April 1999
No. 135

TAUNTON'S

Fine WoodWorking

Pop the curl in curly maple

Three ways to build cabinet doors

The ultimate router tenon jig

Sanding tips

Grinder survey: wet or dry, wheels or belts?

Antique tools at auction

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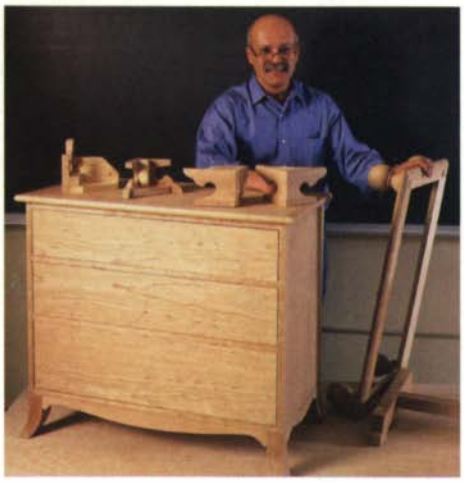
READER SERVICE NO. 35

Fine WoodWorking®

Departments

On the Cover:
Randall O'Donnell's Chippendale stool is an approachable introduction to the construction and joinery used by early Philadelphia chair makers. O'Donnell leads you through the project on p. 55.
Photo: Michael Pekovich

Finishing curly maple, p. 38



Four different cabinet bases, p. 42

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Build a jig for router-cut tenons, p. 62

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Contributors

Toshio Odate (Master Class) is perhaps the best-known practitioner of traditional Japanese woodworking in the United States. Through his workshops, his book, *Japanese Woodworking Tools: Their Tradition, Spirit and Use* (Linden Publishing, 1998), and his articles in *Fine Woodworking*, he has preached the virtues of the Japanese approach. In his native Japan he was a *tategu-shi* (sliding-door maker) until he came to the United States in 1958. He teaches sculpture at Pratt Institute in Brooklyn, N.Y.

Don Kondra ("Curved-Leg Table") was an accountant before giving up a steady paycheck and an assistant to go to work for himself and by himself as a cabinetmaker. Sixteen years later, he has no regrets. Kondra says he's happiest when he's building one-of-a-kind pieces. The table is his first piece for *Fine Woodworking*.

Garrett Hack ("Antique Tool Auction") runs a one-horse farm and builds custom furniture in Thetford Center, Vt. A veteran tool collector, he claimed before the auction to have all of the hand tools he could manage. But once he got there, a few caught his eye and made their way back to Vermont. He is the author of *The Handplane Book* (The Taunton Press, 1997) and is working on a hand-tool book to be published by Taunton.

Mario Rodriguez ("Where Furniture Meets the Floor") served an apprenticeship in the carpenters and joiners union in New York City, a hitch in the U.S. Army and a 12-year stretch as a cabinetmaker, operating a shop in Brooklyn before he began teaching period woodworking in class and in print. After extensively restoring a house in Warwick, N.Y., he has recently moved with his family to Haddonfield, N.J., where he has begun work on a 1930s Tudor-style house.

Martin Seifert ("Making Sense of Motors") has worked all over the world putting huge (5,000-hp and larger) electric motors on mining excavators. He has also worked at the executive level for companies producing electronic equipment that protect and control large power systems, including those used by utilities. He's currently president of SpecTran Specialty Fiber Optics in Avon, Conn., and enjoys making toys and furniture for his wife and three boys.

Steve Latta ("Three Ways to Make Cabinet Doors") has spent most of his career in the cabinetmaking trade, specializing in inlay and marquetry. Latta recently shifted gears and became an instructor at the Thaddeus Stevens College of Technology in Lancaster, Pa. The job leaves him time to take on only an occasional woodworking commission. When he goes home to play dad to a newborn, a toddler and a first-grader, his focus shifts from Sheraton to Seuss.

Randall O'Donnell ("Oval Chippendale Stool") specializes in interpreting fine period furniture. He has been a professional woodworker and builder since his teens. The 28-year woodworking odyssey leading to this exacting craft runs the gamut from building thatched-roof huts in South America to house and log cabin building in this country to high-end millwork and kitchen cabinets to fine period furniture reproductions. He and his wife, Susy, work in a well-equipped 2,500-sq.-ft. shop on their land in the countryside of southern Indiana.

Lon Schleining ("Tips for Better Sanding") has been building custom stairs in Long Beach, Calif., for more than 20 years. He also teaches woodworking at Cerritos College and is a frequent contributor to *Fine Woodworking*. He is currently researching a book on wooden chests, forthcoming from The Taunton Press.

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Letters

Blanket chest made with hand tools provides balance—The article by Mike Dunbar on building the 18th-century six-board chest (*FWW* #134, pp. 48-53) was outstanding. Today's woodworkers have a shop full of power tools. But more and more craftsmen are recognizing that hand-tool skills are essential to achieving the level of expertise that your publication promotes.

When only a small number of operations is required, hand tools are more productive than power tools because they avoid timely machine setup. This type of article provides your already excellent journal with essential balance. *—William White, Williston, Vt.*

Worth the price—In the February issue, the tutorial on glue (*FWW* #134, pp. 60-67) and the one on shellac in Finish Line (pp. 129-130) were each worth the price of a year's subscription. You have managed to find an effective middle ground between the overly artistic and the excessively simple without ignoring issues of aesthetics or the reader's need for clear instruction. *—Frank Murphy, Berwyn, Pa.*

Criticism of dovetail-jig review—Gary Rogowski's dovetail-jig review in the February issue (*FWW* #134, pp. 84-89) was most notable for its errors and omissions. I would like to correct just some of those that apply to the Leigh jig.

The Leigh jig manual has only 16 pages covering variable half-blind dovetails. Two-thirds of the very first page of this chapter is an illustrated and dimensioned chart of depth-of-cut settings for each of the four cutter options, with bold emphases in the text exhorting the reader as to its importance. This is repeated in a two-page "Quick Reference" chapter and the depths again tabulated and boldly referenced in the cutter-selection appendix. However, according to the reviewer, "There are no clues as to the depth of cut you need."

Boards for half-blind dovetails on the Leigh jig have to be routed separately because of the uniquely significant advantage of variable spacing. Neither this important clarification nor, indeed, the fact that the Leigh is the only variable-spaced half-blind jig is mentioned.

Also completely omitted is that the Leigh will allow routing of sliding dovetails, the only jig tested with this function as standard.

Every through-dovetail jig is adjusted for tightness of fit in exactly the same way: by adjusting the relative position of the guide fingers over the top edge of the pin board, or clamp face. By trial and error, in every case. The fact is, the Leigh has the ability to form variably spaced through-dovetails in boards from ¼-in. to 1¼-in. thickness, with just the one template. This makes the use of an adjustable and repeatable graduated scale on the Leigh a necessary feature and distinct benefit in versatility—one not shared by the other jigs. The instructions for initial scale settings are fully and clearly described in the chapter on through-dovetails in the manual, also only 16 pages.

In the future your readers could be better served by a review that provides an accurate, fully informative and, above all, objective report that covers all the features and benefits, advantages and disadvantages of each jig.

—Kenneth M. Grisley, Leigh Industries, Port Coquitlam, B.C., Canada

GARY ROGOWSKI REPLIES: Regarding my statement, "There are no clues as to the depth of cut you need," Mr. Grisley is absolutely correct that the manual does cover this point. I missed the references, and I apologize for the error.

A cold woodworker is not a safe one—I take exception to the comment in Ken Textor's article, "Shop Heating Choices" (*FWW* #133, pp. 89-91), that it is not necessary to heat the cutting, planing or sanding part of a shop.

I found that even 20°F was too cold for my fingers. Anyone operating stationary power tools with cold, stiff fingers and while wearing a winter jacket is asking for an accident. A comfortable workplace is a major step toward a safe workplace. This is true for both the recreational woodworker and the person making a living at it.

I think that a warm workplace, i.e., a T-shirt environment, is especially important for people engaged in the business of woodworking. A warm shop will increase

About your safety:
Working wood is inherently dangerous. Using hand or power tools improperly or ignoring standard safety practices can lead to permanent injury or even death. Don't try to perform operations you learn about here (or elsewhere) until you're certain they are safe for you. If something about an operation doesn't feel right, don't do it. Look for another way. We want you to enjoy the craft, so please keep safety foremost in your mind whenever you're in the shop.

—Timothy D. Schreiner, editor

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–Carmen Storey, Red Lake, Ont., Canada

Another after-market tablesaw fence system—After reading your review of "After-Market Tablesaw Fence Systems" (*FWW* #133, pp. 50-57), we are very disappointed that a decision was made to group the Biesemeyer clones together and review only those with "significantly different designs."

By referring to the Xacta Fence as a clone (defined as an exact replica of another) and thereby leaving it out of the review, you did not give your readers a view of the true variety of after-market rip fences available to them.

When Jet introduced the Xacta Fence several years ago, we were very familiar with many potential drawbacks to the Biesemeyer system. We were aware of the drawbacks because we offered the Biesemeyer as an option on our tablesaws and handled many of the end-user phone calls bringing these drawbacks to our attention. As a result of these comments, Jet made several enhancements to the Biesemeyer system that enabled the user to save time on setup, align the fence much more accurately with less time and repair and replace parts easier and less expensively.

–David Loving, Jet Equipment and Tools, Auburn, Wash.

Just plain wrong on planes—The cover of the February issue (*FWW* #134) shocked me: I see a plane resting on its sole on the bench. Rule No. 1 in the school where I learned woodworking was never lay a plane on the bench on its sole. *–John Mitchell, Hopkinton, N.H.*

Phone number for Shaker-box supplier—In last issue's Q&A department (*FWW* #134, p. 108), the phone number listed for John Wilson's The Home Shop, a source for Shaker-box supplies, was incorrect. The correct number is (517) 543-5325.

Another way to remove nails in trim—I was amazed at Tom Quinn's suggestion in Methods of Work (*FWW* #134, pp. 16, 18) for removing nails from door and window trim by placing the trim on a pine scrap and driving the nail heads into the pine. This goes against the procedure that I was taught many years ago by an old-timer who was very skilled at remodeling homes.

His method is to pull the nails through the board from the back by using a pair of nippers or pincers (held close to the wood) to lever it out. This way you have no splitting, splintering or damage on the front side.

–Hugh Livesay, Jackson, Ohio

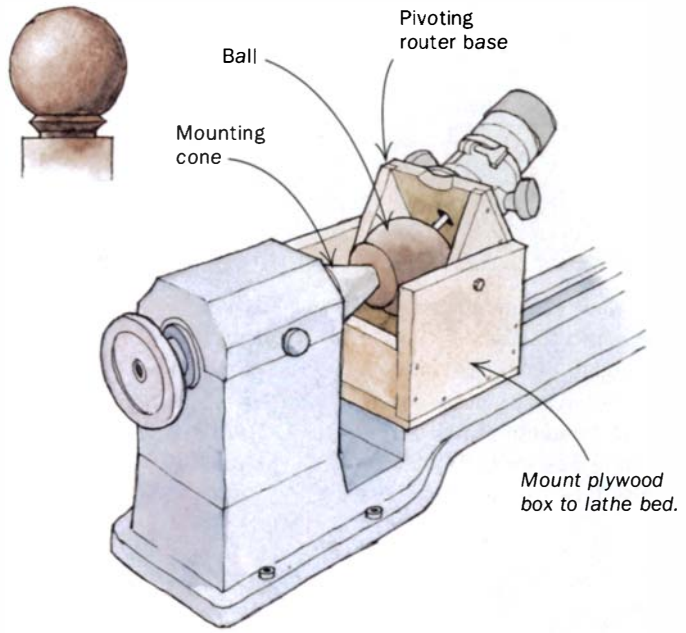
Writing an article

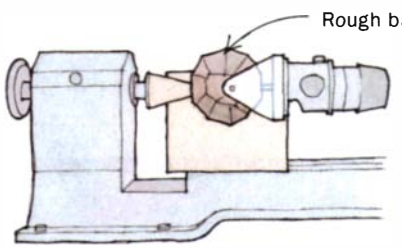
Fine Woodworking is a reader-written magazine. We welcome proposals, manuscripts, photographs and ideas from our readers, amateur or professional. We'll acknowledge all submissions and return those we can't publish. Send your contributions to *Fine Woodworking*, P.O. Box 5506, Newtown, CT 06470-5506.

Methods of Work

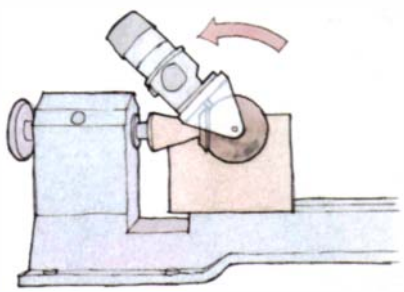
EDITED AND DRAWN BY JIM RICHEY

Roughing out ball shapes on the lathe





1. Start with router in horizontal position.



2. Swing router in arc to shape ball.

It bugged me that when I needed a number of uniformly sized wooden balls for bedpost finials, the only way to make them was to turn each ball from scratch—a painstaking operation. So I came up with this router-based fixture that whips out a rough ball in less than a minute.

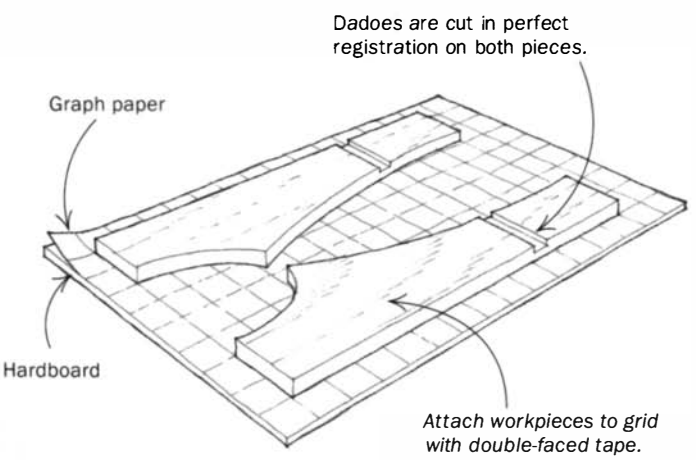
To make the fixture, attach a simple plywood box, open at the top, to your lathe bed. Install a pivoting router base, as shown in the top drawing at left. If you want to make perfectly round balls, carefully locate the pivot points right on the axis of the lathe centers. You can also make some interesting eccentric shapes by lowering the pivot point below the centers.

To attach the ball blanks, screw a block of wood to a faceplate and turn the block so that you have a truncated cone, roughly 6 in. long. Rough out a ball blank on the bandsaw and attach the blank to the cone with a large lag screw that runs through the back of the faceplate and into the ball.

To make a ball, start with the router in a horizontal position. Turn on the router, turn on the lathe and swing the router through its arc slowly to shape the ball (see the bottom drawings at left). You should be able to rough out about 90% of the ball, leaving a small, unfinished section where the ball attaches to the cone. Part the unfinished section off the bottom of the ball, and mount the ball using the lag-screw hole.

If you want a perfectly round ball with no hole—such as a croquet ball—make up a longer blank, so that when it is attached to the cone, the lag screw doesn't penetrate the ball. Rough out the ball, leaving a stem. Separate the ball from the stem and finish the ball by turning it 90° and chucking it between two cone-shaped centers so that you can waste away the stem. By chucking the ball in two or three positions and sanding the surface, you will achieve a virtually perfect sphere. *—Timothy Dalton, Middleton, Wis.*

Registering oddly shaped pieces



Here is a little trick that I discovered while making a display shelf for my wife. With this technique, I was able to keep two small, oddly shaped workpieces in exact registration to each other so that I could rout dadoes in them. I began by mounting graph paper

A new reward for the best tip

Eric Tadsen

Tim Dalton, a cabinetmaker from Middleton, Wis., is the first reader to be awarded a Lie-Nielsen plane for sending in the best tip for this issue's Methods of Work. The plane is engraved with Tim's name, the Fine Woodworking *logo, the issue number and the date. Tim's tip (see above) involves the ingenious use of a router and a lathe to make wood spheres. Send us your best tip—simple, complex, ingenious or so obvious you wonder why no one else has thought of it—and you might get a plane just like the one we gave Tim. Send details, sketches—we'll redraw them—and photos to Methods of Work,* Fine Woodworking, *P.O. Box 5506, Newtown, CT 06470-5506.*

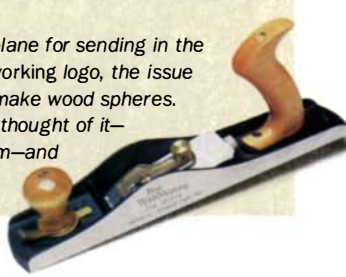


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Photo: Pat Shanklin

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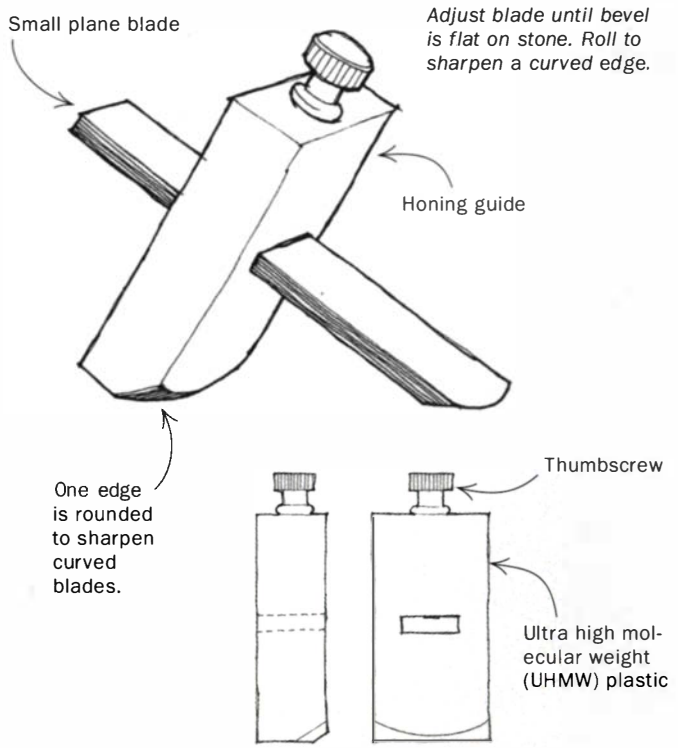
on a squared-up piece of hardboard with spray adhesive. The grid lines on the graph paper allowed me to position the shelf sides on the hardboard in perfect registration to each other. I attached the shelf sides to the hardboard with double-faced carpet tape.

Finally, I flipped the whole thing upside down on the router table and made my dado cuts by running the hardboard against the router-table fence. *—Don DiPiero, Girard, Ohio*

Small honing guide



As a maker and user of finger planes designed for luthiers, I need to sharpen small plane blades at many different angles and radiuses. Commercial sharpening guides are too large to hold the small blades and will not allow a rolling motion to sharpen a curved blade. So I designed this little sharpening guide that solves these problems and makes blade sharpening faster and easier.

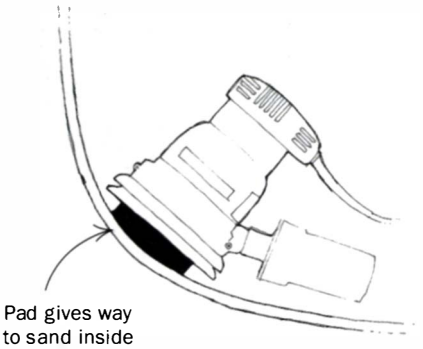
To make the guide, I use ½-in.-thick ultra high molecular weight (UHMW) material, a dense, slippery plastic sold in small sheets to make jigs and fixtures. Woodcraft (800-225-1153) is one supplier. Cut a block of UHMW about twice as wide as the blade and tall enough so that the blade will be centered in the guide when it is being sharpened at the desired bevel angle.

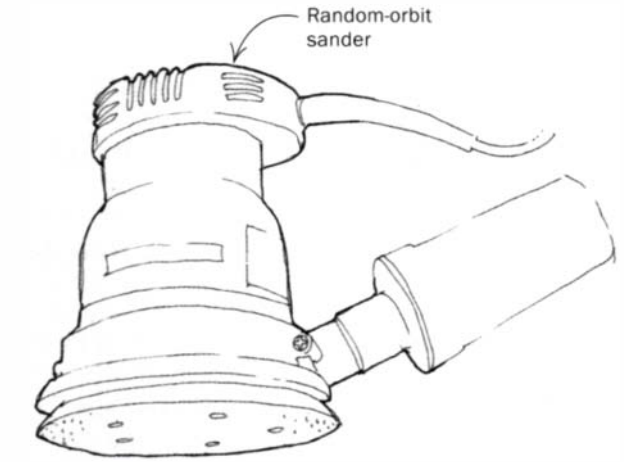
To cut the slot in the UHMW, use a router bit the same thickness as the blade chucked into your drill press. Work the block back and forth against a fence, gradually deepening the slot until you cut through. Then drill and tap a hole through the top down to the slot, and install a thumbscrew to hold the blade in place.

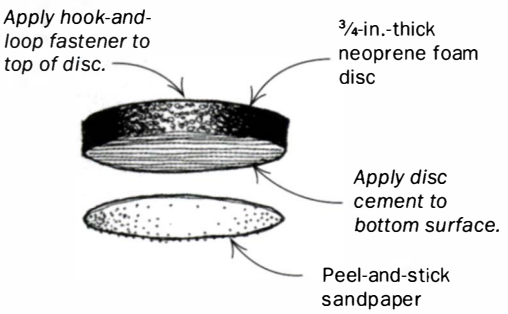
For curved blades, draw a radius onto the bottom end of the guide that will approximate the radius in the blade. Using a sharp knife or chisel, cut away the material but only to half the thickness of the block. This allows you to insert a blade from either direction and sharpen a flat or a curved blade.

—Christopher Laarman, Philomath, Ore.

Sanding concave surfaces with a random-orbit sander







I love my random-orbit sander, which removes material fast, is easy to control and leaves a smooth, uniform surface. When I made a cedar-strip canoe last winter, the random-orbit sander worked like a dream on the outside of the hull, shaping and smoothing the convex curves. On the inside of the hull, however, I was able to use the sander only in some of the flatter areas because the 5-in. pad bridged all but the shallowest concave curves, leaving swirls and gouges at the edges.

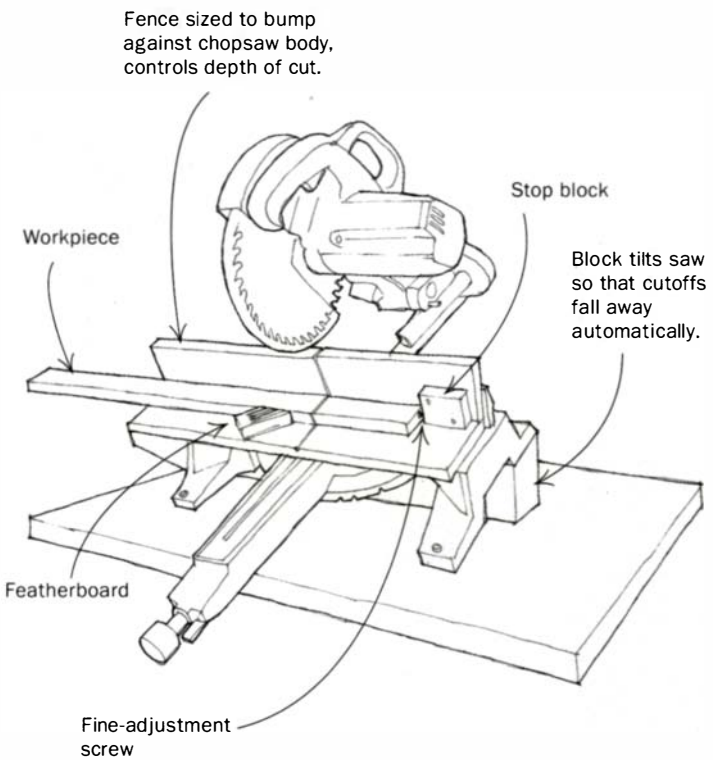
After trying a number of solutions, all ineffective, I extended the reach of my sander by adding an auxiliary disc. I cut a 3-in.-dia. disc from ¾-in.-thick neoprene foam and attached a hook-and-

loop fastener to one side with polyurethane glue. I sealed the other side with Franklin sanding-disc cement, ending up with something that looked like a Nerf hockey puck. You can buy neoprene pads of different thicknesses at computer-supply stores or by mail order from CGR Products in North Carolina (336-621-4568).

By centering the auxiliary disc on my sander's hook-and-loop pad and using self-stick sandpaper sheets, I was able to reach into almost all of the concave surfaces on the inside of the hull. Smaller discs or softer foams would likely extend the sander's reach into even tighter curves.

Take care in accurately cutting the foam disc and centering it on the sander pad. Any imbalances could result in increased vibration at high speeds, which would be transmitted directly to the user's hands and arms. *—Philip Jacobs, St. Paul, Minn.*

Production setup for the chopsaw



When cutting hundreds of identical pieces of wood to length for production work, a chopsaw is essential but not sufficient. To speed up cutting time, you need automatic removal of the sawn pieces. The easiest way to achieve this is to tilt the saw forward by attaching a 5-in. spacer board underneath the rear of the saw.

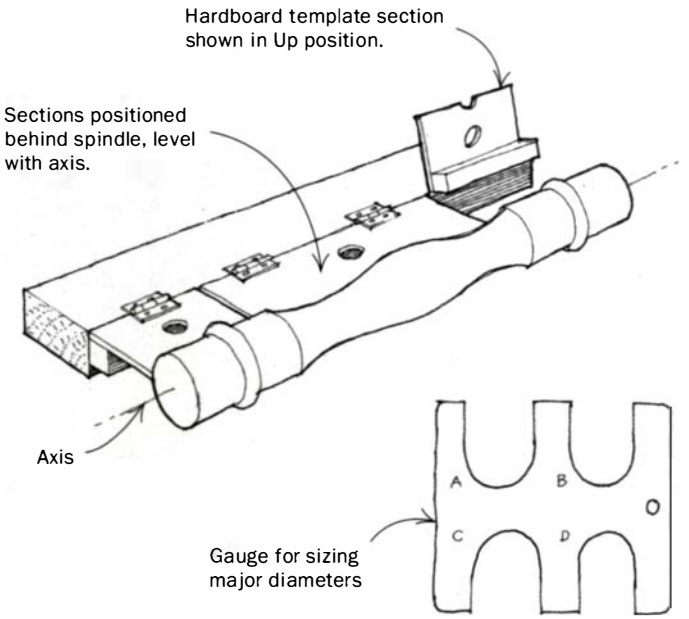
A simple jig is then clamped to the saw table to give you accurate results. The floor of the jig should be melamine or vinyl-coated to allow the pieces to slide off the jig easily. Secure the jig firmly to the saw. To help avoid tearout, screw a fence to the back edge of the jig. Cut the fence to the proper height so that it bumps against the saw body and acts as a depth stop, too.

On the fence at the distance of the cut, plus ½ in., screw a stop block equipped with a flat-head screw for fine adjustment and sawdust clearance. Finally, you need to screw a featherboard to the floor of the jig to keep the workpiece against the fence.

This jig is so easy to build that you can have one for each length you need to cut. You will save the time you spent building the jig the first time you use it.

—Klas Wilzen, Glimmingeg, Malmo, Sweden

Fixture for duplicating profiles on the lathe



I don't own a duplicating lathe. So when I needed to turn several identical spindles, I designed the fixture shown in the sketch above. It was convenient to use and saved me a lot of time.

To make the fixture, first cut a negative profile of the spindle shape from ¼-in. hardboard. Divide the profile into convenient sections, and attach the sections with hinges to a support piece behind the lathe bed, level with the turning axis of the lathe.

Prop up the sections in the open position out of the way and turn the spindle to rough dimensions. Use a simple gauge as shown to size the major diameters—it's faster than using adjustable calipers.

Continue to turn the spindle, approximating the shape by eye. When you get close, flip down a template section in the area you are working so that it is riding on the turning spindle. Continue to remove material and refine the shape until the template drops into place. Repeat that process until all of the sections have been duplicated. With just a little care, you can hold tolerances to within 1/32 in. For final sanding of the workpiece, flip the templates sections up out of the way.

—Richard Herst, Redondo Beach, Calif.

Quick tip: I use plastic-coated playing cards to keep pipe and bar clamps from marring a project's surface. Before a glue-up session, I slip an old deck in my shirt pocket. Then, as I go about positioning the clamps, I slide one or two cards under each clamp pad. Not only does the card's plastic surface keep it from absorbing wood glue like paper or cardboard does, they're thinner and more easily positioned than wood shims. *—R.B. Himes, Vienna, Ohio*

Garrett Wade Tools Free Catalog

SALE A / Cabinetmaker's Clamps Are Very Inexpensive – And Incredibly Useful

Despite their low cost, these are not Taiwan copies. They are high quality German-made.

With a throat depth of 2½", these small fast-acting clamp are endlessly useful. They're light and strong, and the vinyl capped swivel end and perfectly flat jaw minimizes marring.

You'll be glad you have a bunch of them around your shop. You will be able to work faster and more efficiently because you won't have to search for those clamps you need.

		Regular	*Sale*
37F01.10	4"Cab. Clamp (10)	$62.95	$44.95
37F01.20	8"Cab. Clamp (10)	$68.95	$48.95
37F01.30	12"Cab. Clamp (10)	$73.95	$52.95

Combination Set consists of 10 of each of the 3 sizes of clamps. 30 Clamps total- only $4.65 each.

37F10.10 Combination Set $205.85 $139.50

B / Repointed Carbide Drills & Rasps Are An Incredible Bargain

These ⅛" shank drills, used in the electronics industry, have all been professionally resharpened. The assortment will have some duplications but there are about 20 different sizes and types. All are made in the spiral upcut style. The rasps have penetrating tips. A *phenomenal value.*

50J51.01 Carbide Set of 50 $19.95

NEW C / Anchor Knife Slips Right Into Your Pocket

Made by one of the oldest established knife making firms in Solingen (the heart of German knife making) – a solid tool for recreation or day-to-day use in the shop.

This is not a "fancy" knife – just a solid workmanlike tool that just looks terrific and works really well. Anchor inlaid in brass. Hand stropped as a final step. Single ready to use 2½"long blade.

10H07.01 Anchor Knife $29.50

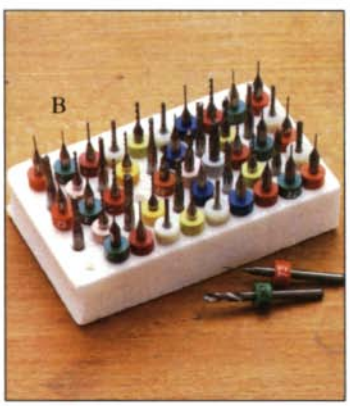
NEW D / A Great Woodworker's Belt Watch

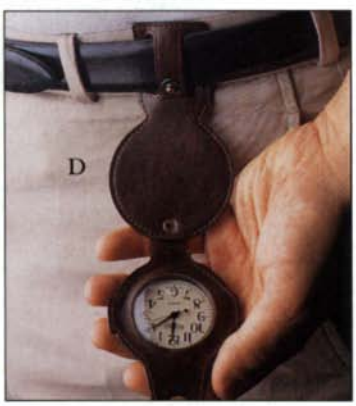
It's a nifty timepiece set upside-down in its leather carrying case, with an integral belt loop. The snap holds it closed until you want to check the time. Then just reach down, snap it open, glance at the face, and snap it back closed again.

A well fitted out craftsmen in grandfather's day carried his watch in his pocket, where it would be safe and clean – if not terribly convenient. Here's a even better solution.

Nothing is on your wrist to be a safety hazard or to be "vibrated-to-pieces" if you are working with machinery. Great for shop work, yard work – you name it.

78W01.02 Woodworker's Belt Watch $64.50





SALE E / Iron Backed Tenon Saw Combines The Best Of Western & Japanese Style Saws

This new saw, with its unique tooth design, works astonishingly well – with a very smooth finish and an exceptionally fast cutting action.

This is a classic Western style tenon saw but with precision diamond cut Japanese-pattern teeth. (A Japanese-pattern tooth design is noted for its very fast cutting properties.) The 12" long blade has 15 tpi, and is set into a ¼" thick solid soft iron back. Depth of cut 3". The body of the blade is .025". Kerf is a narrow .035".

Like all Japanese saws it cuts very smoothly and quickly, but in the Western fashion, on the push stroke. The specially hardened teeth should last a lifetime. Must be used to be believed.

		Regular	*Sale*
93K01.01	Japanese Tenon Saw	$37.50	$29.95

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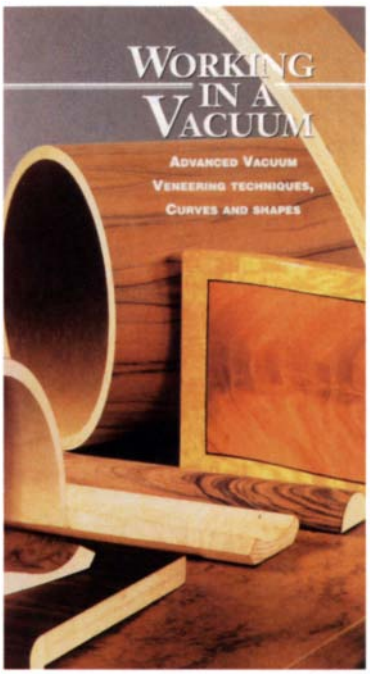
Notes & Comment

Video takes mystery out of vacuum veneering



Working in a Vacuum *from Vacuum Pressing Systems, Inc., 553 River Road, Brunswick, ME 04011 (207-725-0935); 1 hour; 20 min.; $34.95.*

Darryl Keil was a furniture maker before he became a pioneer and champion of vacuum pressing, a method of veneering and laminating wood that uses pumps and vinyl bags instead of clamps. Keil's first video (*Working With Veneer*; 1 hour, 22 min.; $34.95) covered veneering basics. Now Keil, owner of Vacuum Pressing Systems, Inc., has produced a second how-to video, *Working in a Vacuum*, this one about advanced techniques.

The concept of vacuum pressing is really quite simple. Parts to be joined are coated with glue, placed on a shop-built form and slipped inside a vinyl bag. The bag is sealed, and the air is sucked out. Atmospheric pressure takes over and squeezes the parts together with considerable force.

Although the concept may be simple, the techniques for laminating curves can be complex. Keil's video shows how to veneer such challenging forms as cylinders, curved panels, custom moldings and even a spiral staircase stringer.

I had not quite mastered the basics of vacuum veneering before tackling what turned out to be a daunting project, and this video sure would have helped me. For example, when veneering large curved surfaces, veneer sometimes wrinkles in the concave sections. Keil advises that you glue the face veneer to a backer veneer first, with the grain running at right angles to each layer, making what's called a two ply. Two plies resist wrinkling and will form nice, smooth concave curves.

Making a solid, accurate form is important to getting good results. Forms are typically made with plywood or particleboard. They must withstand the tremendous pressure exerted upon them when placed in a vacuum. Keil gives tips on how to make sure your form is strong enough. He shows alternative ways to make forms and demonstrates how to use the forms as guides when trimming the glued-up parts.

The video offers tips on types of glues to use as well as tips on maintaining and troubleshooting the vacuum bag and pump. I haven't seen this kind of detailed information anywhere, and even at $34.95, the video is well worth the price.

—Anatole Burkin, senior editor

Black & Decker wins suit against Pro-Tech

That other brand of black-and-yellow tools—Pro-Tech—may have to get its colors redone after losing a trademark and patent infringement suit brought on by Black & Decker Corp., parent company of the DeWalt line of power tools.

Last November, the U.S. District Court of the Eastern District of Virginia ordered Pro-Tech Power, Inc., to pay Black & Decker $1.7 million in damages for infringing on DeWalt's black-and-yellow color scheme. The court also found that Pro-Tech infringed on Black & Decker's patent on the DeWalt 12-in. compound-miter saw.

Jim Lancaster, general manager of Pro-Tech, a California corporation with Taiwanese owners, said his company will appeal. *—Marc Vassallo, associate editor*

Wood webs

"Wood webs" features useful and interesting woodworking web sites. If you have a woodworking web site you would like to share, send the address to mvassallo@taunton.com.

Cloud Chair

The Internet makes it easy to take a peek at something simply because it's interesting, unusual or especially well done. For the slight effort involved in typing the address home.earthlink.net/~nokogiri/nokoclch.html, plus the minute the page takes to load, you can see a kissing Cloud Chair flawlessly crafted from walnut. Its maker, Mark Grable, has posted six studio photos of the two-seated chair, with close-ups of its joinery and flowing curves. The photos are part of a web site promoting Nokogiri, Grable's Japanese handsaw-sharpening service.

Got milk paint?

If you need some milk paint to finish a Colonial or Shaker piece, or if you simply want to know more about this traditional finish, visit www.milkpaint.com, the web site of The Old Fashioned Milk Paint Co., Inc. The site features a gallery of work finished with milk paint, specifications on milk paint, a color chart, answers to frequently asked questions, a state-by-state list of dealers and an opportunity to order milk paint on-line.

Talking shop

One of the more robust on-line woodworking forums can be found at Badger Pond (www.wwforum.com), a web site presumably named for our woodworking next of kin. Badger Pond actually posts two forums, a main one called Power Tool Forum (even though it covers all aspects of woodworking except hand tools) and a smaller hand-tool-only forum called Neanderthal Haven.

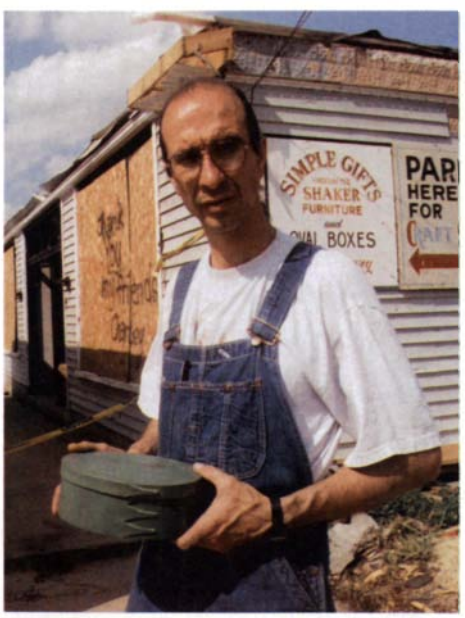
In addition to the two bulletin boards, Badger Pond also sponsors on-line seminars on finishing, hosted by Jeff Jewitt (see his article on p. 38). As this issue goes to print, the live chats are on Wednesday and Saturday between 9:30 p.m. and 10:30 p.m. Eastern time. *—M.V.*

Photos: Marc Vassallo, except where noted

Simple gifts

Shaker craftsman Charles Harvey, owner of Simple Gifts, Inc., is back to making oval boxes and chairs—no small wonder after he experienced a woodworker's worst nightmare. On April 20, 1996, a tornado ripped through Berea, Ky., tearing the roof off Harvey's Old Town shop and damaging the rest of the structure so much that it had to be torn down. Harvey lost time, business and materials, even his 110-issue collection of *Fine Woodworking*.

Miraculously, of the 22 chairs in the shop, only one sustained damage, and that was minor, "testament," Harvey said, "to the hardiness of a well-made Shaker chair." Equally miraculous was the outpouring of support and assistance Harvey received from friends, students and customers. Even though his two employees were forced to find other jobs, they stayed on to help Harvey clean up and refinish his inventory of boxes and chairs. And now Harvey's customers, museum clients and individuals who waited patiently for Harvey to rebuild, have begun placing orders that had been canceled because of the tornado. Since 1982, Harvey has poured love and care into his work, and now he's getting it back. What better reason to be a woodworker?



Back in business. *Charles Harvey's company, Simple Gifts, was devastated by a tornado. But with the help of friends, students and customers, his business is up and running again.*

Storybook marquetry

Right out of a book. *Alex Bouteneff's marquetry panel was inspired by a storybook illustration by Ivan Bilibin.*

When Alex Bouteneff was a boy, his parents, new immigrants to the United States, read him Russian fairy tales, keeping alive the traditional stories of their homeland. Bouteneff loved the scary stories and especially the turn-of-the-century illustrations by Ivan Bilibin.

One Christmas, his parents gave him a hammer and saw and a little table. So began Bouteneff's lifelong interest in building and fixing things, which eventually led to a career as a surgeon.

Just out of college, Bouteneff saw some Russian marquetry at a relative's house. He realized that Bilibin's storybook drawings lent themselves to interpretation in marquetry. He devised his own thoughts on how to proceed, settling at first on a technique that was, he said, "much too complicated." Bouteneff now practices a self-taught mishmash of techniques and has no shop other than a worktable in a spare bedroom. All of his marquetry tools fit into a small paper shopping bag.

Build it, and they will come

A couple of years ago, Marc Adams sold his multimillion dollar cabinetry business and opened the Marc Adams School of Woodworking, smack in the middle of a sea of corn just south of Indianapolis. The cavernous building that once housed the shop and now serves as the school lacks the ambience of a more traditional workshop, but it offers plenty of clean, well-lit elbow room. Legions of woodworkers continue to beat a path through the cornfields, drawn by the location—closer than either coast if you hail from the Midwest—by the variety and reasonable duration of the mostly week-long courses and by the roster of top-flight instructors.

I stopped by the school last June to watch Gary Rogowski lead a course on

Bottom photo, this page: Zoya Tereshkova

building a n Arts-and-Crafts style bookcase. I arrived on a Wednesday afternoon, midway through the session. Although the students had a range of experience (one ran a cabinet shop; another had taken up furniture making only months before), they had already bonded as a group. They had milled and glued up boards on Monday, cut curves and mortises on Tuesday, and now they were busy fashioning through-tenons.

The enormous shop, with its 16 benches (one for every student in the largest classes), three tablesaw stations and on and on, is conducive to unhurried work, and the pace was purposeful but relaxed. Rogowski buzzed around, working one-on-one or gathering the group for impromptu lessons on such techniques as tuning handplanes, sharpening chisels or cutting dovetails. Adams himself popped in and out, and his two assistants stayed close at hand, often working at length beside the least experienced students.

By Friday morning, the time had come to discuss driving wedges into the through-tenons without blowing out the tenons. "Apply moderate pressure," Rogowski cautioned the class with a knowing smile. "Moderate pressure." I had to leave before I saw whether anyone would succeed at heeding his advice. The slower students, in any case, wouldn't be driving in wedges until they were back home.

Up close and personal. *At the Marc Adams School of Woodworking, students gain valuable experience and new skills by working closely with instructors.*

Adams, who at 39 looks impossibly young to have founded what has already become an established school, made it clear to me that a finished piece was not the point of a one-week course. The point, Adams said, is "to get involved in the process, to enjoy the process, to have fun as you build and learn something." Plenty of students do take home finished work (instructor Brian Boggs insists that every one of his students completes an Appalachian greenwood chair, for instance), but Adams is more concerned that each student leaves with valuable experience and new skills.

For more information, contact the school at (317) 535-4013 or visit its web site at www.marcadams.com. —*M.V.*

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330	speed block finishing sander	67
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9125	3 1/4" power plane kit, 6.0 amps	142
9444	profile sander kit w/accys & cs	99
9444VS	Var. speed profile sander kit	111
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9737	VS tiger saw kit with case	167
9862	12v cordless kit w/2 batteries, case	152
9862F	12v kit w/2 batt, charger & flashlite	159
9872	14.4v crdls drill kit w/2 batt. & case	186
97366	6" vs dustless random orb sander kit	159

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Panasonic

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60	8" long bed jointer	1775
64A	1 1/2hp tblsaw w/accufence	745
66	3 hp, 1 ph 10" t.a. saw w/50" fence	1995
66	5 h p, 1 ph 10" t.a. saw w/50" fence	2095
73	1 1/2 hp dust collector	389
75	3 hp dust collector	675
84	combo belt & disc sander	445
412	12 1/2" portable planer	395
471	1 hp dust collector	219

AIRY

EZ2	18 gauge nail/staple kit	109
0249NK	18 gauge brad nailer 3/4"-2" w/case	108
0232NK	18 ga brad kit 3/8"-1 1/4" with case	68
0566T	angle finish nailer 1"-2 1/2"	202
0626NK	18 gauge narrow crown stapler 3/8"-1" withcase	103
0638S	narrow cr stapler 3/4"-1 1/2"w/cs	179
ITM/ART	0241 & 0626 in one case	119

Purchase any tool & you may add this Porter Cable 8 1/4" circular saw with carbide blade Model 368-1 for only $79.00. Let's see our so-called competitors top this one! HURRY...WHILE QUANTITIES LAST!

Fein

MSXE-636-2	Multimaster triangular sander *includes case, paper asst. & 2 blades*	172
99-55-13	Fein turbo vac II	248
MSFE636-1	Random orbit sander	489

RYOBI

AP12	12" port. planer	345
DBJ50	detail biscuitjointer	68
DC500K	detail carver kit	62
HT20VSK	multi rotary tool w/cs & accys	48
ML618	18" woodminilathe	199
OSS450	oscillating spindle sander	149
RE185	2 1/4 hp fixed base vs router	109
SC165VS	16" vsscrollsaw	164

HITACHI

C7SBK	7 1/4" circ. saw w/case	109
C8FB2	8 1/2" slide compound miter saw	438
C10FC	10" compound miter saw	198
C10FS	10" slide compound miter saw	558
DN10DYK	9.6V cdls right angle kit	168
DS14DV-G	14.4v kit w/2 bat & free Gerber tool	209
M12V	3 hp var speed plunge router	189
NR83A	full head strip nailer, 2 - 3 1/2 cap	369
NV83A	coil nailer, 2" to 3 1/4" capacity	369
P20SB	3 1/4" planer	89

freud

TR215	8 1/2" compound saw	238
JS100	biscuit joiner	94
JS102	biscuit joiner w/var. angle fence	118
FT2000E	3 hp plunge router	184
F410	10" x 40 tquietblade	48
F810	10" x 80tquietblade	73
LM72M010	10" x 24tflat top rip blade	36
LUB2M010	10"x60tcrosscut/rip blade	44
LU84R010	10" x 50T red combo blade	42
LU85R010	10" x 80T red crosscut blade	58
LU92M010	10" x 60 teeth TCH laminate	59
LU98M010	10" x 80 teeth TCH lam & wood	67
SD308	8" safety dado with case	116
SD508	new 8" super dado set	167
SD608	8" dial-a-widthdado	198
TK406	10" x 60 teeth thin kerf blade	36
TK806	10" x 80 teeth thin kerf blade	47
TK906	10" x 50 teeth thin kerf blade	34

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#52, 1/2" 6.95 .... BOX OF 12 $79.95
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Makita

5007NBK	7 1/4" circ saw w/cs & blade	128
6095DWE	9.6v cdls drill kit w/2 batt	128
6095DWLE2	same as above w/flashlght	139
6213DWAE	12v cordless kit w/2 batteries	169
6233DWAE	14.4v cordless kit w/2 batteries	199
6333DWAE	14.4v 1/2" cordless kit	209
B05001	5" random orbit sander	67
LS1013	10" slide dual comp miter saw	558
N1900B	3 1/4" planer	146

Milwaukee

6490-6	10" mitersaw	274
6496-6	*new* 10" slide compound miter saw	545
6497-6	10" slide compound saw w/accs	619
6537-22	10 amp recipsaw w/case	178

SENCO

SKS	narrow crown stapler	247
SLP20	brad nailerw/cse 5/8"-1 5/8" cap	198
SFN40	finish nailer 1 1/4"-2 1/2" cap	338

DELTA

11-990	12" drill press	188
14-650	hollow chisel mortiser	238
22-560	*new* 12" portable planer	328
23-710	*new* sharpening center	149
28-185	bench top band saw	167
28-270	14" bandsaw, 1 hp white, enc stand	849
31-780W	osc. sander w/spindles	216
36-865	versa feeder stock feeder	248
36-920	Grand Edition 3 hp unisaw	1699
37-190	6" jointer w/stand	419
40-540	16" vs scroll saw	162
40-650	Q-3 scroll saw	429
43-505	router/shaper	299
50-840	1 hp dust collector, 650 cfm	219
50-850	1 1/2 hp dust collector, 1200cfm	289
50-860	room air cleaner, 850 cfm	234

DEWALT

DW4PAK	18v kit circ saw, recip saw, hammr drill and light	559
DW309K	recip saw, var sp, w/blades & cs	168
DW321K	top handle jig saw kit	158
DW359K	7 1/4" circular saw w/case	128
DW378G	7 1/4" framers saw	168
DW420	5" random orbit sander, psa	62
DW421	5" dstls mdm orb sander, velcro	67
DW423	5" vs dustls random orbit sander	79
DW431	3" x 21" dstls belt sander var sp	185
DW610	1 1/2 hp router, 9 amp	144
DW621	2 hp vs dstls plunge router	198
DW677K	3 1/4 hp planer kit	149
DW682K	biscuit joiner kit	159
DW705	12" miter saw w/carb blade	358
DW708	*new* sliding comp. miter saw	644
DW733	*new* 12 1/2" portable planer	435
DW744	10" portable table saw	499
DW788	*new* 20" var. speed scrollsaw	448
DW965K	12v right angle drill kit	189
DW972K2	12v crdls kit/w battery & cs	179
DW972KS2	12v combo drill & saw kit	274
DW991K2	DW991K with two batteries	206
DW991KC2	14.4v drill & recip saw combo kit	372
DW991 KL2	14.4v drill, circ saw, flashlight kit	349
DW991KS2	14.4V cdls drill & circ saw kit	338
DW995K	18V 1/2" drill w/batt, chrgr & cs	228
DW995KC2	18v drill & recip saw combo kit	395
DW995KS2	18V drill & saw combo kit	377
DW997K	18V hammer drill kit, 1/2" chuck	239
DW997KC2	18V hammer drill & recip saw kit	415

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READER SERVICE NO. 209

The New Router Bit Jack by Veritas®

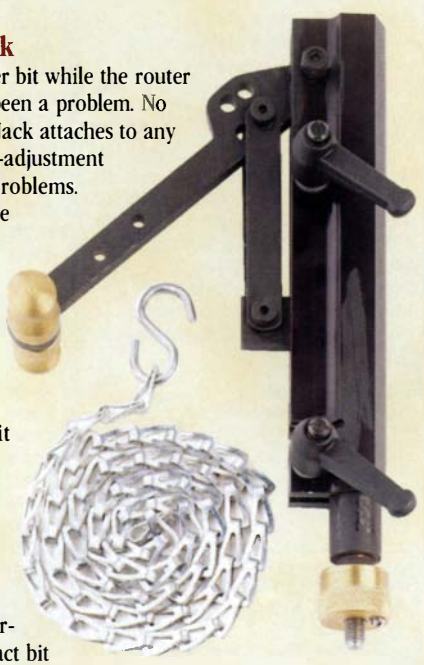
The Veritas® solid-steel router table and its accessories provide the most complete and innovative solutions to everyday routing problems. With the introduction of the new Router Bit Jack, a third dimension (vertical) opens up when used in conjunction with plunge routers.

Bit Jack lowered.

Bit Jack plunged.

Veritas® Router Bit Jack

Adjusting the height of a router bit while the router is fixed in a table has always been a problem. No longer. The Veritas Router Bit Jack attaches to any router with an exposed height-adjustment rod. The bit jack solves three problems. First, major adjustments can be made quickly; no more spinning an out-of-sight nut while lifting the router with the other hand. Just release a gyratory handle, press down on the jack lever, set the bit to the approximate height and tighten the lever. Second, it makes fine adjustments fast and accurate. The fine setting knob has an integral ball detent that steps the bit height in .002″ increments. A full turn is 1/32″ (or .031″). Third, and possibly most important, once you have set the exact bit height you want, you can lock it in and still make progressive cuts, avoiding blast-out and giving you a better finished piece. Best of all, this can be done with a shop-made foot pedal; repeated passes at different heights can be made without delay or using your hands for adjustment. This is ideal for cutting mortises.



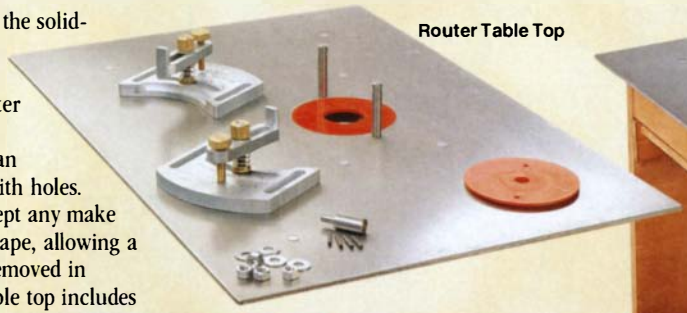
Unfortunately, the Bit Jack will not work with all plunge routers. Because the main piston threads onto the vertical pull rod, it will only work with plunge routers that have this pull rod exposed on the side of the main body. Fortunately, most routers are this way. In our research, we found that there are three primary thread sizes used on pull rods: 3/8″-16 UNC and two metric sizes, M10×1.5 and M12×1.75. Most manufacturers stick to one size. The most common is M10×1.5, used on most Makita, Freud, Ryobi, Bosch, Hitachi and Sears routers. M12×1.75 is used on some Dewalt models, and 3/8″-16 UNC on Porter-Cable. We encourage you to check the thread on your own plunge router with vernier calipers. The diameter across the crowns of the threads (the major diameter) should match or be slightly smaller than one of the three sizes listed.

The extra degree of freedom afforded by the bit jack opens up a whole new range of routing possibilities. Bit elevation can be up to 1 3/8″. Made of anodized aluminum, steel and brass. 8″ overall height. All hardware included, down to the chain for the foot pedal, which you hook up to your own shop-made stand. Patent pending.

FW1020	Veritas® Router Bit Jack, M10×1.5	**$55.00**
FW1021	Veritas® Router Bit Jack, M12×1.75	**$55.00**
FW1022	Veritas® Router Bit Jack, 3/8″-16 UNC	**$55.00**

The Veritas® Router Table System

The heart of the system is the solid-steel Router Table Top. It is guaranteed not to sag under the weight of a router and, at 16″ × 24″, it is a generous size. It has a clean surface; not one riddled with holes. Quick-change clamps accept any make of router with any base shape, allowing a router to be installed or removed in 30 seconds or less. The table top includes a cam-lock system for inserts, allowing them to be installed flush or removed with only a quarter turn. Supported on our stand or a shop-made one of your liking, it serves as the foundation for a fully expandable system.



A router can be installed or removed in 30 seconds or less.

Once your router is clamped, you can easily prop up or flip the plate to adjust bits as shown.

Table Top & Stand Set
FW1005 $159 (save $19)

The addition of the Router Table Fence brings full control to routing. An upper aluminum rail provides straightness and rigidity. The split bottom extrusions make the opening adjustable from 0″ to 8″. Because you can match the opening to the size of bit being used, you get maximum material support on both the infeed and outfeed. Form fitting the ends of the wooden sub-fences further reduces tear-out and improves safety. Fine adjustments, down to 0.001″, can be made quickly and accurately with the micro-adjust.

The Right-Angle Sled straddles the Router Table Fence, offering a sliding arm at an accurate 90° to the fence. This introduces a whole new range of functions to the Router Table system, such as cross and end routing of workpieces. Like the fence, the arm consists of a continuous rigid upper extrusion with two nesting lower extrusions, offering all the same advantages and more. An end-grain wooden backup block can be secured between the lower extrusions, to which you rout into to provide a solid backing to eliminate tear-out on through cuts. Integral fingers allow you to make box joints 1/8″ wide, and any width from 1/4″ to 3/4″, which are properly supported by the backup block.

Table Top, Stand & Fence Set
FW1010 $269 (save $34)

All items are available individually as listed. The sets shown here all include our stand, made from 3/4″ birch plywood (minor assembly required), and a comprehensive 60-page manual.

Other accessories available are a Magnetic Dust Chute for hassle-free dust control, a Work Hold-Down for pressing workpieces snugly against both the fence and the table, and more.

For complete details on the Veritas® Router Table System, please refer to our 1998/99 main catalog.

FW1001	Veritas® Router Table Top	**$139**
FW1002	Veritas® Router Table Stand	**$ 39**
FW1003	Veritas® Router Fence	**$125**
FW1004	Veritas® Right-Angle Sled	**$ 72**

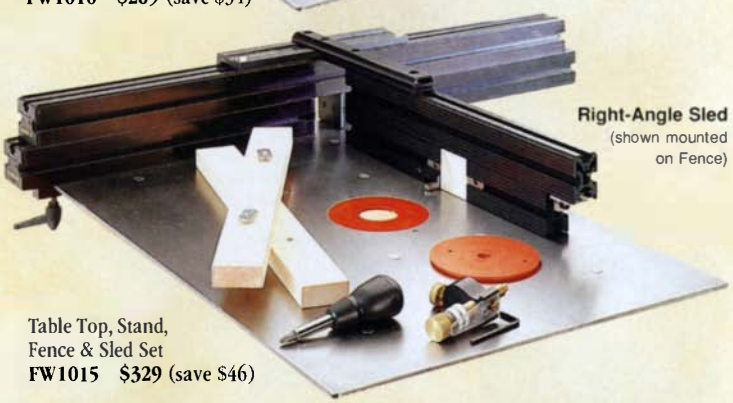


Table Top, Stand, Fence & Sled Set
FW1015 $329 (save $46)

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READER SERVICE NO. 190

Nailer showdown: Porter-Cable Bammer vs. Paslode Impulse

Fuel, not compressed air, powers these finish nailers. *The Porter-Cable Bammer is the least costly of the two, but the Paslode Impulse nailer is easier to operate.*

Long hoses and bulky compressors are two of the annoyances of using an otherwise brilliant invention: a pneumatic nailer. The new Paslode IM250II Impulse and the Porter-Cable CFN250 Bammer finish nailers are designed to take the hassle out of trim carpentry. Both are fired by liquefied gas and use 16-ga. nails up to 2½ in. long. But the similarities end there.

The Impulse feels more like a conventional nailer: Press the tool against the stock, and the tip retracts easily, freeing the safety. A press of the trigger fires a nail with a loud "pop," the result of the gas exploding in the combustion chamber. Because the piston automatically returns to the top of its stroke after firing, the Impulse allows you to work at a fast clip. If you leave the tool sitting idle for a while, no problem. It's ready to go as soon as you are. At about 5¼ lbs. with fuel and a rechargeable battery, the gun is well balanced.

Using the Bammer is a different experience altogether. This nailer requires you to compress the tip nearly 3 in. each time you shoot a nail. That action returns the tool's piston back to the top of its stroke. It's slower than using the Impulse or a typical air-driven nailer. Compressing the tool this way for hours on end, especially in a horizontal or overhead position, is tiring. And if you wish to nail crown molding, the force required to compress the pump can distort or misalign the workpiece. The Bammer also seemed to go to sleep if I didn't use it continuously and then required one or two firings in scrap to get back up to speed and set nails properly. Although the Bammer doesn't need batteries, the nailer (with a fuel cell) weighs about 6 lbs., ¾ lb. more than the Impulse.

The Bammer, at $299, costs a lot less than the Impulse ($499). But I'd spend the extra money on the Impulse. *—Pat Scruggs*

Elmer's invents a perfect glue bottle

In my almost 20 years as a woodworker, I have tried every conceivable container for dispensing glue, from recycled mustard bottles to expensive specialty containers, and found all of them lacking.

The bottle design for Elmer's new Probond yellow glue is everything a glue bottle should be. It's just the right size: big enough to hold a generous supply of glue (12 oz.), but small enough to squeeze easily with one hand. The bottle is wide enough to resist tipping; but if you should knock it over, ridges on the perimeter of the bottle keep it from rolling off the workbench and crashing to the floor.

The bottle has a tip that dispenses just the right amount of glue, and the wide mouth of the cap makes it easy to refill without making a mess. My only complaint is that the tip is a bit hard to remove and fits on only one way. But the odd shape prevents the tip from rolling off the bench.

Elmer's could do a brisk business just selling the bottle. The yellow glue, by the way, is of good quality, too. The 12-oz. bottle with glue costs about $4.

—Niall F. Barrett

Some thinking went into this glue bottle. *Elmer's Probond glue comes in a nicely designed bottle that won't roll off the workbench.*

Photos: Anatole Burkin, except where noted; right, this page: Niall F. Barrett

Cordless right-angle drill from DeWalt

Cordless right-angle drill. *DeWalt's 12-volt right-angle drill has a long paddle trigger that allows for a wide range of grips.*

Once you've used a right-angle drill, you'll wonder how you ever got along without one. There's no better power tool for getting into the narrow confines of already assembled cabinets.

DeWalt's DW965 two-speed driver/drill is a well-designed, rechargeable 12-volt tool. It easily bores 1-in. holes through solid oak without bogging down. All that power comes with a price, however. The battery adds a lot of weight and size to the tool. It takes a strong forearm to drive a screw with the drill an arm's length away.

The soft-textured trigger runs nearly the entire length of the tool and makes it easy to operate the tool from a variety of hand positions. The speed control, located opposite the trigger, is also easy to reach. But the reversing switch, which is located in a small recess below the trigger, is less accessible. It would make more sense to me if the locations of the reversing and speed-changing switches were swapped. With a charger and two batteries, the DW965 sells for $199. *—Roland Johnson*

Carbide-toothed bandsaw blades

For years, American Saw Co. has been making bandsaw blades for metalworking under the Lenox brand name. Recently, the company entered the woodworking market. I tried one of its top-of-the line blades, a Pro Master III, which has carbide teeth. This is an aggressive blade that hacks through the toughest hardwoods easily and leaves a remarkably smooth finish.

I wanted a blade for resawing, and a representative from the company suggested I use a ⅜-in.-wide blade. Common wisdom tells you to use wider blades for resawing. But I haven't had the best results with ½-in.- or ¾-in.-wide blades. The problem, I was told, is that many smaller bandsaws like mine won't tension wider blades properly. Also, the motors on these saws often are not powerful enough to overcome the increased friction that wider blades produce. Surprisingly, the ⅜-in.-wide blade has done more to improve my imported bandsaw's resawing ability than anything else I've tried.

I used a No. 09336 blade, which has a triple-chip grind, a cut used on circular-saw blades. The blade is designed with variable tooth pitch (3 tpi to 4 tpi) and a changing set, features meant to reduce vibration and improve cutting speed. The only negative is the steep price: a little more than $1 per inch. For availability, call American Saw Co. at (800) 343-0626.

—Anatole Burkin

Beaver Tools' air-powered detail router

Pneumatic tools have some advantages over their electric counterparts, namely that they are usually smaller, lighter and last longer. For someone doing a lot of detail routing, the Beaver air router could be a good choice. Other pluses are it won't get hot in your hand like an electric router, and it has a very low level of vibration.

About the size of a laminate trimmer, the Beaver, which has a ¼-in. collet, runs at 20,000 rpm. The tool's been available for several years but underwent some internal changes recently to reduce the weight.

Depth of cut is adjusted by loosening a lock screw and turning a rack-and-pinion screw on the router's body. Bit changing is inconvenient, however. First you must remove the base, held in place with three small set screws. The collet is removed using a pair of ⅝-in. open-end wrenches.

The air-powered router with a fixed base costs $199; the tilt-base model costs $10 more. Accessories include an edge guide and guide bushings. For more information, contact Beaver Tools at (800) 365-6677 or check out the company's web site at www.beavertools.com. *—R.J.*

Router runs on compressed air. *The Beaver air router comes with an optional tilting base.*

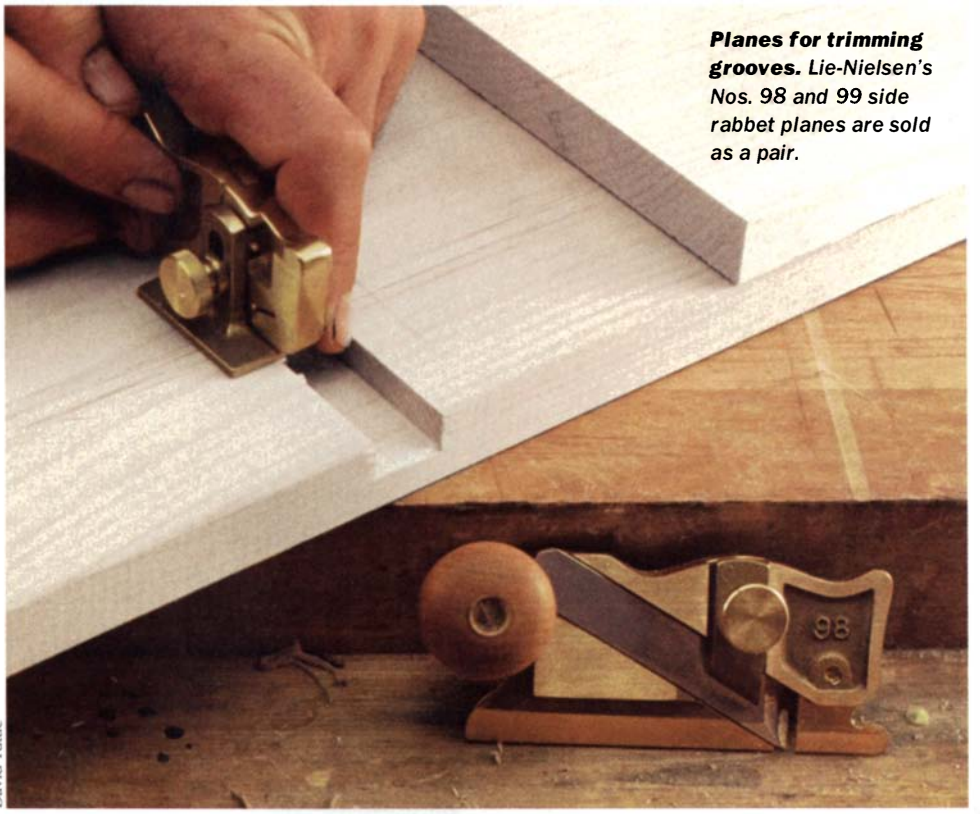
Photos this page: Roland Johnson

A paired set of hand-planes from Lie-Nielsen

Woodworkers like myself eagerly await new offerings from the Lie-Nielsen Tool Co., which specializes in making hand tools based on historical Stanley designs. Available now is a paired set of Stanley Nos. 98 and 99 side rabbet planes.

The planes are designed to clean up or widen the walls of rabbets and dadoes. Out of the box the irons needed only a quick honing before they were ready to go to work. A large, easy-to-turn knurled knob controls the setting of the depth stop. The front foot of each plane can be reversed, effectively shortening the sole and making it a bullnose dado plane. Or you can remove it completely for stop cuts.

Each plane has a cutter on the opposite side so you can pick the one that best follows the grain of the cut. A set costs $185. For information, contact Lie-Nielsen Toolworks (888-751-2106) or visit them on-line at www.lie-nielsen.com. *–David Tuttle*



David Tuttle

Planes for trimming grooves. *Lie-Nielsen's Nos. 98 and 99 side rabbet planes are sold as a pair.*

Jet planer—one-year follow-up

In December of 1997, the Fine Woodworking *staff reviewed 14 midsized thickness planers. We promised to do a follow-up after buying one of the machines and using it for a year. Here's what we found.*

Fine Woodworking bought the Jet 15-in (JWP-15HO) planer used in the review. The Jet, like 10 other machines we tested, was made in the same Taiwanese factory that makes many of the benchtop and midsized planers sold today. If a year's worth of use in my home shop is any indication, this factory turns out some reliable, solid woodworking machinery.

After taking the planer home, I spent about half a day readjusting the major components: bed rollers, infeed and outfeed rollers and chipbreaker. And because I was in deep, I readjusted all three knives for good measure.

By overtightening some of the self-tapping sheet-metal screws in the dust shroud, I stripped out the holes, the only part of the machine that suffered any damage during use. The manufacturer ought to spot-weld some nuts in place, as is done on some other brands of machines. But if you're careful, this shouldn't be a problem.

I made one modification to the inside of the shroud near the exit port, which has jagged, spot-welded sheet-metal tabs that can cause shavings to snag and clog the shroud. I took some window caulk and smeared it over the bumps of the joint. Problem solved.

There's not much else to say. The Jet performs as advertised. And despite being frequently moved around the shop, none of the components ever went out of adjustment during the course of the year. —*A.B.*

Not the last straw

Isobord Enterprises, a Canadian company, has begun manufacturing particleboard made from the straw left over from wheat harvesting. In addition to saving trees, the product, called Strawboard, contains no formaldehyde, which is found in many other brands of particleboard. For more information, call Isobord at (503) 242-7345.

SuperLac discontinued

Eclectic Products has discontinued producing Famowood SuperLac. A spokesman for Eclectic said the company will still make fillers, glues and other products. Distributors will sell out the remaining stock. For availability, call (800) 349-4667.

Pat Scruggs is a builder from Woodbury, Conn.; Niall F. Barrett builds custom furniture in Narrowsburg, N.Y.; Roland Johnson has a shop in St. Cloud, Minn.; David Tuttle is a woodworker from Brantford, Ont., Canada; Anatole Burkin is a senior editor at FWW.

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Pop the Curl in Curly Maple

Woodworkers choose this species for its stunning figure. Here are four goof-proof steps to bring out the best in this premier wood.

BY JEFF JEWITT

FIRST *Raise the surface grain of the wood with a diluted dye stain, as the author is doing in the photo at left.*

SECOND *Add more color to the wood with a second coat of full-strength dye stain.*

NEXT *Add depth to the curl with a liberal coat of oil.*

LAST *Topcoat with a clear finish to make the curl shimmer. The topcoat on the armoire (facing page) is shellac.*

The question from one concerned woodworker was direct. "I built an entertainment center out of curly maple. I want to finish it so that it looks a hundred years old—you know, that caramel color with real dark curl that jumps out and follows you around the room. I spent months sweating over this project, and the stuff was a bear to work with. I really don't want to mess it up. How should I put a finish on this project?"

I understood his concern. I went through the same scenario years ago when I built my first piece out of curly maple. As one of our premier native hardwoods, curly maple is a rough wood to work: The wood is dense, and the alternating grain makes it tough to plane, cut and shape. However, the rewards of this challenging wood pay off when it comes time to put a finish on it.

Using the armoire shown above and on the facing page, I'll show you how to apply my favorite finish for curly maple—one that's virtually goof-proof. I'll also provide some recipes for other color options (see the story on p. 41).

Start with the right stain

Pigment-based stains, which are made of fine, colored powders suspended in a

Photos: William Duckworth, except where noted

You call this stuff stain? *The first step toward finishing curly maple is to apply a highly diluted water-soluble dye stain. This step raises the grain of the wood.*

medium, don't bring out the best in curly maple. The pigment tends to mask both the grain and the figure. For that reason, I prefer to use the more transparent water-soluble dye stains, which are user-friendly. Dye stains can be used one of two ways. In diluted form, they highlight the curl a bit, making it just a tad darker. And used in a stronger solution, they can color the wood and accentuate the curl even more. As always, practice on some scraps first to get the color you want.

Darken the curl and raise the grain— To slightly darken and accentuate the curl, apply a diluted brown dye stain as the first step. I dilute it eight times the recommended concentration, or until it's the color of strong tea (see the photo above). After sanding the wood through 150-grit paper, lay on this dye as a grain-raising step. Wipe or spray it quickly all over the wood as evenly as you can, then let it dry. Sand the raised grain with 180-grit paper. Sanding will remove almost all of the dye color from the surface that has no curl, but some of the color will remain in the curl figure. This is exactly what you want. If you like the color of the wood, leave it this way and move directly to applying an oil sealer. But if you want to add more color, follow this step with a darker coat of dye stain.

Add color and highlight the curl even more— If you decide that you want more color, apply the dye stain you've chosen at its full strength (see the left photo below). Wipe or spray it on evenly and then—while the surface of the wood is still wet—wet-sand the dye into the wood with a maroon Scotch-Brite pad. (Don't use steel wool because the iron in the steel might react with the water and cause black stains that will ruin the finish.) The Scotch-Brite will denib any additional grain raising that occurs. Let the wood dry at least overnight.

Seal the wood with a liberal coat of oil

Sealing the wood with oil adds real depth and some luster to the surface of the wood. I prefer to use boiled linseed oil, but you can use just about any oil finish you prefer. Flood the oil all over the surface of the

A second stain for more color. *The author sprayed this layer of concentrated stain for a quick and even coverage. While the wood was still damp, he wet-sanded the surface with a maroon Scotch-Brite pad.*

Treat the wood like a thirsty dog. *When applying a coat of boiled linseed oil, flood the surface liberally and give it as much as it will drink in.*

Pads lay on shellac in thin coats. *Once you get the hang of it, padding on shellac with a rag can offer advantages over brushing it on. Pads conform to odd-shaped moldings and don't leave thick brush marks in the finish.*

wood (see the middle photo on the facing page) and add more oil to the figured areas as they absorb each coat you lay on. Keep checking the wood every 15 minutes or so, adding oil when necessary. When you reach a point where the wood won't drink in any more oil, take a break and let the oil set for an hour or so. Wipe the excess off and let the wood dry overnight. (You can't be too cautious with oil-soaked rags. Dispose of them properly.)

The next day, spread a light coat of oil over the surface and wet-sand lightly with 400-grit wet-or-dry paper. Don't sand too vigorously—especially on the edges—or you risk cutting through the dye. (If you do go through, mix some alcohol in the dye and dab some on the areas that need touch-up.) Put the workpiece aside and let the second coat of oil dry for a couple of days before moving on to your finish coats.

Topcoat with the film finish of your choice

Although oil is an attractive finish when it's freshly applied, it doesn't stay that way, and it isn't very durable. A topcoat will not only toughen the surface, but the clear film over the dyed and oiled surface also acts as a lens to bring out shimmer and depth in the figured wood.

You can use any one of a variety of topcoats. Varnish will add durability, but my two favorites are shellac and lacquer. Shellac can be applied easily with a brush or a pad (see *FWW* #112, pp. 60-63, for tips on padding shellac), but lacquer looks best when it's sprayed on. Also, because shellac comes in different colors—ranging from a pale straw to a dark garnet—you can shade the surface to tint the final color of the workpiece. Lightly sand the dried oil with 400-grit paper and wipe off the residue before laying on your topcoats.

I apply at least four coats (see the bottom right photo on the facing page), but you can apply more or fewer, depending on your tastes. You can rub out your last coat with 0000 steel wool and thinned paste wax (cut with mineral spirits) for a soft, satiny sheen. □

Jeff Jewitt has written extensively for Fine Woodworking. *He is currently working on a step-by-step finishing book to be published by The Taunton Press next year.*

Light or dark, how do you want your curl?

HERE ARE A FEW OTHER RECIPES FOR FINISHING CURLY MAPLE. THESE ARE NOT RULES WRITTEN IN STONE: YOU CAN VARY THE COLORS AND TECHNIQUES AND EXPERIMENT FOR DIFFERENT EFFECTS UNTIL YOU ARRIVE AT THE FINISH THAT BEST SUITS YOUR TASTES.

AU NATUREL

If you simply wish to keep the creamy natural color of maple, here are two easy options. You can spray a water-white, nonyellowing CAB-acrylic lacquer (cellulose acetate butyrate), which will retain the creamy white color of the wood without imparting an amber cast to it. Or you can brush on several coats of a water-based acrylic lacquer. With water-based finishes, I wipe on the first coat quickly with a rag, then brush on the final coats.

Of these two finishes, I prefer the look of the solvent-based CAB-acrylic lacquer because it kicks out the curly figure better than the water-based finish. Neither of these finishes will turn yellow over time, but the maple underneath the finish will invariably change color.

ANTIQUE MAPLE

Darken the curl and raise the grain with a light-brown water-soluble dye stain. Lightly sand the surface with 180-grit paper, then apply a yellow, caramel-colored dye stain. (I find the stock solutions a bit dark, so I dilute them with double the amount of water.) After the stain has dried, lightly scuff the surface with a maroon Scotch-Brite pad. Apply a coat of oil, let that dry, then seal the surface with one coat of a freshly mixed batch of dewaxed shellac.

When the shellac is dry, scuff-sand with 220-grit paper, then apply a glaze made from van dyke brown or burnt sienna Japan color, thinned with mineral spirits. Just brush it on and wipe it off, leaving a little extra in crevices and corners to simulate an aged appearance. When the glaze has dried for a couple of days, apply the topcoat of your choice. If you're using a water-based lacquer, it's always a good idea to seal in the glaze first with dewaxed shellac.

TWO-TONED EFFECT

Dye the bare wood with a concentrated dark-brown dye stain. Sand the wood level with 180-grit paper, then seal the surface with shellac. Spray on a dye-based toner of your favorite color shade. Primary colors like red and blue will yield some striking effects.

To make a dye toner, dissolve or mix some powdered or premixed dye into a compatible finish and spray it lightly over the surface. Work slowly up to the final color you want. When the toner has dried, seal it in with clear topcoats.—*J.J.*

Photos this page: Michael Pekovich

Where Furniture Meets the Floor

These four traditional bases change the look and style of the same chest

BY MARIO RODRIGUEZ

During the 1980s, when I operated a shop in Brooklyn, we received a steady stream of plain-Jane chests that had been picked up by interior decorators on their trips to the countryside or abroad. I was instructed to give these chests the "Cinderella treatment"—to revitalize them by changing the hardware, possibly adding stringing to the drawer fronts, or maybe making a new top.

By far the most dramatic change took place when I replaced a base. With a new base, a piece would assume a new personality. If I added just the right bracket feet, say, a mundane Victorian behemoth could be transformed into an elegant Chippendale-style treasure. The careful selection of the base proved, time and again, to be critical to the success of the completed piece. And I've found just the same thing to be true in designing my own pieces or adapting period designs.

To demonstrate the impact that different attached bases can have on a basic chest and to show how approachable most are to make, I've built a single, unadorned chest of drawers and fitted it with four different bases: with bun feet, with saber feet, with sled feet and with ogee bracket feet. All four of these bases are drawn from

historical examples, but as you'll see, they can easily be adapted to modern designs as well.

Why you need a base

A chest is essentially a box on a base. The box is where the action is—the drawers, the doors, the shelving. So the base, resting right on the floor, might seem likely to fall beneath our notice. But its impact is strong. First, it literally lifts the cabinet off the floor. The air it puts beneath the piece gives the cabinet definition and makes even an armoire appear lighter. Plunked right on the floor without a base, a large cabinet looks stunted and incomplete; it begins to seem immovable, like a part of the building. A Newport secretary minus its bracket feet would be about as impressive as the Statue of Liberty standing knee-deep in New York harbor.

The proper base should not only elevate the case but also enhance the other features of it. Instead of concentrating all of the detailing on the case and treating the base as an afterthought, I work out the details of the base along with the case.

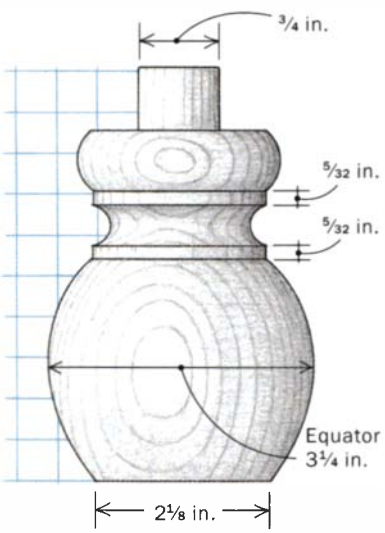
My choice of a base is influenced by the size and weight of the piece. For instance, I wouldn't place a massive, multidrawer chest on dainty saber feet. Structurally, the feet might not support the great weight of the piece and its contents. And aesthetically, a large cabinet supported by diminutive feet might bring to mind a sumo wrestler wearing ballet slippers.

From a practical perspective, the lift a base provides also gives better access to the contents of a piece and protects them from moisture and dirt. In addition, an attached base can simplify construction of the carcase and can easily be replaced if it is damaged.

A base with bun feet

The bun-footed base is a lively design that can animate even a very large piece of furniture. Yet with their low center of gravity and rounded form, bun feet are the sturdiest possible. The base is willing to carry great weight and will even endure being shoved and dragged across the floor. The ball-shaped feet introduce a nice counterpoint to the rectilinear lines of a chest. The balls can be full and round, almost forming perfect spheres, flattened like doughnuts or elongated into cylindrical shapes.

Bun feet originated in Germany and Scandinavia and later were used on Kasten and blanket boxes in America. Bun feet were typically used on fairly massive pieces, but they found their way onto more refined case pieces such as desks and chests during the William and Mary period (1690-1730).



Scale: 1 square = ½ in.

Bun feet are produced on the lathe. In the earliest examples, they were turned from a single block of wood; later, the block was laminated. Each foot has a stem or tenon at the top that is used for attachment to the case. Below that is a ringlike shoulder and then a narrow neck, called the reel, that swells into the ball. The most difficult aspect

BUN FEET

A lathe-turned foot that has its origins in Europe, the bun foot is typically held to the bottom of a case by means of a wedged round tenon locked into a hole drilled into the case or into a molded frame below the case. A flattened section at the bottom of the spherical bun gives the foot a firm stance on the floor.

Bun foot starts with a gouge. *Turn a rough cylinder, then use a pencil to mark out the major segments of the foot, including an equator for the foot's sphere.*

Finish with a rasp. *Use a rasp with a light touch to smooth the bumpy surface left by the gouge and to finish shaping the bun foot.*

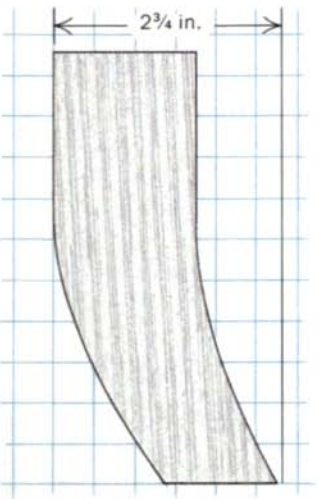
Wrenching accuracy. *To size the round tenon on top of the bun foot, hold an open-end wrench against the back of the foot while cutting the tenon to size with a parting tool. When the wrench slips over the tenon, it's the right size.*

Footed frame. *The round tenons of the bun feet are wedged to holes drilled in a molded frame. The frame is screwed to the bottom of the case.*

Photos: Jonathan Binzen, except where noted; facing page and this page, top right: Michael Pekovich

SABER FEET

The front feet on a Hepplewhite-style saber-footed base curve both to the front and the sides. The back feet curve only to the side, allowing the case to sit tight against a wall. Mortise-and-tenon joints hold together the rails and feet. Pine blocks strengthen corners. The base is screwed to the case through the blocks.



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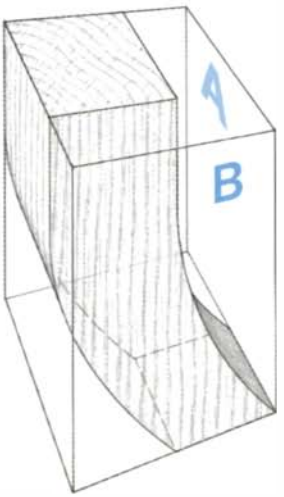
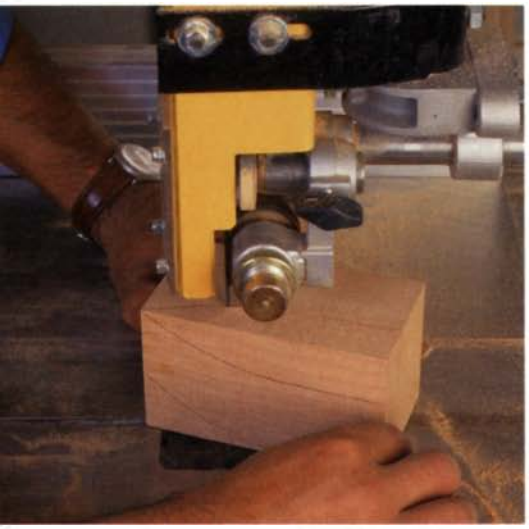


For the compound-curved front feet, trace the layout template on two adjacent faces (A and B) of a 2¾-in. square leg blank. The tracings should meet at the foot's bottom tip. For the single-curved back feet, you need to trace the template only on one side.



Front feet are cut four times. *The front feet on a saber-footed base curve to the front and to the outside, requiring four bandsaw cuts. The first two cuts are made with the blank resting on the same face.*

Tape the waste back on. *After making the first two cuts on the front feet, tape the waste pieces back on the feet. This will give you a flat surface on the bandsaw for the second two cuts.*

Back foot meets the frame. *Saber feet are often linked with rails to create a strong frame that's screwed to the bottom of the chest. The foot is trimmed flush to the frame with a block plane.*

of turning a bun foot is executing a nice, round ball. If it looks like a potato, it won't work as a bun foot.

For a typical bun foot, start by turning a cylindrical blank. Mark out the major segments of the foot on the cylinder, including a line for the equator of the ball and a circle on the end of the cylinder to establish the flat portion where the ball will rest on the floor. Turn the reel and the shoulder first and then begin work on the ball.

Seasoned turners often use a large skew chisel to cut a sphere. By pivoting and rotating the tool, they obtain a smooth, arcing surface that requires little or no sanding. If you have less experience on the lathe, you might have better luck with a stout gouge. The surface you achieve may be a little bumpier, but the gouge is less likely to dig in and ruin the job because only a small portion of the tool's cutting edge contacts the workpiece. Even so, cut carefully, stopping frequently to check for symmetry.

You can use a rasp to perform the final shaping and smoothing. A rasp can be easily controlled and lightly applied to the rotating shape to correct the bun's outline. By varying the pressure, you can control the amount of wood you remove. And unlike a turning tool, the rasp won't dig into the work. Use sandpaper on the spinning piece to attain the final smooth surface.

There is a foolproof technique for turning the tenon on a bun foot to a precise diameter. From behind the rotating workpiece, press an open-end wrench against the tenon while removing material with a ⅛-in. parting tool. The narrow parting tool is used with a scraping action, so it doesn't require careful guidance and can be held in one hand. When the tenon is reduced to the precise final dimension, the wrench slips over the tenon.

The simplest way to attach bun feet to a case is to drill holes into the bottom of the carcase to receive the feet's tenons. But if the interior of the cabinet or chest will be visible, so will the ends of the tenons. In that case, attach the feet to a frame and then screw

Drawings: Vince Babak; upper left photo: Michael Pekovich

the frame to the underside of the chest. Make the frame of solid wood and cut a profile on its edge, which adds a molding to the bottom of the chest.

A base with saber feet

The sleek, graceful saber foot was most popular during the Hepplewhite period (1790-1805), when Baltimore cabinetmakers used it extensively. But with its hard edges and simple sweep, the saber foot transcends period classification and looks perfectly comfortable on modern pieces. Visually, the saber foot works best with pieces that are moderate to small in size, fairly rectilinear in form and restrained in detailing. On the right case, a base with saber feet will confer a sense of poised nimbleness, like that of a dancer.

When designing saber feet, strive for a smooth, moderate curve. Start by making a cardboard template of the silhouette and use the template to trace the silhouette on a square blank. For the front feet of the base, which curve to the front and to the side, trace the template on adjacent sides of the blank; for the back feet, which curve only to the side, trace the template only on one side of the blank. As you design the curve of the feet, err on the side of moderation; a curve that looks good on the template will often appear exaggerated when cut out of the blank, because each foot is a compound curve. Too radical a curve can make a foot look like it is straining under the weight of the cabinet. And, in fact, it may well be. The grain is short at the toe, and the farther the toe extends, the more vulnerable it is to breaking off.

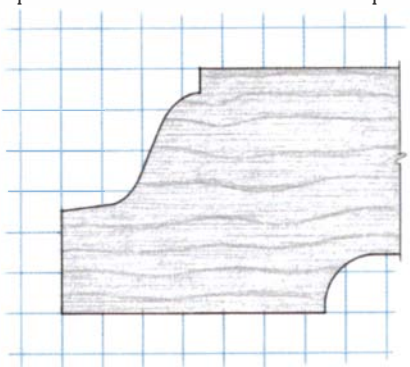
The curves are cut on the bandsaw. After cutting one side of the front legs, temporarily reattach the cutoffs with masking tape. Then rotate the blank and cut the other curve. Clean up the convex curves using a block plane with a very small throat opening and a very sharp blade. I do any further cleaning up with a card scraper. On the concave sides, I begin with a curved soled spokeshave and follow that with rasps and sandpaper.

Saber feet are often linked with rails, creating a strong frame that can easily be screwed to the bottom of the case. Like table aprons, the rails are tenoned on the ends and fitted into mortises in the saber feet. It is simplest to cut the mortises in the feet while the blanks are still square.

A base with sled feet

Solid and low slung, the sled-footed base suggests—and delivers—stability and strength. It can be used on both low storage chests and towering cupboards. I've seen sled feet on painted Scandinavian chests dating back to the 15th century as well as on early 20th-century English Arts-and-Crafts pieces. To me, sled feet conjure up sturdy medieval coffers and cupboards reinforced with iron straps and hinges, or simple rustic furniture built and shaped with little fuss.

The sled-footed base is comprised of two parallel feet joined by a beam. The front ends of the feet typically extend beyond the front of the piece and are often chamfered, rounded over or embellished with an ornamental scroll. A varia-

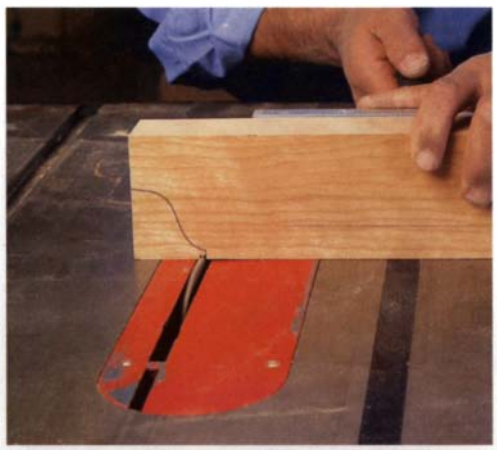


Scale: 1 square = ½ in.

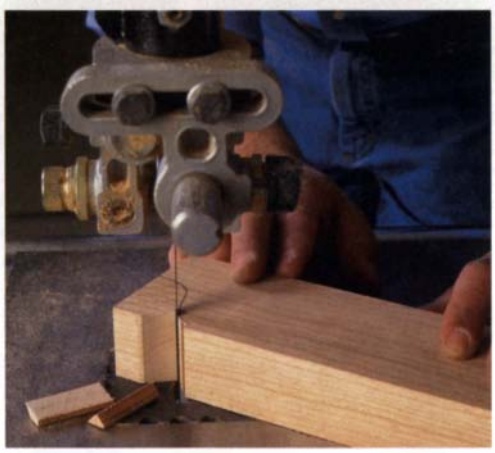
Top right photo: Boyd Hagen; bottom: Michael Pekovich

SLED FEET

This base of European origin is made of three main components: two sled feet and a perpendicular beam. The front of the feet typically protrude beyond the front of the case. A ⅞-in. tenon is turned on each end of the beam, and it is secured through holes in the feet with a wedge (see the bottom photo).

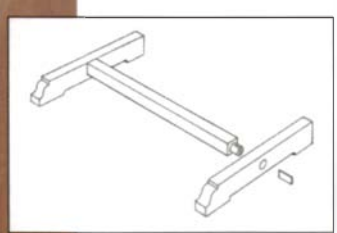


Crisp cuts start on a tablesaw. *Cutting the shoulder on the front of the sled-footed base is best done on a tablesaw.*



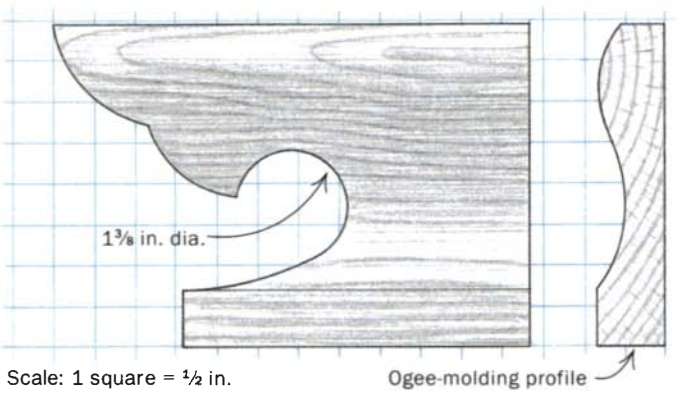
Relieving the waste. *Several bandsaw kerfs cut just to the layout lines of the front of the sled foot will make it easier to maneuver the wood around the blade for the tight corners of the finish cut.*

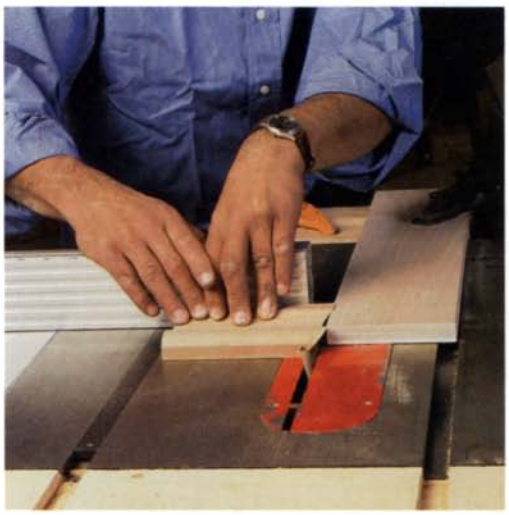
Wedge treatment. *The back of each sled foot is cut square and flush with the back of the chest. Both feet are screwed to the bottom of the chest.*



OGEE BRACKET FEET

Popular in the Chippendale period, ogee bracket feet are made from sections of tablesaw-made ogee molding. The tight inside curve of each foot is cut on a drill press before the rest of the bracket is cut on a bandsaw. The rear feet are molded on the sides only. Flat pine blocks butt to the end of the rear feet and allow the case to sit tight to a wall (see the drawings on the facing page).





Spline time. *An ogee bracket foot is made of mitered sections of moldings and held together with splines. After cutting the corner miter on a tablesaw, the author sets up the saw to cut a groove for the spline, taking care that the height of the spline cut is lower than the height of the thinnest part of the ogee profile.*

Low, inside curve. *Most of the cutout work on the ogee bracket foot is done on a bandsaw. An exception is any tight, constant-radius curve, such as the one near the bottom of the foot, which is more easily cut with an appropriately sized Forstner bit.*

Taped around a square block. *To ensure a tight, 90° miter, set the splined-and-glued bracket foot around a squared block of wood. The miter is held tight with tape until the glue dries.*

tion on this design that you sometimes see is one that raises the carcase off the feet with legs.

Because the shaped end of a sled foot is in front of the cabinet, its shape and finish must be crisp and attractive. Cut the shoulder of the scroll on the tablesaw and the curved outline on the bandsaw. Fair the curves and smooth them with fine rasps, files, card scrapers and sandpaper. Start with a fine, 6-in. tapered rasp to create a flowing curve without any abrupt dips or blips. Work down from the bottom of the shoulder cut to the tip of the foot. Next, take care of the rough surface left by the rasp with a smooth round file and a card scraper. Finally, sand a bit for a silky surface. Make sure the curving edge is square to the sides, not lopsided. Refrain from breaking the edges, keeping everything crisp and clean.

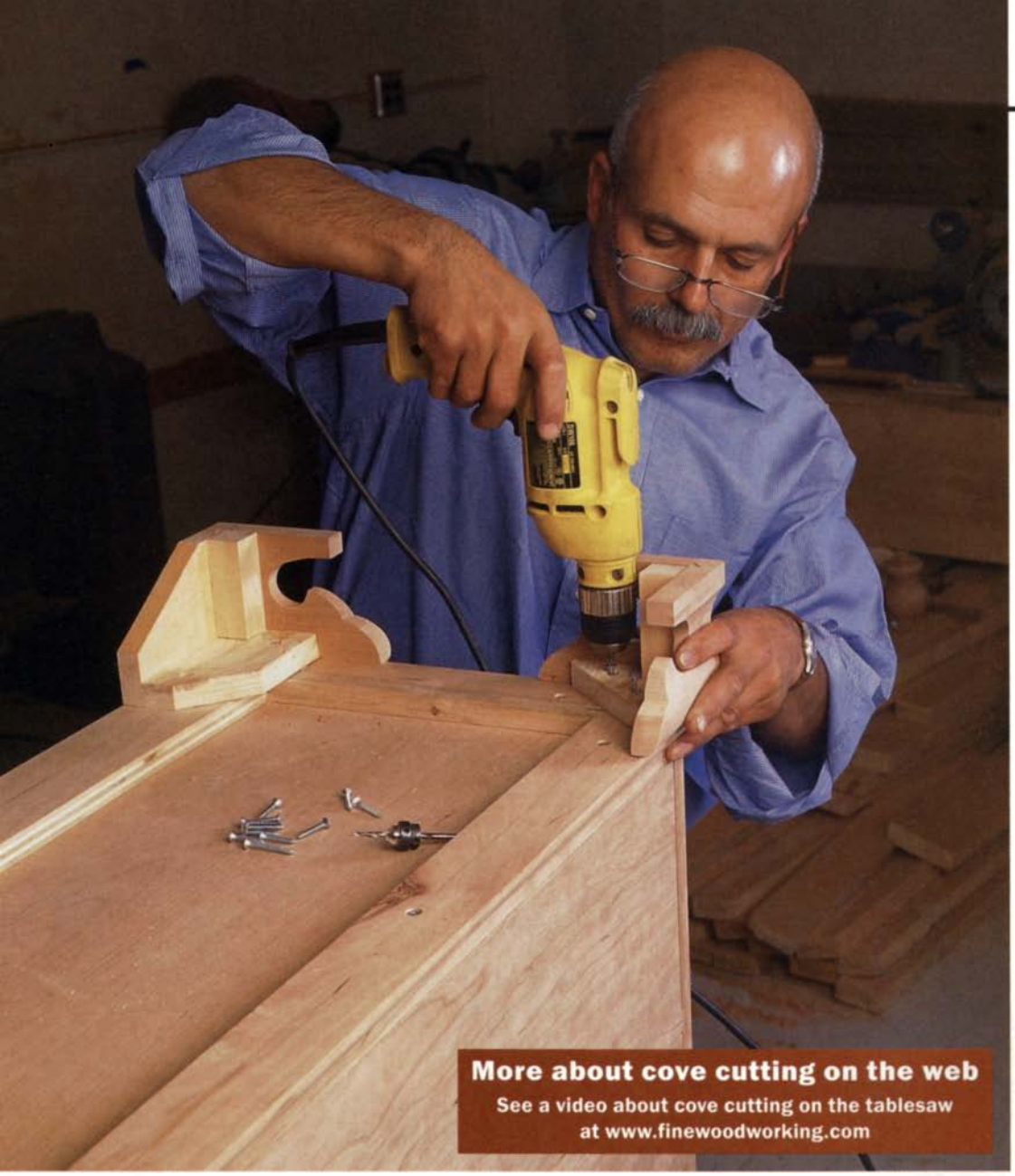
Because the feet support the weight of the cabinet, the beam's purpose is mainly decorative. Not needing maximum strength, I joined the beam to the feet with round mortise-and-tenon joints. Turn the tenons on the lathe and size them with an open-end wrench to an exact ⅞-in. diameter. Then drill a corresponding hole in the feet to accept the through-tenon. For a decorative touch that also ensures a tight, clean joint, cut a thin kerf into the end of the tenon with a dovetail saw and later, when assembling the joint, tap a wedge into the kerf.

A base with ogee bracket feet

I always have fun with making ogee bracket feet and put great effort into their design. Ogee bracket feet give a rectilinear cabinet a fluid, sculptural touch, catching light and shadow in a pleasing way. This sculptural design was popular in the 18th century and typifies the Chippendale style (1760-1790). While displaying the sensuous nature of the wood, ogee bracket feet give a piece a sturdy, rocklike stance.

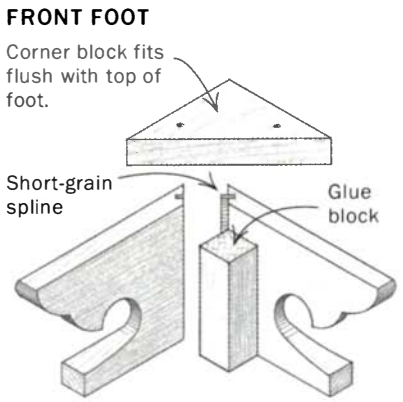
By definition, an ogee is a pair of complementary curves that form an S shape. The relationship of these curves can vary to suit your taste. The curves might be the same radius, or you might have a tight convex curve over a wide, shallow concave curve. The only requirement is that the convex curve be at the top and the con-

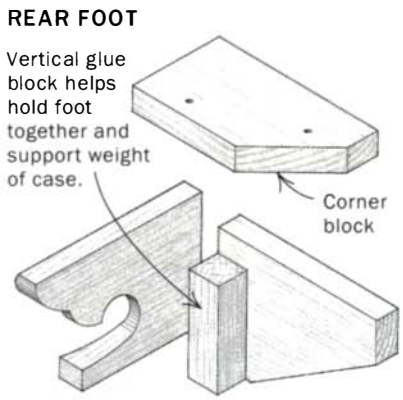
Upper left photo: Michael Pekovich



More about cove cutting on the web

See a video about cove cutting on the tablesaw at www.finewoodworking.com





Screw through triangular corner block. *The back feet on an ogee bracket base are not mitered like the front ones. Rather, the ogee bracket butts a flat pine block that will be invisible when the case is placed against a wall.*

cave curve below. A bracket foot with a convex curve at the bottom is called a reverse ogee.

A successful ogee profile will have a lively, curling contour, suggesting fabric unfurling. In addition to the undulating ogee, a bracket foot is defined by the profile at the end of each wing of the bracket. Some end quite simply; others end with a flourish of scrollwork. When designing a bracket foot, this end profile is read two ways—as a positive form (the foot) and as a negative form (the space beside the foot). You can explore this positive/negative relationship by cutting possible profiles in a light material and viewing them against a dark background.

There are a few ways to make ogee molding (see *FWW* #102, pp. 82-85). I cut the cove with an angled fence on the tablesaw and the convex shape with tablesaw cuts and hand tools. After milling long sections of ogee profile, cut them into 8-in. lengths. Next, designate adjacent pieces to be paired up as feet so that the grain will be continuous around the mitered outside corner of the bracket. The pieces must be marked left and right to produce a pair.

I often use splines to register and align the joint. To cut a groove into the face of the miter, set the tablesaw blade to 45°. Clamp a scrap to the saw table to use as a stop to register the cut, and use the miter gauge to push the stock. Be careful to raise the angled blade no higher than the thinnest dimension of the ogee profile.

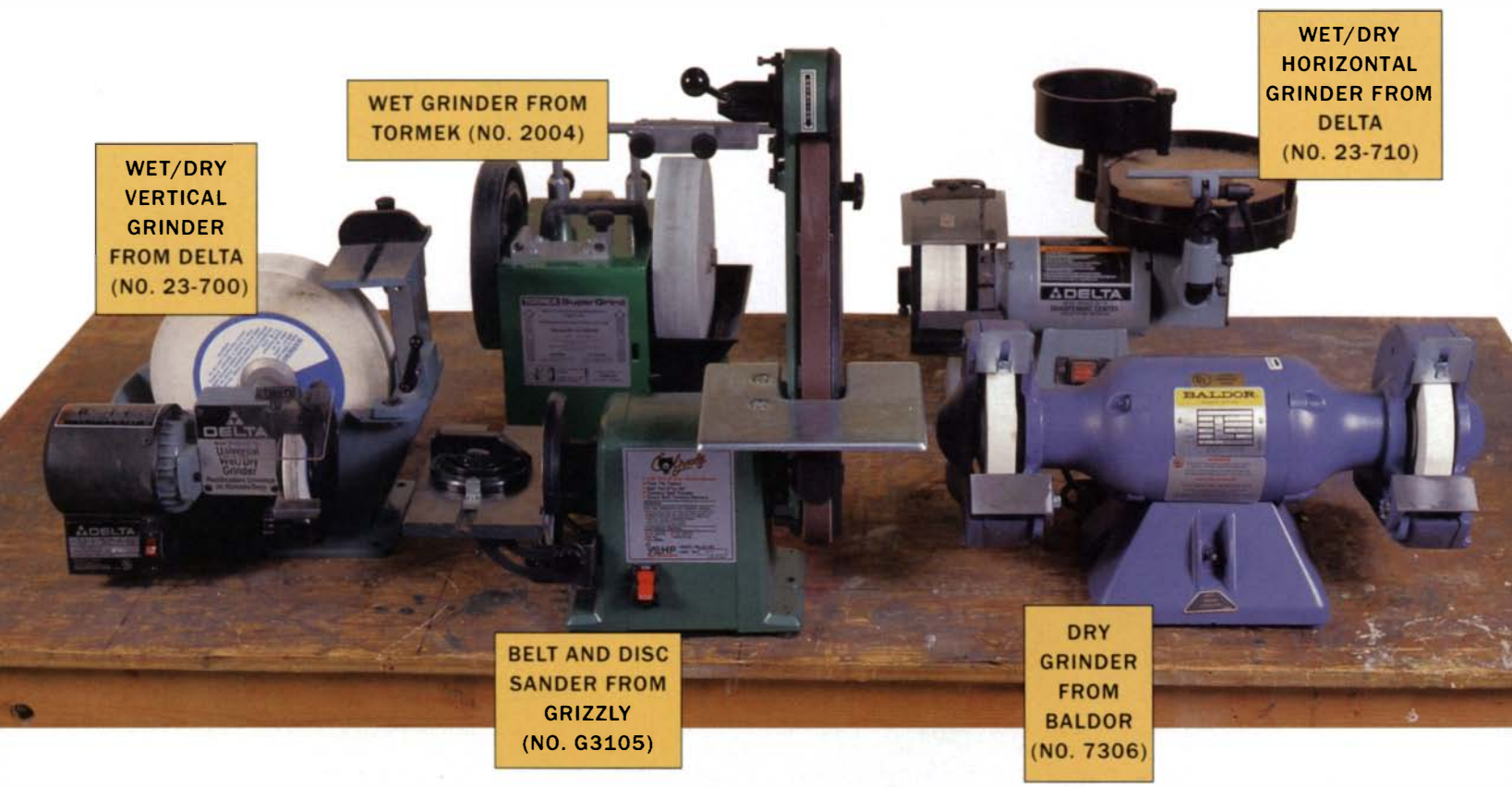
The grain orientation of the spline is critical to the strength of the joint: The grain should run across the width of the spline, not along the length. To produce a spline with the correct grain orientation, make a tablesaw kerf into the end grain of a scrap piece of molding. Then cut the spline free on the bandsaw. Most of the cutout work for the end profile of ogee bracket feet is done on the bandsaw. But to achieve a crisp result for designs that include tight inside curves, I begin at the drill press. I use whatever bit matches the radius I need—Forstner bits or circle cutters—to cut out the inside curves, then I cut the rest of the shape on the bandsaw. □

Mario Rodriguez teaches period furniture making in Manhattan, and he is the author of Traditional Woodwork *(The Taunton Press, 1998).*

Not the Same Old Grind

Wet or dry? Wheels or belts? A survey of machines that shape and sharpen tools.

BY BRIAN T. DERBER



Chances are, sooner or later, most of your cutting tools will need a grinding because a simple touch-up on a benchstone won't be enough. Maybe the cutting edge has a large nick, or the bevel angle is too steep. Whatever the reason, chisels, plane irons, planer and jointer knives, turning tools and carving gouges can be sharpened quickly with the right grinder. It's simply a matter of matching the machine to your needs. What follows is not a head-to-head tool review, but a representative sampling of the types of grinders on the market.

For this survey, my students and I looked at Baldor's No. 7306 bench grinder, Delta's No. 23-700 Universal Wet/Dry grinder and No. 23-710 Sharpening Center (also a wet/dry machine), Grizzly's No. G3105 belt and disc sander and Tormek's No. 2004 SuperGrind water-cooled grinding system (see the photo above).

We tested each machine by grinding a broad sample of tools and discovered that with most of the grinders we looked at, tool rests were too small or didn't allow enough angle adjustments for grinding woodworking tools. In short, we concluded that there is no ideal grinder and that each of these machines has idiosyncrasies

Stay away from silicon-carbide wheels. *The dark gray silicon-carbide wheel (right), which comes standard on most dry grinders, will burn the steel and destroy the temper of most woodworking blades. The softer pink and white aluminum-oxide wheels break down under the stress of grinding, which helps avoid overheating the tool.*

Top photo, this page: Michael Pekovich

that you need to take into account when choosing one for your sharpening needs.

Dry double-arbor bench grinders are most common

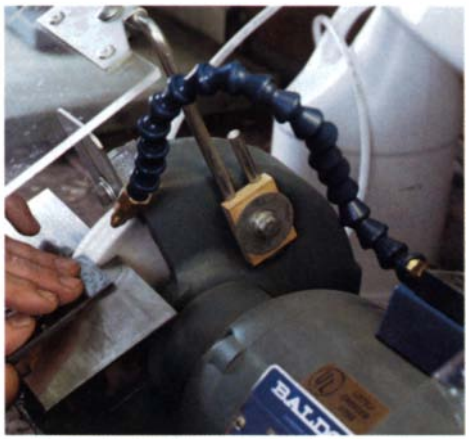
These bench grinders are familiar to most people and, in my opinion, can handle the broadest variety of woodworking tools. Today's motorized dry double-arbor bench grinders evolved from the old hand-cranked grinders. You can find all sorts of bench grinders, from those cobbled from spare parts and used motors to expensive heavy-duty industrial machines, such as the Baldor No. 7306 with its ½-hp motor and 7-in.-dia. wheel. Wheel size and power ratings vary considerably.

Motors usually run at either 1,800 rpm (which is considered slow) or 3,450 rpm. Woodworkers look for a wheel diameter between 6 in. and 8 in. and a rating of ¼ hp or ½ hp. Most bench grinders come with silicon-carbide wheels that will easily burn up any woodworking tool. You should replace these wheels with the softer, bonded aluminum-oxide wheels that are offered in many woodworking-tool catalogs. You may want to buy coarse- and fine-grit wheels to handle a wide variety of tools. Also, the stock tool rests supplied with most bench grinders are poorly designed. Many woodworkers either build a rest of their own or buy an aftermarket rest.

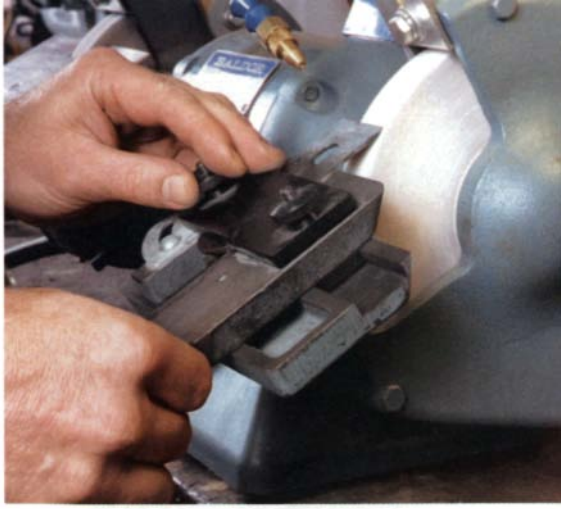
Because they run dry, bench grinders can easily burn the tool steel. Dress the wheels often to keep them running true and to expose a fresh, sharp abrasive surface (for more on dressing, see the story on p. 50). Also, dip the tool in water frequently to keep it from overheating. One accessory that greatly lessens the chance of burning is a misting device (see the left photo above). Other accessories such as felt buffing wheels, rubberized abrasive wheels and laminated paper wheels are available for power honing.

To avoid an accident, follow the manufacturers' recommendations for wheel speeds, and hone with the wheels turning away from the tool edge. Of the grinders we surveyed, there seem to be more aftermarket accessories available for bench grinders than for any other type.

After I replaced the wheels with ones made of aluminum oxide and modified the original tool rest with a straight-edged tool-grinding attachment designed specifically for the Baldor No. 7306 (see the right photo above), this machine performed quite well. The attachment has a screw-advance mechanism that produces predictable results. But keep in mind that bench grinders generally require that you master freehand techniques for grinding most edges.



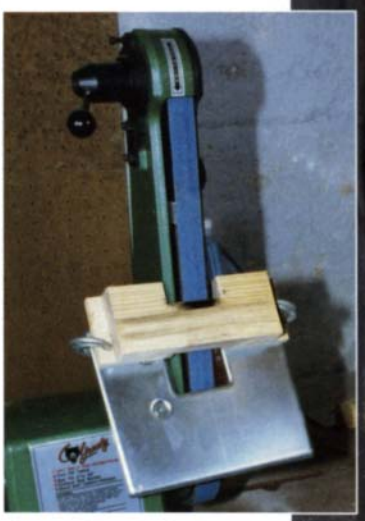
Turn your dry grinder into a wet one. *Misting devices spray a steady stream of water to cool the tool and to keep grinding dust to a minimum. This one runs on a supply of water from a plastic jug and air from a compressor set at 80 to 90 psi.*



This accessory enhances safety and consistency. *A heavy-duty grinding attachment designed for the Baldor No. 7306 secures the blade as you slide it in a steady path across the wheel.*

Belt-sander grinders are a low-cost alternative

You may not have realized it, but sanding belts can be just as useful for grinding steel as they are for sanding wood. Belt-sander grinders typically come with aluminum-oxide belts as standard issue—which will work—but you can also buy specialized sharpening belts designed to grind all kinds of hardened steel. And with many of these types of machines, you can purchase a leather belt and dress it with a honing compound to get a highly polished, mirror finish on your tools. One drawback with these machines is that the tool rests are



Customize the belt sander's tool rest for better performance. *A block of wood, notched and back-beveled to clear the sanding belt, makes this machine more useful for a variety of blades.*

Photos: William Duckworth, except where noted

More than one way to dress a wheel

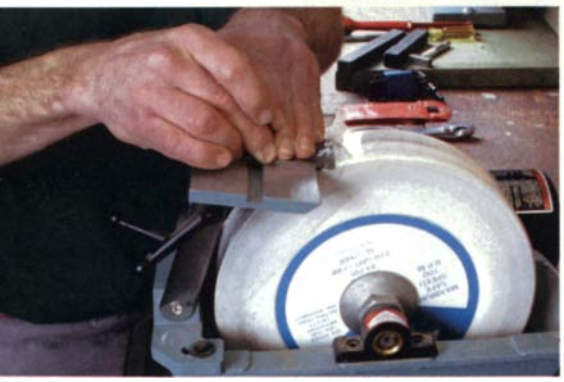
The four tools shown at left use steel wheels, diamond tips, diamond dust or silicon carbide to do the same job: to dress, or refurbish, the cutting surface of grinding stones. Truing up the surface of a grinding stone will make it cut better and lessen the chance of burning the steel.

In general, the steel wheel dresser and the silicon-carbide sticks produce a coarse dressing on badly worn wheels. Diamond-tipped dressers (second and third from left in photo) refurbish a worn wheel to a finer surface. If I could buy only one of these tools, I'd choose the single-point diamond-tipped dresser. Dressing tools are available through industrial suppliers and some woodworking supply catalogs.—*B.D.*

usually limited in versatility. Again, you're often better off designing and fabricating your own rests for your grinding needs.

Belt-sander grinders can handle a wide variety of tools. However, using them requires a refined technique because of the amount of freehand grinding involved. Some people consider this feature an advantage over other grinders that need specialized jigs for every tool imaginable. Typically, belt-sander grinders produce a flat bevel, but an experienced operator can achieve round and even hollow bevels by using the wheel that drives the belt. As with bench grinders, belt-sander grinders run dry, so there is a danger of burning the edge of a tool. Be sure to match the grit size to the amount of stock you want to remove and to dip the tool in water or some coolant frequently. A word of caution: Remove any wood dust that has accumulated on or around the machine because sparks from grinding can start a fire.

Not all tool rests are equal. *The author found the stamped-steel tool rest on the smaller wheel of the Delta No. 23-700 to be inadequate for most grinding needs because of its size and limited adjustability. The tool rest for the larger wheel is more stable and more versatile.*



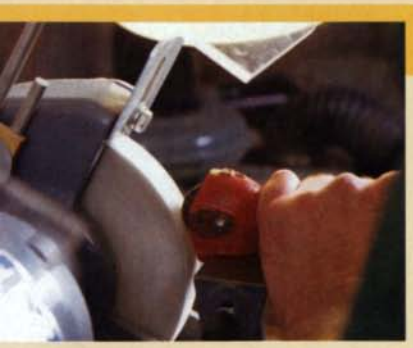
The Grizzly belt and disc sander is a good example of this type of machine. Right off the bat, we rigged up a tool rest to replace the one that came with the machine. This belt-sander grinder is best at handling general woodworking tools such as plane irons and chisels. Smaller tools, or those with odd shapes that require more grinding finesse, are not easy to sharpen with this machine. This belt-sander grinder would be fine for the woodworker who occasionally grinds a tool or who needs a machine that can be used for wood as well as for metal. Learning how to use one of these machines effectively will require some patience.

Grinding from the side on the Delta No. 23-710. *By mounting this tool rest to the side of the wheel, you can get a flat bevel on the blade instead of the hollow-ground bevel you get by grinding the blade from the front of the wheel.*

Wet grinders keep the tool cool

Wet grinders evolved from applying modern technology to the human-powered sandstone grinders of yesteryear. Some current models improved only by replacing the sandstone with aluminum-oxide wheels. Other models are carefully thought out, highly jigged pieces of engineering that can nearly guarantee absolutely predictable results. You can find a low-tech model for around $130, while fancier versions cost more than $800. Some wet grinders have been combined with a dry grinding wheel or a leather stropping wheel to make the grinder more versatile.

All of these machines share some common traits. By incorporating water into the grinding process, they eliminate the danger of burning a tool. The water wheels run at low speeds—usually under 100 rpm—so metal is removed at a slower rate than it is with dry grinders. Even at the low speeds, all of the water wheels are sloppy, so be prepared to deal with slurry slung from the wheel. As a class though, most woodworkers consider these grinders to be the best because of the quality of the sharpened edge. I agree: I am convinced that a



Simple steel (or "star") wheel dressers *sell for about $15. The wheels eventually wear out but can be replaced.*

Single-point diamond-tipped dressers *are priced according to the carat size of the industrial diamond. Expect to pay from $15 to $60.*

Broad-tipped diamond dressers, *rated by the grit size of the diamond dust, cost from $20 to $85.*

Silicon-carbide sticks *produce a coarse dressing on well-worn wheels and cost from $2 to $10.*

dry-ground edge, even one perfectly done, still loses a bit of temper at the microscopic level. Wet-ground edges don't have this problem.

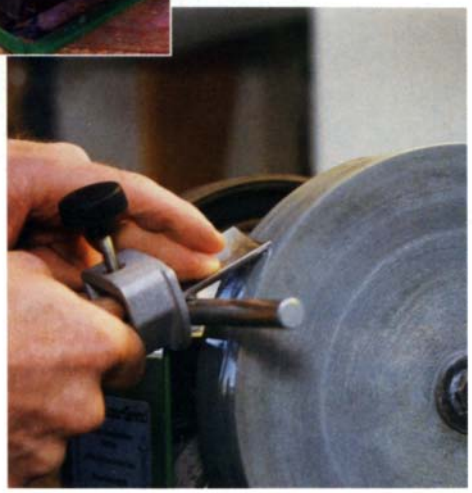
Two of the three grinders we surveyed run the wet wheels vertically, therefore producing hollow-ground bevels. The other grinder uses a wet wheel that runs horizontally, therefore producing a flat bevel.

Two Deltas and a Tormek—The Delta No. 23-700 Universal Wet/Dry grinder is a combination machine with a 5-in.-dia., ⅝-in.-thick, 100-grit aluminum-oxide dry wheel and a 10-in.-dia., 2-in.-thick, 220-grit aluminum-oxide wet wheel. The dry wheel revolves at 3,450 rpm; the wet wheel turns at 70 rpm. The tool rest for the dry wheel is stamped steel of poor design, and it is largely inadequate for most grinding needs. The design of the wet-wheel tool rest is better, but it works only for large, straight-edged tools such as chisels and bench-plane irons. With the wet wheel, you can grind either into or away from the edge of a tool by moving the tool rest. The water well has a small drain screw, but to clean out all of the sludge after using this machine for a while, the unit has to be dismantled. My students and I found this grinder, as designed, limited in terms of the types of blades you could sharpen with it.

The other wet/dry grinder marketed by Delta is the No. 23-710 Sharpening Center. It consists of a 5-in.-dia., 2-in.-thick, 120-grit aluminum-oxide dry wheel that runs vertically and an 8-in.-dia., 1,000-grit aluminum-oxide wet wheel that runs horizontally. This machine, definitely a step up from the model No. 23-700, can sharpen a wider variety of tools. Once again, though, the poorly designed tool rest for the front of the dry wheel allows only a limited range of adjustment. The dry wheel is meant for rough shaping, and you have the option of situating tool rests either in front of or to the side of the dry wheel. That choice means you can achieve either a hollow bevel or a flat bevel on the tool.

The wet wheel is intended for light grinding or even honing and performed well grinding straight-edged tools. I've heard of people who use dedicated wet wheels for gouges only. The wheels are soft enough that the sweep pattern is easily formed into the shape of the wheel. We also tried the sliding tool rest (an optional accessory) for planer and jointer knives, which works on both the dry and wet wheels. No matter what I did to adjust it, I couldn't get rid of a large hollow in the length of a 12-in. blade.

Sharpening a curved gouge on the Tormek. *The carving-tool jig shown here steadies the blade of this curved gouge as it is rolled against the wet wheel.*



And finally, the other wet grinder we surveyed is the Tormek No. 2004 SuperGrind machine. When you buy one of these machines, you're not buying just a grinder but a whole system—and a well-thought-out one. The grinder is simple: a wet wheel on one side and a leather stropping wheel on the other, both running vertically. As separate accessories, you can purchase 10 (and counting) specialized jigs to handle a wide variety of woodworking tools. Most beginners, including my students, love this machine because it produces results that are controlled and predictable.

The Tormek grinder excels at grinding straight-edged tools, but it can also handle curved shapes. There are some weak points, though. This grinder doesn't seem to me to be suited for the rough shaping of tools, because the wheel is soft and wears quickly and is expensive to replace. To date, no jigs or tool rests have been developed for smaller blades such as those we use in finger planes and some hand knives. While the flat tool rest provided for freehand grinding works with larger conventional tools, it didn't work with short tools that required bevels less than 35°. The diamond-tipped wheel dresser works adequately, but it looks to me as though it is likely to wear out quickly because of the way the diamond particles are mounted. On the positive side, the wet wheel well is easily removable for cleaning, and the system comes with a thorough manual. □

Brian Derber makes violins and teaches that craft to apprentices in Oconomowoc, Wis.

Antique Tool Auction:

The Granddad of all Sales

An antique-tool historian looks for a great deal

BY GARRETT HACK

Twenty-five years ago, I didn't know a Bedrock from a Bailey, a Sargent from a Stanley or a Collins from a Keen Kutter, but older tools were cheap, and I bought plenty. I was a carpenter, I needed tools, and these used tools were far better than anything I could buy new. Every detail, from shapely rosewood handles to sturdy parts, spoke of quality, of tools designed to work day in and day out. I was hooked. These days, when I'm not making furniture, I scour flea markets and auctions and write books on antique tools.

I recently headed off to the granddad of tool auctions, the 15th International Tool Auction in Harrisburg, Pa., where you can find the rare, the unusual, the pristine—sometimes in the original box. In short, the best of the best are on the block at this two-day sale in late October. But it's not just a place for studied collectors. It's a good place for the beginning hand-tooler to find reliable and complete tools. You'd do well to mark your calendar for the 1999 auction, scheduled for Oct. 22 and 23.

Imagine a huge hotel ballroom filled with dealer tables. Some are piled high with usable tools of every sort—planes, handsaws, braces, sets of chisels—with more filling shelves and boxes on the floor. Spread over other tables are levels and boxwood rules, old tool catalogs, rare Stanley planes, British tools including many gleaming Norrises and Spiers, hammers and axes. Four 50-ft.-long tables are spread with more than 1,000 tools to be auctioned off, with the most valuable and smallest guarded in glass cases. Add in buyers two or three deep filling every aisle. Such was the scene for Friday's dealer show and preview of Saturday's auction, but the action continued late into the night—over dinner, in ho-

Five, gimme 10. *The hotel ballroom fills with more than 500 bidders, waiting for a tool they just can't live without.*

tel rooms transformed into tool shops, anywhere two tool lovers chanced to meet.

Bud Brown started this auction 15 years ago. Clarence Blanchard, a down-home Mainer with a long history of Stanley collecting, has run it for the past two years. It takes an entire year to put the auction together. Among 1998's gems was a Thomas Falconer coach maker's plow plane, which sold for $22,500. Also up for sale were almost three dozen Scottish planes—unusual and beautiful examples of a plane maker's highest art—from Ken Roberts, an early collector. Among the 762 lots—a tool or batch of tools up for bid—were plow planes, Stanley tools, molding planes and unique tools from many trades.

Blanchard gathers a cross section of tools that appeals to a wide variety of collectors and users and then writes a catalog that entices these collectors and users to bid. A tool might look like a whatsit until you read in the catalog where it was made, by whom, what trades used it, its condition and value estimate. Many bidders don't even appear at the auction; instead, they bid via telephone based on the catalog alone. What convinced me to attend were the catalog photos and descriptions of Spiers and Norrises with value estimates that seemed like bargains.

In the tool world, this is certainly a Big Boy auction, drawing collectors from all over the world. You have little idea who has the deep pockets to pay for tools they want and who, like myself, is there for the education. And it is an education. The auction is a good excuse for tool guys (and gals) to get together and swap stories about their particular tool expertise. There are no better sources to learn about the subtleties and history of tools than these long-time dealers and collectors who have handled, owned or in some cases spent a lifetime working these tools. And to educate newcomers and veterans alike, four experts spoke Friday morning about their years researching shaves, Vermont tools, levels and Stanley tools.

Just being among all of those tools was a chance to learn. A few museums have tools, but none will let you handle and take apart its tools, to see the details of how they were made and how they work. I doubt I'll ever see another Falconer plow, but I'll remember the way this one felt in my hands as I imagined cutting a groove along the sinuous curve of a coach. I might think back to the details of the cutters someday, when I need to make a tool for inlaying along a curve. The auction offers an abundance of tool ideas to file away for a future need—or just to appreciate.

The event was well choreographed. Beginning with the preview, bidders planned their strategies, trying not to look too interested in tools they desired. The Scottish planes I had my eye on had a constant knot of admirers, and I thought they wouldn't be so cheap after all. Fortunately, my favorite was to be auctioned later, in the natural lull following the excitement of the Falconer plane. Hidden in the plane's dovetailed construction were a full and proper iron and a tight throat. The plane was also coated with a century of grime—a discouragement to others, I'd hoped.

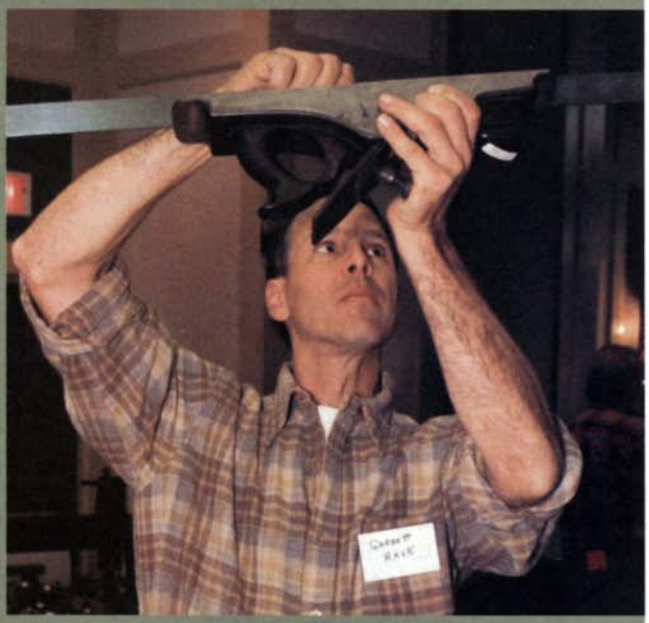
Everyone anticipated the opening lot, sensing the mood, wondering how the prices would fall. Not one of the 500 chairs in the room was empty. Twenty common Stanley planes started things off, with hesitant bids and bargain prices. Slowly, things built to a $500 sale on an ancient bronze knife, a $1,600 plow plane, a Stanley No. 1 in good condition for $1,000, and things were off and running at an average of $422 per lot. Prices followed estimates until an O.R. Chaplin Pat. No. 3 smoothing plane was offered. All it took was two competing buyers, and the price jumped rapid-fire by hundred-dollar bills to $3,500—more than four times the estimate. The following lots seemed like bargains.

Let me dispel any assumption that all of these tools sell for unreal prices. Yes, some do, but not all. Most are heading for collections, so you're competing against a high-end market. But there are plenty of user tools. Because many attendees fly in, heavy or large items can be

One of a kind. *Auction coordinator Clarence Blanchard displays the esteemed Falconer plane while the auctioneer calls bids that quickly climb to $22,500.*

Photos: Matthew Teague

What to look for in a "new" old tool



The most useful woodworking hand tools were manufactured, so they're common and affordable. Condition and rarity establish the selling price—chipped Japan finish, dings, surface rust or any similar minor defects can turn off a collector and make a perfectly usable tool more affordable. Bear in mind, if you buy a tool in top condition, you will pay more, but you can also get a better price if you decide to sell it.

Broken tools aren't a bargain unless you can fix them. Take things apart and look for hidden cracks (tap on the body and hope for a nice, high ring). Is it complete? Empty tapped holes might mean a missing part. Mismatched parts are harder to spot but don't necessarily affect how the tool functions. Some cleaning and tuning is inevitable with used tools, but rust can kill them. You can sand off surface rust, but deep rust welds parts tight and can pit cutters so badly as to render them useless.

Stanley, Sargent and Miller's Falls all made high-quality tools, any of which will be an asset to your shop. If you're just getting started, a No. 4 or No. 5 bench plane is common and very useful for general planing. Bedrocks, top of the Stanley line, are worth the extra price if you can find them. Diston makes the best saws; Irwin or Jennings makes the best auger bits. Chisels, gouges or any edge tool marked cast steel is likely to be top quality. Makers stamped their names on tools they were proud to sell.

In general, education is the best guide to buying secondhand tools. Talk with dealers, visit tool sales and ask plenty of questions. Be patient, and buy tools as you need and find them.—*G.H.*

Room 163 is open. *Throughout the show and late into the night, dealers display and sell their wares in hotel rooms converted into showrooms.*

bargains, such as two workbenches that sold for $120 and $125. If auctions make you nervous, enjoy the show but shop among the dealers where you can find complete No. 78s for $25, No. 4s and No. 5s for as much, saws, chisels, scrapers—enough to equip a shop and still come out ahead over new tools. Jump into the auction for unusual items you can't find anywhere else.

Tools in top-notch condition, with clearly marked makers' names, always bring high dollar—the rare or unusual even more so. Common tools sell in cycles, way up one year and leveling off or dropping the next. Braces are way down from a few years ago—as much as a third—and Bedrocks and Norrises are way up. It's a quirk of the auction scene that British tools can sell for considerably less here than in England and Stanley items for as much or more there. Such wasn't the case this day: The first Scottish planes came and went too high, and I never even got off a bid.

Everyone had been waiting for the Falconer plow plane. The auction had built to the proper mood for such a sale, through a series of smaller crests: a wooden thread-cutting engine for $8,000, a Tidey double beveling plane for $11,000 (below the estimate and the ebony Tidey that sold for $27,000 two years ago) and a Stanley No. 164 for $4,700. Until Don Rich's recent death, the Falconer plane was the premier piece in his collection of coach maker's plows, a tool he had desired for years but sadly owned only for a short time. The plane is one of three known and the only complete example, but a starting bid of $18,000 quickly squashed any bids from me. A minute later the plane was sold to an absentee bidder, heading to another collection, surely to be admired but never used again.

With the room all atwitter with speculation about the mystery bidder, the grimy Spiers panel plane came up. I wanted it, so I pulled the classic Statue of Liberty, with my bid card firmly planted in the air until the gavel fell: It was mine for only $450. My energy waned, as it did for others. Only the hardy remained to pick up late bargains.

The end of one auction is the beginning of the next, as high prices bring out more tools from collections for the next auction. Sure, there is a bit of greediness in all this accumulating of things, chasing the high dollar. But then there are friends like Craig and Larry who come every year for other reasons. They spread cloths on their hotel beds and place tools for sale everywhere. The tools are only a come-on to swapping stories and enjoying themselves. My fortune cookie at dinner one night told me what I already knew: "You are surrounded by fortune hunters." Yes, but it's the best kind of fortune. □

Garrett Hack is the author of The Handplane Book *(The Taunton Press, 1997).*

The curved frame and the carved cabriole legs come together with simple joinery

Oval Chippendale Stool

BY RANDALL O'DONNELL

It's real easy to get excited about making a stool like this. Compressed into this little gem are the chief hallmarks of the Colonial Philadelphia chair makers: finely carved feet on graceful legs tenoned into a thin curved frame, topped off with an upholstered slip seat. Less than a handful of original oval stools exist today. To my eye, this Chippendale-style stool commands a presence far beyond the small amount of material needed to build it.

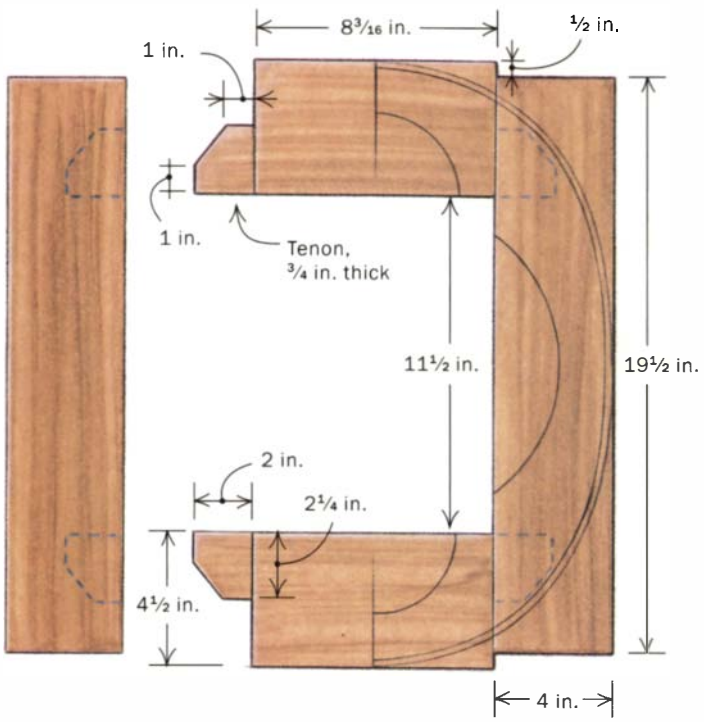
With its curves, carving and fine proportions, 18th-century-style furniture is hard to ignore. Over the years, I've built all kinds of things from wood, but making furniture in this style continues to offer the most satisfying challenge. That challenge lies not just in the cutting and carving but in researching the history and construction details of the piece.

In my part of the country, there are not a lot of original examples of this type of furniture to examine, so to capture the essence of a particular piece, I have to do a lot of homework. First I read all of the related books and magazine articles I can find. Then I travel to check out similar pieces in museums or, if possible, in private

Photos: Michael Pekovich, except where noted; top: Dennis Preston

MASSIVE TIMBERS AND SIMPLE JOINERY

This handsome little stool starts as a hefty rectangular frame.



Assemble the frame. *The bulk of the frame has been reduced by bandsawing arc-shaped segments prior to assembly.*

collections. The research is far more time-consuming than actually making the piece.

This stool is an outstanding example of the Philadelphia Chippendale school of chair making. For chairs with curved seats, Colonial Philadelphia chair makers tenoned the legs up into a stout frame. In most other areas, chair makers tenoned the frame members into the leg the same way a table's aprons are tenoned into its legs; that resulted in a strong joint but a wide frame. The Philadelphia approach sacrificed just a little bit of strength for an elegantly thin frame.

Although making a curved frame and attaching curved legs may appear daunting, the joinery is dirt simple. In this article, I'll describe how to construct the frame and make and carve the legs. I'll also show you a foolproof assembly process and touch on applying the finish.

Make full-sized patterns and a rabbeting template

Start by making full-sized plywood patterns of the seat frame, leg and knee block (for dimensions, see the drawings above and on the facing page). Additionally, you'll need to make a template to guide the router for wasting away material to form the rabbet for the slip seat.

The frame pattern provides the curve of the oval and the mortise location for the leg tenon. To avoid cutting errors, enlarge this quarter-segment pattern to full size and use it to make a complete oval pattern. Mark out one quarter of the oval, and then, using the centerlines as reference marks, flip the pattern over to mark out the remaining quadrants.

I make a plywood router template for rabbeting the frame for the slip seat. When sizing the oval opening in the template, figure in

Dennis Preston

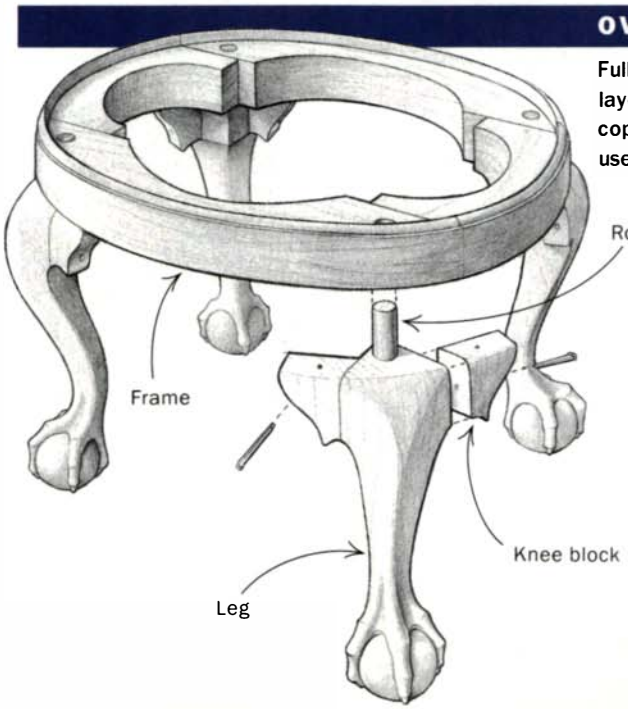
A router makes fast work of the seat rabbet. *Use a full-sized oval pattern to establish the layout line.*

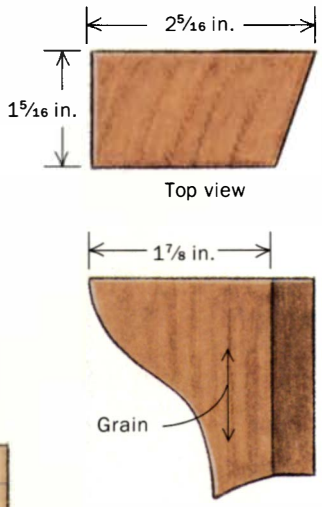
Dennis Preston

This gouge is good. *To hog away stock the router couldn't reach, the author used a gouge.*

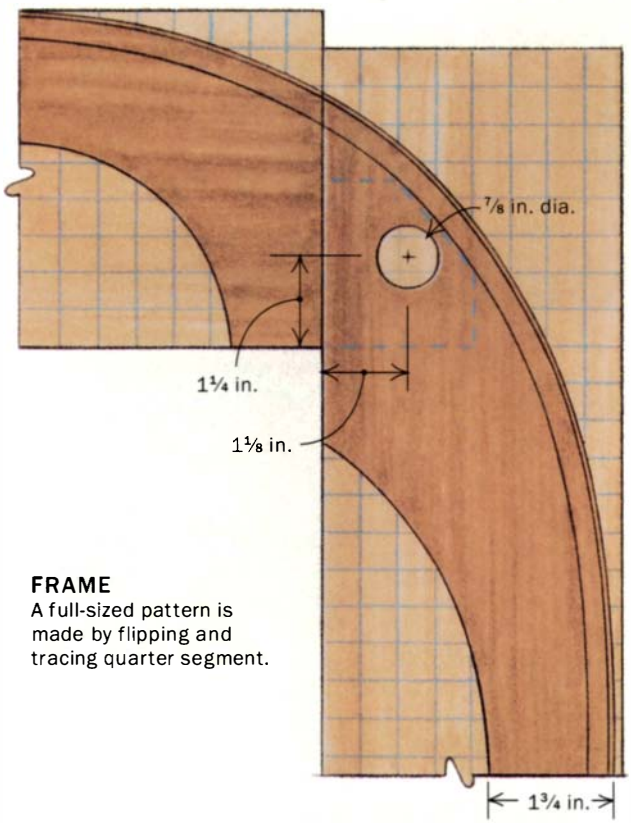
OVAL CHIPPENDALE STOOL

Full-sized patterns help avoid errors and simplify layout. These patterns are 40% scale. Use a copying machine to enlarge them to full size, or use the grid to develop the full-sized patterns.

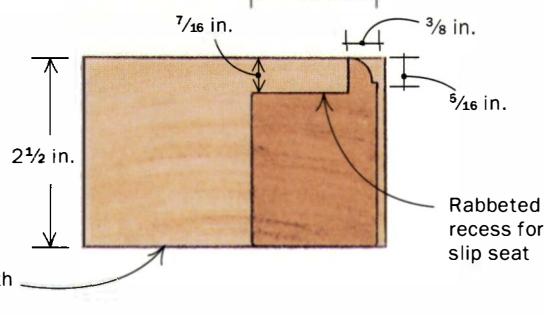


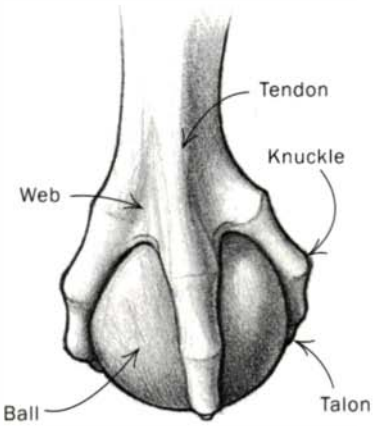


KNEE BLOCK

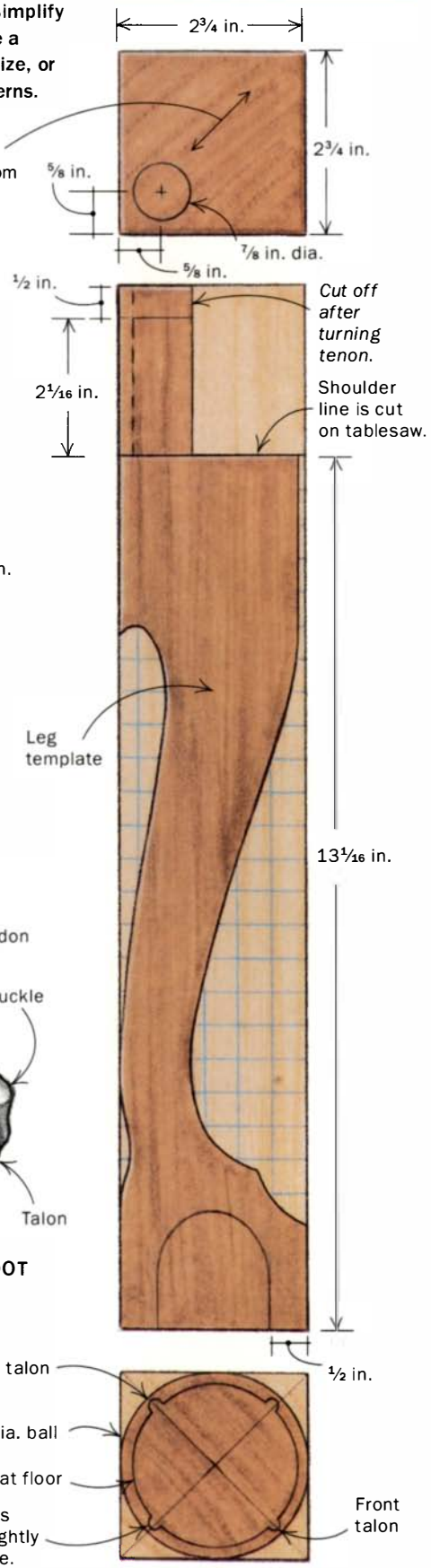


FRAME
A full-sized pattern is made by flipping and tracing quarter segment.





BALL-AND-CLAW FOOT



LEG

Drawings: Bob La Pointe

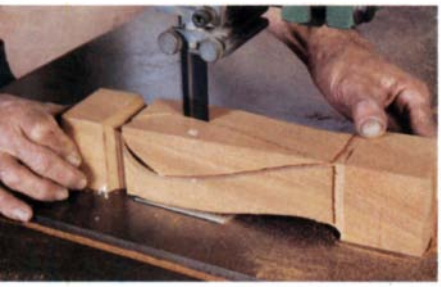
the offset between the router bit and the guide bushing you will use to cut the rabbet. Be sure to save the interior offcut from the rabbeting jig. It will be used as a router platform for cutting the bead on the top edge of the frame.

Join a rectangular frame, then shape the oval

It's astonishing that this small stool starts out with timber-frame-sized members. To build the frame, start by milling the stock to 2½ in. thick and cutting the four frame members to size. It helps to orient the frame stock so that the heart side faces down. This orientation results in an arc-shaped grain pattern that rises toward the middle of the frame, which looks much better than a slumping grain pattern.

Referring to the full-sized pattern, mark out and cut the mortises and tenons. For mortising, I use a plunge router to remove most of the waste and hand-chisel the corners and sloping transition in the mortise. A bandsaw makes fast work of the tenons. Again, I carefully pare to the layout line with a chisel.

Many original Philadelphia pieces simply left the inside of the beefy frame rectangular, but I prefer to cut away a lot of the excess bulk to reduce the mass. Prior to assembly, I bandsaw large arc-shaped hunks from the frame interior.



Dennis Preston

Lighten the load, then turn the tenon. *Rough bandsaw the leg, leaving a bridge of material to hold the first cutoff in place. When turning the tenon, use a short tool rest for best support.*

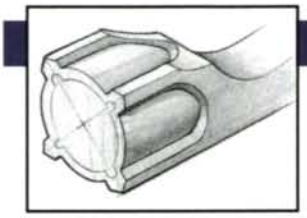
Now, glue up the frame. Don't worry about clamp marks on the frame edges, because they will be cut away when you saw the oval. After the glue dries, use the pattern to mark out the ⅞-in.-dia. mortises and then drill them.

Some Philadelphia chair makers used a separate, applied lip to house the slip seat because it was more economical. For me, it's easier to make the lip by rabbeting the frame, using a router to waste away the excess stock quickly. Using an exterior template and router guide bushing prevents cutting into the lip. Because the router base is too small to provide adequate support while cutting the area toward the middle of the frame, I use a gouge to pare away the waste. After rabbeting the frame, saw it to the oval shape on the bandsaw. I use an oscillating edge belt sander to clean up the profile to the scribe line.

An edge bead on the seat rim forms a neat transition from the frame to the slip seat. The rabbeting template offcut, placed where the slip seat goes, provides the platform for supporting the router. You could use a standard beading bit for this edge bead, but I prefer to end up with a less-machined looking result.

I first make a 1/16-in. rabbet around perimeter of the frame and then round over the top edge with a cabinetmaker's file. Develop the bead by making a series of small parallel chamfers, with the grain, along the perimeter of the frame. I think the slight irregular-

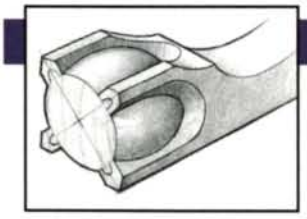
CARVING A BALL-AND-CLAW FOOT



1. ESTABLISH A CYLINDER

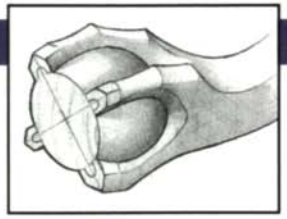
Outline the toes with a V-parting tool. *Cut to the depth of the larger circle marked on the bottom of the foot.*

Shape between the toes. *Use a #2 gouge and cut to a cylindrical form between the toes.*



2. SHAPE THE BALL

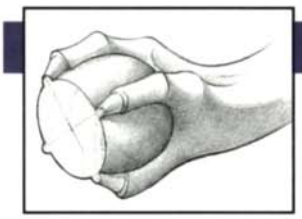
Round the top, then the bottom. *Carve from the equator toward the ankle with a #2 gouge. Work around the ball to develop a sphere. Then carve down from the equator to shape the bottom of the ball.*



3. LOCATE AND CARVE THE KNUCKLES

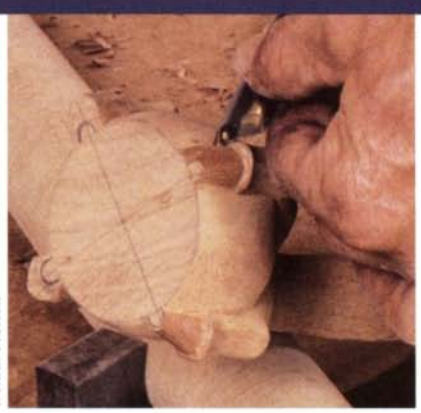
Mark the knuckles. *The front and side toes have three knuckles; the back toe has two.*

Shape the toes. *Round over and slightly undercut the toes. The areas between the knuckles are scalloped and thinner than the joints.*



4. CUT THE TALONS AND TENDONS

Carve the talons. *Taper the talons to about ⅛ in. at the bottom of the foot. Note that the side talons taper to a point slightly behind the line.*



Dennis Preston

Dennis Preston

Prominent tendons produce a strong-looking grip. *Define the tendons and web using a #8 bent gouge. Work up from the ball to the knee.*

Four-legged uniformity. *Complete each stage on all legs before moving on to the next stage. Use rifflers and sandpaper for a refined foot.*

Temporary fixing. *With the ball and claw complete, prepare to carve the knee by dry-fitting the leg to the frame. Use screws through the knee blocks to hold the leg in place.*

Knee work. *With the leg dry-fitted, rough-shape the upper leg, blending the knee to the frame. Final fairing with a rasp is done after glue-up.*

ities resulting from this process give an authentic handworked look to the piece.

Bandsaw the cabriole legs, then turn the tenon

The leg material should be sound, straight-grained stock. Cut the 2¾-in. square leg billets to size. Allow an extra ½ in. of length on the tenon end for the lathe's spur center. It will be cut off after the tenon has been turned. Use a full-sized pattern to mark out two faces of each leg. Orient the pattern on the leg billet so that the resulting leg profiles are knee to knee. Mark the center point of the round tenon on both ends. To define the start of the tenon, cut the shoulder lines at the top of the knee on the tablesaw.

Before turning the leg, cut the cabriole shape on the bandsaw to reduce the leg mass and lathe vibration during the tenon turning. When cutting cabriole legs, I use the bridge method described in *FWW* #117, pp. 82-83, to eliminate the need for reattaching the offcut stock. Briefly, when bandsawing the first cabriole profile, don't saw off the waste completely. Instead, leave a small bridge between the leg and the waste. This allows you to cut the other side of the leg profile without having to reattach the sawn-away stock. Cut through the bridge after the second profile has been cut.

Once the leg has been rough-cut, turn the tenon. Mount the leg on the lathe with the tenon nearest the headstock. The spinning blur of a leg may look a little scary, but it's quite safe because all of the work is confined to the tenon. Use a short tool rest so there's no chance of getting pinched between the leg and the tool rest.

Carve the feet

By about 1755, the ball-and-claw foot had become firmly identified with the American Chippendale style. The motif is thought to have originated in China as a dragon's claw clutching a pearl. To make the feet for this stool, draw two concentric circles on the bottom of each foot. A 2¾-in.-dia. circle is the full diameter of the ball. A 2 7/16-in.-dia. circle is the ball diameter at the floor. Mark the equator—the horizontal centerline of the ball—⅝ in. from the bottom of each foot. Now, mark the toe outline from the drawing.

To achieve uniformity, carve the four legs together, advancing all four from one stage to the next. I use only a few carving tools to make the feet: a V-parting tool, a #2 gouge, a #8 long-bent or #8 spoon gouge, a rasp and a riffler. The tool numbers refer to the gouge's cutting-edge radius, or sweep.

Start by outlining the toes on the ball using a V-parting tool. Using the #2 gouge and the V-parting tool to refine the outline, cut the ball area to a cylinder by working to the layout line marked on the bottom of the foot. Then smooth this area with a rasp to produce a nice, uniform surface. With the #2 gouge, round the top area of the ball, working from the equator and deepening the toe-to-ball junction with the V-parting tool. Be careful not to remove any stock from the center point of the equator—this is the basic reference for the ball diameter. Round the lower half of the ball, working down to the inner circle. Keep referring to the other three surfaces between the toes to maintain the spherical shape. Once you have the ball rounded, smooth it with a riffler.

Now, mark out the toe joints: three on the front toes and two on the back. Round over the toes, slightly undercutting them at the ball surface. Scallop and thin the toes between the knuckles, making the knuckles more prominent. Once the toes have been defined and rounded, mark out the talons ½ in. from the bottom of the foot—Philadelphia-style ball-and-claw feet tend to have rather stubby talons. Note that even though the side toes are forward at the centerline for most of their length, their talons taper to a point slightly behind the centerline. The front and back talons are aligned on the centerline. Taper the talons to about ⅛ in. dia.

Now comes the part that really gives a feeling of tension in the foot: cutting the web and defining the tendons. Use a #8 long-bent gouge and start defining the extent of the tendons. Work from the ball up toward the knee, leaving the web proud of the ball by about 1/16 in. Smooth the carving with rifflers and small pieces of sandpaper. Shape the leg from the ankle to the knee with a rasp and rough-sand the lower leg and foot. The upper leg will be shaped and faired to the frame in the next step.

Fit the knee blocks and fair the upper legs

The knee blocks make the visual transition from the legs to the frame and buttress the joint. Fitting knee blocks to a curved frame is somewhat different from the usual rectangular frame because the blocks flare away from the leg to meet the frame.

Dry-fit the legs into the frame, aligning the flat knee-block sur-

Photos: Dennis Preston

Glue the legs in the frame. *The knee blocks temporarily screwed to the frame ensure that the legs go back in the same position. The knee blocks are glued in place after the leg glue joint has started to set.*

face of the leg parallel to the frame's joint line. Now, screw the knee blocks in place to hold the leg in this position for rough shaping the upper leg. Be sure to mark the legs and knee blocks so that you can return them to the same positions on the frame. Carefully remove the legs without disturbing the knee blocks.

Finish up

With the knee blocks still screwed in place, glue the legs to the frame. Once the glue has started to set (about 10 minutes), remove the knee blocks, one at a time, apply glue and screw them back in place. After the glue-up, replace the screws in the knee blocks with hand-forged nails for authenticity.

After the glue dries, use a #2 gouge and a pattern maker's rasp to blend the curves of the upper legs and knee blocks into the frame. The final smoothing is done with sandpaper, starting at 100 grit and ending with 180 grit. Sponge with water, then give the surfaces a quick hit with 400-grit paper to remove any raised wood fibers.

Susy, my patient wife, does the finishing and really gets the wood's figure to pop. She colors the wood with red mahogany aniline dye, followed by a washcoat of shellac. Two separate applications of paste filler with a black tint, spaced a day apart, follow. Finally, several coats of buttonlac shellac topped off with Behlen's violin varnish make the stool glow.

Crowning this regal little stool with a silk damask-covered slip seat completes the project. I make the frame, and an upholsterer does the webbing, padding and fitting of the fabric. To make the frame, I simply join a rectangular assembly of poplar, bandsaw it to the oval shape ⅛ in. smaller all around than the seat recess and cut a heavy chamfer around the top outside edge. □

Randall O'Donnell makes period-style furniture at his shop in the countryside near Bloomington, Ind.

Micro-Adjustable Tenon Jig

Precise positioning permits you to rout a tenon in less than a minute

BY PATRICK WARNER

Most of the furniture making I do is experimental. Nothing in the design is standard. Consequently, when making tenons for joinery, I want a jig that will accommodate a wide range of sizes. Some adjustable woodworking jigs use the tap-and-clamp method. That works, but it's simply not very handy when you're making lots of different-sized tenons.

The jig I use to make tenons (see the photos at left and below) is nowhere near as sophisticated as some screw-driven woodworking machinery, but with a slight turn of the adjusting handle, I can dial in tenons to within 0.001 in. and cut 2-in.-long tenons in under a minute. The range of travel allows for shoulder widths up to ⅝ in. A straight bit in a router does the cutting. The jig works with either a template guide bushing or a bearing-guided pattern bit.

Although only one face is machined at a time, the work can be flipped, remounted and milled in fewer than 10 seconds. The jig shown here will only cut two-faced tenons or four-faced tenons on narrow stock (approximately less than 1½ in.). For four-faced tenons on wider boards, you can (1) expand the size of the travel mechanism and clamp base to accommodate all four cuts; (2) cut the two short tenon faces by hand; or (3) build another similar jig for wider stock so that it will handle the other two faces.

Cutting a stack of tenons in under three minutes. *Precise adjustments and fast-acting toggle clamps on this jig allow you to make uniform router-cut tenons in quantity.*

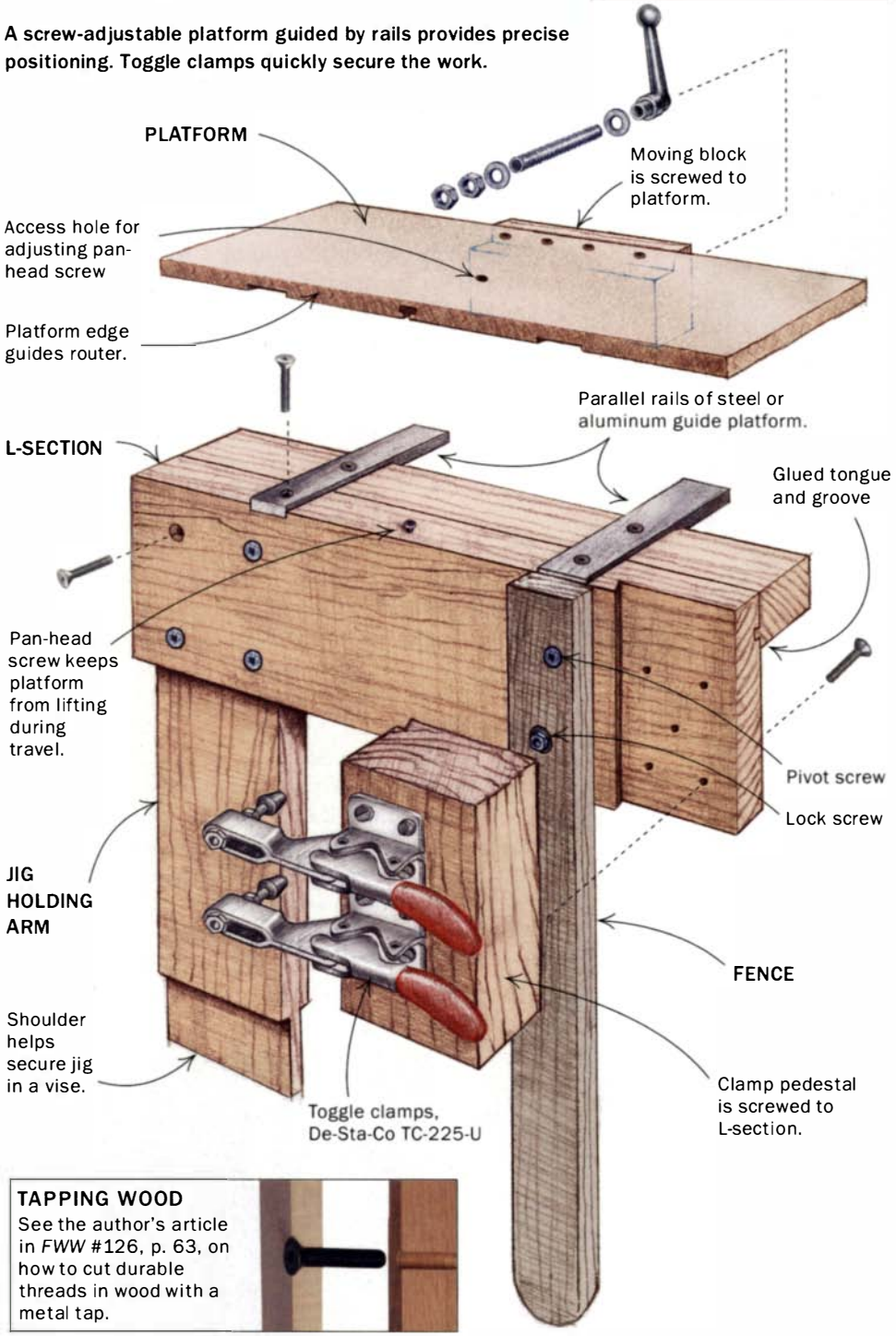
Making the jig

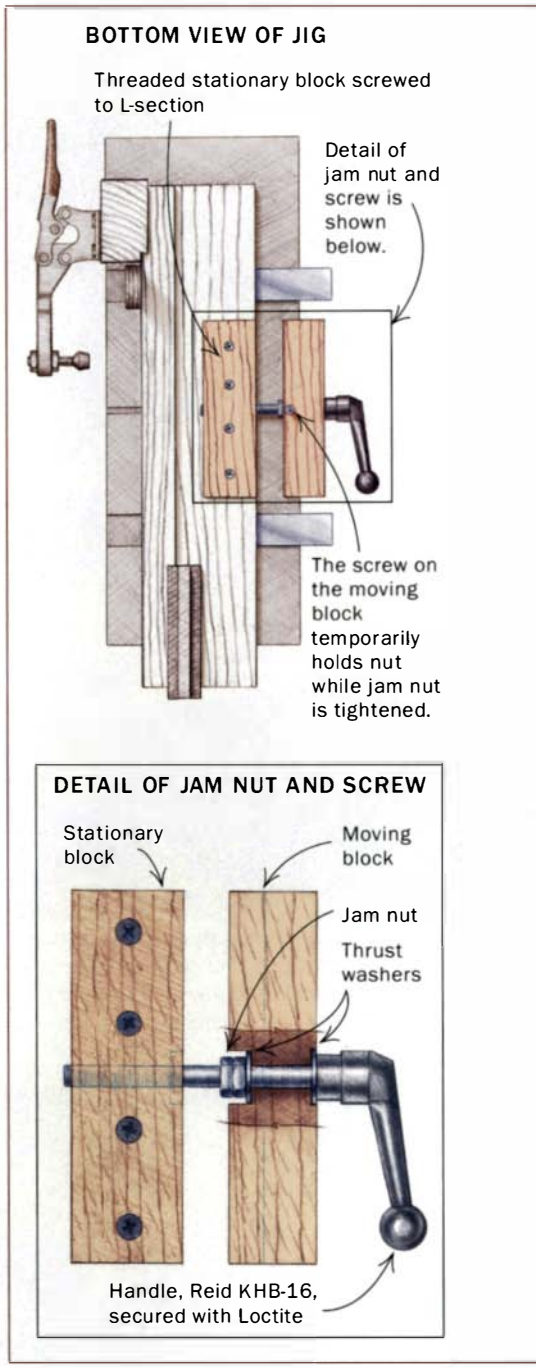
A simple L-section forms the backbone of this jig (see the drawings on the facing page). An adjustable platform above the work supports and guides the router, controlling the tenon size. This platform is positioned by a

Photos: Dennis Preston

JIG ANATOMY

A screw-adjustable platform guided by rails provides precise positioning. Toggle clamps quickly secure the work.





TAPPING WOOD

See the author's article in *FWW* #126, p. 63, on how to cut durable threads in wood with a metal tap.

threaded rod (or lead screw) and held in alignment with metal guide rails. Toggle clamps secure the work in place, while a holding arm allows the jig to be secured in a vise or clamped to a bench. This jig will hold stock up to 8/4 thick and 10 in. wide and of any length.

The jig is made mostly of wood, but for many parts I used metal joinery methods, which produce rugged, accurate jigs. Rabbets or grooves align parts, and machine screws hold them together. I cut threads directly into the mating wooden part using machinist's taps (see *FWW* #126, p. 63). You could also use wood screws, carriage bolts and threaded inserts for the assembly.

For strength, most of the wood used in this jig is red oak. The adjustable platform, however, is medium-density fiberboard (MDF) because I wanted a smooth, flat, stable material to guide the router.

L-section and guide rails—Begin by sizing the two pieces of stock that form the L-section. I joined these pieces with a shallow tongue and groove and glue. After the glue dries, router-cut all of the joinery and the guide-rail slots, and drill and countersink the holes for the machine screws.

I made the platform guide rails for this jig from ¼-in. by 1-in. steel flat bar. Aluminum flat bar would have worked just as well

Drawings: Melanie Powell

A template makes matched rail slots. *Align the front edge of the template with the L-section. Repeating this operation on the platform ensures that the rails stay in alignment and that the jig operates smoothly. The cuts are made with a top-bearing pattern bit.*

and been easier to cut and drill. The guide rails are let into and fastened to the L-section. The platform has mating slots to engage the rails. The four slots must be correctly spaced and parallel; otherwise, the platform will bind. I made a simple 10-in. by 17-in. rail template from ⅜-in.-thick MDF (see the photo at left) to cut the slots. Using a top-bearing pattern bit, I cut two 1-in.-wide slots about 1 in. longer than the platform width and perpendicular to the open end (the reference edge) and slightly deeper than ⅛ in.

Cut the flat bar to length and drill and countersink the mounting-screw holes. Position the rails on the L-section and mark the center points for the screws. Be sure to set the rails back from the face of the L-section by about 1/16 in. to prevent a collision with the router bit later when you trim the platform edge. Now, drill and tap these holes and mount the rails.

The platform—Once the rail slots have been milled, route a T-slot midway between the two rail slots. This T-slot engages a #10 pan-head sheet-metal screw in the L-section and keeps the platform from lifting during its travel. A hole through the platform allows convenient access to the pan-head screw for adjustment.

For the travel mechanism, I used a 5/16-in., 18-tpi (threads per inch) screw thread. One full revolution produces 1/18 in. (0.056 in.) of platform travel; a quarter turn, therefore, produces 0.014 in. of platform travel, and so on.

The key parts of the travel mechanism are a threaded stationary block attached to the L-section, a moving block fastened to the platform and a 5/16-in., 18-tpi threaded rod with a lever (see Sources of Supply on the facing page). The moving block is rabbeted along the edge to join the platform and is drilled for a 5/16-in. through-hole and counterbored on the inside face to house two nuts and a thrust washer. A thrust washer on the opposite side is recessed into a shallow counterbore. After screwing these two blocks in place, mark the pilot hole for the thread through the 5/16-in. hole in the moving block using a machinist's transfer punch. The transfer punch has the same nominal shank diameter as the drill. A small

Tapping holes. *Turn the drill-press spindle by hand. Once the tap engages the wood block, it self-feeds, cutting uniform threads.*

Square the fence to the platform. *Tighten the two fence-mounting screws to lock the position. A slightly oversized hole allows the fence to be positioned at exactly 90°.*

Edge trimming. *Trim the platform edge parallel to the L-section face. The metal rails are set back from the face to prevent damaging the router. A vacuum hose catches the MDF dust.*

point exactly in the center of the punch perfectly centers the two holes. Now remove the stationary block and cut threads using a drill press (unpowered) as a tapping fixture (see the bottom left photo on the facing page).

Two nuts tightened against each other hold the screw and the lever assembly in the moving block. The pan-head screw is tightened against the innermost nut to prevent it from turning while the jam nut is tightened. Once the nuts are tight, the pan-head screw is backed away, allowing the shaft to turn freely.

The fence, clamp pedestal and jig holding arm—Cut the stock for the fence. The fence pivots on a 5/16-in., 18-tpi flat-head machine screw. The lower screw has an elongated hole, which allows the fence to be positioned exactly 90° to the underside of the platform (see the middle photo on the facing page).

To mount the clamp pedestal, transfer the bolt-hole pattern from the L-section. Use the clamp base as a pattern to locate the pilot holes for the mounting screws. The jig holding arm is lap-bolted to the L-section. Transfer the mounting-screw location from the L-section. The shoulders on the end of the arm help keep it square in the vise and resist rotation during use.

Dialing in the perfect tenon. *If the test cut results in too big a tenon, adjust the jig and cut again. The author has made a number of jigs based on the same basic design; the screw clamps on the jig shown here will hold wider stock than the jig on p. 62. The top surface of the platform is a handy place for notes and reference lines for cutting multiples or to repeat a setup at a later time.*

SOURCES OF SUPPLY

TOGGLE CLAMPS AND HANDLE

Reid Tool Supply Co., 2265 Black Creek Rd., Muskegon, MI 49444; (800) 253-0421

Also available at local industrial supply houses and through other mail-order hardware suppliers.

THREAD-LOCKING ADHESIVE

Loctite is sold in most automotive-supply stores.

Truing up the platform edge—Remove the fence and clamp pedestal and secure the jig in a vise. Now, extend about 1/32 in. of platform past the face of the L-section. Using a router with a flush-trimming bit (bearing on the end of the bit), cut the platform edge parallel to the L-section face (see the right photo on the facing page). This matches the platform edge to the L-section face. Reassemble the jig, and you're ready to make tenons.

Making tenons with the jig

I prefer using a fixed-base router when I make tenons with this jig. A plunge router may be better for multiple-depth cuts, but it's difficult to plunge one safely along an edge because of the small footprint and high center of gravity.

Install the cutter and guide collar on your router, and set the depth of cut. Adjust the toggle clamps to the stock thickness. Very large work may require the addition of a C-clamp. Be sure to position the work against both the fence and the underside of the platform. Routing in this orientation, across the grain, quickly peels away material. Nevertheless, deep cuts should be done in multiple passes.

Position the platform at your best first guess and rout the first cheek of the tenon. I usually climb-cut (moving along the edge right to left) because there is so little resistance to the cut. When climb cutting, take light cuts to avoid a runaway router. Reposition the work and cut the opposite cheek without moving the platform. Test the tenon in its mortise. If it's too big, determine by how much and divide by two. Then move the platform back by that amount and repeat the cut (see the photo above). □

Patrick Warner lives in Escondido, Calif. He has written three books on routing and even has a web site on the subject. Visit the site at www.patwarner.com.

Curved-Leg Table

BY DON KONDRA

Although I rely heavily on machines to get the job done quickly, I aim to build furniture that looks organic and invites people to touch it. That's why I've turned to using lots of curves in my work. It's true that building swoopy furniture requires more labor than making stick-straight pieces, but I think curves are appealing. And they're also more interesting from a design or construction point of view. Furniture that's square to the world bores me.

Once you get hooked on curves, a whole new world of design opens up. I always make full-sized drawings on newsprint (end rolls) that can be purchased cheaply from the local newspaper. Working from an accurate drawing is the key to finessing the joinery and accurately milling curved parts. To get consistent results and to minimize the amount of handwork required, I also make a router or shaper jig.

I've made several versions of this hall table, and no two were alike. The current version (shown here), with a walnut top and curly maple base, suits me for now. But who knows? The next one might have a different curve or two.

Make templates to draw the curves

The two most prominent features of a hall table are the top and the legs. The top is rectangular with edges that are beveled under. The legs are curved gently and tapered, and the edges are rounded over. To ease the transition from the square, dark top to the curvy, light base, I created a gap (negative space), which makes the top appear to float. The top is secured to a pair of cross braces with four screws.

Whether you wish to copy this plan or use it as a starting point for your own design, the first step is the same: Make a simple jig for drawing smooth curves (see the story and drawings on the facing page), and use the jig to make a drawing template out of ¼-in. medium-density fiberboard (MDF) or hardboard. That template is then used to lay out the leg-shaping jig (see the story and drawings on p. 68). The drawing template need only have a convex curve on one side.

Once the curve has been drawn on the MDF, cut the template on the bandsaw and fair the curve using a belt sander or sanding block. It's worth taking your time on this step, because everything you make later will be dependent on the template.

Use the template to pencil in the legs on the working drawing. If you don't like what you see, make another template with a different curve. To draw the tapered half of the leg, move the template to a different angle. You can make a table with the legs splayed out, plumb or tilted inward slightly. I think a table looks best with the outside edges of the legs in a plumb line. Being plumb gives the piece a solid look. This is a personal decision. If the legs are splayed outward, the piece looks pot-bellied, which feels relaxed. If the legs are

Making a floating top is easy.

Designing just the right leg curve is the hard part.

splayed inward, the table looks as if it's perching or poised to jump, which creates a feeling of tension.

Acclimate leg stock in your shop before shaping

The legs are the most time-consuming parts of this project, but they also define the piece. You're going to be removing a fair amount of material from the rough stock, so it's important that you have dry wood. Most of the wood I use has been kiln-dried, and I like to have it in the shop for about a month to stabilize before I start roughing it out.

Cut the leg blanks from the same 8/4 plank to ensure grain match, and leave them for a day or two to stabilize. Joint the leg blanks to 1⅞ in. square. (If you end up with stock slightly undersized after making your leg-shaping jig, you can salvage the project by gluing cardboard or veneer shims to both faces of the jig's fence.)

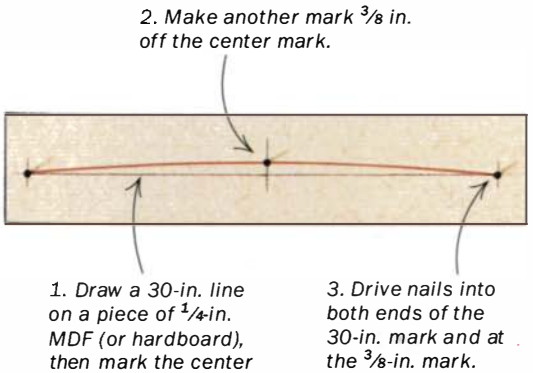
The legs are cut in two stages—first they're bandsawn, then they're machined on a shaper or router with the help of a jig. I prefer using a shaper equipped with two 1½-in. straight bits stacked atop a custom-made bearing. A shaper is more stable and powerful than a router table, which allows me to remove more material in one pass and thus get the work done faster. But the method is essentially the same when using a router table, which I'll describe here.

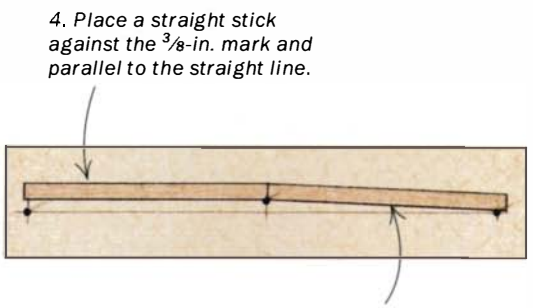
Because I didn't own a 2-in.-long pattern-cutting bit, I figured out a way to shape the leg using a standard 1⅛-in.-long pattern-cutting bit and a flush-trimming bit (see the top photos on p. 69). This procedure requires three router cuts for each face of a

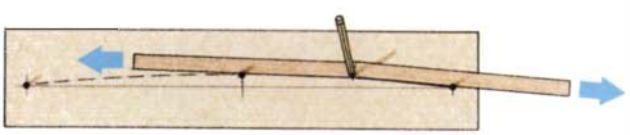
Photos this spread: Grant Kernan

Drawing smooth curves

Here's an easy way to draw smooth curves using sticks and nails. I used this method to make a drawing template for the curved legs of my hall table. The method isn't new (see *FWW* #28, pp. 14-16), but it's worth repeating. The curve I used for the legs of the hall table was based on a rise of ⅜ in. over a run of 30 in. —*D.K.*



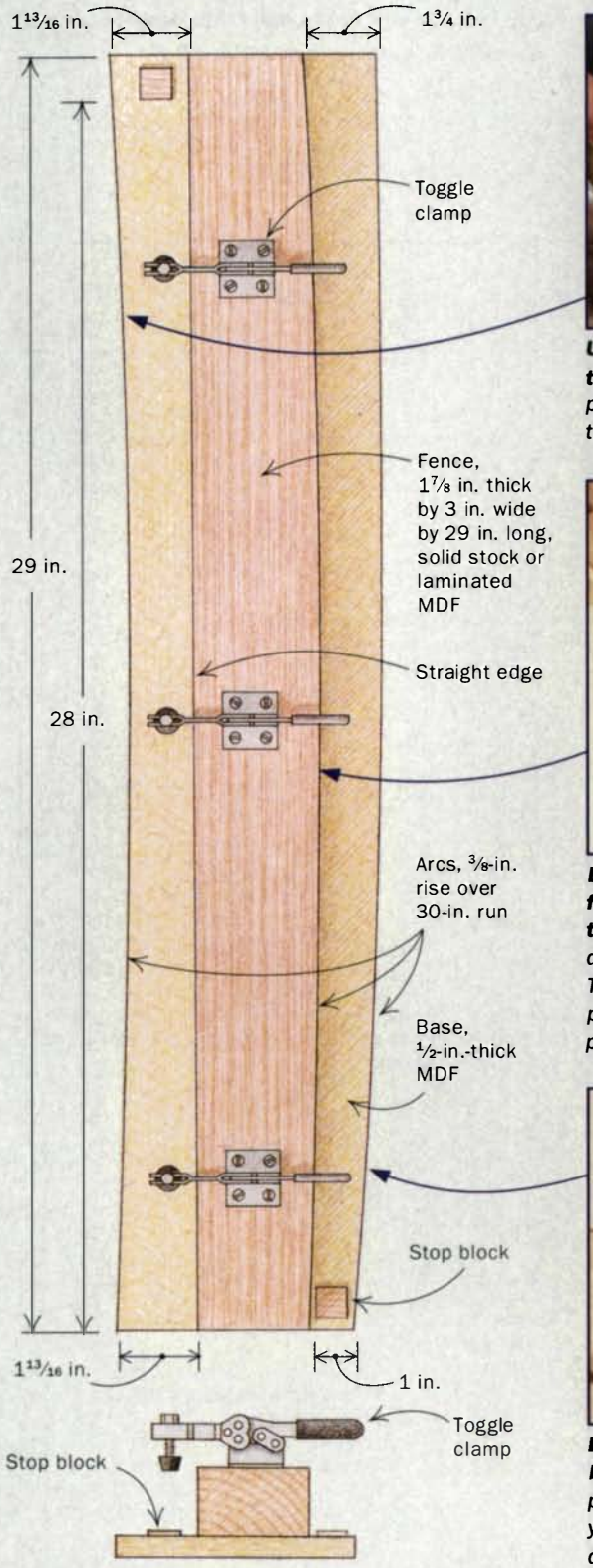




6. To draw the arc, place the sticks against one end nail and the middle nail. Hold a pencil against the intersection of the two sticks and slide the sticks across the nails, letting the pencil drag along. Repeat on the other half of the curve.

A jig for shaping curves

When making curved parts, I prefer using a jig. It speeds up the job and gives me consistent results. The jig is nothing more than a hold-down device connected to a template, which is used in conjunction with a pattern-cutting bit. Use the base of the jig to lay out the curves onto the faces of the leg stock, then bandsaw off the waste. Next, clamp the stock in the jig and make the final cuts. The most efficient way to work is to lay out and cut one face of each leg at a time, then go on to a second side.—*D.K.*



Use the leg template to lay out the jig. *Draw a concave curve on a piece of ½-in.-thick MDF. Bandsaw the waste and sand the edge fair.*

Draw a convex curve on the fence of the jig using the same template. *Bandsaw the waste, but don't bother fairing the surface. The curved surface ensures the partially shaped leg will register properly and securely to the jig.*

Lay out the convex curve on the base of the jig. *Angle the template to create the amount of taper you wish to incorporate into the leg design. Cut and fair the curve.*

leg. To cut down on steps, use an extralong pattern-cutting bit (see Sources on p. 71) that will allow you to cut each face in one pass (see the bottom photo on the facing page). You still may need to cut each face in two passes because some routers won't let you raise the collet close enough to the throat of the table.

Place a leg in the nontapered side of the jig and secure it with the toggle clamps. Flip the jig on its side and clamp it in a vise. Using the base of the jig as a template, trace a curve onto the leg. I use a dull pencil, which leaves a fat line that's easy to see when bandsawing. Rotate the leg 90° and repeat. Remove the leg blank and bandsaw off the waste, staying outside of the lines.

Put the leg back in the jig and tighten the clamps. Shape one side. Then flip the leg 90° and shape the other bandsawn face. Complete two faces of all of the legs (see the drawings on the facing page).

Now move to the other side of the jig. Reposition the toggle clamps 180°. Place the concave side of a leg against the curved side of the fence and tighten the toggle clamps. Flip the jig on its side and again use the base of the jig to trace the curves of the last two faces onto the legs. Bandsaw the waste, then finish on the router table or shaper. Use wooden wedges or bandsawn waste to help register the toggle clamps on the legs after the tapers have been cut.

After machining, use a scraper to smooth ridges and tearout. Although you might be tempted to finish shaping the legs, don't round over the corners yet. It's better to mark and cut the mortises for the aprons while the edges of the legs are still crisp.

Cut joints for legs after shaping

Refer to the drawing on p. 70 for the rail measurements and cut your stock to size. You can also use the drawing and a sliding bevel gauge to transfer the angle of the apron pieces where they meet the legs. It's not much of an angle, about 2°.

The leg-to-apron joints can be either mortises and tenons or dowels. Because a hall table generally doesn't take the kind of abuse a dining table is subjected to, the joinery doesn't have to be bombproof, just secure and accurate.

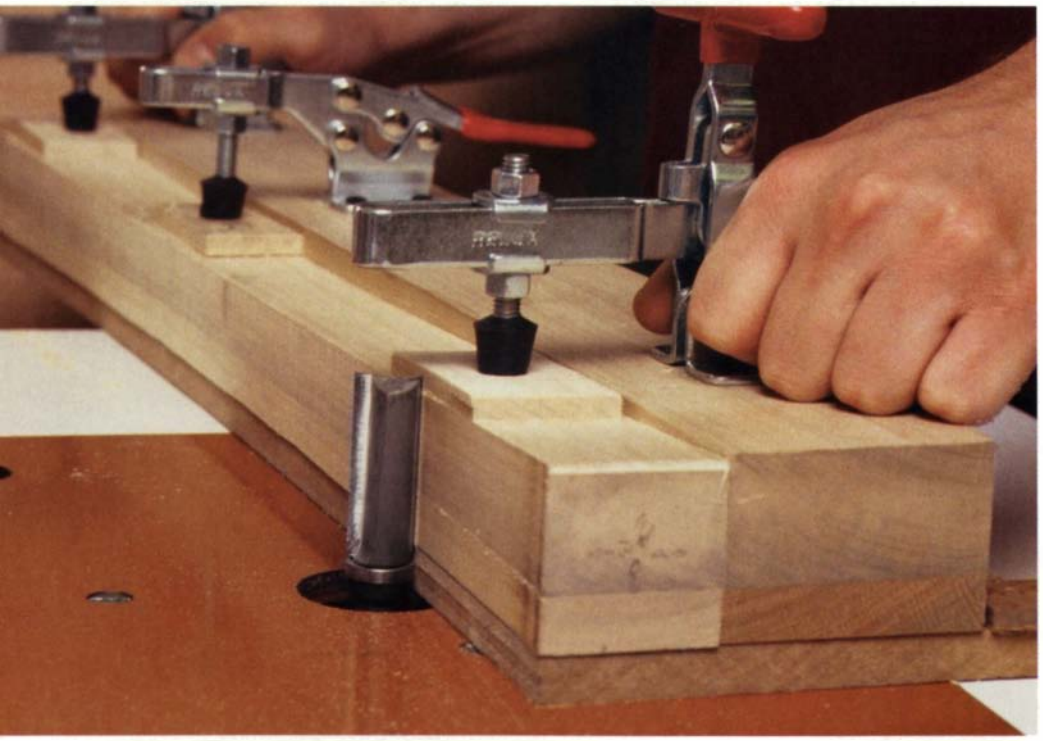
After cutting the joints, use a ⅜-in. roundover bit to soften all four corners of the legs. The top and bottom edges of the rails are chamfered with a 45° router bit, leaving a reveal of about ¼ in.

Photos: Anatole Burkin, except where noted

Use a pattern-cutting bit and flush-trimming bit ...

Use standard bits to machine the leg. *With a 1⅛-in.-long pattern-cutting bit, you can machine the leg on a router table. First, make one pass with the leg clamped in the jig. Next, remove the leg from the jig and make a second pass, using the machined surface to register the bearing. Finish by using a flush-trimming bit, registering the bearing against an already machined surface.*

... or get a bit to do the job in one pass



An easy way to machine the leg. *You can remove all of the waste in one pass with an extralong pattern-cutting bit in an inverted router.*

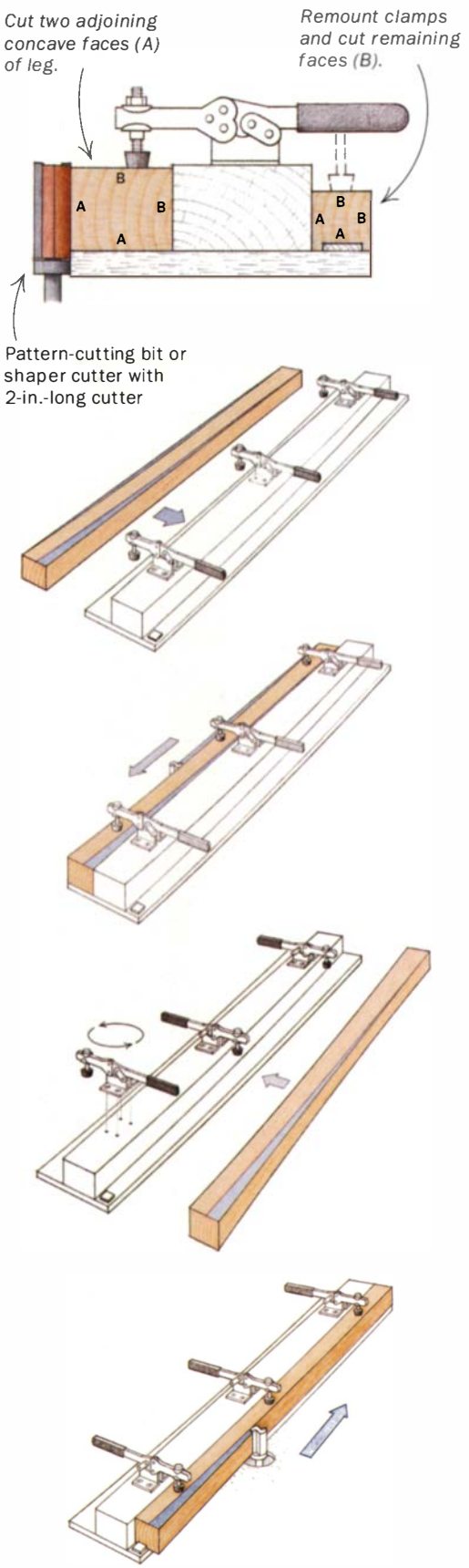
A pair of cross braces, attached to the rails, holds the top ¼ in. above the rails. Refer to the drawing on p. 70 for dimensions. Dry-fit the pieces. Once you're sure the parts fit, glue up the side-to-side assemblies. Once they're dry, glue the front and back aprons and cross braces together.

Keep an eye on the overhang

The amount of overhang in a tabletop greatly influences the overall look. Make the top too long and wide, and you may not even see the apron, which gives you a spindly looking piece of furniture. A top that's too small can have a negative affect as well.

Usually it's best to rough-cut the top, then lay it on the base, varying the overhang on two edges. Stand back and see what it looks like, then take some measurements when you're happy with the look. I settled on an overhang of ⅞ in.,

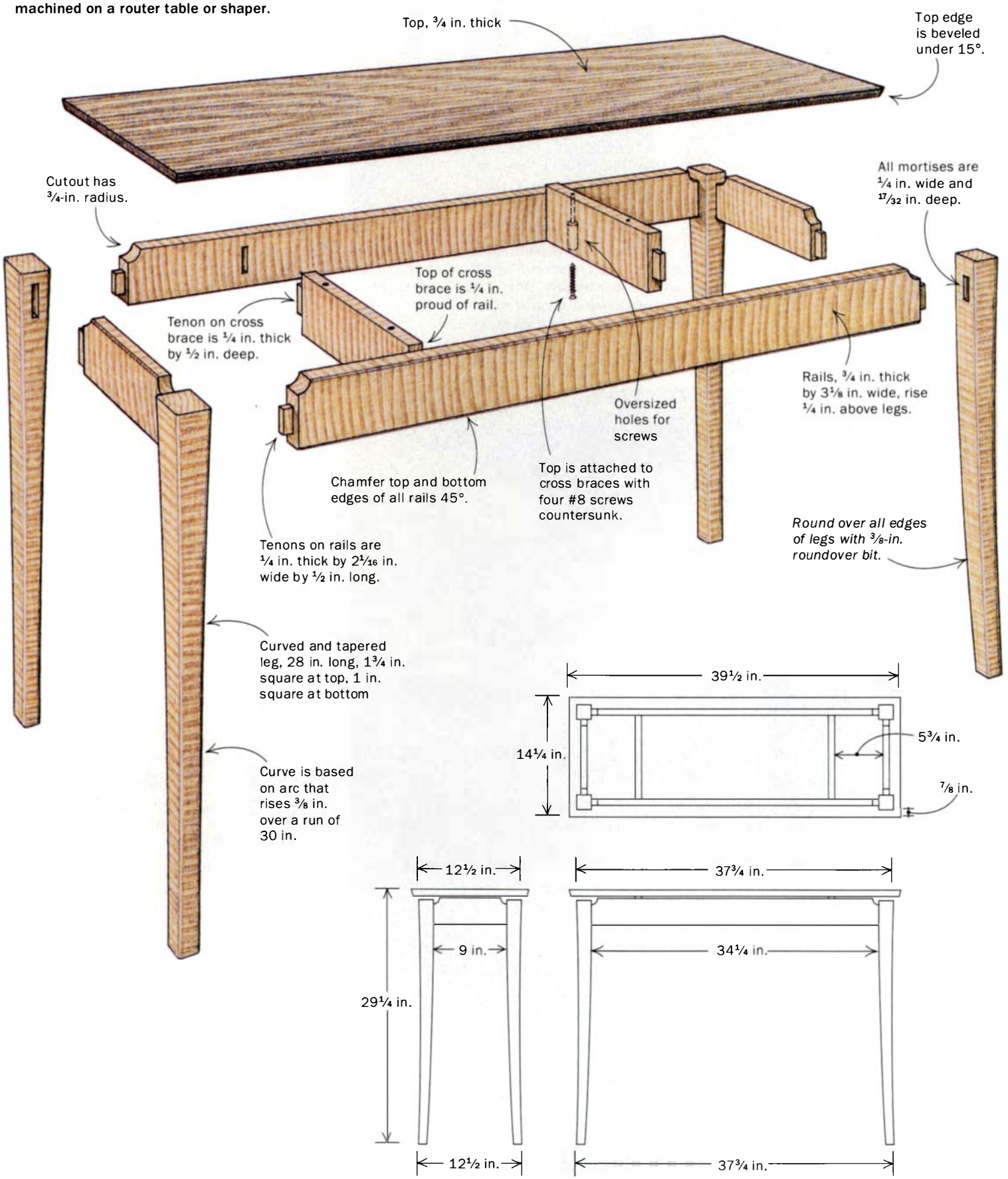
TWO-SIDED JIG HANDLES CURVES WELL



Drawings: Vince Babak

TABLE WITH CURVED, TAPERED LEGS

Legs are rough-cut on the bandsaw, then machined on a router table or shaper.



Balancing a design

A table's footprint affects the look of the piece. *The author prefers the symmetry of legs where the outside spread is equal at the top and bottom.*

Before cutting the top to final dimensions, rest it on the base. *Then, experiment with the amount of overhang that looks right to you. The author settled on an overhang of ⅞ in. The edge is also beveled under 15°.*

measured from the rails. The top is ¾-in.-thick walnut, and all of the edges are beveled under 15°. The top is attached to the cross braces from below with four #8 screws. The holes in the cross braces are oversized to allow the top to shrink and expand without blowing out the base.

No expensive finishing equipment is required

When you have maple with lots of curl, you don't need dyes or stains to bring out the wood's natural beauty. That's why I used a simple oil/varnish finish that I mixed myself.

My wipe-on finish consists of one part pure tung oil, one part spar varnish, two parts paint thinner and a few drops of Japan drier. Mix only as much as you think you'll use on one project because the drier will age the finish rapidly, even when placed in a sealed jar. For a project of this size, about half a cup (4 oz.) is plenty.

Apply the mixture using a lint-free rag that's saturated with the finish. The idea is to keep a thin film of finish on the wood, without any drips. I think this works better than applying it heavy, then wiping it down with a dry rag, which leaves too little finish behind.

The finish will be dry to the touch in about 20 minutes. I apply three coats, one a day over a period of three days, rubbing the piece down between coats with a gray Scotch-Brite nylon pad. Wait about three days after the final coat, then give the piece a final polishing with a white Scotch-Brite pad. If the pads leave scratches in the finish, it means your finish is still soft, so wait a day or more. You can fix the scratches by wiping the area with a rag slightly dampened with paint thinner. If you ever need to repair this finish, sand lightly and apply another coat. □

Don Kondra builds custom furniture in Saskatoon, Sask., Canada.

SOURCES FOR ROUTER BITS

RIDGE CARBIDE TOOL CORP. (201-438-8778)

Pattern-Cutting Bit #12-8B-F2. This is a ½-in. shank, ¾ in- dia., 2-in.-long straight carbide bit that comes with a ¾-in. bearing and lock collar slipped over the shank. Cost: $59

JESADA TOOLS (800-531-5559)

Jesada sells top-bearing kits, and you can make your own custom pattern-cutting bit using a straight bit. The kit consists of an Allen key, bearing and stop collar. A collar and ¾-in. bearing to fit over a ½-in. shank router bit cost $14. Jesada also sells router bits.

Safety tip: Be sure that at least 1 in. of the shank is inserted into the router collet.

Making Sense of Motors

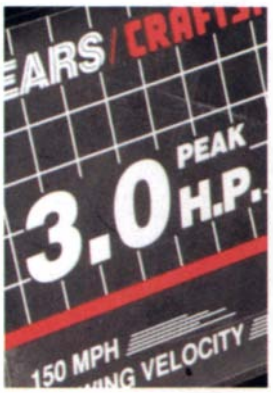
How to cut through the horsepower hype and compare power tools

BY MARTIN SEIFERT

Motorized tools often come with fabulous claims of high horsepower ratings. For example, in my shop I have a vacuum, a router and an air compressor with labels boasting outputs of 3 hp, 3.5 hp and 5 hp, respectively. They are all intended to plug into the same 115-volt, 15-amp residential outlet.

Well, if I jammed the circuit breaker so that it wouldn't trip, maybe I could get that kind of horsepower out of these tools before they went up in smoke. When you see the terms "maximum" or "peak" horsepower, watch out. Horsepower claims couched in those terms aren't complete lies, but they're not always useful for evaluating true power.

Woodworking machines aren't meant to be run like dragsters, pushed to within a couple of rpm of meltdown. They're built to operate at steady cruising speeds with occasional bursts of power. When shopping for motorized tools, I look at the fine print on motor labels and do a little math.



Hyping horsepower. *The term "peak horsepower" is not as meaningful as "continuous horsepower," a truer measure of a tool's performance. When assessing motors, look at the small print and compare amp ratings.*

Many things affect power output

An electric motor is a device that converts electrical energy into motion. The amount of current pumped into that motor determines, in part, how much horsepower it puts out. A horsepower is a unit of power that's defined as 746 watts. A watt is also a measurement of power; the electric meter on your house tabulates how many watts of power you consume every minute of every day.

The power that comes into your house is parceled out in amps and volts. Think of amps as the volume of current and volts as the pressure. One amp under the pressure of 1 volt equals 1/746 hp. That brings us to the simple equation for figuring out horsepower: (amps × volts) ÷ 746 = hp.

If that's all there were to it, figuring out a motor's horsepower would be simple. But two other things affect the equation: power factor (pf) and efficiency (eff), things that have to do with how a motor is built and how much of the current goes directly

What to look for in a universal motor

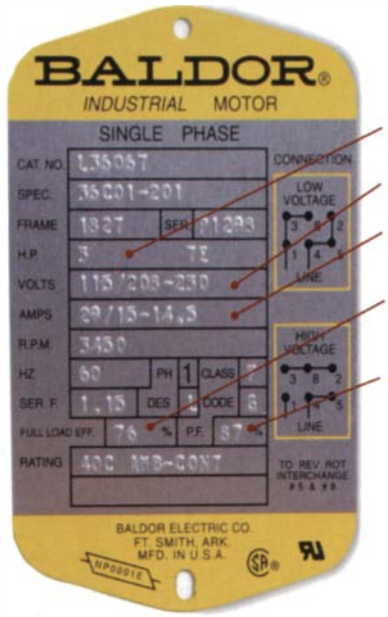
There are a few easy-to-spot qualities to seek out in a universal motor, the type usually found on portable and benchtop tools such as drills, routers and sanders. (Bigger induction motors, like those found on stationary tools such as saws, grinders and planers, are mostly enclosed and can't be evaluated as easily.) The first step is to bring along a few tools when shopping, such as a screwdriver and penlight.

I am not shy about taking a new router off the shelf and unscrewing the brush cover to take a peek inside. A good-quality commutator on a tool that's been broken in should be brown (like an old penny) and smooth, which means the brushes are leaving a nice, thin film of material behind. If the copper is very shiny or grooved, the brushes are stripping away metal. (A new commutator that hasn't been used will be the color of shiny copper.)

Another sign of quality is the number of segments in a commutator (see the photos

DECIPHERING CONTINUOUS HORSEPOWER

The nameplate on an industrial motor, such as this 3-hp Baldor, gives you all the information you need to figure out continuous horsepower. Not all manufacturers provide this information.



$$\frac{\text{amps} \times \text{volts} \times \text{power factor (pf)} \times \text{efficiency (eff)}}{746} = \text{continuous horsepower}$$

$$\frac{29 \text{ amps} \times 115 \text{ volts} \times 0.87 \text{ pf} \times 0.76 \text{ eff}}{746} = 3 \text{ hp in the example above}$$

into creating motion. Power-factor and efficiency ratings—both of which reduce horsepower output—vary among motors, and they're not things most tool sellers publicize. Power-factor and efficiency losses of between 10% and 30% are pretty common. A company's technical-support department may be able to tell you what the power-factor and efficiency ratings are for any given product if you really want to know.

You can trust amperage ratings

Look at any motor's nameplate, and you'll see two essential numbers: amps and voltage (see the photo above). And assuming that the motor has an Underwriters Laboratory (UL) label, it has been tested to run safely at the rated voltage and amperage without turning to toast (for some tips on evaluating a motor, see the story below).

Because voltage can vary slightly, most tools will run fine between 110 volts and 120 volts. But for consistency's sake, I'm going to assume a voltage of 115 when making comparisons.

Horsepower claims aren't regulated like amperage ratings, and manufacturers can make a lot of interesting claims. Take that 3.5-hp router I own. It's rated for 13 amps. Let's do the math:

(13 amps × 115 volts) ÷ 746 = 2 hp.

Power-factor and efficiency losses will bring that number down to around 1.5 hp, which is the most continuous horsepower you can expect from any tool that plugs into a 115-volt, 15-amp circuit. The equation for calculating continuous horsepower goes like this:

(volts × amps × pf × eff) ÷ 746 = hp.

Yes, many motors will survive a surge in amperage under heavy load and produce

WIRE COMES IN DIFFERENT GAUGES

The lower the number, the fatter the wire. High-amp tools require a thick wire. As the length of a cord increases, so must the wire gauge. Check a tool's instruction manual for specific guidelines.

10 ga. Best for large stationary machines

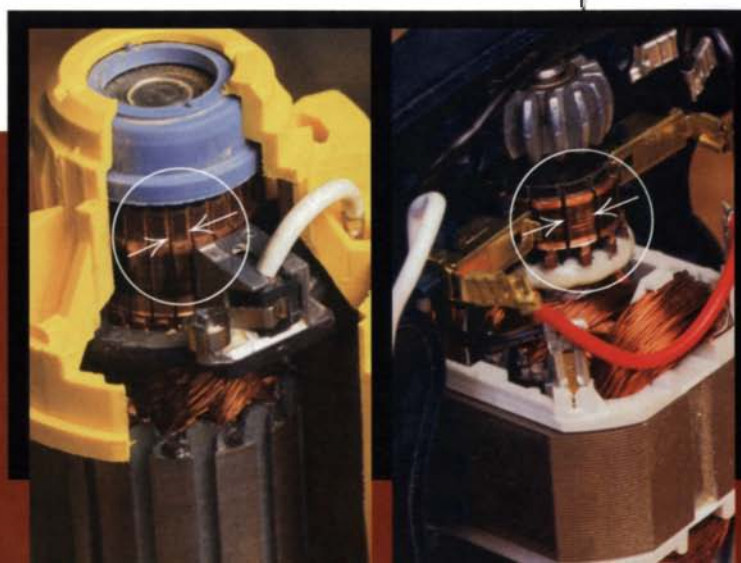
12 ga. Good choice for most portable power tools

14 ga. Short runs okay for small- to medium-sized tools

16 ga. Okay for light fixtures or light-duty tools

at right). While looking through the brush-access port of a well-made tool, there should be three segments of a commutator visible. That means each brush is in contact with at least

continued on the next page



A COMMUTATOR TELLS A LOT ABOUT A MOTOR. *A universal motor, as found on most portable power tools and many benchtop machines, has a commutator, the copper bars at the base of the shaft. A good commutator should be a dull copper color and contain many segments, like the one on the left. The commutator on the right has fewer segments, the sign of a lower-quality tool.*

Quick checkup for power tools

Testing the current draw (amps) of a motorized tool is a good way to spot problems. And it takes only a few minutes using an ammeter. When I'm shopping for used tools, I take the ammeter with me and test tools on the spot. I also test new tools after bringing them home from the store to make sure they're working properly—or as advertised.

I prefer Fluke Corp. professional equipment (425-347-6100), but Radio Shack (800-843-7422) sells some less-costly testers that will work, too. To get useful information, you'll need to test tools under a load. It's important that the cutting tool be sharp and that the load be a typical woodworking operation.

For example, to test a drill, I'll chuck in a sharp, large bit and bore into a chunk of wood while a helper observes the meter. The Radio Shack ammeter has a special female plug that a tool plugs into; a male plug from the meter goes into the wall outlet. With other meters you must open your service panel and isolate the hot wire. Either way, turn off other appliances or lights to the circuit being used for the tool test, then record the reading while running the motor at full load.

If the reading varies 10% or less from what's on the nameplate, I'm not worried. I enter that number in the tool's manual for reference. Down the road, if a tool isn't performing well, I'll check it again. If the reading is different, then I know the tool needs servicing. For example, a high reading on the ammeter when a tool is not under load may indicate that a bearing is about to seize.—*M.S.*

extra horsepower as well as excess heat. But that's like pushing the rpm of your car well into the red zone before shifting gears. You can get away with it for a while but at a cost in longevity.

Robert Carson, the electrical engineer at Delta International, says excessive temperature is the enemy of electric motors. "The bad thing about running hot is that temperature burns up a motor. There's a general rule of thumb: You load the motor up to the amps on the nameplate, and that produces a safe operating temperature. That motor is designed to run 40 years like that. But every time you overheat a motor by 10°, you halve the life of it. On a new tablesaw, if you're ripping thick oak at an overly fast rate and overheating the motor by 10°, your motor is good for 20 years. Do it again, then it's good for 10 years. Do it again, then five years. And so on."

Motors on many newer tablesaws come with thermal overload protection. When the motor overheats, it automatically shuts down and won't start until it cools. This is a good safety feature to look for. But if you have a saw with thermal overload protection and it continually shuts down, chances are you're asking it to do too much. Assuming there's no problem with the tool, the blade and your power supply, you either need to change the way you feed stock or get a more powerful machine.

Other things that affect power output

The actual power output of electrical motors is affected by other factors, including the length of wire from the circuit breaker to the tool, the number of other outlets connected to that line, the type of extension cords used and the condition of outlets, switches and motor bearings. If you have other tools or lights running off the same circuit as a high-amp motor, the motor may not be able to get enough current to reach its full potential.

To give a motor all of the current it needs at full load, do not use an extension cord longer than absolutely needed and use the proper gauge wire recommended by the tool manufacturer. I never use a cord smaller than 12 ga. (the higher the number, the smaller the diameter) for any tools in my shop. A 12-ga. power cord can handle up to 20 amps (for more on wire gauge, see the story on p. 73).

There's another trick to preventing an overload. Whenever possible, I wire my induction motors (the nameplate usually says whether this is an option) for 230 volts (see the left photo on p. 73). The advantage of changing from 115-volt to 230-volt operation is that all else being equal, at twice the voltage the equivalent power tool will run with one half of the current. Because current is what overloads wires, by halving the current I give myself a greater margin. For a given cord length I have one half the problem, or I can go twice as far from my socket with the same tool. Put another way, a contractor-style tablesaw that's rewired for 230 volts may give you the edge to rip a hunk of 8/4 maple without tripping the overload protection or circuit breaker. □

Martin Seifert works in the automation and power plant generation industries and enjoys woodworking in his spare time.

Universal motors (continued)

three sections of the commutator at any given time. On cheaper consumer-grade motors, you'll only see one or two segments in contact with the brushes. More segments means the tool will have a smoother torque output when under load.

Put the tool back together, plug it in and examine the arc around the commutator. On a good-quality motor, the arc will be confined close to the brushes. The arc on a cheaper motor will be blowing out all over the place like a Fourth of July sparkler.

In general, better-quality tools typically come with soft rubber power cords that stay pliable even in cold weather. But there are times when I don't need an industrial-quality power tool, so I'll settle for less. I will replace the power cord, though, if it's made of stiff vinyl. Replacing the cord will make the tool easier to use.—*M.S.*

Three Ways to Make Cabinet Doors

Construct joints for fine furniture, glass panels or cabinets to go

BY STEVE LATTA

In a perfect world all cabinet doors would be constructed using stout mortise-and-tenon joints, built to last generations. When I reproduce an 18th-century piece, I build doors whose joints will outlast these achy joints of mine. My clients pay for that, and I would not sleep at night giving them anything less.

At the other end of the spectrum, would I go to the same effort for a bathroom vanity that will end up on the curb after the next remodel? Probably not. There are faster ways to make a door. A door meant for hiding everything from towels to toilet cleansers doesn't have to rise to the level of a hutch.

I could come up with a dozen or more methods to join doors, but there are three that will solve most needs: doors for the finest furniture, doors for glass panels and low-budget doors that you need to get done in a hurry.

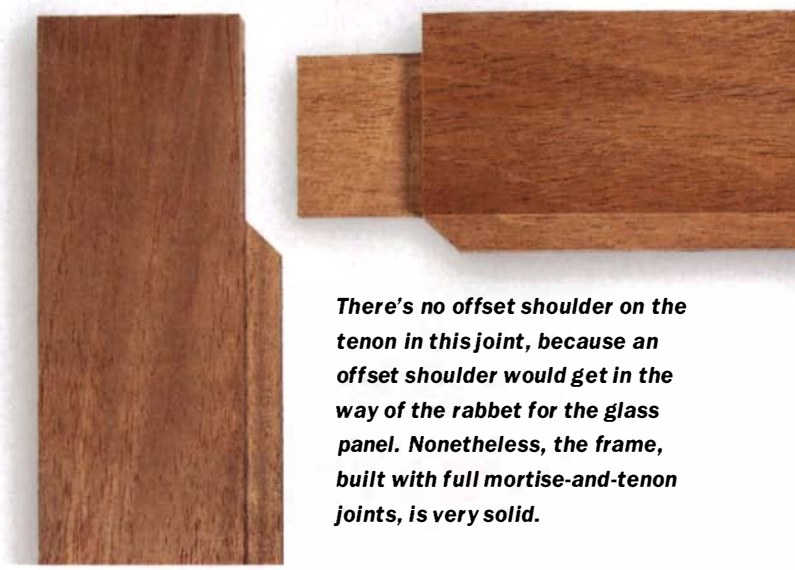
Best method for strong, classic frames

After cutting the stock to its rough size, mold a profile and cut a slot in all of the frame members. Although sometimes I'll use just the sticking portion of a cope-and-stick set to cut the profile and groove in one pass, I often resort to standard router bits. By mixing and matching standard bits, I have an infinite

SOLID PANEL

Full mortise-and-tenon joints make this the best method for constructing fine furniture. Additionally, the tenon's offset shoulder adds rigidity to the joint. The profiled corner must be mitered for the joint to close.

GLASS PANEL

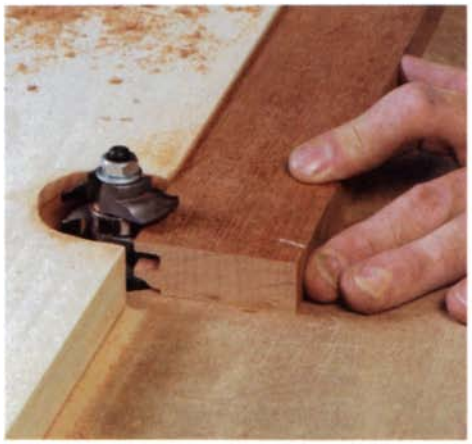


There's no offset shoulder on the tenon in this joint, because an offset shoulder would get in the way of the rabbet for the glass panel. Nonetheless, the frame, built with full mortise-and-tenon joints, is very solid.

COPE AND STICK

Cope-and-stick bits are used to machine the profile, groove and stub tenons. To strengthen the weak stub tenon, glue a plywood panel in the frame.

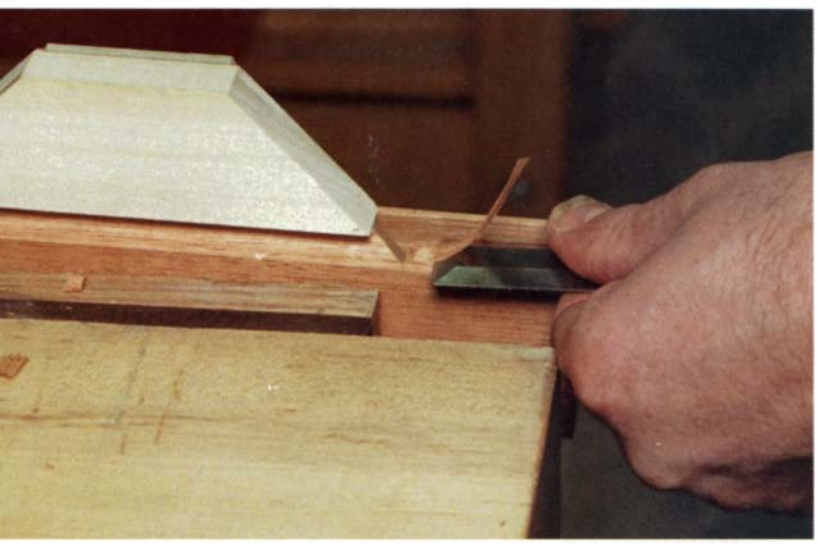
Photos this page: Michael Pekovich



Shape the rails and stiles on the router table. *The sticking portion of a cope-and-stick bit cuts the profile and groove in one pass. Set the fence flush with the bearing.*

Rails must have offset shoulders. *Guide the stock along the tablesaw fence and push it using a backer block for extra support.*

Cutting the cheeks without a tenoning jig. *The rail is pushed along an auxiliary fence clamped to the tablesaw's fence. A backer block prevents tearout.*



Make final adjustments using a chisel. *The back wall of the groove on the stiles must be removed up to the miter. On both rails and stiles, use a guide block—a piece of scrap cut at 45° and clamped to the stock—to miter the inside corners of the profile.*

variety of profiles available to me. Cope-and-stick bits come in just a handful of profiles. To cut the slot, you can use a slot-cutting bit or a dado head on the tablesaw.

Mortises are cut next. These are usually located on the stile members. Cut them with your preferred tool, the same thickness as the width of the groove, flush with the walls of the groove. I generally cut the mortises to within ⅜ in. of the outside edges of the doors. But if you're making doors whose backs will be rabbeted for an overlay construction, leave at least ⅝ in. beyond the mortise. That way, when you cut the rabbet around the perimeter of the door frame, you won't cut into the joint.

Next, cut tenons on the rails. This involves a couple of setups on the tablesaw because the rear shoulder is offset more than the front shoulder. The offset has two advantages: It adds an element of triangulation to the joint, which makes it very strong, and it looks good from both sides. Begin by cutting the shoulders on the tablesaw, which will require two setups. Then cut the cheeks. To account for shrinkage, I prefer to machine tenons a hair oversized, then let the stock settle overnight.

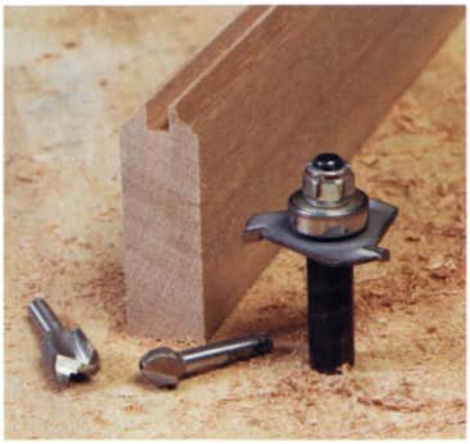
For a tight fit, handplane the cheeks until the joint slips together snugly. Lastly, the molded profile must be mitered at the inside corners. I do this by hand, using a chisel and a simple jig. To locate the miter, fit a rail to a stile as far as it will go, mark the inside corner, disassemble and clamp the jig to the stock. Then shave away the waste with a chisel.

This method produces an exceptional joint that can be improved by draw-boring or wedging either a blind or through-tenon (see *FWW* #132, p. 74). With a typical 1½-in.-long tenon, the amount of glue surface is about four times that of a ⅜-in. stub tenon, the kind you typically end up with when using cope-and-stick router bits. It's unlikely that you'll ever have to repair a door built this way.

Door frames for glass panels and more

When a project calls for doors with glass panels, you need a frame with a rabbet on the back to house the glass. Although you could use the previous method for glass-paneled doors, it's not ideal. Be-

Photos: Anatole Burkin, except where noted; bottom, this page: Michael Pekovich



Use a sticking bit or make your own profile from stock router bits. *A straight bit, left, a cove bit and a slot cutter were used to mold this profile. As an added touch, both sides of this frame were profiled.*

Shoulders are the same height on all sides of the rails. *After cutting the shoulders, raise the blade high enough to remove the cheeks.*

Miter both walls of the groove. *Using a guide block and chisel, pare away the miter, which in this construction will show on both the front and back of the door.*

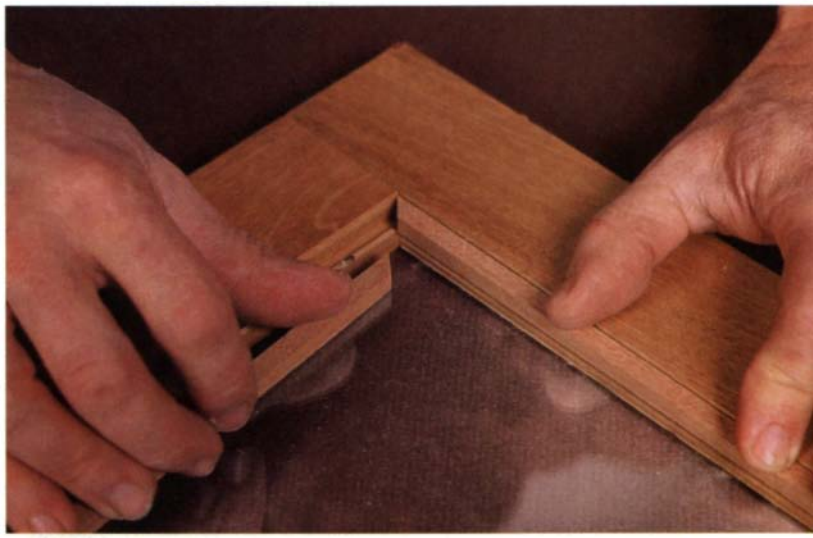
cause of the offset shoulder cut on the rails, a rabbet cut into the back of the frame will also end up offset and won't look good.

After milling the rail and stile stock to rough sizes, I run the molding. Cut the profile using either of the previous methods: by using the sticking portion of a cope-and-stick bit or by mixing and matching standard router bits.

Next, cut the mortises, same as before. The tenons, however, are cut differently. Forget about setting up for the extra shoulder cut on the back of the rails. Cut all of the tenons with continuous shoulders all the way around. Again, make them a hair thick and let them sit overnight.

As in the previous method, the molded profile must be mitered for the joint to close. But because there's not an offset on the shoulders of the rails, both the front (the profiled edge) and rear walls of the slots must join in a miter. Use the same jig as mentioned earlier and a wide chisel to miter both walls at the same time. When you dry-fit the frame, you'll notice the back looks funny because of the miter. But for glass panels, rip off the rear walls of the groove, which eliminates the miter. To hold the glass, I'll often rely on tinted glazing putty alone. You could also rip strips of the same species of wood and screw or nail them in place, mitered at the corners. (Cut the bottom piece in two for ease of removal should the glass need replacement.)

If you like this construction method (it's faster than the first) and want to apply it to floating wood panels, here's a trick to make the back of the frame look as elegant as the front. Run a profile along the back inside edge of



A glass panel is fitted from the rear. *After ripping away the rear wall of the groove, insert the glass and secure it with small strips of wood nailed or screwed in place.*

Same method, two applications. *By profiling both walls of the slot (top), you can make an elegant frame for a solid panel. Or rip off the rear wall (bottom) and fit a glass panel.*

Photos this page: Bottom left and right and middle right: Michael Pekovich

Cope-and-stick bits do most of the work. *The sticking portion of the bit cuts the profile and groove in one pass. These bits are best suited for ¾-in.- to ⅞-in.-thick stock.*

the frame. That funny-looking miter is transformed into an elegant inside corner, and the door will look good on both sides.

Cope-and-stick joints need reinforcement

A lot of inexpensive kitchen cabinets are built using cope-and-stick router bits. These tools cut the profile, groove and stub tenons in two quick operations. Many of these bits leave you with ⅜-in.-long tenons. (For more on the styles of cope-and-stick bits, see the story below.) Some router-bit manufacturers, such as Jesada, offer bits that cut 7/16-in.-long tenons. That's a slight improvement, but I wouldn't put solid-wood floating panels in door frames joined this way. A combination of seasonal movement and an occasional slammed door will take a toll.

The weak point of cope-and-stick doors is the profiled edge. Routing the profile removes a fair amount of wood. Yet this area is expected to do double duty as a mortise wall. Pull or push too hard on a door, and the stub tenon will split off the molded edge. The stub-tenon-to-groove glue joint is another weak area. There's not a lot of surface area to glue, and if you mill these parts a little loose or the wood shrinks, the joint will fail.

Cope-and-stick router bits

REVERSIBLE BIT

COMBINATION BIT

MATCHED SET

Cope-and-stick bits are made three different ways. *Reversible bits must be disassembled between coping and sticking cuts. Shims are used to adjust the fit. Combination bits are raised or lowered, depending on the cut. They may also be shimmed. Matched sets have separate coping and sticking cutters. No shims are used.*

There are three types of cope-and-stick (sometimes called rail and stile) router bits: reversible, combination and matched. All must be used in a router table. And although each bit has a bearing mounted on its shaft, I always use a router fence set flush with the bearing for extra support. To understand these bits, it helps to define their components.

The sticking is the profile and groove that is cut along the edge (long grain) of the stile and rail. The coping is the reverse pattern that is cut on the end (end grain) of the rail. The coping cutter leaves a stub tenon as deep as the groove for the panel.

For a tight-fitting joint, the bits must be machined to high tolerances, and

Top left and bottom photos, this page: Michael Pekovich

Rout the matching coping. *Use a backer block when cutting the coping along the end grain of the rails.*

To strengthen these joints, use a plywood panel (or other man-made product) and glue it on all four sides to the grooves. I know some woodworkers who try to beef up the stub tenons with dowels or loose tenons and then install floating solid-wood panels. They can help, but I've seen these fail prematurely. On most pieces of furniture, we're not talking about a lot of joints. Making full mortise-and-tenon joints just makes sense to me. □

Steve Latta is an instructor at the Thaddeus Stevens Institute of Technology in Lancaster, Pa.

Where cope-and-stick joints fail. *The molded edge, which has been reduced in thickness, is a weak spot in this joint. That's why it's a good idea to glue plywood panels into the grooves of the door frame, which will produce a much sturdier door overall.*

this isn't always the case. If you can't get a joint to fit after much trial and error, contact the manufacturer and see about getting a replacement. All of these bits require set-up time. Once you have a setup that produces good joints, make samples and keep them for reference.

Although prices vary greatly among manufacturers, reversible bits tend to be the least expensive of the three types. They're also the most difficult to use. After routing the sticking, a locknut must be removed in order to flip-flop the top cutter before machining the coping. Shims may have to be fitted between the bearing and top cutter to fine-tune the fit.

Combination bits, which are intermediately priced, have all three cutters positioned on the bit's shaft. To change between the coping and sticking cuts, the bit is either raised or lowered. Again, shimming may be necessary to get a good fit. With some bits, it's just hard to get a good fit; either the tenon is snug and the coping is loose, or vice versa.

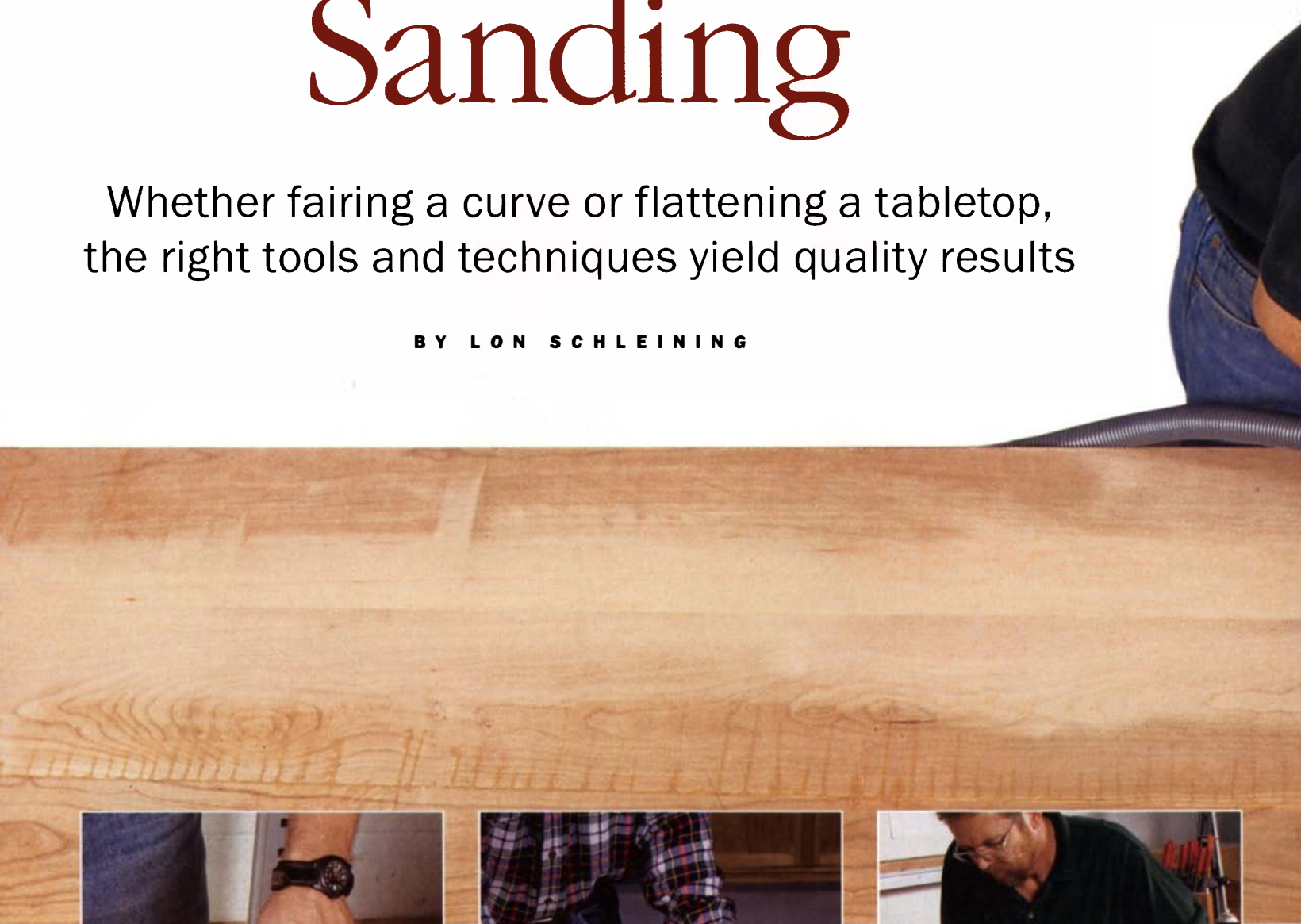
The most expensive option is to purchase a set of matched bits that are machined to complement each other. Although I've never conducted an in-depth comparison test, among a random sampling of bits I had on hand, the matched set produced the best fit.—S.L.

Reversible bits are adjusted by using shims. *A good-fitting coping and snug-fitting stub tenon require some trial-and-error when adjusting the distance between the cutters.*

Tips for Better Sanding

Whether fairing a curve or flattening a tabletop, the right tools and techniques yield quality results

BY LON SCHLEINING



PICKING THE RIGHT SANDING TOOL

FLATTENING A TABLETOP

FAIRING A CURVE

When I tell students in my woodworking classes at Cerritos College that sanding is one of my favorite activities, they usually look at me like I'm a little cracked. But the truth is, I look forward to sanding—especially that last hand-sanding, which tells me I've finished another job. With thoughtful planning and the right tools, sanding doesn't have to be tedious.

I approach sanding in two stages: shaping and smoothing. If the piece still needs some work after it is cut and pared with other tools, then sanding tools can complete the shaping. If I'm working on a curved piece with changing grain direction, for example, I can shape it more easily with a sanding tool than with an edge tool. There is also less chance of tearing out the grain.

Shaping uses 80- to 120-grit sandpaper and powerful tools. I use a 4-in. by 24-in. belt sander, 5-in. and 8-in. rotary disc sanders, a right-angle random-orbit sander, an inflatable, handheld drum sander and a spindle sander—whatever best fits the job I'm up against. During shaping, I sand until I can no longer spot any machine marks, lumps, glue marks or deep scratches. If I find rough patches, I go back to shaping with 100-grit sandpaper before I begin smoothing.

Smoothing usually involves using less aggressive machines and paper grits of 120 and finer. I use an orbital sander, palm- and pistol-grip random-orbit sanders, as well as hand-sanding blocks of various shapes and sizes—both flexible and rigid. If this sounds like a lot of sanding tools, it is. It just boils down to the fact that it takes different tools to handle different jobs efficiently.

Both sanding stages are best done sooner rather than later—ideally, prior to assembly. This usually saves me from sanding for long periods of time, and it also keeps me from sanding into tight spots. A drawer is a good example. If the interior pieces of a drawer need sanding, do so before assembling the drawer. This way the sanding can be done in minutes without the difficulty of sanding into inside corners. Any miters or frame-and-panel assemblies can be handled the same way, saving countless frustrations. Then after assembly, usually only a light hand-sanding is needed before the finish is applied.

Sanding involves removing all of the machine marks and the scratches left by rougher-grit sandpaper. Then, using finer and finer grits, the scratches from the previous sandpaper are reduced until the piece is smooth. Often, grains come off the paper as the sanding takes place. And if larger sanding grains from earlier grits are left on the surface, they can be rubbed into the board and gouge the wood. You can prevent this by vacuuming dust and sanding debris before moving to finer grits.

The first step toward efficient sanding is to make sure you remove all of the scratches from the previous tool. I spend more time (80%) with the rougher

Photos: Matthew Teague

grits and less time (20%) with the finer grits. If you sand thoroughly with each grit and move from one grit to the next without skipping, no single grit takes a long time. After removing milling marks with 100 grit, don't skip 120 and 150 grits. No matter how long you sand, 180-grit paper will not remove scratches made by 100-grit paper. And when you're sanding, sand the entire project one grit at a time. Sanding only part of the project will inevitably result in a poorly sanded project, and the finish will suffer.

Use finer-grit sandpaper on rougher, more aggressive tools. I rarely use grit even as rough as 80 on my belt, orbital or disc sanders. One hundred grit is just about as fast and won't leave such deep scratches. Remember that even though the grit itself is finer on 100-grit paper than it is on 80 grit, there is more of it—so the cutting speed is often the same. The harder the wood, the harder it is to remove scratches. On woods like hard maple, it is very difficult to remove the scratches left by using rougher grits like 80 or even 100. You can alleviate this problem by starting with 120-grit or finer paper.

Most woodworkers have heard the expression, "Let the tool do the work." No where is this more applicable than with sanding. The machine should supply the power. The sandpaper should supply the cutting action. All the operator should supply is guidance, not downward pressure. If you find that you're applying so much downward pressure that you're getting tired, chances are your sandpaper is too dull or your machine is too light for the job.

The microscopic grains of sand on sandpaper are initially very sharp. They cut into the surface quite readily with little effort or pressure. They soon dull, however. The sharp points

Tuning and using a belt sander

An uneven sander won't flatten anything. *The author replaces a belt sander's metal platen with graphite-coated canvas using the old platen as a pattern. A new, flat platen can make a big difference in a machine's performance.*

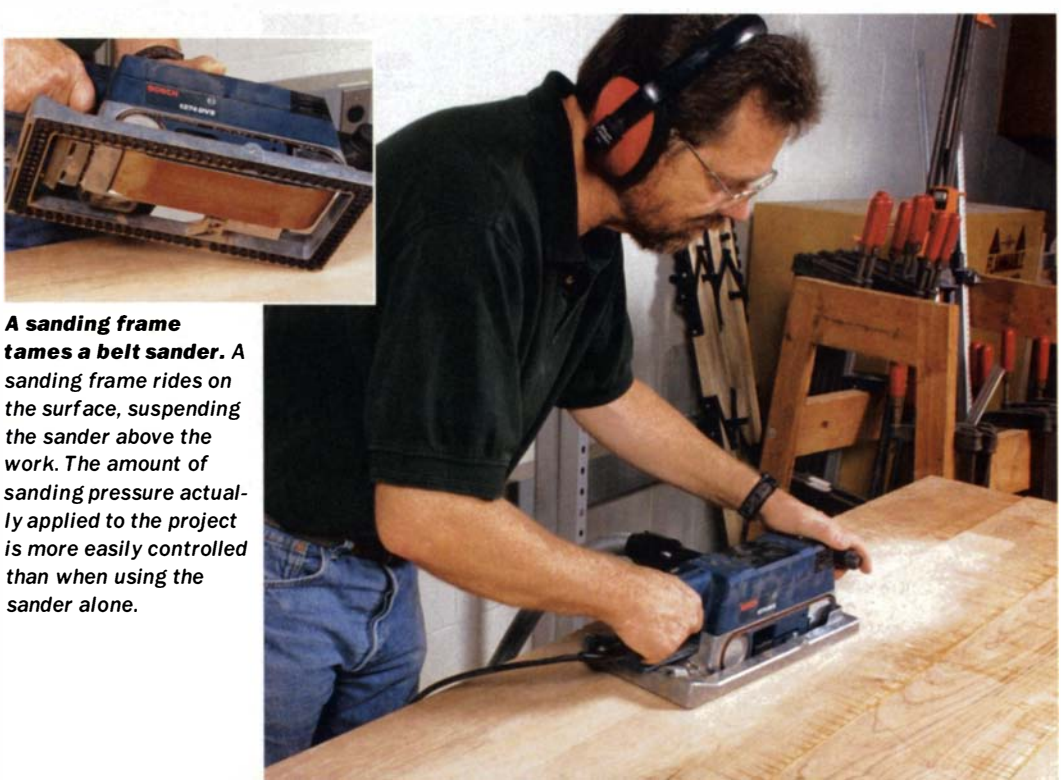
On most projects, my belt sander is the first tool I reach for. I've heard countless horror stories from students and woodworkers about projects they've destroyed with belt sanders, but with a few adjustments and a little practice, it's an invaluable tool.

One big problem I've noticed is that the stock sheet-metal platens on most belt sanders are rarely flat from the beginning, much less after hours of use. As the belt rubs against and heats the platen, the metal distorts, creating a convex platen that will leave a dished-out sanding pattern. Luckily, platens are easily replaced with graphite-coated canvas (see the photo at left), the material normally used on larger sanding tools. The canvas is available from Klingspor (800-228-0000).

A belt sander must sit flat on the surface to do its job. Start with the sander resting on the work. When you pull the trigger, the machine will lurch forward a bit. But once it starts sanding, simply let it float on the surface. Keep it moving, but don't grip the handles so tightly that you tilt the machine or prevent it from floating across the surface.

Practice helps. Cover a surface with pencil marks to see whether you're actually sanding where you think you are. Then sand only a few seconds between inspections. You might be surprised to see that you didn't sand where you thought you did, and vice versa. You'll see that to sand out to the edge, the sander must hang about half its length over the edge.

If you're as frustrated with a belt sander as some of my students are, try a sanding frame. A frame helps control a portable belt sander so that it sands evenly (see the photo below). Sanding frames are now available from most sander manufacturers, and though the investment is small, the difference is tremendous, especially if you're just starting out.



A sanding frame tames a belt sander. *A sanding frame rides on the surface, suspending the sander above the work. The amount of sanding pressure actually applied to the project is more easily controlled than when using the sander alone.*

Using orbital and random-orbit machines

An orbital sander is a wonderful tool, but if used incorrectly it can ruin a nice project in seconds. A tool long relied upon in the boat-building trade, the large 8-in. disc will remove material at an amazing rate.

An orbital sander removes material as the disc spins in a circular pattern. There are soft, hard, flat and curved pads—all used with different techniques and for different jobs. Soft pads conform to curved surfaces, and curved pads will sand to a feather edge. Hard, flat pads sand surfaces flat. I use a variable-speed Milwaukee with a special pressure-sensitive adhesive (PSA) foam pad. I also have a buffing attachment for buffing out finishes.

A random-orbit sander works like an orbital sander, except the disc not only orbits but also rotates. The random action produces a sanding pattern that is almost indiscernible on the surface of the wood. On flat surfaces, this can save you from hand-sanding completely. But if you try to sand a curved surface or the edge of a project, the rotation of the sanding pad stops. Sanding anything but flat surfaces with a random-orbit sander defeats the whole purpose of using this machine.

Always hold it steady and flat. *Some newer orbital sanders are as aggressive as belt sanders. As with any sander, the pad should be held flat on the surface. Any time the pad is tilted, it digs a crater in the surface of the work. Back up a grit or two to remove them.*

Hand-sanding with a block

Always use a block when hand-sanding a flat surface. Without a block, hand-sanding applies pressure only where your fingers are, resulting in a surface that will never be as flat as you'd like. A block spreads the pressure evenly across the board. To apply pressure to the high spots on the board without loading up the paper, cushion the block with cork or felt. As the sandpaper cuts, the dust is deposited more evenly on the surface, not just in a few spots.

Do not use a hard wooden block for hand-sanding. The sandpaper almost immediately gets filled up in just a few spots. These spots then build up into small, volcano-shaped high points, and the result is a project that has scratches in it, even after all your hard work.

My sanding block is nothing more than a block of wood with felt glued on one side. I cut a block the right size, glue ¼-in.-thick felt on it, and that's it. I make my sanding blocks one-third the size of half of a sheet of paper and then glue on the felt. For sandpaper, I tear sheets in half, then fold this half piece into thirds (see the photo at left). The entire sheet is used with this system. Folded in thirds, there is sand exposed on two sides. One side sands, the other goes against the block, sticking to the felt. When both of these sides are worn, refold the paper to expose the last third for the final sanding. This is one time where saving labor is worth more than the material. I only apply light pressure, and I change the paper often. Once paper gets dull, I throw it away and grab another piece.

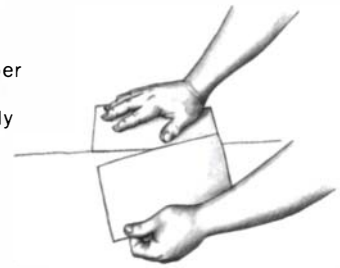
For hand-sanding contours, a larger piece of sandpaper better fits my hands. The drawings at right show an efficient way to use a whole sheet of sandpaper without waste.

Folded half sheets for a sanding block. *Tear paper in half and fold it into thirds, taking care to use every surface before you discard the sheet. Felt on the block evens out the sanding pressure and helps hold the paper in place.*

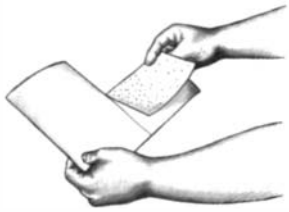
FOLDING A FULL SHEET FOR HAND-SANDING WITHOUT A BLOCK

Folding a sheet of sandpaper into quarters ensures that all surfaces get used. With this system, the cutting sides don't dull by rubbing against each other.

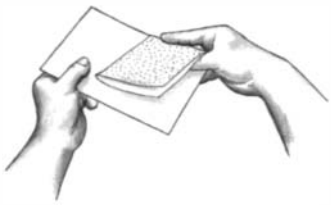
1. Sandpaper is creased but torn only halfway across its length.



2. First quarter of paper is folded with grit facing out.



3. The two thicknesses of sandpaper are folded onto sheet's third quarter.



4. Fourth quarter of paper is folded into final shape, without ever having to fold grit onto grit.

Drawings: Mark Sant'Angelo

break off, the paper gets clogged with dust and cutting no longer takes place—only rubbing. And this rubbing has the effect of polishing or glazing the wood's surface, not smoothing it.

Sanding efficiently means going through a lot of sandpaper. It's a hard rule to get used to, but I save a great deal of time and sweat by throwing away sandpaper before it gets dull. You can feel the paper lose its cutting action when sanding gets easier. This is because the paper is sliding over the surface instead of digging in. Use the oldest belt or disc until it is dull, then throw the old one out and reach for a new one. That way you won't have 50 partially used sanding belts on the shelf.

The shadows left by glue may not be visible until the finish is applied, so around glue joints sand a bit more to ensure that the glue will be completely removed. I always try to err on the side of sanding too much rather than too little. When it looks like you're finished, sand just a little more.

If you're using a penetrating oil finish, you'll want the surface as smooth as possible, up to about 400 grit. But if you're using a water- or alcohol-based stain, the stain will raise the grain when it is applied, so stopping at 150 or 220 grit makes more sense. The first coat of finish sealer, paste filler, stain or primer will harden and stabilize the surface. Then move to the finer grits, from 180 to 400. Read and follow the instructions that come with the finishing materials before you start the sanding process. Let the tools and sandpaper do the work. In no time, your project will be perfectly sanded and ready for finish. □

Lon Schleining is a stairbuilder and woodworking instructor in Long Beach, Calif.

Flattening a tabletop

Flattening a tabletop is one of the toughest sanding jobs, especially if your glued-up boards are not quite flush with one another. But the plan of attack is quite simple: Remove the high spots and avoid sanding the low spots. Here's the easiest way I've found to bring a tabletop flat.

1 First concentrate on the glue joints because they will eventually be the low point to which you must work once they're flush. With a belt sander, I sand with 100 grit at about a 45° angle, first to the right of the grain pattern and then to the left. Sand evenly in both directions. This way there's a chevron pattern to the sanding marks.

2 & 3 Use a straight board as a batten and coat it in chalk to see where the top is not flat. Rubbing the board across the top quickly highlights the high spots where more sanding is needed.

4 Once you sand off all of the chalk, start the process over. Eventually, the piece will be flat. If this sounds oversimplified, it's not. Once the surface is flat, use the same grit to sand with the grain to remove the cross-grain scratches.

It's possible to do this flattening with a well-tuned and very sharp handplane using the same technique, but you risk digging into the work or causing tearout. On the other hand, for a few dollars, a commercial drum sander can flatten your tabletop in just a few minutes.

Rounding the gluelines. *Horizontal chalklines stripe the surface, and only the highest spots—the gluelines—are sanded in vertical stripes until the curve nears its final shape.*

Fairing a curve

Chalking high spots. *A thin batten is coated with chalk, then bent across the surface to find high spots in the curve. The chalk marks are sanded away with a sanding block.*

Pliable sanding block. *The author glues sandpaper to ¼-in. plywood, which bends and slides smoothly over the surface, keeping a curve in line.*

Fairing a curve means shaping it to eliminate any lumps or hollows. In woodworking, as in sculpture, the only means you have to make the curve fair is to remove material. This means that you must concentrate on the high spots and leave the low spots alone. This sounds simple enough, but in practice it's sometimes difficult even to tell the difference.

Sanding just to be sanding almost always makes the curve more lumpy. On edge curves, I often see students attempting to smooth or fair a curved piece on the spindle sander by running the entire curve over the sander without stopping to feel the surface. I know they are about to have a bigger problem than they already have, so I stop them, with a reminder that sanding done sparingly and selectively will give them the result they seek.

The correct process is to sand the curve for only a few seconds, just enough to remove tool marks. Then run your fingers over the surface, feeling for consistency. When you find a high spot, mark it with chalk or pencil and remove only these lumps, staying away from the hollows as much as possible. Stop and feel the surface again, marking the spots in need of sanding as before. Gradually, the surface becomes smoother and the curve more fair.

Sometimes on larger curves, the lumps are hard to feel. You can find high spots by coating a batten (a flexible piece of wood) with chalk. Bend this batten across the surface and rub it back and forth. The chalk will rub off on the high spots, leaving a clearly marked area to sand.

Virtually dust-free sanding

The dust produced by sanding is the finest and probably the most harmful. Newer sanding tools collect more of the dust generated, but there are still a few ways to get even better dust collection. With portable sanders, I don't use the dust-collection bags. Instead, I increase the effectiveness of the internal vacuum system by hooking a vacuum hose directly to the sander.

My best defense is a shopmade downdraft table. There are commercial versions available, but I made a simple 2x4 frame and covered both sides with ¾-in. plywood. On one side I cut a hole to accept hookup from a dust-collection system. I also drilled a number of small holes. Not only does the suction from the dust collection pick up stray dust through the holes, but it also helps hold the project to the table.

A downdraft table keeps it clean. *The author's sanding table is just a box drilled with holes to suck the dust away. This simple box, made of plywood and 2x4s, hooks up to a dust-collection system or shop vacuum.*

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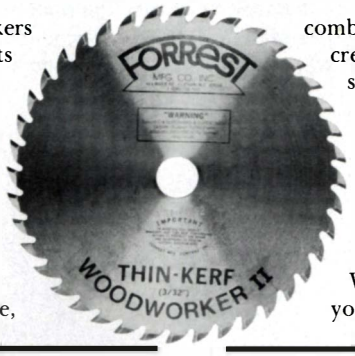

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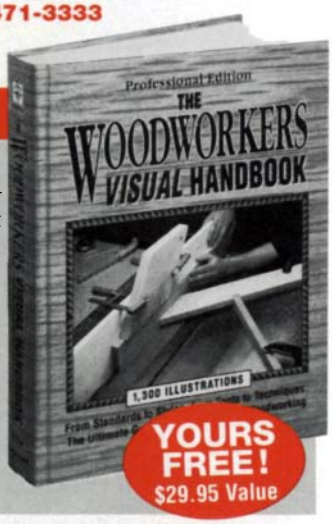

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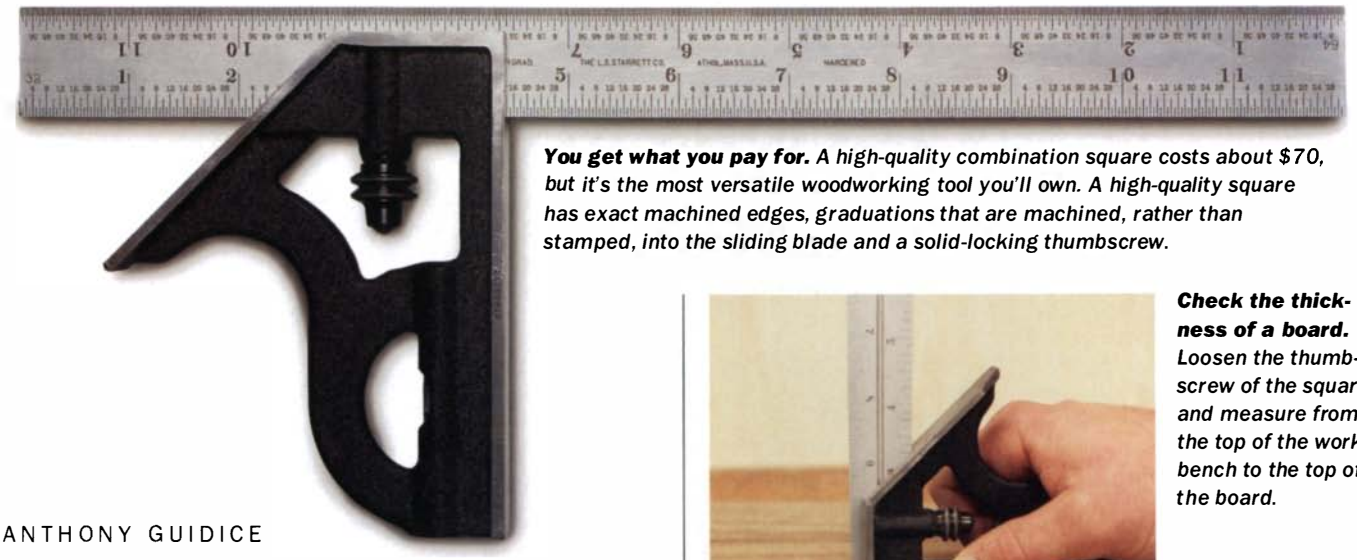
Rules of Thumb

The combination square: a perfect name for a near-perfect tool



You get what you pay for. *A high-quality combination square costs about $70, but it's the most versatile woodworking tool you'll own. A high-quality square has exact machined edges, graduations that are machined, rather than stamped, into the sliding blade and a solid-locking thumbscrew.*

BY ANTHONY GUIDICE

The combination square is the most versatile measuring tool there is. It is so valuable that I have my beginning students use it to the exclusion of all other measuring tools—at first. The tool teaches beginners the concept of accuracy in layouts and measurements. You mark a line and look at it. It isn't automatically square. Does it look square and straight? If it's not, you're the cause, not the tool. For a beginner, using a simple tool helps develop this concept. It keeps the mind uncluttered. Later, a student can use marking gauges, cutting gauges and center markers. But far from just a great learning tool for woodworking students, the combination square is an indispensable little device for all woodworkers.

Use it as a depth gauge ...

A combination square works very well as a depth gauge and a thickness gauge. I use mine as a thickness gauge when I'm using a power plane. I lay a board flat on the workbench, loosen the thumbscrew on the square and measure the distance between the top of the board and the bench. To measure the depth of a mortise, rest the square on the edge, extend the blade into the mortise and read the depth. To use it as a height indicator for a tablesaw blade, preset the depth you want and raise the tablesaw blade until a tooth at the top center contacts the square.

As a marking gauge ...

The combination square is a good substitute for a marking or cutting gauge. For hand ripping and planing, clamp the work in the bench first. Set the dimension on the square and lock it. Slide the square along the edge of the board while guiding a marking knife or pencil with the edge of the blade. This takes practice, but you can get the hang of it pretty quickly. For mortises and tenons, mark with a sharp pencil on the work, adjust the square to that and mark the whole joint with the knife. The same technique can be used to mark depth on the end of the board for hand-cutting dovetails.

As a try square and to calibrate your tablesaw ...

An accurate combination square can also be used as a try square. It can measure inside corners or outside corners. Quite often I use

Check the thickness of a board. *Loosen the thumbscrew of the square and measure from the top of the workbench to the top of the board.*

Use a combination square as a depth gauge. *To check the depth of a mortise, rest the head of the square on the face of your wood and lower the blade into the mortise.*

The square works as a marking gauge. *Set the blade to the desired width, hold the head against the edge of a board and, while holding a pencil at the end of the blade, slide the square along the edge of the board.*

Top photo: Michael Pekovich

my combination square for marking 90° crosscuts or 45° miters when I'm making a cut with a handsaw.

I calibrate my tablesaw with the combination square. Raise the blade all the way, then lock the combination-square blade flush with the corner, and sight for 90° by holding the square tight to the sawblade, making sure the square's blade isn't resting on the edge of any of the blade's teeth. Use the square without the blade to calibrate the 45° setting.

You can also use a combination square to check the squareness of your tablesaw blade to the miter-gauge slot. First, unplug your saw and raise the blade to its full height. Mark one of the saw teeth with chalk. Rotate the marked tooth to the front of the blade insert, rest one edge of the square in the miter slot and extend the combination-square blade out to the tooth. Rotate the marked tooth to the back of the sawblade insert and check it with the square. If the blade tooth doesn't meet the square exactly as it did in front, you need to adjust the saw.

Or set your router

I have a jig for cutting mortises with a plunge router, and I use a combination square to set the edge guide. I lock in the distance from the edge of the jig to the mortise on the combination square. I use that setting to set the distance from the bit to the edge guide. To rout dadoes, you can set the distance from the edge of the router base to the bit, then use that to set a straightedge clamp. In a router table you can use the combination square just as you did with the tablesaw blade to measure the depth of a cut.

Quality costs and quality counts

An important consideration when buying a combination square is its quality. Good ones can cost upwards of $70, but they are worth their weight in gold. Poor-quality combination squares are fine for rough carpentry like framing, but you really need a high-quality square for precise work. Errors accumulate very quickly in woodworking, particularly in machine work. If you start measuring inaccurately and making cuts, before you know it, one side of your work could end up being 3/16 in. shorter than the other.

There are several things to look for when acquiring a combination square. The sliding blade of a good square is heavy and stiff, and the measurement graduations are machined into the blade rather than stamped. The square's head—the part that holds the blade—should have an easy-to-use locking thumbscrew that holds the blade with viselike rigidity.

There is also a difference in how a high-quality combination square works. An accurate combination square is absolute in its indications; you can very easily tell if the work is on the mark or not. By comparison, measurements from a poor-quality combination square aren't clearly defined because either the measurement graduations aren't easily read or the measurements aren't accurate.

As I've said, a good-quality combination square is versatile: Use it as a depth gauge, a marking gauge, a square and a ruler. The sliding blade can also be removed from the head and used as a short straightedge or as a handy ruler. A final note, and this is important: never, never, never use the blade of your combination square as a mini prybar or to pop open a paint can. ... Although, if you want to stretch the meaning of "combination" and possibly ruin the trueness of the blade, it will work quite well for those tasks, too.

Calibrate your tablesaw. *Lock the blade at the 90° end of the head and hold the square against the edge of the sawblade, making sure the square's blade rests along the edge of the sawblade, not against one of the teeth.*

Check the squareness of the saw table to the sawblade. *Hold the square tight to the miter slot and set the blade so that it just touches the edge of a blade tooth at the front of the blade insert. Rotate the blade, slide the square back and check the same tooth at the back of the insert. If the tooth doesn't meet the square exactly as it did in the front, your saw needs adjusting.*

Use it as a router gauge. *It's easy to check the base-to-bit distance on your router. You can then use the square to set up a straightedge for routing dadoes.*

Photos: Jefferson Kolle, except where noted

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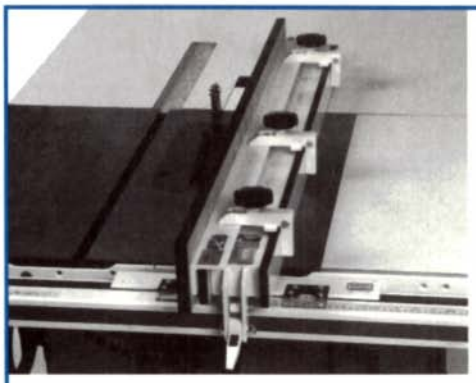

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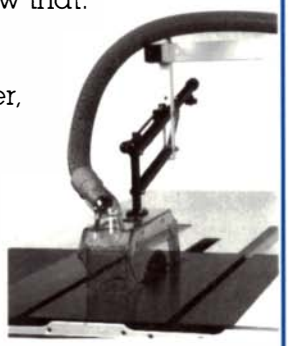

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31-695	6" Belt/9" Disc Sander	441	299
23-710	Sharpening Center	217	145
31-460	4" Belt/Disc Sander	198	119
40-560	16" 2 speed Scroll Saw	230	129
40-540	16" var/spd Scroll Saw	249	159
11-990	12" Bench Drill Press	255	184
11-090	32" Radial Bench Drill Press	405	279
43-505	1/2" Bench Router/Shaper	398	299
22-540	12" Bench Top Planer		Sale 259
22-560	12-1/2" Planer w/ extra knives		329
36-865	Versa Feeder Stock Feeder		249
36-220	10" Compound Mitre Saw	294	199
36-240	10" Sliding Mitre Saw	589	439
37-070	6" v/spd Bench Jointer	351	265
14-650	Hollow Chisel Mortiser	380	249
17-900	16-1/2" Floor Drill Press	490	329
17-920	NEW Mortise Chisel Kit		Sale 59
36-285	8-1/4" Builders Saw w/ stand	Sale	275
34-555	Sliding Table	487	359
36-250	10" Slide Compound Saw	825	455
31-780	Oscillating Spindle Sander	253	194
31-780K	31-780 w/ 31-781 spindle set		209
46-700	12" Wood Lathe	575	465
40-650	Q3 18" Scroll Saw	Sale	389
36-905	30" Unifence	346	259
36-906	50" Unifence	444	309
36-444	10" Contractors Table Saw	Sale	579
37-195	NEW 6" Professional Jointer	625	539
33-830	NEW 10" Radial Arm Saw	851	729

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22-675	DC380 15" Planer	Sale	1175
28-275	14" Band Saw 3/4 HP	Sale	595
28-280	14" Band Saw 1 HP motor with enclosed stand	Sale	739
28-270	14" Band Saw 1 HP w/ 50-274 mobile base. 28-855 rip fence, & 28-266 cool blocks	Sale	849
31-280	Sanding Center w/ stand	Sale	789
37-190	6" Deluxe Jointer	603	445

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50-850	1-1/2 HP, 1200 CFM	Sale	285
50-851	2 HP, 1500 CFM	Sale	489

MILWAUKEE TOOLS

6527	NEW Sawzall with case	343	169
6537-22	6527 w/quick lok blade change	224	179
0407-22	12V Drill w/kyls chuck&2 batt	380	175
0224-1	3/8" Drill 4.5 amp magnum	236	132
0234-6	1/2" Drill 4.5A mag 0-850 rpm	255	134
0235-1	1/2" Drill w/keyless chuck	255	139
0244-1	1/2" Drill 4.5A mag 0-600 rpm	255	139
0222-1	3/8" Drill 3.5 amp 0-1000 rpm	213	124
0228-6	3/8" Drill 3.5 amp 0-1000 rpm	207	109
0375-1	3/8" close quarter Drill	255	148
0379-1	1/2" close quarter Drill	288	165
6546-6	Screwdriver 200 & 400 rpm	150	89
6547-6	6546-6 w/bits,1/4" chuck & cs	185	109
5399	1/2" D-hdle Hammer Drill Kit	356	219
5397-1	3.8" w/ spd Hammer Drill Kit	275	145
5371-6	1/2" w/ spd Hammer Drill Kit	360	194
3107-6	1/2" v/spd right angle Drill Kit	411	234
6142	4-1/2" Grinder w/cse & acc	224	132
6490-6	10" Mitre Saw	496	269
6491	6490 w/ carbide blade & bag	594	345
6494-6	10" Compound Mitre Saw	585	319
6266-6	Top Handle Jig Saw	315	159
6496-6	10" Slide Compound Saw	1050	569

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LU82M010	Cut-off 10"	60	93	32
LU84M011	Comb 10"	50	78	45
LU85R010	Super Cut-off	10" 80	115	68
LM72M010	Ripping 10"	24	69	38
LU73M010	Cut off 10"	60	84	49
LU87M010	Thin Kerf 10"	24	72	45
LU88M010	Thin Kerf 10"	60	88	49
LU98M010	Ultimate 10"	80	128	68
LU91M010	Compnd Mitre 10"	60	88	54
F410	Quiet Blade 10"	40	95	54
SD308	8" Dado - Carbide		230	119
SD508	8" carbide w/case & shims		344	172
FB100	16 piece Forstner Bit Set		338	194
94-100	5 pc. Router Bit Door System		320	169
FT2000E	Plunge Router		Sale	185

HITACHI TOOLS

C8FB2	8-1/2" Slide Compound Saw	1169	449
C10FS	10" Slide Compound Saw	1627	579
C15FB	15" Mitre Saw	1346	645
NV45AB	Coil Roofing Nailer	935	379
NT32AE	NEW Pinner 5/8" - 1-1/4"	Sale	85
NT50AE	NEW Pinner 3/4" - 2"	Sale	125

MAKITA TOOLS

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5090DW	3-3/8" Saw Kit 9.6 volt	280	159
DA391D	3/8 angle Drill 9.6V	166	114
DA391DW	3/8" angle Drill Kit 9.6V	341	175
6095DWE	9.6 volt Drill Kit w/2 batt	Sale	125
6095DWLE2	6095DWE w/flashlight	Sale	139
632007-4	9.6 volt Battery	47	30
632002-4	7.2 volt Battery	39	28

NEW 18 VOLT MAKITA TOOLS

6343DWAE	1/2" Drill Kit	Sale	249
5620DWA	6-1/2" Circular Saw Kit	Sale	259
DK1016	1/2" Drill & 6-1/2" Saw combo kit	Sale	389

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6233DWAE	14.4V 3/8" Drill Kit	358	205
9900B	3"x21" Belt Sander w/bag	347	165
9924DB	3"x24" Belt Sander w/bag	360	175
N1900B	3-1/4" Planer with case	263	142
1912B	4-3/8" Planer	352	205
N9514B	4" Disc Grinder 4.6 amp	118	65
DA3000R	3/8" Angle Drill	355	185
2708W	8-1/4" Table Saw	637	295
6405	3/8" Drill Rev. 0-2100 rpm	115	65
6013BR	1/2" Drill Rev. 6 amp	270	159
9401	4" x 24" Belt Sander w/bag	458	219
5007NBK	7-1/4" Circ Saw w/ case	250	125
LS1011	10" Slide Compound Saw	995	429
LS1211	12" Slide Compound Saw	1620	695
3901	Plate Joiner Kit	376	159
3612C	3 HP Plunge Router	492	259
LS1040	10" Compound Miter Saw	460	259
LS1013	10" Dual Compound Slide Miter Saw	1088	599
BO5010	5" Random Orbit Sander	142	72
LS1220	NEW 12" Compound Miter Saw		379
9227C	NEW 7/9" Polisher	350	195
SJ401	NEW 16" Bench Scroll Saw	300	175
2702	NEW 8-1/4" Table Saw		Sale 299
2703	NEW 10" Table Saw		Sale 319

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SNS45	NEW Stapler 7/16" crown, 1" - 2"	540	379
SLP20	Pinner w/cs 5/8 -1-5/8"	422	199
SKS	Stapler 5/8 - 1-1/2"	390	279
SN70	Framing -Clip Hd 2 - 3-1/2"	725	449
SN65	Framing -Full Hd 2 - 3-1/2"	709	379
SN600	NEW Framing 2 - 3-1/2"	699	369
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A100LS	Finish Stapler 1/2" - 1"	180	119
A150LS	Finish Stapler 1/2" - 1-1/2"	220	149
A125BN	Brad Nailer 5/8" - 1-1/4"	160	99
A200BN	Brad Nailer 5/8" - 2"	215	139

BOSTITCH AIR NAILERS

Model	Description	List	Sale
N80S-1	Stick Nailer		Sale 325
RN45	Coil Roof Nailer 3/4 - 1-3/4	845	359
N60FN-2K	Finishing Nailer w/ case	557	269
BT35-2K	Brad Tacker 5/8" - 1-3/8" with case, oil, & brads	279	125
MIIIFS	Flooring Stapler 15 gauge	902	539
S32SX-1K	Finish Stapler-1/2" - 1-3/8" with case & oil	269	139

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EY6230FQKW	NEW 15.6V Drill Kit with 2 Ironman batteries, 30 minute charger & case	425	209
EY3503FQWKW	5-3/8" 12V Wood Cutting Circular Saw Kit	500	259
EYC103	EY6100FQKW drill, EY3503FQW saw, 2 batteries, 15 minute charger, and case	Sale	299

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B-50	50" Commer. Saw	443	325
T-SQUARE 52	52" Homeshop	360	275
T-SQUARE 40	40" Homeshop	335	255
T-SQUARE 28	28" Homeshop	325	245

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DW378G	7-1/4" Framer's Saw	210	169
DW222	3/8" Drill, 0-1200 rpm	184	105
DW231	1/2" Drill, 0-850 rpm, 7.0 amp	240	129
DW236	1/2" Drill, 0-850 rpm, 7.8 amp with keyless chuck	264	149
DW124K	1/2" right angle Drill	590	329
DW321K	Top Handle Jigsaw Kit	300	164
DW364	7-1/4" Circ. Saw w/brake	294	162
DW610	1-1/2 HP 2 handle Router	266	149
DW411K	1/4 sheet Palm Sander w/ cse	88	58
DW682K	Biscuit Joiner with case	448	169
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DW621	2 HP Plunge Router	400	218
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DW675K	3-1/8" Planer with case	292	164
DW677K	3-1/4" Planer w/ case	268	155
DW431	3 x 21 v/spd Belt Sander	338	188
DW421	5" Palm Ran. Orb Sander	144	74
DW423	Palmgrip Random Orbit Sander - variable speed	170	94
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DW673K	Laminate Trimmer Kit	364	188
DW272	Drywall Gun, 0-4000, 6.3 amp	160	95
DW276	Drywall Gun, 0-2500, 6.5 amp	160	95
DW935K	14.4V 5-3/8" Trim Saw Kit	444	237

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DW972K-2	3/8" variable speed w/ two 12V XR batteries	362	184
DW991K-2	3/8" variable speed w/ two 14.4V XR batteries	415	209
DW994KQ	1/2" variable speed w/ one 14.4V XR batteries	458	239
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DW938K	Recipro Saw Kit	520	269
DW995K	1/2" Drill Kit w/ 1 battery	428	229
DW995K-2	1/2" Drill Kit w/ 2 batt.	Sale	259
DW997K	1/2" Drill/Hammer Drill Kit	454	249
DW936K	5-3/8" Saw Kit	458	249
DW995KS-2	DW995K Drill, DW936 Saw and case	Sale	385
DW991KC-2	DW991K 14.4V drill kit, DW937 14.4V recipro saw,& case		375
DW995KC-2	DW995K 18V drill kit, DW938 18V recipro saw, & case		395
DW997KC-2	DW997K 18V drill kit, DW938 18V recipro saw, & case		419

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DW788	20" Scroll Saw	Sale	469
DW733	12" Planer w/ extra blades	Sale	399
DW744	10" Portable Table Saw	Sale	499
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DW792	15 gallon	Sale	279
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1587AVSC	1587VS Saw Kit with case and *New* Progressor blades	Sale	149
1584VS	Barrel "CLIC" Jig Saw	288	149
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Q&A

Proper tablesaw blade height

Howard Lewin's article on tablesaw safety (FWW #132, pp. 84-89) says to "make sure the blade is never more than ⅛ in. above the board being cut." But doesn't the physics behind his technique warn us of danger? A blade that is barely higher than the board imparts forces on the board that are directed primarily toward the operator. If the board binds, kickback results. If the blade is as high as it can be, the forces the blade puts on the board are primarily up and down. With a high blade, as long as the board is on the table bed, isn't kickback unlikely?

—Ric Bejcek, Phillips, Wis.

Kelly Mehler replies: Unfortunately, blade height can't ensure that a board will stay on the bed of a tablesaw. As Howard Lewin points out, kickback occurs when the teeth on the back of the blade lift the stock off the table and propel it toward the user. Regardless of blade height, the wood tends to rotate away from the fence and into the back of the blade. With the blade spinning at more than 100 mph, there's big trouble when it lifts the board.

There *is* slightly less chance of kickback when the blade is raised higher through the board. With a high blade, more of the blade's plate surface (the area that does not have teeth) keeps the stock from pivoting as easily as it can when the blade is lower. A high blade will also make cuts that are cleaner, cooler and less likely to burn—especially when using a high-quality, smooth-cutting blade.

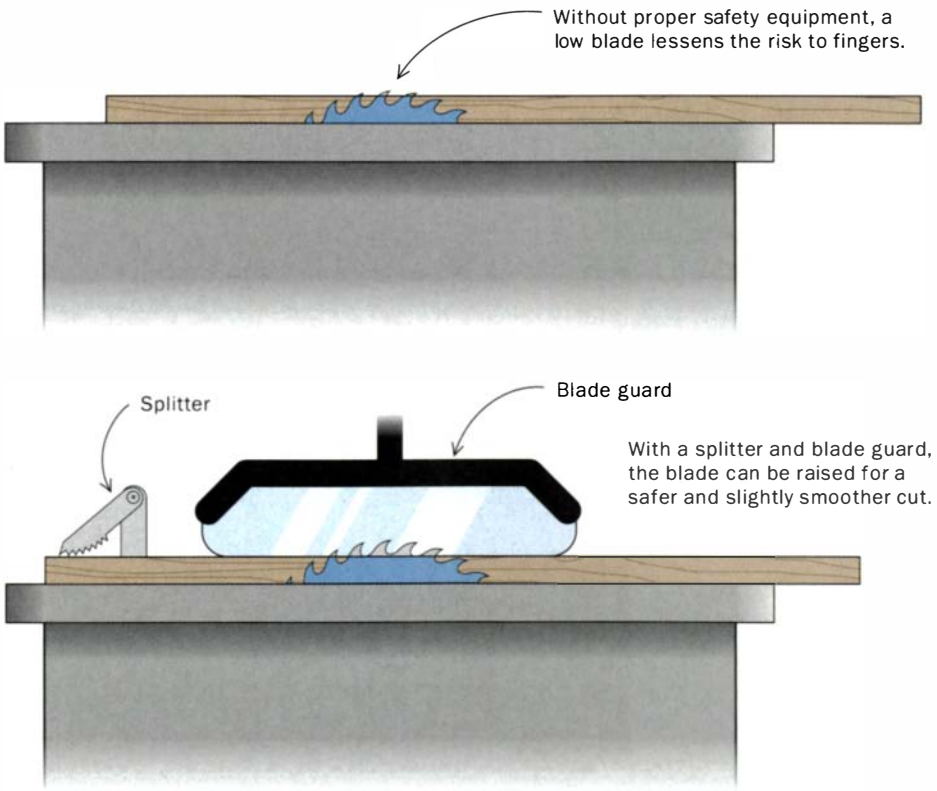
But the back of the blade tends to pull the stock up off the table, putting you at constant risk. A high blade won't alleviate kickback, and it also introduces a great many other hazards. Simply put, with more of the blade exposed, there is a greater threat of cutting yourself. When I use a splitter and a guard (almost always), I raise the blade so that the gullets clear the board. But without proper safety equipment, using a low blade height is certainly the safest way.

For me, lessening the chances of kickback is not a viable option. It's kind of like asking how far through the windshield you'll go if you don't wear a seatbelt. All of the knowledge in the world does little good unless you can physically stop kickback, and using a splitter is the surest way. Until U.S. manufacturers provide more accommodating safety equipment, all woodworkers are at risk.

In short, kickback is a risk no matter how high the blade is raised. Keep the blade low and use a splitter and blade guard. It's the safest option.

[Kelly Mehler is the author of *The Table Saw Book*, published by The Taunton Press.]

DETERMINING PROPER BLADE HEIGHT



Does Japan drier have a shelf life?

I bought a pint of Japan drier about four or five years ago, and the can is still about half full. How does Japan drier work, and does it have a shelf life?

—Martin O'Brien, Winston-Salem, N.C.

Chris Minick replies: The first use of drying promoters to assist the curing or hardening of vegetable-based finishes is lost somewhere in antiquity, but it is clear that the ancient Egyptians understood their value and used them. Today, the need for metallic driers in oil-based varnish is the same as it was more than 4,000 years ago—without them, the varnish doesn't cure.

Modern organo-metallic driers are divided into two categories: primary driers (or active driers) and secondary (or auxiliary) driers. Primary driers such as cobalt or manganese compounds are known as surface or skin driers. They promote rapid skin formation on the wet varnish but do little to harden the underlying varnish. That is why active driers are rarely used alone. Instead, active primary driers are added to the varnish along with compounds of calcium, zinc or zirconium (secondary driers). The result is a finish that cures evenly throughout its thickness. Once mixed in the varnish, the driers are slowly absorbed, and the varnish loses its ability to dry in a reasonable amount of time. This problem is more prevalent in satin or flat varnish than it is in the glossy variety.

Japan drier, a balanced mixture of metallic auxiliary drier sold in pint cans at most paint stores, can be added in small amounts to revive an over-the-hill varnish. However, too much drier can

Drawings: Michael Pekovich

actually retard the curing reaction. Worse yet, overdoing the drier may cause the varnish coat to become brittle, resulting in premature finish failure. It is safer to purchase fresh varnish than to doctor old varnish back to life.

Japan drier does not have a shelf life. As long as the can has been tightly capped to prevent solvent loss and the solution is not discolored, it should be safe to use. [Chris Minick is a chemist and contributing editor to *Fine Woodworking*.]

Food-safe adhesives

In some cutting boards, numerous small pieces are used and could potentially contaminate food during vigorous cutting and chopping. What glues are safe to use on cutting boards and other kitchen items? —Peter Kurisoo, Missoula, Mont.

William Tandy Young replies: There are no federal regulations that specifically govern the use of adhesives in the making of wooden cutting boards. This is probably because woodworking glues usually cure to inert solids that won't contaminate food or poison you.

The two least desirable glues for cutting boards are urea resin glue and resorcinol. Although both have superb strength and moisture resistance, they contain formaldehyde, a toxin that lingers in glued work in small residual amounts before dissipating. And because some urea glues also have fairly low shock resistance, don't use them when making cutting boards less than 1 in. thick.

Epoxy and polyurethane glues are better choices. Both are strong and highly moisture resistant (epoxy is considered waterproof) and withstand the stresses of vigorous use. Of the two, polyurethane is the better choice, because it doesn't require mixing, is easier to apply and has superior heat resistance once it cures. If your cutting board isn't going to be exposed to much heat or moisture, you can glue it up with a type-II polyvinyl acetate (PVA) glue instead.

If the glue you're using requires mixing, mix well. When adhesives such as epoxy aren't thoroughly mixed, trace amounts of uncured resin hardener can be absorbed by the wood as separate uncured components. These components are toxic in their uncured state. Lastly, when you're choosing wood for cutting boards, try to avoid species that can be toxic, such as cocobolo and Jamaican dogwood. [William Tandy Young is the author of *The Glue Book,* published by The Taunton Press.]

Burnishing a cabinet scraper

I can't get my cabinet scraper to make shavings like I know it can. Can you tell me the proper way to prepare it for use? —James Lauter, Chicago

File the edge

Mario Rodriguez replies: The cabinet scraper is capable of producing a cascade of paper-thin shavings, without a trace of tearout, and leaving a silky surface in its wake. It is indispensable for removing plane tracks left behind by handplanes, metallic stains caused by clamps and dried glue drips. With a sharp scraper you can skim over veneered surfaces, passing seams and swirling grain with barely a second thought. I consider scrapers to be one of the small miracles of traditional woodworking.

Flex the scraper

A scraper works by having a small burr that is turned over its edge. As you push or pull the scraper across a wooden surface, this sharp burr does the cutting. Turning an effective burr on a flat scraper can be exasperating. But once you get the simple process down, tuning and using a scraper is rewarding work.

Start with a good-quality scraper. I prefer the Sandvik brand, 0.08mm, with a milled edge, but the process is the same for any brand or size. First joint (flatten and straighten) the long edges of the scraper with an 8-in. to 10-in. second-cut mill file. This step also restores the edge to full thickness—essential for an effective burr. Be sure to steady the file for a square, unbeveled edge. After filing, some people also flatten the edge on a waterstone, but I find that I can turn a more aggressive edge if I go straight from a filed edge.

Burnish

Hold the file flat on the scraper or pass the flat sides of the scraper over a waterstone to remove any "false" burr, particles clinging to the freshly filed edge. After this step the scraper's edge should be straight, square to the sides and restored to full thickness.

The next step is a little unusual, but it's the way I was taught and the way that has always given me the best results. While holding the scraper across your palm, press the far end of the scraper into a workbench corner. Lean your weight into the scraper, causing it to flex slightly along its length. While the scraper is bent, pass a burnisher along the curved edge. Angle the burnisher toward the inside of the curve at 2° to 5°. Later, when you use the scraper, bend the cutting burr in the opposite direction. This method consistently produces a heavy burr that cuts aggressively.

Burnish all four long sides of the scraper, and don't repeat the process until all of the burrs wear dull. [Mario Rodriguez is a contributing editor to *Fine Woodworking*.]

Powderpost beetle infestation

I recently found three white ash boards in my lumber storage that were infested with powderpost beetles. I destroyed the boards immediately, but I am worried about the lumber that was surrounding these boards (cherry, walnut, oaks, mahogany, exotics, etc.). There's no visible damage. Should I be concerned about using the other species? —Rick Seiss, Florence, S.C.

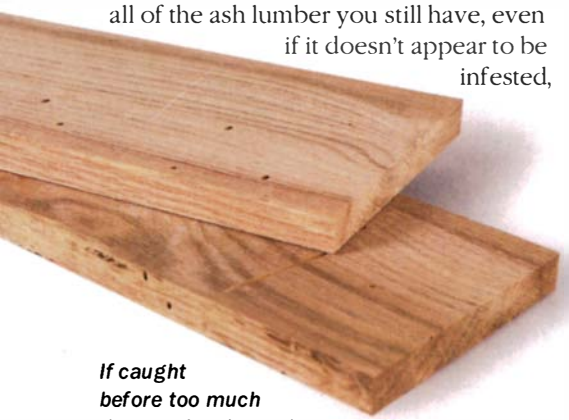
Jon Arno replies: I experienced virtually the same dilemma about a decade ago. The problem is that powderpost beetles love ash about as much as monkeys love bananas. In fact, it is probably their most perfect food source.

The sad thing is you didn't have to destroy the infested boards. I was able to save most of what I had by cutting it into

Photos: Mario Rodriguez

short pieces and putting them in the kitchen oven along with a tray of water to keep the humidity up. Exposing the wood to 190°F for about two to three hours, depending on the wood's thickness, will sterilize it. What I salvaged was good only for small projects, but at least I was able to use up most of it.

As for the remaining inventory, I would recommend the following: First, pull out all of the ash lumber you still have, even if it doesn't appear to be infested, and store it somewhere else so that it is completely isolated. Monitor the stock for as long as you can afford to set it aside—a full year wouldn't be too long. If the telltale little conical piles of dust don't begin to reappear, I'd go ahead and start using it. As for the ash, if you have a lot of it, you may want to have it commercially dried.



If caught before too much damage has been done, small beetle-infested boards can be salvaged in the kitchen oven.

The other species you mentioned, cherry, walnut, oak and mahogany, are less susceptible than ash; however, powderpost beetles will attack the sapwood of many species, even some with highly resistant heartwood. There are chemical treatments that offer a more certain cure, but they are oily and alter the character of the wood so much that I prefer to live with a little risk.

[Jon Arno is a woodworker and wood consultant in Troy, Mich.]

Avoiding a chalky finish when French polishing

For many years now I have finished pieces by French polishing, as taught by George Frank (FWW #58, pp. 70-74). I've always obtained lovely results, except that eventually the pores of the grain look chalky, as if moisture were trapped. I have also seen this on antique pieces, but there must be some way to avoid it. Any suggestions? —Cynthia Neer, Boston

Jeff Jewitt replies: French polishing imparts depth and luster to wood that is usually obtained with thick applications of varnish or lacquer. The reason that such depth and clarity can be achieved with such a thin application of shellac has to do with the substance used to fill the pores—pumice. Pumice is also the culprit in most problems with French polishing.

In traditional French polishing, 4F pumice is used to fill the pores of open-pored woods like mahogany and oak, but it can also be used on small-pored woods like cherry. The pumice is sprinkled onto the surface with a pad called a tampon that has an inner core charged with a little shellac and alcohol. The idea is that the pad abrades the surface of the wood with

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the pumice and makes a "paste" of oil, wood dust, shellac and pumice that serves as a very transparent pore filler. This is where problems can arise.

Pumice is a white powder and is very high in silica content. Because it is essentially powdered glass, it has a low refractive index. In mediums such as oils or shellac, pumice becomes transparent when these products surround the irregular microscopic glass fragments. This works fine as long as the medium dispersed around the pumice particle is invisible. But when the pumice is no longer dispersed by shellac or oil, it will revert back to its white appearance and cause a chalky or cloudy effect under the finish. In your case the pumice was initially transparent because it was applied to mineral-oiled wood. Gradually, the mineral oil absorbed into the cellular structure of the wood. The pumice left at the wood surface then turned white.

There are two ways to overcome this problem during application. The first method involves an adjustment in technique. After oiling the wood (I prefer linseed oil to the mineral oil suggested by Mr. Frank), sprinkle pumice on the surface. Then saturate some padding cloth with a 2-lb. cut shellac solution so that it's practically dripping wet. Using this shellac-soaked rag, wipe the pumice into the wood with circular motions and frequently recharge the pad with shellac. This technique assures that the pumice is mixed with plenty of shellac to keep it transparent. In Mr. Frank's article, he uses little shellac, and when I have polished his way I have experienced the same problem you describe.

The other method you can use is simply to premix the pumice and shellac and then apply this "filler" almost like a paste wood filler. To make the filler, dissolve 4 oz. (by weight) of shellac flakes into 4 oz. (by volume) of denatured alcohol. After the flakes have dissolved, stir in 3 oz. to 4 oz. (by volume) of 4F pumice. Stir thoroughly and then apply this thick mixture with a stiff bristle brush to the surface you're polishing. Scrape the excess off with a rubber squeegee and then remove the excess with an alcohol-dampened cloth. After drying, any excess can be sanded off. This technique is tricky on larger surfaces, but it's perfect for complex surfaces where it's hard to work the pumice into corners.

To solve the problems you now have, you have to work shellac in the pumice that's trapped in the surface and pores of the wood. Saturate the surface with alcohol to dissolve the shellac on the surface and then scrub with a gray abrasive pad. Periodically squirt some 2-lb. cut shellac on the surface to mix into the slurry you'll kick up. This should work into the pumice and disperse it enough to make it transparent again. [Jeff Jewitt repairs and restores furniture in North Royalton, Ohio.]

Do you have a question you'd like us to consider for the column? Send it to Q&A, Fine Woodworking, P.O. Box 5506, Newtown, CT 06470-5506 or e-mail it to fwqa@taunton.com.

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Japanese mortise-cutting techniques

BY TOSHIO ODATE

When woodworkers from any part of the world are building cabinets and furniture, framing houses or making doors, chances are they will use a mortise-and-tenon joint somewhere. This fundamental joint consists of a tenon with a shoulder on each side that fits a mortise of the same size.

The Japanese way of making this joint is quite different from the Western approach, which has been well described by Tage Frid, Ian Kirby and Frank Klausz in previous issues of *Fine Woodworking*. In Japan, where traditionally there is much less furniture than in Western homes, rooms are often "decorated" with *shoji*—translucent paper sliding panels—or with *fusuma*—opaque paper sliding panels. The sliding-door maker (called a *tategu-shi*) uses through-mortises and blind mortises, but they both are cut differently than Western mortises because of the proportions and compression ability of the softwoods used.

Through-mortises for furniture, doors and screens

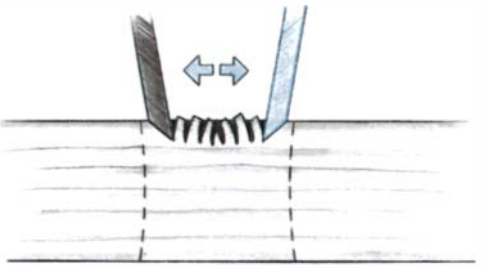
The door maker's through-mortise, called a *tsuzumi*, is slightly convex at the middle of the end-grain walls to squeeze the tenon and lock it in place. This joint is traditionally used for exterior doors. The stiles are always about 1¼ in. to 1⅜ in. thick, so the door maker uses ⅜-in. and ¼-in. chisels for most of his mortise work. Cabinetmakers would use a less severe version of this same convex mortise because hardwoods compress less. The through-tenon would be hidden on furni-

THROUGH-MORTISES

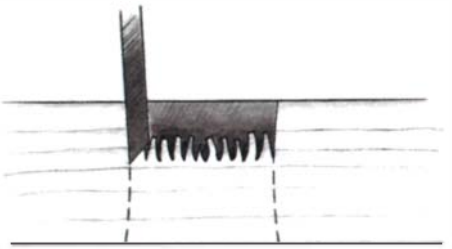
Japanese door makers and cabinetmakers use this through-mortise for exterior doors and for interior furniture where the joint won't be visible.

On your marks. *A Japanese mortise marking gauge is not adjustable. The two pins are set at the width of the mortise.*

Start in the middle. *Mortising chisels, or* mukohmachi, *look pretty much the same as the Western version. The first cut is made in the middle of the mortise with the bevel facing out. Succeeding cuts are made by alternating the direction of the bevel and moving out from the center of the mortise.*



Angle the chisel to cut the end-grain face of the mortise. *At the narrow end of the mortise, the chisel is positioned flat-face-out and is angled to make the inside of the mortise convex.*



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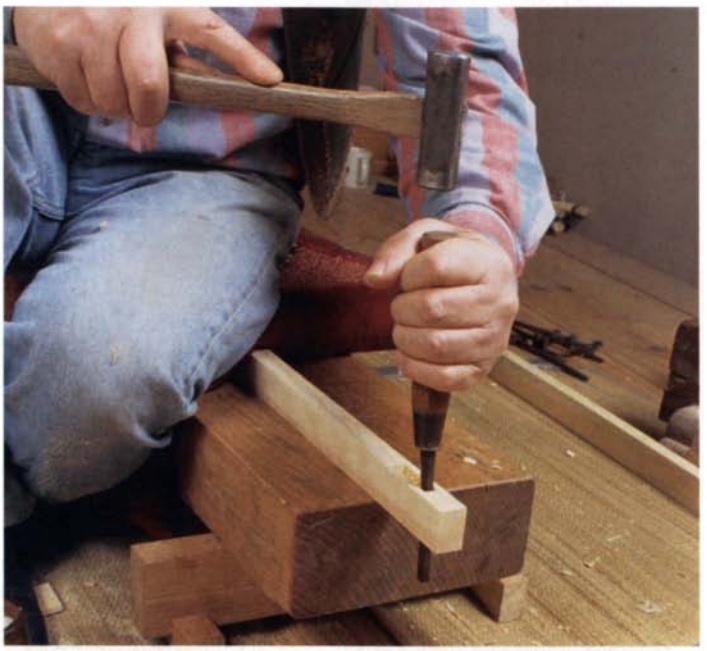
ture, out of sight on top of the piece or behind a closed door. The cabinetmaker's tenon might also employ two shallow wedges to pull it to the outside edge of the convex mortise wall.

The door maker marks his mortise with a Japanese marking gauge. Japanese gauges are permanently set for one chisel size, either ⅜ in. or ¼ in. The door maker scores the cut on both ends for length with a marking knife. The mortise is chopped out with a chisel, starting in the middle and working out to the ends. The craftsman turns the chisel around with every strike. That way, most of the waste is pushed out of the way as the cuts are made.

The final mortise cuts are made with the flat, back side of the chisel facing toward the end line and leave the end-grain wall slightly convex. The door maker wouldn't use a butt chisel to cut along the cheek line because the width of the mortise chisel is the same size as the tenon. Using a butt chisel might change the width of the mortise. For a through-mortise, half the depth is cut from one side, then the workpiece is flipped and cut from the other side—the same method often used in the West. The door maker uses a blunt strike-through chisel, called a *uchinuki-nomi*, to push out the waste. These tools really aren't chisels in the strict sense because they don't cut. In fact, they could be pieces of wood or metal cut smaller than the mortise.

Japanese furniture and door makers crosscut the tenon shoulders before the cheeks are ripped because an overcut slightly in error will not show once the joint is assembled. The tenon is cut wider than the mortise by about 1/64 in., or less, depending on the type of wood being used and the size of the tenon. The length of the tenon starts out ⅛ in. to ¼ in. longer than the mortise depth, and the four corners of the end are chamfered with a handplane. Rice glue is usually applied for assembly: It lubricates the pieces, making them easier to join, and serves as a filler around the rough fibers of the cheeks. (Cabinetmakers use animal glue.) After a tenon is squeezed past the narrow halfway point of the mortise, moisture from the rice glue helps the tenon expand back to shape, locking it in place. On large pieces of furniture made of hardwood, two wedges would push the end of the tenon back out to the sides of the mortise. After

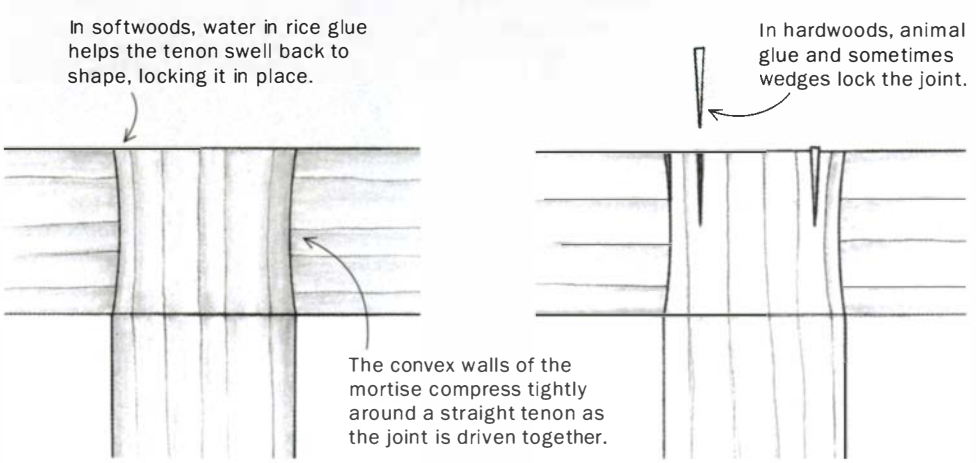


THROUGH-MORTISES (continued)

"Chisels" for removing waste. *Blunt strike-through chisels, or* uchinuki-nomi, *are not really cutting chisels in the traditional sense. They clear waste out of through-mortises and can be made from pieces of wood or metal.*

Chamfered tenons are easier to insert. *Through-tenons can be cut a bit long, chamfered for ease of insertion and then planed flat after the joint has been assembled.*

SOFTWOODS VS. HARDWOODS



assembly, the extra tenon length is sawed off and then planed flush, removing any marking lines. If a door needs repair and the joint needs to be taken apart, a slight hammer blow will break the glue bond.

Blind mortise: seeing light through the wood

In Japanese woodworking, especially with furniture and interior doors, end grain and wedges are considered unappealing and certainly not elegant. For this reason, blind mortise-and-tenon joints are considered more appropriate for interior work. This is not such an easy task because of the scale of the work. Most Japanese rooms are small compared to American rooms, so the scale of screens and door frames is smaller.

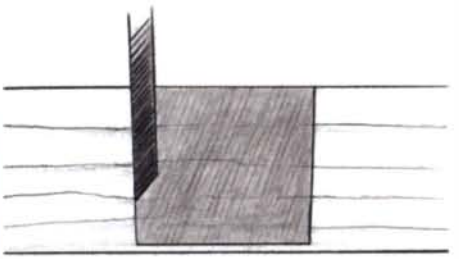
While sitting on a *tatami* (grass-mat) floor, the room is encircled by shoji or by fusuma. Wide-face stiles for interior panels don't work: The proportions are not soothing to the eye. The face of the stile should be ⅞ in. to 1¼ in. wide, and for strength the rail tenon must go almost all the way through the mating stile. For this type of work, the Japanese have special chisels: the *mori-nomi*, or harpoon chisel, and the *sokozarai-nomi*, or bottom-cleaning chisel. When the mortise is finished, light can be seen through the bottom.

The end grain of a blind mortise is tapered slightly inward—just like the socket of a chisel handle or a tapered sliding dovetail joint—so the pressure will be even from the mouth to the bottom of the mortise. If the wall were straight, you would only have pressure around the mouth—not a strong joint. The tapered shape also makes this joint easier to take apart for making repairs later.

Another strictly enforced rule of a doormaker's apprenticeship is not to damage the top edges of the mortise by using a chisel as a lever to remove the waste. I do not hear about this much in Western woodworking, but I was hit and yelled at many times during my apprenticeship for this very transgression. We never use the corner of a mortise for leverage or even accidentally press down on it with the bevel side of the chisel. One reason is obvious: The damage will leave a space that can be seen after the joint has been assembled. Another reason is that because of the very limited length of the tenon, such damage would weaken the joint.

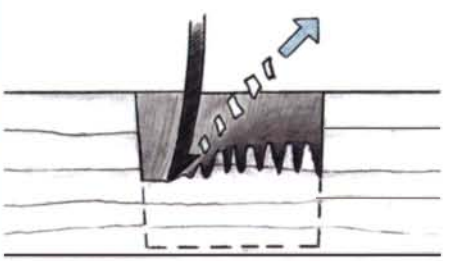
BLIND MORTISES

Used in room-divider screens, blind mortises are slightly tapered. Straight tenons are squeezed to fit the shape.

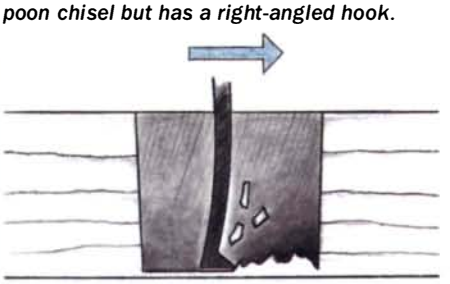


Blind mortises must be very deep without breaking through. *A homemade depth gauge, made from a small scrap, indicates when a blind mortise is deep enough. It is also used to mark the length of the tenon, which is cut a little shorter than the mortise.*

Harpoon the waste. *After the first round of cuts with a mortise chisel, the chips still attached must be cleaned out with a harpoon chisel, or* mori-nomi, *that has a severely hooked end.*



Scrape and scoop. *The bottom of a blind mortise is cleaned up with a bottom-cleaning chisel, which is similar to a harpoon chisel but has a right-angled hook.*



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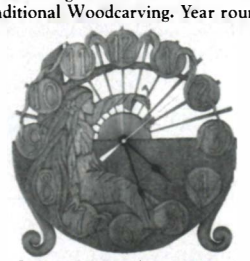

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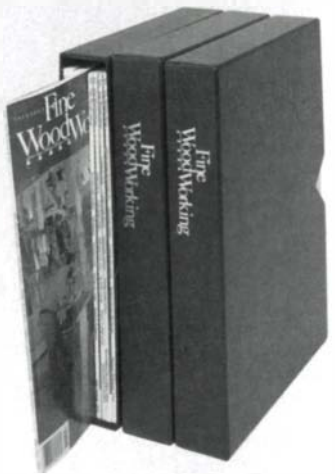

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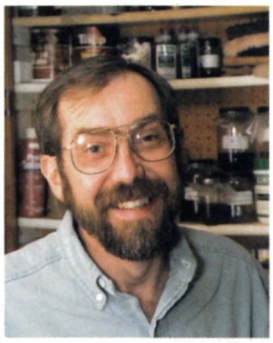
BY CHRIS MINICK

Wood vs. weather: the scoop on outdoor finishes



Spring is in the air and a young man's fancy turns to ... Well, if he's a woodworker, putting a finish on outdoor projects may come to mind. A good finish on an interior furniture project might last a lifetime. Not so with any wood that will be exposed to the ravages of weather.

I know of only two finishing strategies for outdoor projects. One, do nothing at all. Two, apply a finish and hope for the best. If your decision is to apply a finish, be prepared for periodic maintenance: Outdoors, no finish will last forever. The trick is to select a finish that protects the wood but requires as little maintenance as possible.

One real option: do nothing

As disagreeable as it may seem to a woodworker, the do-nothing tactic is a viable option for any wood subjected to the rigors of weathering. I offer this insight not as a joke but for those who may have never really considered this alternative. While paint, varnish and other decorative coatings add beauty to wood, their protective benefits are not absolutely necessary. Bare wood of some species can survive the elements for hundreds of years without the aid of protective coatings.

Moisture, sunlight and temperature extremes exact a heavy toll on bare wood, with a photochemical process fueled by ultraviolet (UV) light and accelerated by water. Wood is chiefly composed of cellulose and hemicellulose fibers and lignin. Both cellulose and hemicellulose give wood its strength while lignin acts as a natural glue to hold the whole thing together. The weathering process starts as a gradual yellowing or browning of the wood surface. This color change occurs when UV light strikes a lignin molecule, altering the chemical structure of the molecule. The chemically altered lignin loses its adhesive qualities and leaches out of the wood, leaving behind a fuzzy, rough surface rich in cellulose fibers. It is these exposed cellulose fibers that give weathered wood that characteristic silver-gray appearance. Interestingly, once the wood surface has attained that silver-gray stage, UV degradation slows dramatically, because the light does not penetrate beyond the outermost surface of the wood.

However, attacks by rain and moisture continue. The rapid swelling and shrinking of wood caused by fluctuating moisture levels can result in checking. Ultimately, this process causes structural failure—not exactly what you may have had in mind for your patio furniture.

So if you've decided to put some kind of finish on woodwork exposed to the elements, you can choose between two broad categories: film-forming finishes and penetrating finishes. Each category has its own strengths and weaknesses.

Film-forming finishes: paints and varnishes

Paint, probably the most-used finish for exterior surfaces, does the best job of protecting wood from the damaging effects of outdoor exposure. The same pigments that add color to the paint also reflect most of the UV radiation, so the binder that holds the paint together, as well as the underlying wood, are well protected. Paint films weather slowly by surface erosion, protecting the wood for several years. Repainting when the primer shows through will renew the protection and minimize surface-preparation problems. Paint provides good protection on vertical surfaces (house siding), but it is usually short-lived on horizontal surfaces (furniture and decks). Standing water will penetrate any paint film and lift the film right off the wood in large blisters. Aside from this one flaw, paint is a great choice for outdoor wood. Unfortunately, paint also completely hides the wood surface, a property not always popular with woodworkers.

Clear film-forming finishes, such as interior-grade furniture var-

No finish means no maintenance. *Unfinished outdoor furniture requires no attention, but eventually the wood will deteriorate. Teak, cedar, cypress, redwood, ipe and mahogany last longer outdoors than other woods.*

Paint finishes are like children: They need a lot of attention. *This cedar lawn chair has been exposed to sun, snow and rain for four years. Note how the finish on the vertical back slats fared better than that on the horizontal seat and arm pieces.*

Bottom left photo: Timothy Schreiner

nishes, preserve the visual beauty of wood for only a short time. Clear gloss varnish lacks the protective pigment of paint, so UV radiation not only attacks the unprotected varnish film but also passes through the varnish and deteriorates the wood underneath. The varnish film quickly becomes brittle, and cracks appear in the film. At the same time, UV radiation destroys the lignin at the wood surface, so rainwater can penetrate the cracked film and loosen the varnish film. Presto, peeling varnish. Once the finish starts to peel, the only course of action is to sand it off and start over. Satin and flat varnishes fare better than the high-gloss variety because the silica flattening agents used to decrease the gloss act as protective pigments and reflect some of the UV radiation.

Exterior varnish is chemically different from interior varnish: The drying oil-to-resin ratio is higher to better accommodate outdoor wood movement. Also, the resins in exterior varnish have increased UV resistance. Traditional marine spar varnish made with a tung-oil phenolic resin is perhaps the best clear finish for wood that will be exposed to direct sunlight and heavy moisture. Dry tung-oil phenolic varnish films are highly flexible and resist UV degradation better than other exterior varnishes. (They are often used to coat the wooden parts of boats.) This stellar performance is not without a price: Spar varnish is dark yellow when first applied and darkens with age, which makes it unsuitable if you want a light finish on a piece of outdoor furniture.

Traditional tung-oil phenolic spar varnish can be hard to find, though most marine-supply or farm-supply stores carry at least one brand. Polyurethane spar varnish, a newcomer to the exterior varnish field, has replaced marine spar varnish in many applications. The polyurethane finish has the flexibility and light resistance needed for exterior use, and it's considerably less yellow than marine spar varnish. However, the life span is about 25% lower. Expect about four years of service life from a tung-oil phenolic spar varnish, about three years from polyurethane spar varnish and less than one year from interior-grade varnish.

A HOMEMADE WATER REPELLENT

The author mixes a batch of penetrating finish using his drill press with a stirring paddle. He refurbishes his deck every two years with the recipe shown below.

Ingredient	Amount
Mineral spirits	1 gal.
Paraffin wax (canning wax)	2 oz.
Exterior varnish	1 qt.
Burnt-sienna tinting color	1/4 oz.
Raw-umber tinting color	1/4 oz.

Add the mineral spirits to a 2½-gal. (or larger) bucket. Shave the wax into small curls, add to the mineral spirits and mix until all of the wax is dissolved, which may take an hour or more. After that, add the exterior varnish and the tinting colors. (This mix of equal parts of burnt sienna and raw umber yields a redwood tone. You can vary the tints to get whatever color you want.) Add a fungicide, available at paint stores, if you live in a hot, humid area.

Penetrating finishes: stains and water repellents

Penetrating finishes, as the name implies, absorb completely into the wood, leaving no detectable surface film. Semitransparent stain, water repellents and wood preservatives fall into this category. These finishes effectively resist the penetration of liquid water but allow water vapor to migrate unimpeded into and out of the wood, making it less likely to warp, rot or split. Because the finish becomes an integral part of the wood structure, both finish and wood undergo simultaneous degradation when exposed to outdoor weathering. But they degrade at a greatly reduced rate compared to that of bare wood.

The pigments in semitransparent stains slow the process even more by reflecting some UV light. Most penetrating stains are relatively short-lived: Expect an average life of about two years. The great thing about these stains is that short life span is more than made up for by the ease of reapplication. When the finish has reached the end of its service life, nothing is left to scrape or sand away. Simply wash off the dirt and spray on another coat.

Years ago I developed my own home brew for a penetrating finish to use on my deck, based on a formula developed by the USDA Forest Products Laboratory in Madison, Wis. My recipe is shown at left. I use a drill press equipped with an inexpensive paint stirrer to mix up a batch. I spray this mixture onto the deck with a pump-up garden sprayer, then blot up any runs with a paint pad. Apply two coats, allowing 24 hours between them, the first time you treat a deck. A coat every two years keeps the deck looking new. It takes me less than four hours to mix a batch and treat my 12-ft. by 24-ft. deck.

One strategy for a premium finish

Experiments by the Forest Products Laboratory have shown that paint will last up to twice as long outside if the wood has been waterproofed prior to painting. (Makes sense—eliminate wood movement caused by water, and you eliminate cracked and peeling paint.)

Here's how you do it: Apply two coats of my homemade water-repellent penetrating finish described above (but leave out the pigment) and let it dry for a few days. Scuff the surface with a Scotch-Brite nylon pad to remove the excess wax, then apply two coats of an oil-based, exterior-grade primer. (Oil-based primer will adhere to any residual wax, but latex primer may not.)

Finish off by topcoating the primed wood with latex semigloss trim enamel. Trim enamel has a higher percentage of resin than normal house paint, which makes it a more durable finish. And yes, latex paints last longer, go on more easily and hold their color better than oil-based paints. Unless you're recoating a surface that is heavily chalked from age, modern latex paints are superior to oil-based paints.

Photos: William Duckworth, except where noted

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READER SERVICE NO. 167

GRINLING GIBBONS, MASTER WOOD CARVER

Grinling Gibbons (1648-1721) was, perhaps, the world's finest wood carver. The Cosimo panel shown here was commissioned by Charles II of England as a gift to an Italian duke. The 55-in. by 42-in. limewood panel, considered by some to be Gibbons' masterpiece, earned him £150. After hanging for more than three centuries in Florence, where it survived a flood, a mudslide and a gas explosion, the panel was recently returned to England for an exhibit of Gibbons' work at the Victoria and Albert museum in London. A new book by David Esterly, *Grinling Gibbons and the Art of Carving* (Harry N. Abrams, Inc., 1998), was published in conjunction with the exhibit.

Photos: Courtesy of Abrams, *Grinling Gibbons and the Art of Carving* by David Esterly