to allow access to the SawStop cartridge from below the table. We found that this door can be stuck open against the saw frame. If this happens, tilting the arbor can snap the door off (as we did).

Along with the riving knife, a standard blade guard is included. While the guard was an improvement over most stock blade guards, it couldn't be used when making very thin rips (when you would want to use it) and the anti-kick-back pawls interfered with pushing work past the blade.

The Mechanism

Of course you want to know how the safety mechanism itself functions. We have good and not-so-good news about that. The by-now well-known hot dog test provided dramatic and perfect results, stopping the blade immediately with little damage to the hot dog.

But we also had an accidental firing of the brake mechanism. After changing the blade cartridge over to our dado set the cartridge fired as the saw was turned back on, damaging one of the cutters on our expensive dado set. SawStop shipped a replacement cartridge overnight, but if you were operating a business, you'd be out \$60 to \$70 for a new cartridge as well as the price of a new dado set.

Representatives of the company told us that the computer chip information from the fired cartridge indicated that the space calibration between the blade and the pawl was at fault, though we'd successfully used the same dado set and cartridge on the saw a number of times before the misfire.

The Bottom Line

It seems like we're beating up on SawStop here, but overall we think the saw is a success. We're more than willing to chalk up some of our disappointments to a first-time saw manufacturer. We feel confident SawStop is currently addressing many of these concerns in a proactive manner. As these improvements continue, the steep price of the saw will be more reasonable in light of providing a safer saw alternative. **PW**



A riving knife serves as a splitter behind the blade, keeping material from binding after being cut. More importantly, it moves up and down with the blade and can be used when making grooves and dados, while a standard splitter can't.

PROS:

- + Beefy trunnions
- + Riving knife
- + SawStop system for safety
- + Dust-collection shroud
- + Oversized on/off switch
- + Generally well-made saw

CONS:

- Cartridge misfire with dado
- Poor fence scale
- Overvalued fence
- On/off switch too easy to hit
- Expensive
- Caution is required with dust shroud's door

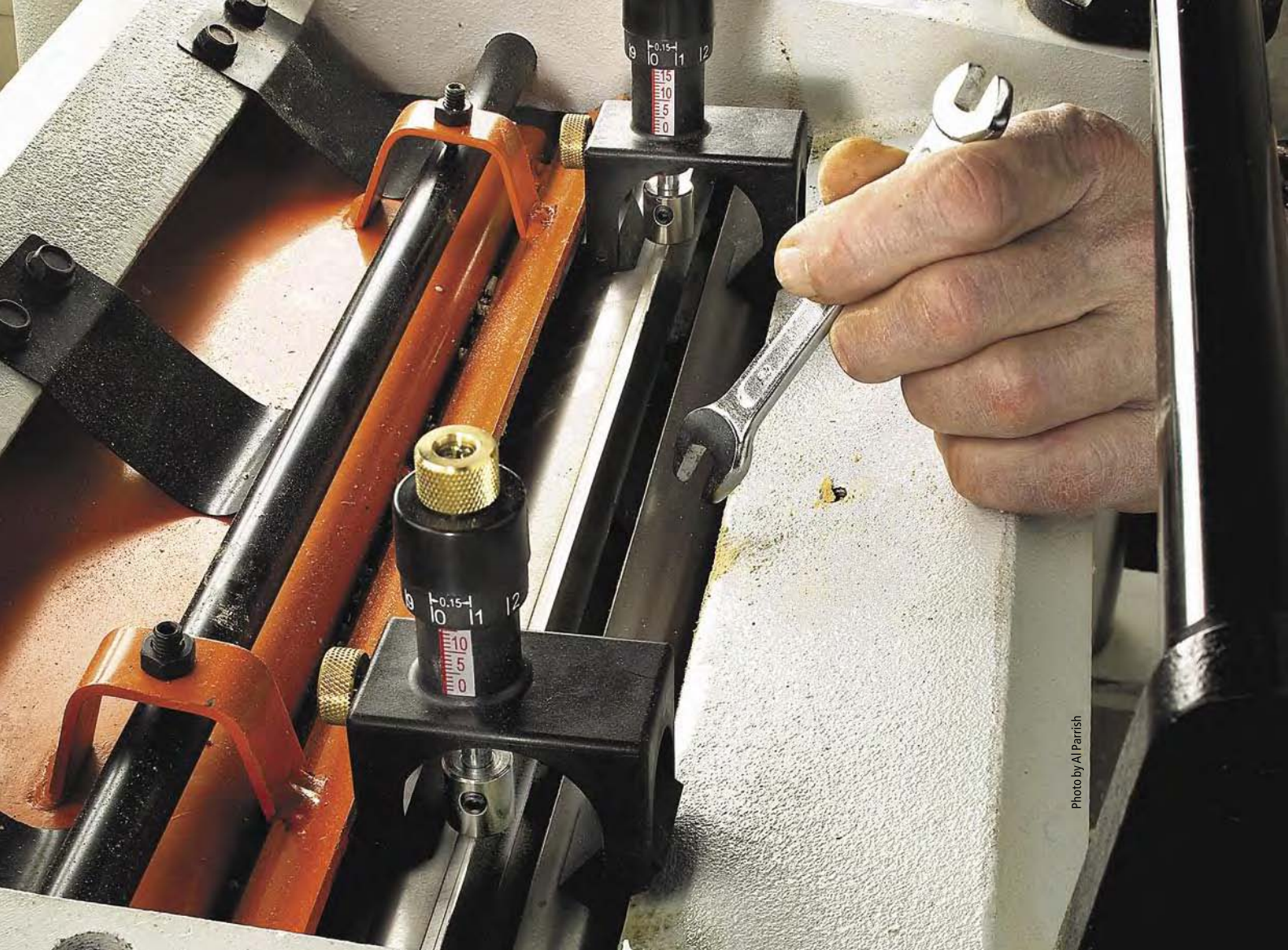


Photo by Al Parrish

Setting Jointer & Planer Knives

A close look at jigs and techniques for getting your knives positioned quickly so you can get back to work.

One of the great pleasures of woodworking is having a reliable and accurate jointer and planer. If these two machines, used in the first stages of any project, can be counted on to produce edges that are truly straight and square, and faces that are parallel, you're off to a great start. Every step that follows will be easier, and you'll be happier with the end results if you start by making good parts.

by Robert W. Lang

Comments or questions? Contact Bob at 513-531-2690 ext. 1327
or robert.lang@fwpubs.com

But even the most accurate planer and jointer setups will degrade over time, particularly as the knives dull. Although it's important, we tend to put off changing jointer and planer knives until we must.

The trouble is, we don't do it often enough to keep in practice. When we do get to it, we need to recall how and why we do these things. This article will serve as a refresher on the steps to take and a close look at some of the tools available to help. You can spend a fortune on tools you may only need once or twice a year, or you can achieve good results inexpensively.

For a jointer to function properly the tables must be parallel to each other, and the edges of the knives must be even with the surface of the outfeed table when the knives are at top dead center. With a planer, the tips of the knives should be a consistent distance from the top of the planer bed.

Ideally, either of these knife/table relationships will result in the knives projecting from the cutterhead a consistent distance. In many cases, you may have to set one end a little higher or lower than the other to obtain the results you want.

When setting knives in a jointer, you can work directly from the outfeed table. But with a planer, you can't reach the knives and measure to the bed at the same time, so getting the knives set right is more involved.

Welcome to Machinist Land

When setting up machines, the critical distances are smaller than most woodworkers are used to. To measure accurately to .001" you need to use a tool normally used by machinists – a dial indicator – along with some way to hold it where you need it.

Dial indicators can be obtained

for \$20 or less, or you can easily spend 10 times that much. Save your money and get the cheap imported one. It will do everything you need it to. Four of the tools we looked at are just clever ways to hold a dial indicator.

The other type of jigs we tested are aids that hold knives in position while you tighten them in place. This is a distinct step from measuring the location of the knives. You don't really need to measure if you can get the knives close enough to achieve predictable results.

These devices use magnets to set the knives in relation to the cutterhead for setting up a planer or to set the knives relative to the outfeed table of a jointer. You can set jointer knives with a straightedge and most planers come with a jig to accurately set the knife distance. The trouble is, you need one hand to hold the jig, one hand to hold the knife against the jig, and a third hand to turn the wrench. So the magnetic jigs add a real benefit.

No matter what method or jig you use, keep in mind that tightening the nuts that hold the knives in place can shift them slightly. Tighten the nuts initially just enough to keep the knife from dropping. Make sure they're in the right position and tighten the two nuts on the ends first. Then go back and snug up the nuts in between.

Go around a second time, tightening alternate nuts all the way, like you would tighten the lug nuts on the wheel of a car. Don't overtighten the nuts; an open-end wrench should tighten the fastener to the proper torque when it is snug.

Buy a second set of knives, and send the dull ones out to a professional sharpener. When you change knives, change one at a time. If you remove them all at

once you run the risk of distorting the cutterhead as you tighten each knife. This could cause you to have to start over once you have them all in place.

Don't bother getting knives arm-hair-shaving sharp. When you run the machine, the wear of the spinning blades on hard wood will blunt that razor edge very quickly. You need a good edge, but not a great edge.

Before changing knives I make some measurements first so I can tell if I'm actually improving conditions. How close is close enough? If you can get the knives to within two or three thousandths of an inch, the high knives will wear down even with the others in the first few hours of operation. Let's look at some of the available measuring jigs I tested.

Grizzly President's Special

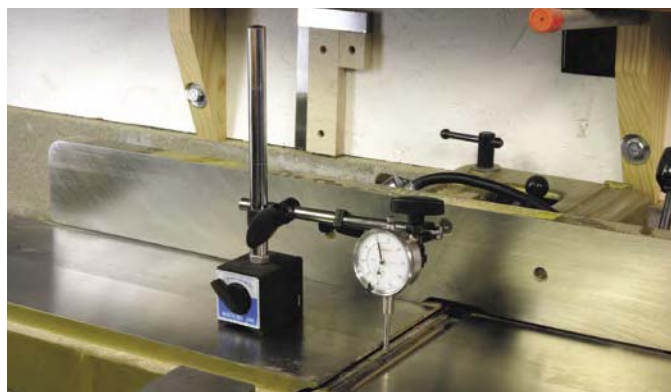
The simplest, and by far the cheapest, was the Grizzly Magnetic Base/Dial indicator Combo – President's Special. Nearly identical sets are available from a number of sources. This is an imported dial indicator, a magnetic base and an articulating arm all in one. The indicator is of good quality, but it comes with a conical tip and Grizzly doesn't offer a set of flat tips. (However we've heard that Grizzly is working to change that.)

THE TRUTH ABOUT CAST IRON

We tend to think that cast iron is an inert material, something we can count on to be flat and stay flat. But when you start measuring in thousandths of an inch, that just isn't so.

When cast iron cools, it hardens from the outside in, and it takes quite awhile to completely harden. This sets up stresses in the material. Manufacturers used to let castings sit for years to stabilize before grinding them true and flat. Today iron is machined and on the boat in a short period of time. Much like a piece of wet wood that is put through a planer, new cast iron can warp and twist even though the surface appears to be flat and smooth.

Even when castings are given time to season, the material is still relatively flexible. You can bend jointer tables by using them to pick up the machine, and you can distort a table saw or band saw top by the way you tighten the bolts holding them to the machine. The tops on machines that aren't sitting perfectly level can also distort. However, what appears to be a major problem can often be corrected by leveling the machine, and loosening and retightening the fasteners. —RL



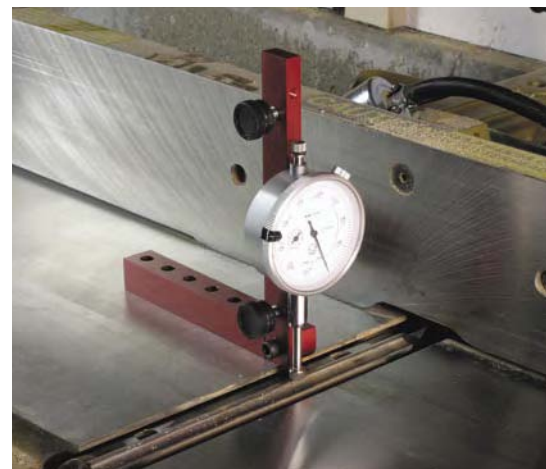
The magnetic base/dial indicator combination is, at \$20, by far the least expensive of the devices we tested.



The Oneway Multi-Gauge sits solidly because of its mass, and the dial indicator can be turned to read it from any direction.



The Rotacator's compact size makes it ideal for measuring between the bed and the knives when setting up a planer.



The A-Line-It was designed to work with its bars in the miter-gauge slot of a table saw. It can also be used to set jointer knives.

SOURCES

Grizzly

800-523-4777 or grizzly.com

- Magnetic Base/Dial Indicator Combo – President's Special G9849, \$19.95
- Woodstock International Planer Pal H2301, \$99.95
- Woodstock International Mini Planer Pal G3641, \$29.95
- Woodstock International Jointer Pal G3360, \$26.95
- Woodstock International Rotacator G1738, \$99.95
- Dispoz-A-Blade replacement blade system G6660, \$144.95-\$239.95

Oneway

800-565-7288 or oneway.on.ca

- Multi-Gauge #2289, \$79.95

In-Line Industries

800-533-6709 or in-lineindustries.com

- Deluxe A-Line-It Kit \$144.95

Woodcraft

800-225-1153 or woodcraft.com

- Magnetic Planer Knife Setting Jigs \$49.99

Prices correct at time of publication.

The magnetic base has an off/on switch. The magnet is powerful, so you need to turn it off to move the base. The arm that holds the indicator is adjustable in many ways, and one of the arms has a fine adjustment function. This is great if you need to reach inside a machine, but for checking jointer knives there were too many knobs to tighten. It was time consuming to make all the settings and adjustments needed. This was adequate for measuring jointer knives, but there was too much mechanism to fit between the bed and the cutterhead of our planer.

Oneway Multi-Gauge

The Oneway Multi-Gauge is a serious piece of cast iron, machined with two parallel edges and one square edge. It holds a dial indicator with a flat tip. The size and weight of the holder make it steady and solid. It's heavy enough to stay in place without a magnet, and the indicator can be rotated so you can see it from different directions.

This is an ideal setup for checking jointer knives, but its mass caused problems in checking our planer. It was difficult to get it positioned for a reading without the holder getting in the way.

There was a small usable area on our planer bed where it could be used without the top being hit by the pressure bar, or the bottom on the bed rollers.

Rotacator

The Rotacator is much smaller than Oneway's Multi-Gauge, and is a casting with a machined flat magnetic base. The small dial indicator can be rotated in 90° steps so it can point up, down,

right or left. The magnetic base holds it in position, but the magnets don't grip too tight, so the device is easy to move.

This proved to be the easiest to use in the planer, and second only to the Oneway on the jointer. The biggest drawback is the lack of a knob on the top of the dial indicator. Often while checking knives you need to lift the plunger, and this was an awkward operation with the Rotacator.

DIAL INDICATOR 101

Unless you're a professional machinist, an inexpensive dial indicator will meet your needs. Here are some tips on using one:

- The tip of the indicator can be changed. Cone-shaped tips are alright for checking flat surfaces, but will drive you crazy trying to align the edge of a knife at top dead center with the point of the tip. A flat tip will do a better job of checking knives; they give you a range for locating top dead center rather than one exact spot. Sets of tips can be obtained for just a few dollars.
- Always loosen the locking set screw before resetting the indicator to zero to avoid damaging the mechanism.
- Have a solid method of holding the indicator. Any play or movement will keep you from getting accurate readings.
- Remember to keep a consistent reference of where you are measuring from. Keep the surface free of dust and debris.
- The dial indicator is best used to measure relative distances, such as the difference between both ends of a cutterhead.
- The indicator should have a grip at the opposite end of the tip, so that you can pull the tip out of the way when you need to.

—RL

A-Line-It

This jig is a combination of aluminum bars that can be configured in different ways to hold a dial indicator. To be fair, this seems to have been designed for table saw alignment, and jointer and planer applications are secondary.

It performed decently in measuring jointer knives, although the base was not as stable as the cast bases. In the planer it was hard to get the device located so that the dial could be read without the

leg resting on the bed rollers, or with the dial indicator out of the line of sight.

None of the jigs we've discussed so far really help you position the knives in the first place. What they do is tell you the precise location relative to something else. To put the knives in place, you need something like the following:

Planer Pals

A pair of magnets hold on to the planer's cutterhead, while a third

magnet holds the knife the right distance from the head. The knife-holding magnet is adjustable; you set it to the existing knife projection. You can use a feeler gauge or shims if you need to correct an existing setup.

Some care is required to get these set exactly where you want them on the cutterhead. Once in place, the magnets firmly hold the knives while you tighten the nuts. It's not quite foolproof, but certainly fool-resistant.

There is also a Mini Planer Pal, for small planers, which lacks the adjustment feature.

Magnetic Planer Setting Jig

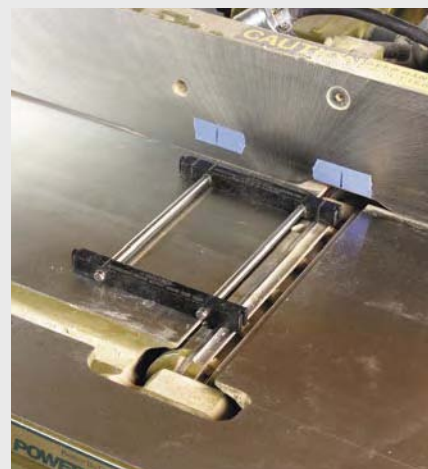
This is similar in concept to the Planer Pal, but nowhere near as reliable. The magnets are much smaller, and as a result, it was harder to get it and keep it in the right place. The third magnet has a fine screw adjustment.

The weak magnets and a bit of play in the arms led to poor

STEPS FOR SETTING JOINTER KNIVES

- Unplug the machine! Remove the guard. Check the tables for alignment with a straightedge.
- Locate top dead center of the head and mark it on your jointer's fence.
- If you're using a jig or dial indicator, make a second reference mark on the outfeed table so you can locate it in the same position relative to top dead center.
- Remove and replace the knives one at a time, buy a second set of knives and keep a sharp set in reserve.
- If your machine doesn't have jackscrews, it's easier to move the knives down than it is to move them up. If you have the fasteners just tight enough to keep the knife from falling, you can push it down flush to the outfeed table by using a block of wood.
- If you have springs or jackscrews, bring the knives up to a straightedge, straight block of wood or jig so that they are even with the top of the outfeed table when the knife is at top dead center.
- Make sure the cutterhead is at top dead center when you set or measure the position of the knives.
- Tighten the bolts holding the knives snug, alternating bolts. Tighten all the bolts a second time. Be sure that the knives aren't raising up as you tighten.
- Double-check your work by measuring the distance from the top of the outfeed table to the top of each knife at top dead center.
- Make sure your dial indicator is set in the same position relative to the knife and table at each end of each knife.

—RL



To set the knives, position the knife at top dead center. Marks on the fence indicate this and the position of the jig. Transfer the second mark to the table if you need to remove the fence.



The first step in tuning a jointer is to make sure that the tables are aligned and parallel.



You can use a simple block of wood or plywood to set and hold jointer knives flush with the outfeed table.

STEPS FOR SETTING PLANER KNIVES

- Unplug the machine!
- Before you start, measure from the bed to the cutterhead to determine if they are parallel.
- Then measure from the bed to the knife at bottom dead center at both ends of the cutterhead.
- If the bed and cutterhead are parallel, you want to set the knives a consistent distance from the cutterhead. If they are out of parallel by a few thousandths, you can compensate by setting one end of the knife out by the difference. However, if they are out more than that, you will need to adjust the bed of the machine.
- Change one knife at a time. Set your jig the correct distance from the cutterhead based on existing knife placement or using the manufacturer's specifications.
- Tighten the knives just enough to hold them in place without falling while you set them in place. If you have springs, let the jig push against the knives to set the correct distance. If you have jackscrews, adjust the screws to set the knives against the jig.
- Tighten the knife like you would tighten the lug nuts on a car wheel. Alternate nuts, get them snug, then go around a second time.
- Make sure that tightening doesn't move the position of the knife. The turn of the wrench can move it a few thousandths of an inch.
- Double-check your work by measuring the bed-to-knife distance at each end of each knife.

—RL



The easiest way to set the knife at the proper distance is to use a magnetic jig. Leave yourself room for the wrench when you position the jig.



Tightening the knives can cause them to move away slightly from the cutterhead. Use a jig to hold them while tightening and always double-check your work afterwards.

results. Tightening the knives in our planer's head pushed the jig out of place by about .005".

Jointer Pal

This device, which holds jointer knives with magnets, comes in two versions, one with a plastic base, and a more expensive one with a metal base. The plastic one seemed to grip a little better than the metal. Like the Planer Pal, these work very well if you can get (and hold) the cutterhead in the right place.

The key to using the Jointer Pal is getting the cutterhead exactly at top dead center, and then making reference marks on the jointer fence and the outfeed

table to get the jig positioned correctly for each knife.

Making the Right Choice

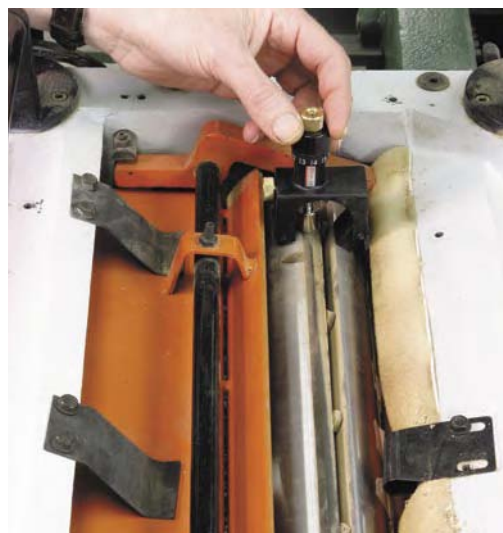
There are two steps to changing knives. The first, and the only really necessary one, is setting the knives in the right position. The second step is accurately measuring where the knives are. If you use the measuring tools for setting, you will go insane watching the needle on the dial indicator bounce up and down a few thousandths as you position and tighten the knives. We like the magnetic holding jigs, but aren't so sure about the value of the measuring tools we tested.

All were well made and quite

The magnet holding the knife in the Planer Pal is adjustable to set the knife the correct distance from the cutterhead.



The Magnetic Planer Setting Jig also has an adjustable knife magnet, but its small size made the jig less reliable.



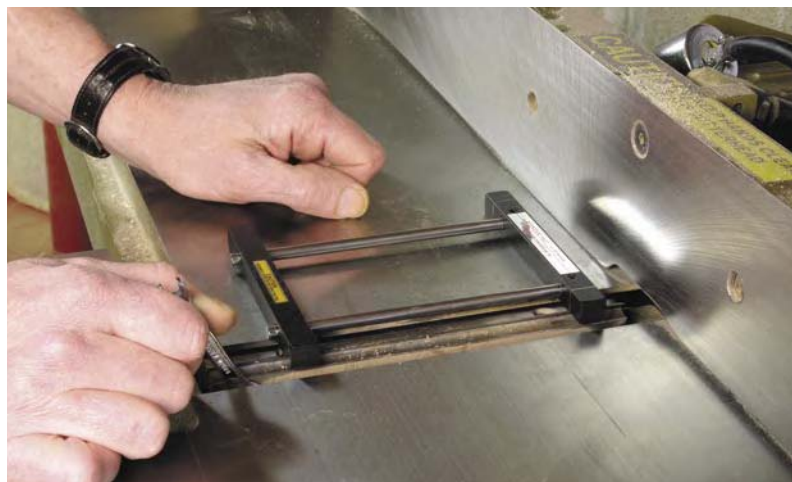
effective for different, specific tasks. For example, for setting up a table saw, the A-Line-It is hard to beat. For jointer knives the Oneway Multi-Gauge came out on top. On the planer, the Rotacator did an excellent job.

Unfortunately, none of them was adaptable enough to recommend as a good, all-around measuring tool. To have the best way to measure each machine would mean an investment in several rather expensive devices.

The relatively cheap dial indicator and tip set comes very close

to performing as well for a fraction of the cost. With an hour or two, and a handful of rare earth magnets, you could put together purpose-built jigs for each of your machines, and save a considerable amount of money.

Changing jointer and planer knives isn't something you have to do very often. However, when it's time to do it, it pays to have some tricks up your sleeve, and a third, or even a fourth hand to help get the job done. That way you'll soon be back to working wood, accurately. **PW**



The Jointer Pal uses magnets to hold the knife even with the outfeed table.

SPIRAL CUTTERHEAD ALTERNATIVE

Installing jointer and planer knives with speed and accuracy takes practice. And like many skill-driven activities, you must routinely use the skill or lose it. For the home woodworker, knife changing just doesn't happen with the frequency necessary to become, or remain, proficient at it.

Equipment manufacturers began to address this problem years ago when they introduced portable planers with disposable knives that installed on fixed indexing pins. Similar systems are also available for many jointers. These indexing knives virtually eliminated the need for knife-setting skills.

Enter now a great leap forward with the introduction of spiral cutterheads using indexing tooling, either in the form of a flexible knife in a spiral position or indexed insert tooling arranged in a helical configuration. In either case, knife setting becomes simple.

But why spiral? The primary benefit is a superior cut, particularly in figured woods where changes in grain direction lead to tear-out. The spiral, most notably on the flexible-blade version, produces a shear cut rather than a straight cut. It's akin to angling your hand plane when cutting rather than heading straight into the wood. The spiral cut also leaves less pronounced knife marks, sometimes called "washboard," on the wood.

While spiral cutterhead technology has been used in industrial woodworking for years, it hasn't been practical for home wood-

workers because of the high cost. These days, manufacturers like Powermatic, Grizzly and others are now offering spiral heads on new equipment at reasonable prices.

An important development has occurred



with aftermarket spiral cutterheads now available through Sunhill Machinery (800-929-4321 or sunhillmachinery.com). The company is now offering three-knife replacement heads for jointers and planers starting as low as \$195 for 6" jointers and \$285 for 8" models. Disposable, replacement knives are about \$20 for 6" and \$30 for 8" jointers. Helical heads with carbide insert tooling are about double the price.

But even if the price is tempting, how difficult is the task of replacing a cutterhead in most jointers? The answer is surprisingly easy because Sunhill provides the new cutterhead complete with bearings and mounting blocks

installed. After removing the guard, fence and belts, the removal of two nuts is all it takes to allow you to lift the original cutterhead from the machine.

Switch out the pulley to the new cutterhead, set the cutterhead back in place, secure the two nuts and it's done. Align the outfeed table with the top dead center of the new cutterhead knives, put the belts, fence and guard back in place, and you're ready to go. In all, it took me about 30 minutes, start to finish.

Although the new cutterhead comes with the knives already installed, I removed and reinstalled them to get a feel for the process. By the time I had installed the second and third knife I had mastered the proper indexing method. I returned to the first knife and made an adjustment, and the job was completely done. From start to finish, the knife-changing operation took about 20 minutes.

What about planer cutterhead replacement? I didn't attempt this, but looking at three 15" models I determined it isn't nearly as easy as the jointer. There are a lot more parts between you and the cutterhead on a typical planer. If you consider swapping out a cutterhead in your planer, I recommend you fully investigate what will be required for your machine. It should be within the abilities of anyone possessing average mechanical skills, but it looked like a long afternoon's worth of work to me.

— Steve Shaney

How to Pursue an Ideal Form

Seek perfection, and you may attain excellence.

Once I complimented a student new to turning on the pleasing shape of her very first bowl, which she was working on. She burst out laughing and exclaimed, "I'm not in charge of that!" When you're just getting started, simply making clean cuts and avoiding kickback or other disasters may seem like more than you can hope for. If you have made only a few bowls, you may not have given much thought to the more abstract aspects of design. But as you begin to acquire more control of the process, you will start thinking about how to make the next bowl a better one. That's a big part of what I mean here by design. It's deciding or recognizing what you like; what kind of materials, shapes, proportions, details, etc. you prefer or are interested in exploring.

Because design is about form as well as function, designing a bowl is more than just figuring out how to attach the wood to the lathe and what gouges to use in turning it. Who has not seen a piece that is so beautiful



Photos by the author

"In anything at all, perfection is finally attained not when there is no longer anything to add, but when there is no longer anything to take away ... perfection of invention touches hands with absence of invention, as if that line ... had not been invented but simply discovered ..." wrote Antoine de Saint Exupéry in *"Wind, Sand and Stars."* While perfection can't be attained, when a bowl's lines are as simple, clean and peaceful as those found everywhere in nature, I know it's a successful piece.

it seems to have simply grown, like a flower, rather than to have been made by a mere person? If we are lucky and have practiced our cuts well, we may even have made such a piece ourselves. What is it, precisely, that makes such a work so powerful? Is there a way to make sure your next turning has that kind of presence?

Basic Design Considerations

At a basic, concrete level, there are practical considerations of craftsmanship. Make sure the bowl is cut cleanly; tear-out, dips from too much sanding and other surface flaws will detract from the impact of a piece.

Remember, the first thing anyone looking at a bowl is going to do is pick it up, feel the curves and turn it over to look at the bottom. Keep those curves nice and smooth. Acceler-

ating or decelerating curves tend to be more pleasing than simple arcs, but whatever the curve is, make sure it doesn't have any bumps or dips in it. Finish the foot or bottom of the bowl to the same level of detail and craftsmanship you have used in the rest of the piece.

Be sensitive to the material. Wood with lots of color and figure probably works better in a simpler piece; a more complex shape or more detail work would better show off a plainer wood. If you combine different woods in one piece, be aware that not every wood works well visually with every other one.

These basic things alone may not make a piece great, but if you get them wrong, they will definitely prevent it from being great, no matter how original the concept might be.

Acquire 'Good Taste'

But what about those less concrete aspects of design; what about – dare I say it – the "Art" of it?

"I don't know much about Art, but I know what I like." It's a cliché, but I've heard many versions of this statement. And most cer-



Good design is good design, regardless of the item(s) being made. Look at the exquisite curves, proportions, relationships and craftsmanship in these Macassar ebony and holly chess pieces by Mark Burhans. The crowns are different on the king and queen, but are strongly related, as are the inverted curves. The idea of reversing the woods could be put to good use in many projects.

by Judy Ditmer

Judy, author of two turning books and many articles, has been turning since 1985. She teaches and demonstrates her skills throughout the United States and Canada.

tainly, to some extent, what you see as good design will be about what you like; about your values and personal preferences. That is as it should be.

Nevertheless, there is a reason that certain shapes, lines, proportions and details are used again and again not only by a particular artist, but by artists working in very different media and in very different times and places. If you go to a museum and look at bowls and other vessels of clay, wood, glass, bronze, jade and other materials made thousands of years ago, you will often see many similarities between those ancient pieces and modern work made in these materials. Sometimes it's surprising how sophisticated and contemporary very old work seems. Certain proportions and other design elements are used again and again in objects created by people in vastly different cultures, times and personal circumstances.

Notice and describe to yourself the characteristics of work you like (and don't like). Read and listen to what other people say about these things. Be aware that everyone has biases; identifying them gives you a basis upon which to decide for yourself what constitutes good work. You probably won't agree with everything you hear, but be open to

other perspectives. You will learn something about how others see with regard to design, and what they value. You are then free (and better prepared) to decide your own values; clearly defining what you care about in your own work will begin leading you to your own identifiable style.

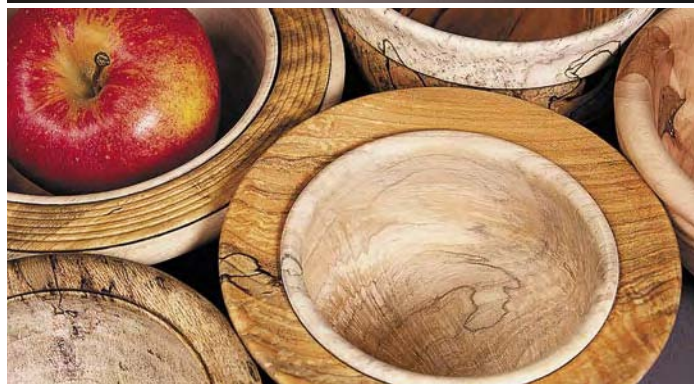
Increasing your understanding of what it is that makes a piece successful (or not so successful) will help you to create strong work. There is no reason to assume that you will somehow just know this; at the very least you may need to pay attention to things in a new way, and you'll have to acquire the language to describe these things in order to be able to really see them. If all you are looking at is the wood itself, then any piece you see made of beautiful wood may seem like a good piece to you. Certainly there is nothing wrong with beautiful wood; it's one of the things most of us love about woodworking. But if you want to make your own work stronger and more distinctive, you must notice far more than that, and do more than choose a spectacular hunk of wood to use. After all, anyone with a few dollars can get an astounding piece of wood to turn. It's what you do with it that makes the difference.



This wall sculpture of olive and bleached sycamore is especially about relationships. The curves and details of the two (cut apart) sycamore discs relate, through contrast and repetition, to each other and to the central olive disc. The uncut olive piece (being partly covered by the sycamore sections) has apparent shapes that echo those of the other pieces. This makes a sort of spiral-arm galaxy shape in the center, which continues these relationships.



One of the best exercises to increase your understanding of design is simply to make a lot of something; the particular item or design isn't as important as the opportunity to try many variations of such elements such as color, shape, proportion, etc. This experience will translate to other objects, even if they are quite different than the ones you have made in quantity. You will be able to evaluate options more thoroughly when planning a new item, because you will have taught yourself to see many possibilities, as well as to understand how modifications will influence the feel of the final design.



Consider and Observe

Consider such elements as shape, proportion, curves, volume, repetition, contrast, relationships, detail, positive and negative space, mass, direction and acceleration. There will be others, depending upon the particulars of the item you are making. Some elements will be more noticeable or important than others in any given piece. But by taking them (and how they relate to the piece as a whole) into account, you will begin to understand what things to look for in a piece that you really like, and how to articulate them so that you can incorporate them into your own work where appropriate.

Pay attention. Look at other work, and not just other turnings. Museums are full of incredible work in many materials and from many eras. Art and craft shows, and exhibitions of contemporary work are other places you can often see fine work in glass, clay and other materials in addition to wood. And of course, there are thousands of readily available books that can bring worlds to you. But don't just notice other work; observe the natural

world for those shapes, proportions and limitations that express the deepest truths about how the universe is put together.

Realize the Impossibility of Perfection

Perhaps you remember Plato's concept of the Ideal Plane. Paraphrased and simplified, it holds that every actual physical object is an imperfect expression of the corresponding Ideal. Any given object (chair, violin, table, bowl), however exquisite, well-made or elaborate, is beautiful only to the extent it expresses the Ideal form it represents.

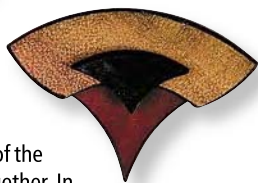
I have developed my own personal version of this concept, having found Plato's a bit too removed from my own reality of making shavings (after all, Plato thought artists were

enacting a kind of madness in making art; as he saw it, art was twice removed from the Ideal). To me, for each particular chair, violin, table or bowl, there exists, in some place more real than reality, an ideal version of that specific chair, violin, table or bowl.

This is why it is possible for me to look at a bowl I've made and say what is "wrong" with it, even if it is a very good one. I can still say, it's a shade too thick here, or the foot is a touch too small, or this angle is not quite right or this detail does not relate to that one as tightly as it could. A bowl I have made is beautiful only to the extent it approaches its Ideal version. And because it may approach but never reach that perfection, there is always good reason to make the next bowl. **PW**



Simple finger tops might not seem to offer much in the way of design opportunities. Yet even here there is a chance to learn. Lately I've been playing with a whole new shape for some tops; a shape I somehow hadn't yet noticed while making those first 60,000 or so. The degree to which tiny variations affect the design can be quite surprising. My understanding of that "new" shape deepens each time I make it.



If you're using different woods in one item, make sure some element of the design ties them together. In this jewelry (earrings and pin), the curves are repeated and/or reversed to create relationships among the different shapes and colors of the various pieces. The eye is drawn around and around the piece as it follows these connections. That is part of what makes a piece (whether a bowl, chess piece, earring or any other item) seem alive. This energy distinguishes a really good piece from a similar, technically competent one that just doesn't quite make it. Without good relationships within the piece to tie all the elements together, the eye will easily exit the piece, and it will seem dull and lifeless.



Last but not least, don't forget the foot. A bowl is three-dimensional; there is only a bottom because of gravity, not because it doesn't matter what happens down there. Whatever the level of detail, craftsmanship, etc. you have used in the rest of the piece should be continued on the foot. That's another thing that distinguishes first-rate work.

Template Mortising

Your plunge router and a simple guide enable you to cut a mortise anywhere.

Template mortising is an excellent technique for all sorts of special mortising challenges. It works for everyday mortising applications as well, but most of us already have an established setup for making door frames, leg-and-apron constructions, and the like. Where I use templates for mortising is any application that can't easily or accurately be done with a hollow-chisel mortiser or my setup that uses a plunge router, edge guide and mortising block combination (see "Router-made Mortises & Tenons," October 2004). For example:

- Any mortise in the face of a panel.
- A difficult-to-position mortise, such as one in a round part, one cut into the arris of a leg, one cut into an already-shaped part, or one to be cut at an angle. In these situations, the use of a template allows you to make a cradle that immobilizes the workpiece and provides a flat, sound, bearing surface for the router.
- Multiple mortises, such as those needed for spindles in a chair backrest, twin mortises that join stocky rails to posts, double mortises that join a very wide rail to a leg. A template eliminates the little variations in mortise size or spacing that can make assembly of these constructions especially trying.
- A mortise in a part, such as a chair leg, that itself is shaped using a template. You can incorporate the slot for the mortise into the template for shaping the part.

Here's how a mortise template works: The template is a flat piece of plywood or Medium-density Fiberboard. It has a slot or a window that's actually larger than the mortise you want. To make the cut, you use a router (preferably a plunge router) fitted with a

Templates are an effective way to make multiple, identical mortises. With them, you control both size and location in one step.

template guide. The guide's protruding collar is trapped in the template slot, limiting the router's movement. The only cut the router can make is exactly the cut you want.

Guide Bushings

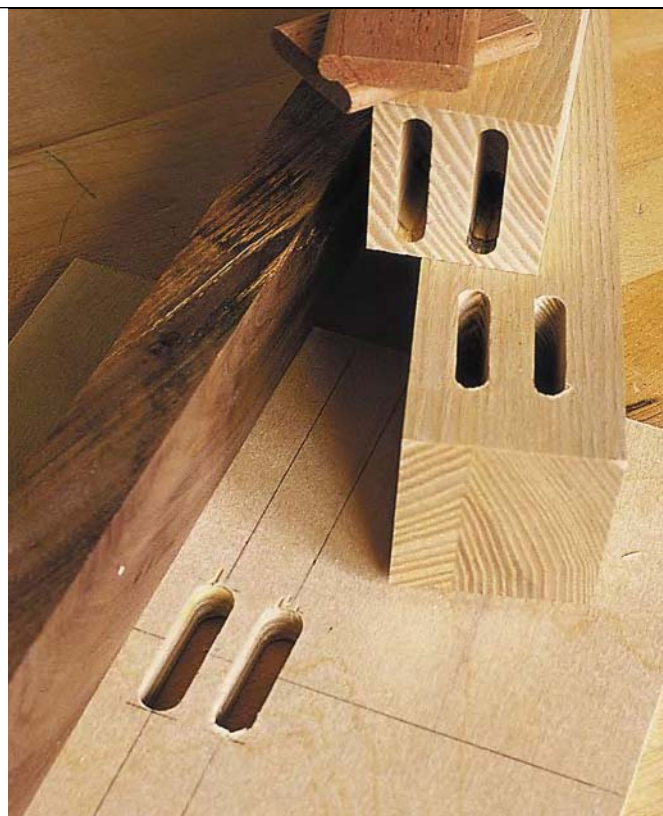
The pivotal gadget in the operation is a template guide, sometimes called a guide bushing or guide collar. It looks a lot like a big washer with a short tube projecting from it. The "washer" fits into the bit opening in the router base and the bit extends through the tube, which usually is called the collar.

The collar rides along the edge of the template, just the way the pilot bearing on a bit does. But unlike a pilot bearing, this guide doesn't move when you change the extension of the bit. Consequently, you can contact the template edge with the guide, then plunge the bit into the work and make a cut. Plunge deeper and deeper to excavate the mortise, and all the while, the guide is in contact with the template, controlling the router.

Obviously, the bit has to be smaller than the inside diameter of the collar.

by Bill Hylton

Bill is the author of several books about furniture construction and router operations. His most recent book is "Bill Hylton's Power Tool Joinery" (Popular Woodworking Books).



Photos by the author

A number of issues come into play in pairing a guide with a bit for template mortising. One is the flow of chips out of the cut. Unless there's a good reason for keeping the guide as small as possible, I like to provide good clearance between the bit and collar to allow the chips to clear the cut—using a $\frac{5}{8}$ " or $\frac{3}{4}$ " guide with a $\frac{3}{8}$ " bit, for example.

Guide bushings are manufactured with collars (those projecting tubes) ranging in length from $\frac{1}{4}$ " to $\frac{9}{16}$ " (the larger the diameter, the longer the collar). This is intended to help stabilize the router on edge cuts, when most of the router base is largely unsupported. That little extra length can be beneficial. The trade-off is that with the larger guides, you have to use templates at least $\frac{5}{8}$ " thick, and that extra thickness is subtracted from the depth-of-cut capacity of your plunge router.

If this becomes a problem, you can easily cut down a collar. Use a hacksaw or a bench grinder. I've trimmed most of my guides to just less than $\frac{1}{4}$ ", so I can use them with $\frac{1}{4}$ "-thick templates. That adds $\frac{1}{2}$ " to the depth of a mortise I can rout with a template, and in a few instances, that's been a big help.

What bit should you use? If you are routing a commonplace mortise, say $\frac{3}{8}$ " wide by 2" long and 1" deep, you'd use a $\frac{3}{8}$ "-diameter bit. In this regard, template mortising is no different than other approaches.

For mortising, I do prefer up-spirals, but I'm not doctrinaire about it. I've often used regular straight bits in one- and two-flute configurations. But spirals cut cleanly, reduce the stress on the router, and help pull chips out of the cut. (This can be especially helpful because the template-guide can block the escape of chips. They can only exit through the clearance gap between the collar and the bit.)

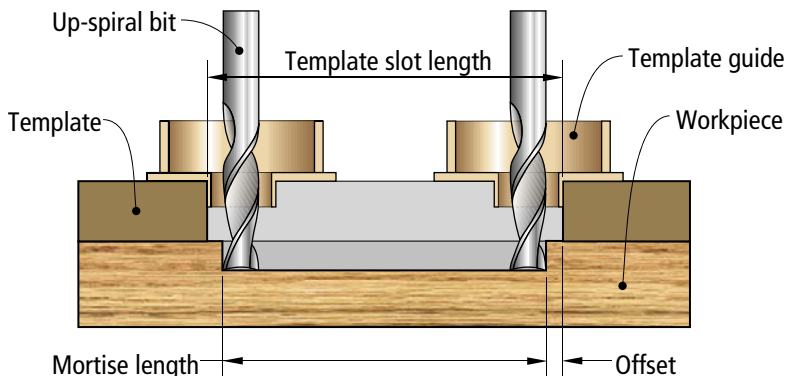
Making the Template

First calculate the size of the slot or window that's necessary to produce the desired mortise. If the mortise width matches the cutter diameter, the template slot should match the diameter of the guide being used.

To determine the slot length, you have to add twice the offset to the mortise length.



This template slot is $\frac{3}{4}$ " wide, and the mortise is $\frac{5}{16}$ " wide. The big differential between bit size and guide bushing size, coupled with dust extraction on the router, helps clear the chips as you cut.



To the length (or width) of the mortise add twice the offset to determine how long (or wide) the opening in the template must be.

Offset is the difference between the radius of the guide and the radius of the bit. If you're using a $\frac{3}{8}$ " bit in a $\frac{1}{2}$ " guide, the offset is $\frac{1}{16}$ ". Thus, if the mortise is to be 2" long, the template slot must be $2\frac{1}{8}$ " long. If you opt for a larger-diameter guide, then the slot must be both wider and longer.

Making the template is as simple as routing a blind slot. Lay out the slot, then cut it with a plunge router and edge guide. Or cut it on the router table. In most instances, the mortise length isn't a critical dimension. By that I mean, the exact length – to the 32nd of an inch – is not as important as having all mortises be the same.

Some woodworkers are completely comfortable briskly laying out the slot, then cutting it by eye from mark to mark. I guess I'm just a little compulsive, so I use a V-groove bit in the router to set the edge guide and to set stops for the router to govern the slot length, as shown below. Hand-tighten the V-groover

in the collet and plunge it to the template surface. Set the point right on your layout line and bring the edge guide against the edge of the stock. Slide the router along the stock to be sure the bit tracks on the layout line. Then position the V-groover on the end point. Set a stop block against the router base and clamp it to the stock, as shown below. Move the router and set the second stop block. (Bear in mind that the cut will be longer than this setup by the diameter of the bit. You have to account for the bit when you lay out your marks.) With the edge guide and stops set, swap bits to actually cut the slot.

If you have more than one slot to make in the template (for doing twin mortises or double mortises, for example) you cut them similarly. Making a second slot in line with the first is a simple matter of moving your stops to new locations. Making a parallel slot can be easily accomplished by switching the reference edge or adjusting the edge guide.

Success with template mortising begins with a precision template. Lay out the mortising slot on a line drawn parallel to an edge of the template blank. Before routing the template slot, use a V-groove bit in the router to align the tool on the line (inset) and set the edge guide (left). Then switch to a straight bit to rout the slot.



With the bit aligned for the end of the slot, set a scrap against the router base and clamp it. Note that the template blank is set on a sacrificial piece of plywood that protects the benchtop.



If you have a string of shallow mortises to cut in several parts, using a template to rout them can ensure the mortises are uniform across the run of parts. Invest the time to make a precision template. Typically, workpiece layout is eliminated, as are minor variations in mortise size and spacing.

Locating the Template

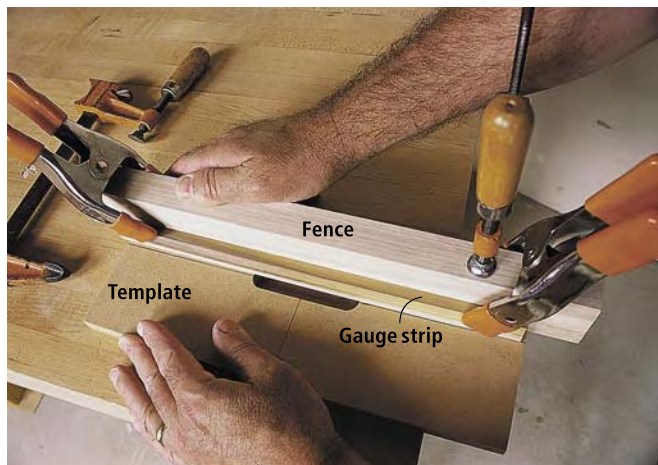
Your next hurdle is locating the template on the workpiece and securing it. You should know exactly what you're going to do, of course, because that was all part of your initial plan. Right?

How you do it depends, obviously, on the size and shape of the workpiece.

A template for a mortise in a panel may be positioned using the cross hairs of a center line and a midline, laid out to aid in routing the slot, as shown below. You might use carpet tape or hot-melt glue to attach the template for the cut. I've actually screwed the template to the part in a few cases.

For commonplace work such as stiles or legs, you can mount a fence to the template. Then you clamp the part to the fence. A stop attached to the fence can position the work so you don't have to lay out each piece. Or that midline can be your registration mark.

Use the laid-out centerline as a reference for mounting a fence and a gauge block to position the fence in relation to the line. Plane a piece of stock to the appropriate thickness. If the mortise is to be centered across the edge of the workpiece, that thickness would of course be half that of the working stock. Align an edge with the layout line and clamp the block to the template, as shown above. Apply glue to



In most cases, you'll want a fence on the template so you can position the template quickly and accurately on a workpiece. Plane a gauge strip to half the working stock's thickness. Clamp it to your fence, then align it at the centerline laid out on the template. Clamp the fence to the template. Run two or three screws through the template into the fence.

the edge of the fence. As you press the glued edge to the template, slide the fence tight against the gauge, and clamp it to both the template and to the gauge. Then you can turn the assembly over and run a couple screws through the template into the fence. (Just don't glue the gauge to the assembly!)

Cutting the Mortise

Cutting the mortise is a job for a plunge router. Install the guide bushing and chuck the bit in the collet. Set the router on the template, guide collar captured in the slot. Bottom the bit against the workpiece, zero out the adjuster, then set the depth of cut.

The routine is to move the router back and forth, cutting progressively deeper. "Proper" feed direction becomes irrelevant. The template reins in the router, allowing it to move only on a defined line and distance. Release the plunge mechanism to raise the bit before lifting the router from the template.

What's going to happen is that chips will clog both the cut and the slot in the template.



Where a mortise is located in the face of a panel, use cross hairs to position the template. Lay them out on the template blank to guide the cuts that create the "window." Lay them out on the panel, to delineate where the template must be placed.

You need to interrupt the cutting periodically to vacuum out these chips. If you don't, and you focus doggedly on getting it routed, you'll get chips packed so tightly in the ends of the template slot that you'll need to dig them out with a narrow chisel or an awl.

Dust extraction as you rout is a major boon. I almost always use DeWalt's DW621 for mortising, primarily because of that router's dust extraction system. (This isn't a knock against built-in or add-on dust extraction available on other brands and models, few of which I have actually tried. The 621's system works for me and that's what I use.) In most instances, dust extraction reduces interruptions. **PW**



A plunge router with some form of dust extraction is best for template mortising. Without it, chips can foul the template slot. The template is a solid platform that supports the router under both plunge posts.

The Art of Engineering Flutes

Dave Copley, an ex-aircraft engineer, makes world-class wooden flutes in a small garage workshop.

Dave Copley tenderly lifts an African blackwood flute with sterling silver keys and rests it against his lips. A complex, hard-edged sound emerges from the handcrafted instrument as he plays a traditional Irish slip jig called “The Snowy Path” (written by Mark Kelly of the band Altan).

Copley says a wooden flute sounds different – darker – than the sound from the more ubiquitous metal flutes.

The sound made by wooden flutes was standard fare in orchestras until the late 1800s. Metal flutes, which produce a much brighter sound, are far more common today. However, wooden flute makers still exist and we found two – Copley (a 52-year-old ex-aircraft engineer) and his wife, Marlene Boegli (a 44-year-old silversmith) – in a small garage workshop in southwest Ohio.

Copley and Boegli’s workshop is broken up into specific workstations. Each station has



Photos by Al Parrish

Dave Copley (left) and Marlene Boegli handcraft wooden Irish Session flutes in a small garage workshop in southwest Ohio. Copley has been playing the wooden flute for 10 years.

a woodworking or metalworking machine or tool that has been specifically designed to turn several small pieces of African blackwood, and several bits of silver, into a beautiful instrument where precision is paramount. Copley and Boegli’s life experiences, as well as their carefully planned workshop, make them well-equipped for the task.

Engineering, Woodworking and Music

Copley was born and raised in Derby, England. He attended college in Cambridge where he studied materials science for three years. His first job was improving the reliability of aircraft engines for Rolls-Royce. In 1979 he accepted a job with General Electric Co. (G.E.) doing the same thing, and moved to Cin-

cinnati. In 1986 he and Boegli married and bought the house they live in today.

After Copley moved to the United States, he became interested in woodworking. He built several pieces of furniture and a loom for his wife. Copley also became interested in Irish music, which he later learned to play. His first instrument of choice was the tin whistle (a small flute that’s played by blowing into its end, similar to a recorder). Ten years ago he began to play the wooden flute, which he now plays as a member of an Irish band called Ceol Mhor, which is Gaelic for “Great Music” or “Loud Noise.”

The moment Copley picked up a wooden flute, he knew he wanted to make one. One of his co-workers at G.E., an amateur bagpipe player, made Irish bagpipes. During lunch, Copley would talk with him about the building process. One evening, his co-worker drove to Copley’s house with a lathe, some wood, some turning tools and some basic lessons. Copley fell in love with the process, which requires



Each flute is made from five short sections of wood such as African blackwood (plus an end cap), sterling silver and cork.

by Kara Gebhart Uhl

Comments or questions? Contact Kara at kara.uhl@fwpubs.com.

engineering and woodworking skills. He saw his vocation and avocations blending. When it came time to make the rings and keys, he turned to his wife.

Boegli began silversmithing after taking a metalworking course (which she describes as her “sanity course”) while in nursing school. Since then she has spent much of her free time making custom jewelry. Crafting the silver rings and keys simply was an extension of skills she already had learned.

In 2000 Copley began working part-time at G.E. in order to devote more time to making flutes. In the fall of 2000 he and Boegli (who, at the time, worked from home making jewelry and hand-woven goods) began to sell flutes locally. Some of their first sales were at the Cincinnati Celtic Festival where they had a booth. With no marketing, they decided their best bet was to offer the lowest price, so they did. They sold their flutes for a mere \$195 each.

Today Copley and Boegli sell their Irish Session flutes, also called Copley flutes, through their company, Celtic Lands, around the world. Most sales generate from their web site (celticlands.com) and by word of mouth in the form of positive reviews on online bulletin boards and discussion groups. Prices range from \$800 to \$2,200.

Designing a Modern Wooden Flute

In the beginning, Copley spent much of his time on flute design – something he’s still constantly striving to perfect. The design he chose to pursue for his Irish Session flutes weds the best features of Pratten’s Perfected flutes produced in England in the second half of the 19th century, and the English Rudall and Rose flutes of the early 1800s.

Copley and Boegli offer keyed and keyless versions of their flutes. The keys on the keyed flute are made from sterling silver and mount on integral wood blocks on the flute’s body.

Most of the flutes are made from African blackwood. Copley hooked up with a company called Prosono International, which locates, selects and processes African timber specifically for woodwind instruments. The African blackwood is delivered in nicely packed wooden crates. Each order lasts Copley for three to four years – the costs of shipping and importation make it uneconomic to purchase any smaller quantities.



Copley tricked out his 1940s 36" General lathe to work like a gun drill. A hardened steel rod is used to drill the long hollow that runs down the middle of the flute. An air compressor and dust collector are key to the system.

Small Workstations for Precision Work

While precision is clearly evident in Copley and Boegli’s flutes, it’s evident in their workshop, as well. Their detached garage is divided into two rooms by a wall. The back portion of the garage is accessed by an opening in the wall – plastic flaps act as a door. The actual shop – a 24' by 14' room – functions as a system of small workstations, each designed to handle a specific task.

When walking through the plastic flaps, one immediately notices a 1940s 36" General lathe, which Copley bought used. “It’s nice to have good, old, solid stuff,” he says. The lathe is configured for gun drilling, which is the process used to make gun barrels. As you can see in the picture above, a hardened steel rod drills a straight pilot hole through the center of the flute sections. (Note that each flute is made up of six parts– the end cap plus five short sections.) A homemade plywood jig holds everything in place. An air compressor shoots air to blast away chips and keep things cool. A dust collector helps to control the dust. (Because many woodworkers and musicians develop allergies when introduced to African Blackwood, Copley is careful about having good dust-collection systems.)

continued on page 106



Copley made this reamer, which he uses to create the flute’s tapered cylindrical shape. As with many flute-making aspects, here precision is very important to the instrument’s sound.

continued from page 103

The final hole inside the flute is tapered. Copley calls the exact shape of this hole his "secret weapon." This shape is largely responsible for the sound the flute emits. It's created by initially enlarging the gun-drilled hole in a series of steps. This process is also done on the lathe. The final taper is produced by hand-reaming using shop-made reamers (as shown on page 103). The outside shape is turned on a small Grizzly metalworking lathe, which offers .001" accuracy.

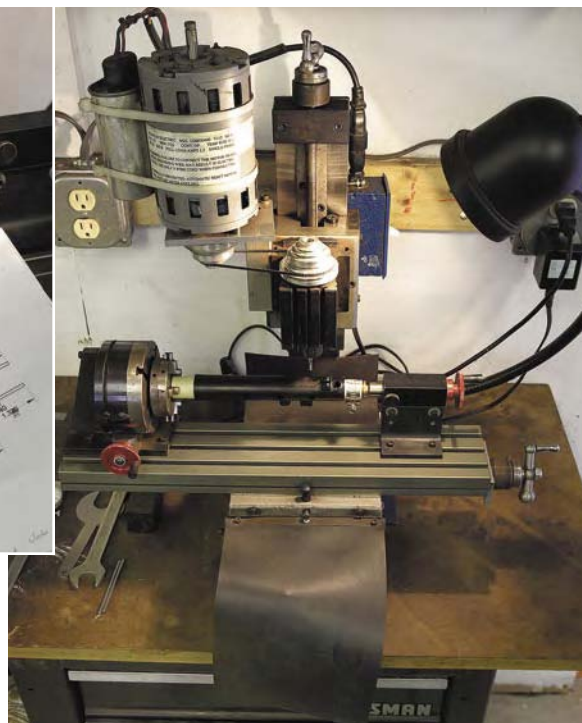
A 3-year-old benchtop vertical milling machine made by Taig Tools (right) cuts away wood to make the holes and the integral raised blocks for the keys. Copley says using it is much like the old story of Michelangelo carving the statue of David – basically you take everything away that isn't David.

Much of the precise (and exhausting) work is done on the milling machine as these measurements – the size and shape of the holes – are very important to the quality of sound. While Copley's standard flutes are in the key of D, he will make ones that play higher or lower – these, obviously, require differently sized and shaped holes.

Boegli heats, pounds, forms and cools the flutes' rings, keys and key cups on an old metal office desk in the back corner of the shop. Because her work often involves a blow torch, fire-resistant paint covers the walls.



Copley uses a benchtop vertical milling machine made by Taig Tools to drill the keys and make the integral blocks for the buttons. Above you can see an illustration he uses for this process.



Other things to note: Copley uses a 10" Craftsman table saw to rough-cut stock. A tool cart on wheels with labeled drawers has proved highly useful. Fluorescent lighting covers the ceiling and anti-fatigue mats are positioned in front of several workstations. Shelves – a recent addition – line the walls.

Typically African blackwood is air dried in the basement of the house for two years in block form. Once the blocks are rough turned, they are air dried another six months. Once the flute pieces are finish turned, Copley puts them in the kitchen oven at 120° F for an hour. There the ends of the wood pieces dry, which causes each piece to shrink very slightly. This short-term shrinkage allows Copley to better fit the silver rings. Once fit with rings, the wood pieces swell as they re-absorb moisture from the air, creating an even tighter fit. Careful drying ensures a flute that has a constant sound and keys that stay put.

Copley and Boegli agree that the worst aspect of the shop is power – right now they're stuck with 120 volts. The best is the commute to work everyday – they simply walk to the garage but never get in the car.

Engineering a Quality Life

Copley and Boegli sit together at the kitchen table drinking tea while flute pieces cook in the oven. The flute pieces are undergoing a torture test, Copley says. After the oven experiment Copley plans to pour boiling water over them to see what they can withstand.

When not conducting science experiments, Copley and Boegli average 30 flutes each year. Currently the average wait time is



Marlene Boegli does all of her silversmithing on an old metal office desk in the back corner of the garage workshop.

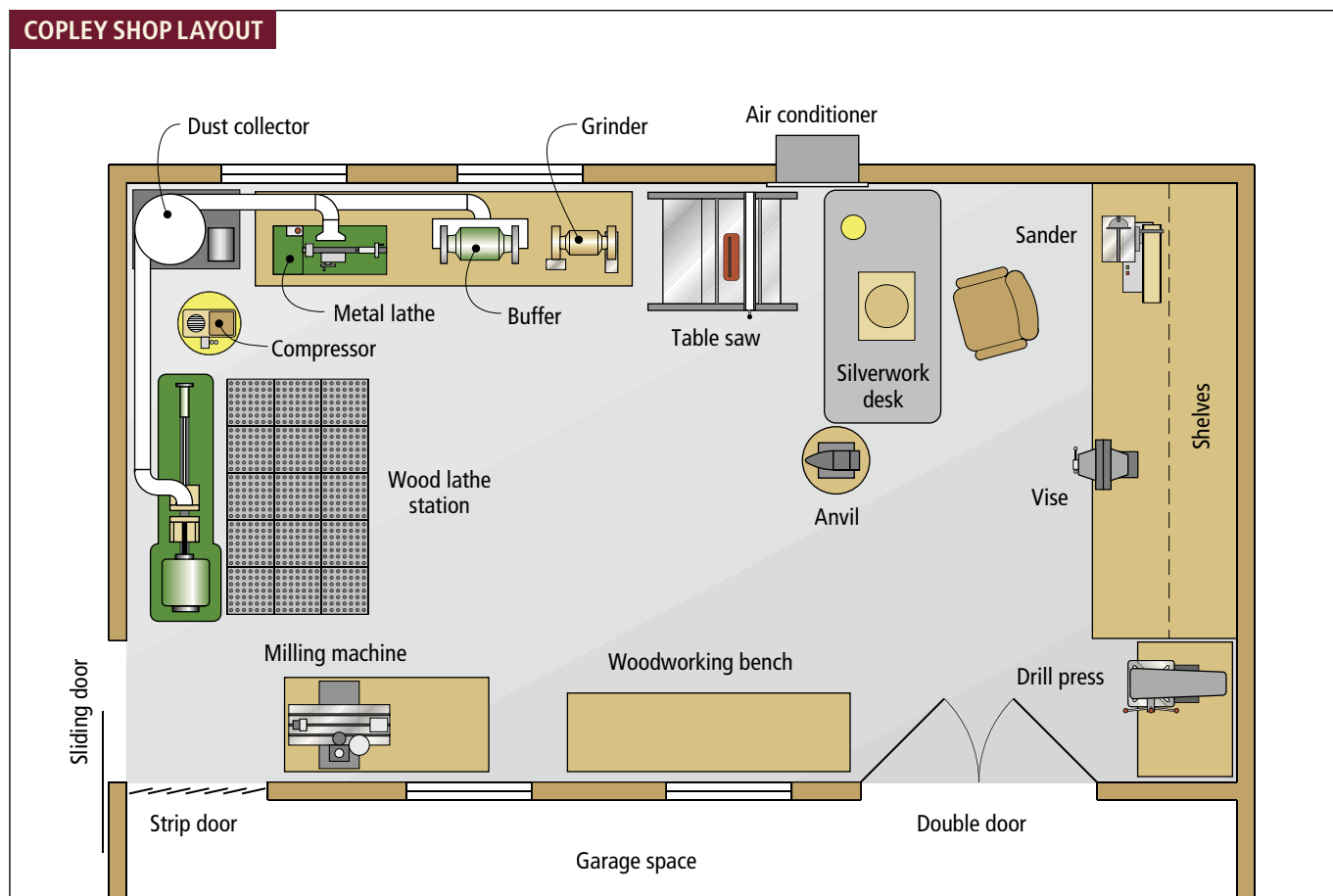
three months. A keyless flute takes about one week to make while a keyed flute can take two to three weeks to make. While Copley and Boegli say they deliberately don't record the hours they spend working, they estimate they put in about 20 hours each week.

Copley and Boegli have two children, 8-year-old Alan and 10-year-old Mary Rose. Boegli says they appreciate that their children can see something being made, start to finish, and then see it being sold. And while it can be difficult to work with children around (Boegli laughs as she says home schooling will never be an option), she adds that it's nice to be at home when the children are home.

Copley says he has no regrets about quitting his engineering job to make flutes. Although their income now is less, before quitting, Copley and Boegli worked hard to pay off their house. Today, Copley says they enjoy reduced stress and a better quality of life – a blend of engineering, woodworking and music-making, with no daily commute. **PW**



Copley and Boegli's garage workshop is made up of several work stations, each set up for a very specific flute-making task.



Wood Conditioner Confusion

Contradictory finishing information is frustrating. Here we clear up one example.

Each month *Popular Woodworking* receives many letters from readers confused and frustrated with finishing. What many readers don't realize is that much of their frustration is a result of misinformation and contradictory instructions offered by finishing experts and manufacturers. Phil Crabtree recently pointed out some of these inconsistencies in the following letter to *Popular Woodworking*, which I've shortened a bit:

"You left me a little confused with your description of wood conditioner ('Flexner on Finishing' April 2004, page 94) when you said that I should let the wood conditioner cure completely (overnight) before applying a stain.

"The label on my can of Minwax Wood Conditioner instructs me to apply the stain 'within two hours' – well before the wood conditioner has cured. On page 109 of the first edition of your book, 'Understanding Wood Finishing' (Rodale Press), you say, 'Allow the solvent to soak in. Wipe off the excess. Then apply the stain before the solvent evaporates out of the wood.' You also go on to say that using wood conditioner isn't a very effective method for obtaining even stain penetration, and you recommend using a gel stain instead.

"In a recent article in *Woodworker's Journal* (June 2005), Michael Dresdner says, 'The important thing is to stain while the wood is still wet with conditioner. Allowing it to dry before staining will decrease its effectiveness.'

"I know that you and Dresdner are two of the foremost experts on finishing, and Minwax is a very large company. So now I'm thoroughly confused. Can you help me clear up the confusion?"

I'm quite aware of these inconsistencies, of course, and I've been surprised that no one has pointed them out sooner. In this column I offer an explanation. Explaining what is going



The instructions on the cans of Minwax and Olympic Wood Conditioners (the most widely available brands) say to apply a stain "within two hours" of applying the wood conditioner. Varathane's web site, woodanswers.com, says to apply the stain quickly "before the conditioner dries," but Varathane says on the can to wipe off the excess and then "allow the conditioner to penetrate for 30 minutes before staining." Talk about contradiction! The instruction that works best is to wait overnight.

on with these varying instructions should be instructive and illustrate the difficulties we "experts" face in trying to make sense of this crazy wood-finishing industry.

It all begins with what manufacturers of the products tell us. By the time I wrote the first edition of "Understanding Wood Finishing" in 1992 and 1993, I had realized that many manufacturers mislead about what they are selling us – for example, thinned varnish is often labeled "tung oil" and water-based finish is sometimes labeled "lacquer" – and I pointed this out in a number of places. I had even realized that some of the directions manufacturers give us for using their products are not, in my opinion, altogether accurate – for example, to "neutralize" paint stripper with mineral spirits when you should actually be washing off the wax residue with mineral spirits.

For whatever reason (probably because the

task of identifying all the misinformation was just overwhelming), I hadn't yet realized that the directions on cans of wood conditioner were simply not likely to produce the most desired effect. I was trying to work within the guidelines Minwax and the other brands set for me. "Apply the stain within two hours."

As you point out, this resulted in my concluding that wood conditioner just isn't very effective at eliminating blotching. Gel stain does a much better job.

For years thereafter I continued to struggle with this product. If you were to include in your research some of the articles I wrote during this time, you would see that my instructions were to keep the surface wet until dry spots stopped appearing, then apply the stain. I was still working within the parameters the manufacturers had established. (I mean, how could it be that these finishing companies wouldn't tell us the most effective way to use their product?!)

I would imagine that Dresdner was working within the same parameters. He resolved the dilemma similar to the way I had, by applying the stain immediately (not just "within

by Bob Flexner

Bob is author of "Understanding Wood Finishing," now in its second, fully revised, edition. To order, visit amazon.com, your local bookstore or your woodworking supply store.

two hours”). The wood is soaked with thinner, which hasn’t yet evaporated, so very little colorant is able to penetrate and get deep into the wood. Plus, the color is watered down substantially by the thinner. Though not eliminated, blotching is at least significantly reduced using this method.

The problem with this solution (and with mine) is that it doesn’t work on large objects such as furniture or cabinets. Ten minutes or longer will go by before the stain gets applied, so a lot of the thinner will have evaporated and blotching will be worse.

The Solution

Then one day it hit me. I often use lacquer thinned a little more than half with lacquer thinner as a “washcoat” to make blotch-prone woods stain evenly. Because lacquer dries rapidly, I’m always applying the stain over a cured finish. What if I let the wood conditioner, which is just varnish thinned with two parts mineral spirits, cure overnight? I tried this and it worked perfectly, just like lacquer washcoats do. The stain colored evenly.

So I reported this in the *Popular Woodworking* article that you cite. This procedure is different than what I wrote in my book 12 years ago, and I feel bad about this. The excuse I make to myself when I discover that I got something wrong is that there is too much bad information to be correctable in just one pass. I knew at the time I wrote “Understanding Wood Finishing” that I would almost surely miss something.

I reasoned that doing anything was better than continuing with the existing situation – inaccurate labeling and constant repetition

of old myths – and that I or someone else could always come along later and correct what mistakes still existed.

Though what I’m about to say may serve to take me off an imagined pedestal, everyone needs to realize that we who write a lot about wood finishing are “experts” partly because we are willing to stick our necks out on some subject, realizing that we may not be entirely right the first time around. We’re simply researchers, searching for the best methods. We report our results but occasionally further research leads to different conclusions. We’re not necessarily wrong (as the example in this article demonstrates), but we may not have the subject entirely pegged.

We’re All Refinishers

Here’s another bit of inside information that you might find interesting. With one very significant exception, the major wood-finishing

authors and teachers have spent a good portion of their (our) lives refinishing furniture. We aren’t exactly finishers; we are refinishers. There’s an important difference.

Finishers usually do the same thing over and over. They master a procedure or “schedule.” Refinishers do something different on every project – if we are good, anyway. Refinishers have to be able to imitate all the “looks” that have ever existed.

But even refinishers have to make a huge transition to be able to teach amateurs. Refinishers use lacquer and other finishes that dry fast. And we spray the finish. Spraying lacquer and applying stains in an efficient manner doesn’t prepare us to teach about oil, varnish, polyurethane, gel stains, etc. We have to learn the quirks of these finishes and how they differ from the sprayed finishes. This can sometimes be a real challenge, as I’ve illustrated here. **PW**



Professionals use thinned lacquer as a washcoat instead of wood conditioner. Lacquer dries very rapidly so it is thoroughly dry before a stain is applied. The result is that a lacquer washcoat is very effective at eliminating blotching (as shown at right).



To stain a softwood such as pine, my advice is to forget about wood conditioner (applied on the left side under a liquid stain) and apply a gel stain instead. (The middle shows the liquid stain applied directly to the wood.) You will have much better control of the color, and you will need only one step and one product (the gel stain) to achieve a virtually blotch-free result (right).



You can easily make your own wood conditioner by thinning one part varnish (or polyurethane varnish) with two parts mineral spirits (paint thinner).



In the far left panel, I applied a common pigmented oil stain directly to the wood. I then applied Minwax wood conditioner to the rest of the board. I applied the same stain to the second panel immediately, the third panel after 10 minutes, the fourth panel after two hours and the rightmost panel the next day. You can see that the longer I wait before applying the stain over the still-wet wood conditioner the more pronounced the blotching, and that the blotching isn’t completely removed until I let the wood conditioner cure overnight – at which point the coloring is considerably lighter, but even.

Quit Crying and Get to Work

So you can't afford (insert dream tool here). Boo hoo. Hit the flea markets then start making sawdust.

Yeah, you heard me. Oh sure, I know exactly how it is. The new catalogs come piling into your mailbox and you're drooling on your shoes. You need a 36" planer and an infill plane stuffed with ivory and ebony, and 1,000 board feet of curly, high-color walnut. Yeah, you need them alright.

So, what? You're just going to sit there and wish your life away? Get in the game. You simply cannot buy skill. You must pay your dues like everyone else.

Hit the swap meets and yard sales like a maniac. Learn to restore everything. Guess what? Those old hand tools you see offered that nobody's taking? They weren't so dumb 100 years ago and if you learn how to tune them, great things can be accomplished. The most common and easy-to-get old tools now are the very ones that sold the most once-upon-a-time. They sold the most because they were the most useful and they're still the most useful.

For example, get a Stanley No. 4 smoother and a No. 5 jack. These two will take you furthest, fastest. If you don't see rosewood handles, keep looking. Other sizes and brands might appeal when you get your legs under you, but nothing else you can find for \$20 or less will be as good. Repairing minor things such as a chipped tote tip or rust scraping beat struggling with an inferior tool.

You want a No. 80 scraper, too. Scraping is faster and cheaper than sandpaper and when it comes to getting old finish off wood, nothing compares.

When buying handsaws, look for Diss-ton and Sons on the medallion screw. This



Illustration by Pat Lewis

means it's old enough to be a truly good saw but nowhere near an expensive collectible you can't use. Get a full-sized 8-point handsaw, a 20" 10-point panel saw and a 12" backsaw. Straight up, you'll find the most use for these. And grab an old dog of one for a \$1, too. Cut up, it's a great hand scraper.

You also can find good, old chisels. When buying, ignore practically everything else but the length of the blade. Stubby little things are for somebody else. The best blades were always long. Make your handles. Who wants to hunt for what size they're looking for in a "set" of matching handles? It's better to just make them all different.

Old machines often can be bought for near nothing, too. What? Were your hands painted on? You can't change a bearing or shim an arbor? If you can't clean and polish an old saw table did you think you'd have better luck with a Chippendale highboy? Look for mass in a machine. If you can pick

it up easy, you don't want it. But don't be fooled by a big, ground cast-iron table where it shows and a featherweight arbor lurking where the sun don't shine. Also inspect for cracks but use rust or flaking paint as a bargaining device. A clean-looking, quality, hand power tool with the cord cut off is nearly always a find!

When buying old machinery, investing in a book on electric motors is wise if you're going to be rebuilding your stuff. Every town has a used book store and there are huge ones in college towns. Public libraries are still free and if you have a computer, vast resources and help are available online.

Wood also is available out there if you scrounge. I've seen amazing things built from old pallets. Take a yard-sale table apart, look down the street on trash pickup day, cut some green sticks and boil them in a pot of water. Simmer one hour per inch of thickness and they won't crack. These are perfect for lathe work.

Get up and make what you can out of what you have to work with, because something beats nothing any day. **PW**

by Scott Grandstaff

Scott is a semi-retired cabinetmaker in Happy Camp, California.