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glue-up
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armoire project**

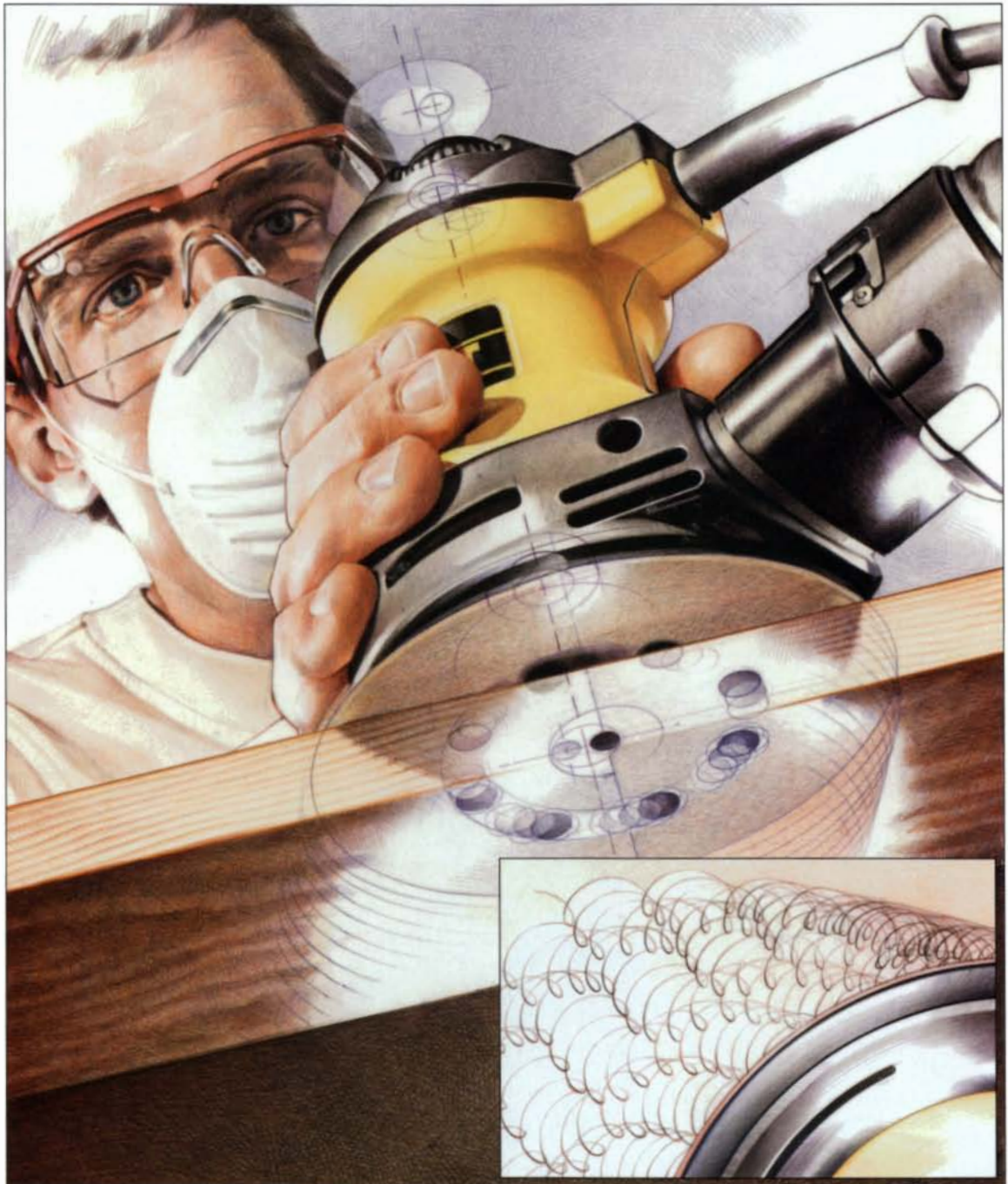
Tablesaw safety

**Edge profile
design guide**

**How to apply
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**Honing guide
comparison**

**New feature:
Chris Minick's
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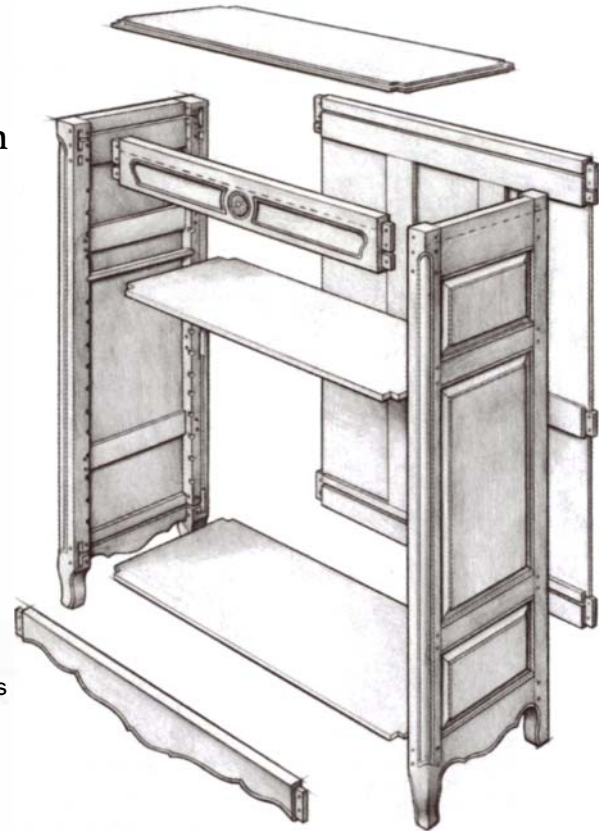
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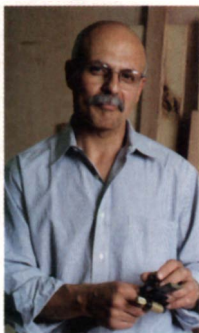
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Contributors

Chris Minick ("Finish Line") learned the how's of finishing by helping his grandfather, who did it for a living in Pittsburgh, Pa. A degree in organic chemistry and 25 years of experience developing stains, finishes and sandpaper have taught him the why's of applying finish to wood. With this issue of *Fine Woodworking*, we are launching a regular feature column on finishing. Chris will share his knowledge of the subject with the always-practical goal of helping our readers improve their finishing talents.



Bill Crozier ("An Inspired Tool Chest") designs and builds furniture and cabinetry in downtown Providence, R.I. After studying woodworking under Tage Frid at the Rhode Island School of Design (RISD), he had a spell as a professional musician, built some instruments and then worked in half a dozen woodworking shops before opening his own in 1986. He currently teaches woodworking part-time at RISD.



Marlo Rodriguez ("Honing Guides") started woodworking in 1976 when a department store botched the delivery of a floor-sample sofa for the third time. "I got my \$75 deposit and bought a woodworking book," he says. "I made a sofa with a jigsaw and a drill. It

worked and was comfortable, but I could tell there was something off with the workmanship." He then called the New York City Council of Carpenters and began a four-year apprenticeship. He is currently a woodworking instructor at the Fashion Institute of Technology in New York City and has been a contributing editor to *Fine Woodworking* since 1993.

Jon Arno ("Southern Yellow Pine") inherited a love for wood. As he says, "I probably had sawdust in my diapers." His grandfather completed formal training as a cabinetmaker in London before moving to Michigan to build curved stairways for the mansions in Grosse Pointe. His father started a window sash and repair business that his mother's family built into a thriving lumberyard and building-supply store, where Arno currently works. He also works as a wood

consultant and gives seminars on Early American furniture styles and wood identification for antique dealers and museum personnel.



Ian Ingersoll ("Break Out of the Bathroom Vanity Box") designs and creates furniture in West Cornwall, Conn. His work is rooted in Shaker design yet fully conscious of the present. With his latest designs, Ingersoll has sought to

achieve a lot with a few deft moves, crafting furniture the way a poet creates haiku. Employing a dozen artisans, Ingersoll's shop continues the long tradition of woodworking in Litchfield County.

Howard Lewin ("Tablesaw Safety") runs Custom Wood Design in Hawthorne, Calif. An avid turner, he has patented a number of his own tool designs. One of the first variable low-speed bowl lathes, the Lewin Bowl Lathe, is now produced by Woodfast in Australia. He teaches at the Otis College of Art and Design and is at work on a book about the tablesaw (F&W Publications).



Chris Gochnour ("Post-and-Beam Armoire") spent a few years waiting tables before he started making them. A passionate skier, he developed machine skills working in a shop making snowboards; he also designed and manufactured his own line

of skateboards. These days, he makes furniture and built-ins in the expanded garage shop beside his house in Salt Lake City.

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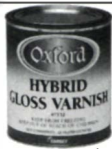
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The best woodworking club in America?



Two of the questions readers often ask are “How can we start a woodworking club,” and “How can we make our woodworking club better and more active?” I’m usually at a loss for answers. However, earlier this year, I welcomed the opportunity to judge part of the annual Design in Wood competition of the San Diego Fine Woodworkers Association.

Judging this show was pure woodworking joy. Of the 316 entries, there were at most a handful I would not have wanted my name on. It was the best display—

pound for pound—of woodworking I’ve seen. From carving to turning to toys to furniture making, the talent on display was incredible. The collected pieces inspired me to get home to the workshop.

The quality of the show in this case, I believe, resulted from the quality of the organization that sponsored it. The San Diego Fine Woodworkers Association is arguably the most active woodworking group in the nation. With 1,400 members and a regular meeting attendance approaching 300, the organization educates its members about new tools and skills, helps local charities by building and donating chairs every year, and provides a place where serious woodworkers of all experience levels can get together. The club is blessed with being in an area with lots of woodworkers, lots of money, lots of retirees, lots of woodworking expertise and good woodworking schools. But its secret has been in keeping everyone active and involved long after other groups would have dissolved under the weight of so many egos. Simply, the group’s leaders put woodworking before themselves. For a look at this year’s Design in Wood winners—among them, Ray Allen’s 30-in. turned bowl shown above—check out the group’s Web site (www.sdfwa.org), and see “Notes & Comment” in our December issue.

There is another group of furniture makers that is jelling nicely after only two years as an official organization. The Furniture Society, which brings together mostly professional designers and craftsmen from across the nation, met in June for its second annual meeting. The group likes to discuss weighty matters such as “Meaning and Value in Studio Furniture,” but its annual meeting also provided lots of hands-on seminars on cutting joints, applying finishes and drawing. *Fine Woodworking* took part in the gathering and sponsored a demonstration by Kristina Madsen (see the back cover of *FWW* #121) of her surface-carving techniques. For more information about the group, you can contact the Furniture Society at Box 18, Free Union, VA 22940, or e-mail (furniture@avenue.org). —*Tim Schreiner, editor*

There was no sexist “rule of thumb”—A correspondent complaining in the August issue about your new department name “Rule of Thumb” says the term is offensive because it derives from a 17th-century law about the size of stick with which you can legally beat your wife.

I’ve heard the same story but can’t find any evidence that it’s true. According to the Oxford English Dictionary (2nd ed.), rule of thumb has always meant what it means now, and the first citation dates from 1692. Neither the OED nor the Oxford Companion to Law mentions any connection between rule of thumb and instruments of assault.

Let’s not reject a time-honored piece of vocabulary just because someone has made up and circulated a gruesome story about it. —*Michael A. Covington, University of Georgia, Athens, Ga.*

Praise for drawer-engineering article—I just finished reading Will Neptune’s “Engineering a Table with Drawers” (*FWW* #130, pp. 40-45). This is a magnificent example of education in a magazine. I’m a software engineer by trade, a woodworker by hobby. While I’ve built tables and other pieces over the years, I, like Mr. Neptune’s student, had never made the connection of the commonality between the designs. More articles like this would help those like myself step from being plan builders into designing practical furniture by applying common design elements of a style to an engineered structure. Thanks again!

—*David Moens, Chandler, Ariz.*

That’s no two-car garage—I enjoyed the article “Great Shop in a Two-Car

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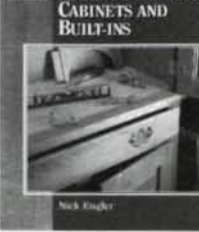
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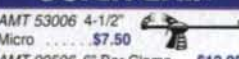
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Garage" (*FWW* #131, pp. 50-55). Curtis Erpelding has a lot of good, innovative ideas. However, to call the space a two-car garage because it has two overhead doors is misleading. It certainly is larger than the typical two-car garage. Based on the picture, it looks like it could easily house three cars. It would have been helpful if the actual dimensions of the space were included in the article.

—Mike Larson, Fairport, N.Y.

A new theory about saw nibs—I am pleased to report that I have uncovered the true purpose of the nib on an old handsaw. For several years, while perusing flea markets and the like, I had noticed a gentleman of a certain age who always seemed to be carrying a sheaf of old saws under his arm whenever I saw him. At some point, I noticed that his saws were always of the nibbed variety.

This spring, I finally stopped him and asked about his collection. "Collection?" he asked. "I don't collect. I paint country scenes on them. And this," he said

indicating the nib, "is where the chimney on the log cabin goes."

—Allan Fisher, Pittsburgh, Pa.

More about tyloses and decay—I must respond to the letter and editor's note (*FWW* #131, p. 10) refuting my earlier assertion that tyloses contributes to decay resistance in wood (*FWW* #130, p. 102). In wood cells, tyloses function as minute baffles, which reduce the wood's permeability. In other words, they function as a barrier to the absorption of moisture.

The fungi that decay wood go dormant when the moisture content drops below about 18%. Throughout the greater part of North America, the moisture content of wood seldom exceeds this level. Therefore, to promote decay, the wood must absorb more moisture than is normally available to it. Basically, it must get wet as a result of precipitation or condensation. Any anatomical feature of a wood (such as tyloses) that retards its capacity to take in water prolongs its structural integrity in a typical exterior

environment where it is exposed to periodic precipitation.

Perhaps in a test where various wood samples were exposed to a perpetual (artificial) environment conducive to decay, the presence or absence of tyloses would make no difference. In the real world, however, it does.

—Jon Arno, Troy, Mich.

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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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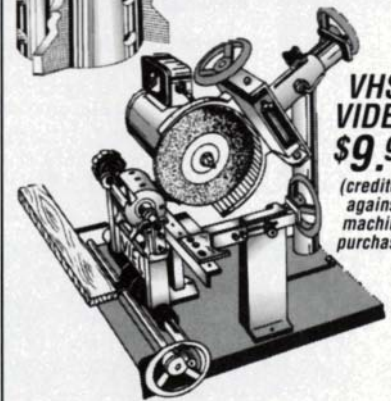


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Photo: Pat Shanklin

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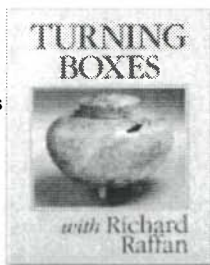
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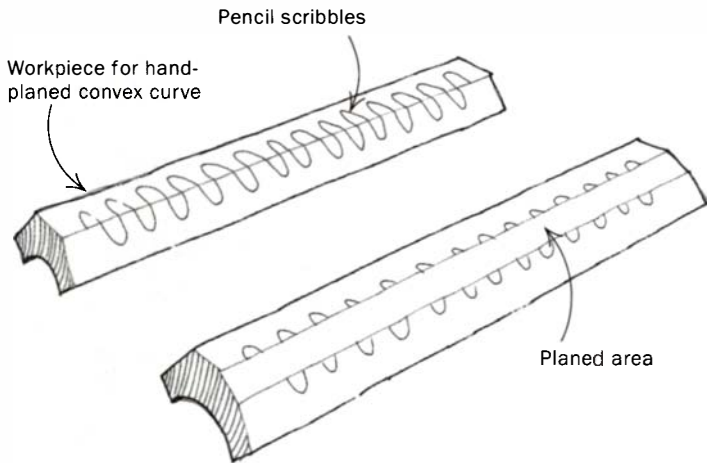
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Handplaning a convex surface

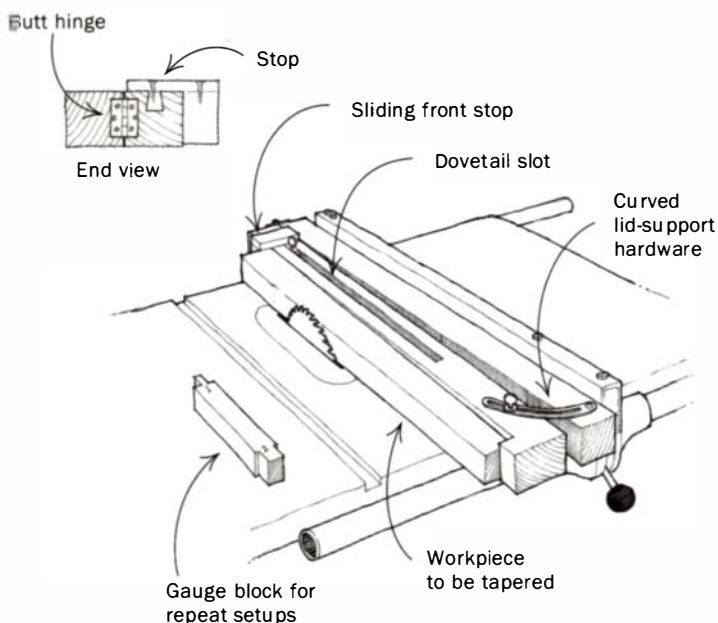


Handplaning a consistent convex shape is tricky. Here's a technique I discovered when I was shaping a crest rail. Starting with a beveled workpiece straight from the tablesaw, I began by planing off the apex of the bevel the length of the boards. I quickly realized that it was going to be tough to keep my plane at the proper angle for the entire length of the board and to keep the curve consistent.

So I squiggled some pencil lines back and forth across the bevels the whole length of the workpiece. By planing through the lines, I could quickly gauge how much material I was removing and hold the plane at the correct angle.

—Val Nelson, Everett, Wash.

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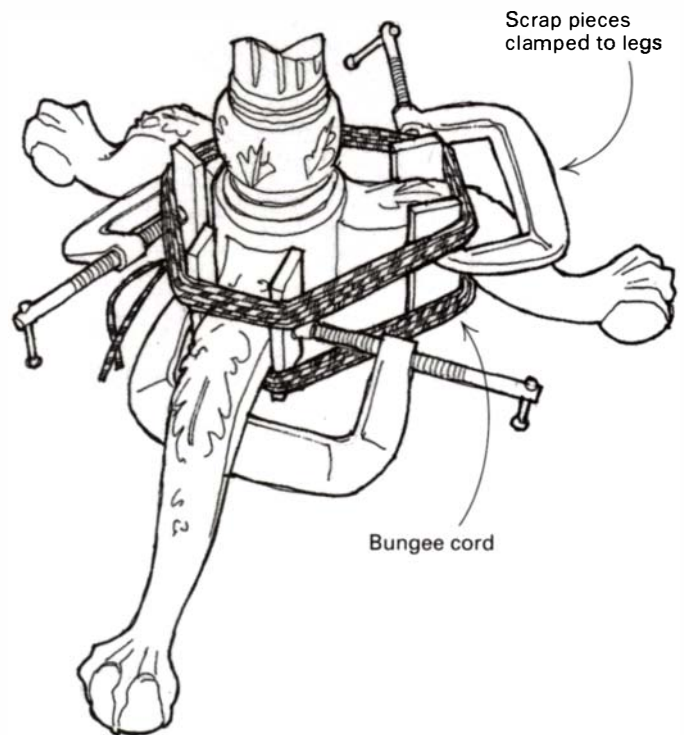
To repeat a given setup, you will need a gauge block. The gauge block contains three critical measurements: the rip-fence to blade setting, the initial taper angle and the second taper angle. To use the gauge block, first determine the rip-fence setting using the block's length. Then, to set the initial taper angle, insert the no. 1 end of the gauge block in the gap between the two arms at the bottom end of the jig. Lock the arm at that initial setting, and cut two sides of the taper on all legs. Next insert the no. 2 end of the gauge block in the gap, adjust the jig to the second angle, tighten it in place and make the third and fourth taper cuts on all legs. To finish the legs, clean up the cuts with a jointer or handplane.

—Eric Orcutt, Tallahassee, Fla.

Quick tip: To keep glue from freezing in a cold shop, place a 15-watt light bulb in an old fishing cooler, and store the glue in there.

—James L. Miller, Frederick, Md.

Clamping pedestal table legs



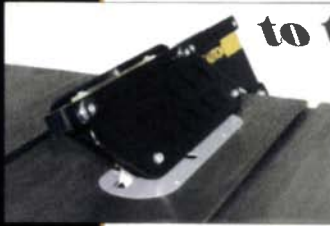
Clamping the dovetailed legs of a pedestal table during glue-up is not easy. There is no place to put the clamps. On the first table I made, which was designed by Franklin Gottshall, I left a square protrusion on the knee of the leg, per his suggestion, to provide a clamping perch. But the protrusion had to be removed later, leav-

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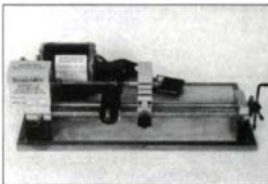
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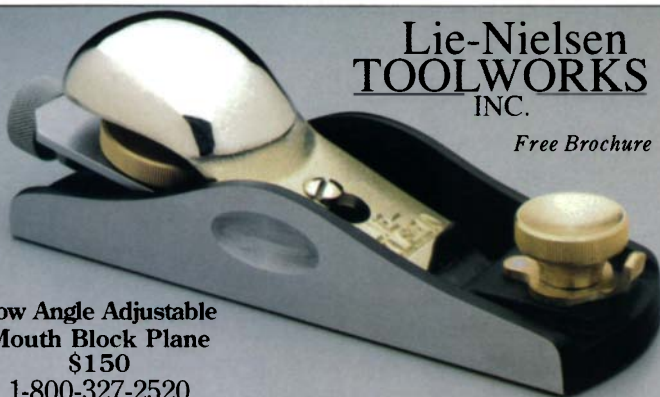
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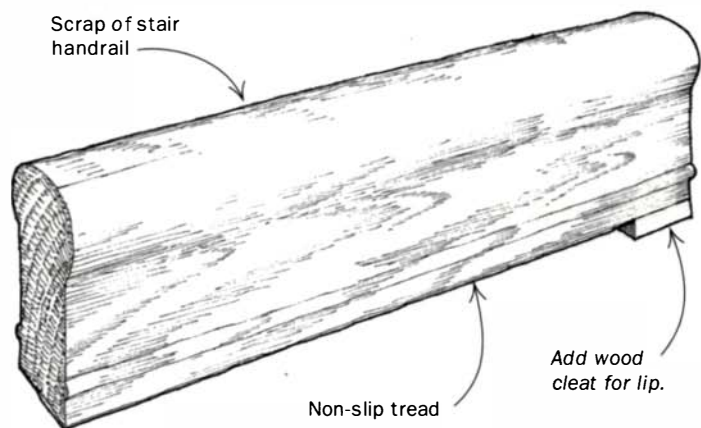
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Methods of Work (continued)

ing an awkward spot to be carved and shaped. Wiser the second time around, I used clamped scraps and a bungee cord, as shown in the sketch. It worked perfectly, and it allowed me to finish carving the legs before gluing up the table.

—*Dr. Thomas M. Wheeler, Montgomery, Ala.*

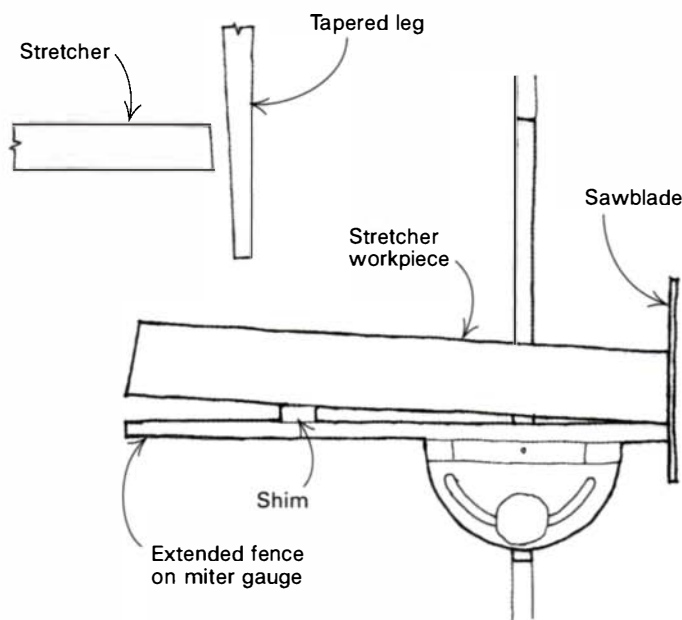
Handrail push block



When I had a nice piece of oak handrail left over from a stair project, I used it to make a push block for my jointer. I stuck some self-adhesive, non-slip tread to the bottom of the handrail and glued a small lip to the back to hold a workpiece firmly in place. The push block is solid, ergonomically correct and, at 4 in., tall enough to prevent even long fingers from extending into the danger zone.

—*Mike Vincent, Littleton, Colo.*

Cutting stretchers for tapered legs



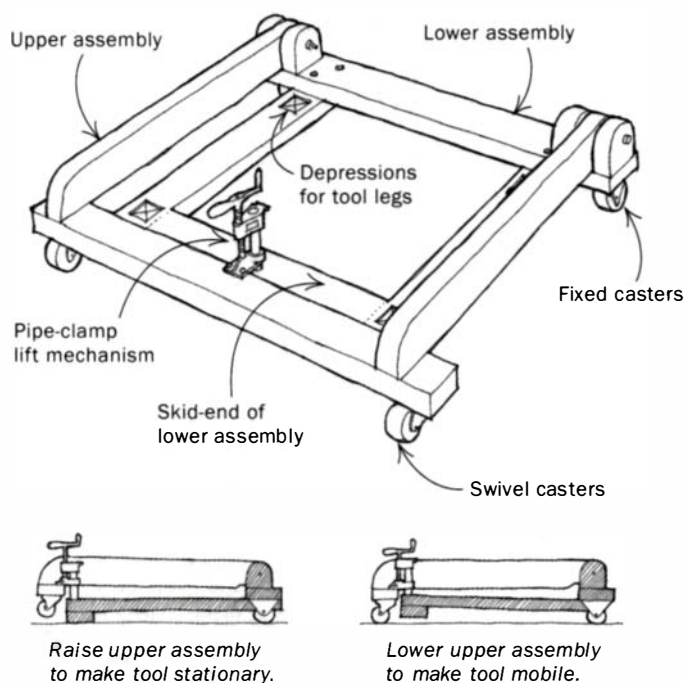
The ends of stretchers that join to tapered table legs must be cross-cut at the same angle to join the legs properly. You can calculate the angle and set the tablesaw miter gauge to the calculated angle.

But there is an easier and more accurate method—similar to the way carpenters cut roof rafters.

Characterize the taper as x in. of taper over y in. of length. When you characterize the taper in this way, it's easy to set the proper angle by leaving the miter gauge set at 90° and shimming the stretcher out from the miter gauge to get the correct angle.

For example, if the leg tapers $\frac{1}{4}$ in. over each 12 in. of length, place a $\frac{1}{4}$ -in. shim 12 in. from the sawblade to set the correct angle of the stretcher cut. Cut one end of the stretcher; then flip it over, and cut the other end to the desired length. If necessary, you can use a smaller shim closer to the blade if you maintain the same x to y ratio. In the example cited, a $\frac{1}{8}$ -in. shim 6 in. from the blade would accomplish the same result. —*James Potzick, Potomac, Md.*

Mobile tool base



If, like me, you have collected more large stationary tools than you have room to store, this mobile base will enable you to move heavy equipment around your shop.

The base consists of two assemblies, an upper and a lower. The lower assembly has fixed casters at the rear and a wood skid at the front. Tool legs sit in depressions cut in the lower assembly. As long as the skid is on the floor, the weight of the tool keeps the assembly from moving. When the skid is lifted from the floor by the pipe-clamp lifting mechanism, weight is shifted to swivel casters on the upper assembly, and the base is free to roll.

Construction of the wooden parts is simple. All pieces are cut from standard 2x4s, except the back part of the lower assembly, which is ripped from a 2x6. For the lifting mechanism, use the screw end of a Pony No. 50 pipe clamp with a $7\frac{1}{2}$ in. length of $\frac{3}{4}$ -in. pipe. Drill two holes through the face of the clamp, and install wood screws to hold it to the upper assembly. Drill a hole into the skid for the pipe, and position it in the lower assembly so that the wheels on the upper assembly just touch the ground when

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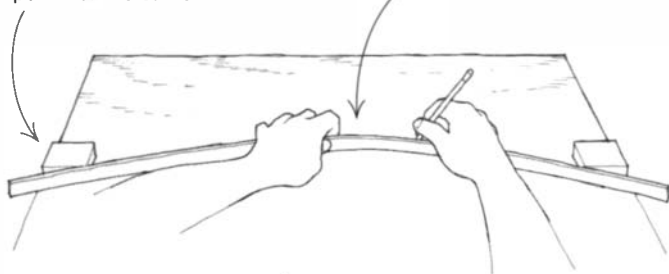
the clamp screw is at its midpoint of travel. Drill a $\frac{5}{16}$ -in. hole through the pipe, and pin it into the lower assembly with a $\frac{1}{4}$ -in. lag screw. Tightening the clamp raises the skid-end of the lower assembly, allowing the mobile base to roll.

—Jeffrey D. Anderson, Melbourne, Fla.

Drawing a curve with a spline

Blocks applied with hot glue to workpiece at end points of the curve.

Push middle of spline to apex of curve.



Drawing a curve with a thin wooden spline is an awkward task for one person to do. You really need one pair of hands to hold the spline steady and another pair to draw the curve. Here's how to draw a curve without having to search for a helper.

Rip a $\frac{3}{32}$ -in.-thick spline from $\frac{3}{4}$ -in., knot-free stock, about 6 in.

longer than the curve you want to draw. Mark the centerline on the spline. Make two stop blocks out of scrap stock. Mark the two end points and the middle apex point of the desired curve on the workpiece, and attach the two stop blocks at the end points with hot-melt glue. With one hand, place the spline against the two blocks, and push it up, aligning the center mark with the apex mark on the workpiece. Draw the curve with the other hand.

—John Saggio, Little Neck, N.Y.

Disposable benchtops

Every shop needs more benchtop work space from time to time. And gluing and painting operations are best done on a surface where drips or spills won't mar the permanent top. I use several portable work surfaces that I made by gluing two pieces of corrugated cardboard together—with their corrugations at right angles—to increase rigidity. These panels are lightweight, easy to handle, easy to store and inexpensive.

Once a workpiece has been glued or painted, I leave it on the portable pad and move it to a safe area until the glue is set or the paint has dried.

—Don Anderson, Sequim, Wash.

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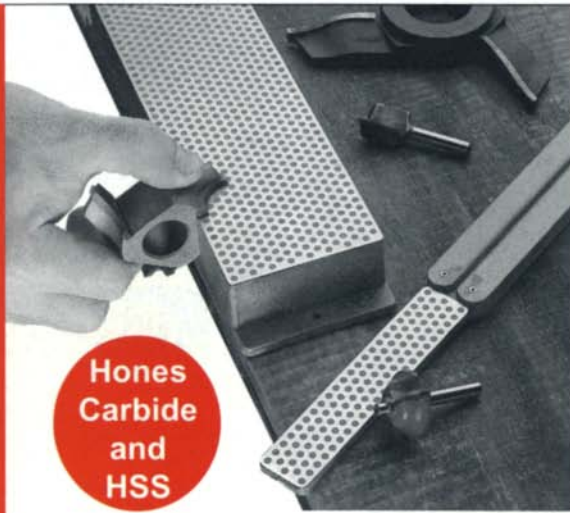
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Notes & Comment

Woodworking: the next generation



At a time when many high schools are scaling back their woodworking programs, Springfield High School in Delaware County, Pa., is letting the sawdust fly. The school's woodworking course, taught by George Trout, is so popular that last year 150 students had to be turned away. That leaves 120 in the program who are working in a shop designed to handle 60. No one seems to mind the crowded conditions. In preparation for the school's annual Celebration for the Arts, many students stay in the shop into the wee hours of the morning. "The quality of their work is astounding," says D. Douglas Mooberry, owner of Kinlock Woodworking, a Unionville, Pa., shop known for building and restoring 18th-century furniture. "It's all problem-solving," Trout says. "If you have 100 pieces to put together, you have 100 problems to solve." Few of Trout's students intend to make a career of woodworking, but it's heartening to hear of so many students who prefer building furniture to watching television.

—Marc Vassallo, associate editor

Better than a night on the town. High school woodworking students in Springfield, Pa., spend long hours in the shop, often staying past midnight.

Carpenter of the bone

We've come across a number of orthopedic surgeons who are also woodworkers. We suspect most of them began as doctors and gravitated toward woodworking as an avocation because of its affinity to their medical work. On the other hand (no pun intended), orthopedic surgeon Dr. E. Jeff Justis of Memphis, Tenn., began as a woodworker.

Justis has woodworking in his blood—he still owns a cherry four-poster bed built by his great-great grandfather. His own half-century of woodworking began at the age of 10, when an uncle gave him a jigsaw. The move to orthopedic surgery came after an internship in general medicine. A colleague visiting for dinner saw one of Justis' woodworking projects and said, "Anybody who can build furniture like that ought to be able to fix bones."

The more Justis thought about the connection, the more sense it made. Both woodworking and orthopedic surgery are manual skills, often relying on surprisingly similar techniques. Consider joinery: When the radius bone (the larger bone in the forearm) develops a tumor at the wrist, the cure is to cut off the end of the bone and replace it with a short length of fibula removed to no ill effect from the leg. To connect the bones, Justis employs a step joint—first cousin to the woodworker's lap joint—strengthened with screws.

People often ask Justis whether he worries that a woodworking accident will injure his hands. Justis says that the loss of a hand would be just as damaging to him as a woodworker. "Certainly I make more money as a surgeon," Justis says, "but the value of woodworking to me is as great or greater. In surgery, I can't be very creative. In woodworking, I can experiment with a joint. The wood won't sue me ... and it doesn't bleed." —M.V.



A dowel is a dowel. For woodworker and orthopedic surgeon E. Jeff Justis, a dowel works equally well whether joining two blanks for a turned bedpost or, as shown in the X-rays, stabilizing a bone fracture.

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Smooth plane from a rough casting

Have you ever wondered what it would be like to fashion a tool from superior materials and include your every desired option? For me, the elusive ideal was a smoothing plane worthy of its name. The best smoothers are reputed to be rare and valuable models by Stanley and Norris.

High-quality bronze castings for a number of classic designs are available from The St. James Bay Tool Co., 122 E. Main St., Mesa, AZ 85201 (800-574-2589). Most are patterned after Norris originals. I purchased a casting listed as a Norris No. 51 style, round-sided smoother with lever cap for \$49, plus a lever cap screw for \$6. The machined version of this casting costs \$149, and the finished plane with ebony in-fill and an adjuster lists for \$520.

I used a milling machine and a metal shaper to make my plane, but many of the essential operations, such as opening the throat, are handwork, as is shaping and polishing the casting. Crafting the plane requires considerable effort,



Diamond in the rough. Stephen Thomas machined the plane of his dreams from a rough casting made by The St. James Bay Tool Co.

but the results are worth it.

Be forewarned: St. James castings are not kits. They're wonderful chunks of metal, to be sure, but quite raw. Moreover, there are no drawings, plans or instructions available. But for those up to the task, making your own Norris-style plane just might be a smooth move.

—Stephen M. Thomas,
Elmira, N.Y.



Wood Webs

Searching for router bits? Try Router Bits on the Web (www.routerbits.com). Started by woodworkers and computer enthusiasts Lew Smith and Peggi Carman, Router Bits on the Web offers more than 800 router bits, all manufactured by Whiteside Machine Co., Forstner bits by Fisch Precision Tools and books and videos on router techniques. The well-organized site has an excellent search engine that allows you to find router bits by name, profile, bit type or part number. The profile index is illustrated with thumbnail sketches: For exam-

ple, click on Dovetail or the picture of a routed dovetail housing, and you'll link to a list of dovetail bits. The site is always open and claims to ship most orders within 24 hours.

If you're curious about who's making what these days, try searching for Web sites of individual woodworkers or small woodshops. If you're a professional or an aspiring one, you may find some ideas to help you build your own site. The site built by Hopewell, N.J., furniture maker John Hein (pluto.njcc.com/~jhein) is a good example. Hein's homepage has a crisp photo of a coopered cabinet, plus a short piece on Hein and his work. Links from the home-

Deep-freeze your tools?

What happens when you cool a tool to -300°F ? According to 300° Below Zero, a cryogenic tempering service in Wooster, Ohio, deep-freezing a metal tool with liquid nitrogen improves both the performance and longevity of the tool.

The cryogenic system used by 300° Below Zero cools the steel slowly to -300° , holds it there for 24 hours, then carefully returns it to room temperature. At -300° , alloys containing austenite, a soft form of iron, experience a conversion of austenite to martensite, a harder form of iron. The cold temperature also promotes the formation of fine carbide particles, called binders, which eliminate weak and soft spots and give the steel complete uniformity of hardness.

Converted martensite is very brittle, so cold-tempered tools had a tendency to shatter. The company purportedly avoids this problem by tempering the tools to 300° following the cryogenic treatment.

300° Below Zero cryogenically treats everything from industrial tools to musical instruments, gun barrels and golf clubs. Woodworkers might want to consider cryogenic treatment of drill bits, router bits, lathe knives or other high-speed-steel tooling. The price for treating such items is \$13 per pound.

Cryogenic tempering is a one-time, permanent process, but 300° Below Zero cautions that it won't turn poor alloys into good ones. For more information, call (330) 683-3375.

—M.V.

page include a longer biography of Hein, a discussion of his work and influences, and a photo gallery of Hein's projects. Hein provides a photo index, so you can get an overview of the collection before taking a closer look at a given piece and its details.

For more of what small woodshops are doing on-line, try Putney, Vt., furniture maker Richard Bissell's site (www.putney.net/bissell) or Green Design Furniture Co. (www.greendesigns.com) of Portland, Maine. The logo alone is worth a visit.

Have you found any interesting woodworking Web sites? Send the address to jkolle@taunton.com.

—Jefferson Kolle, senior editor



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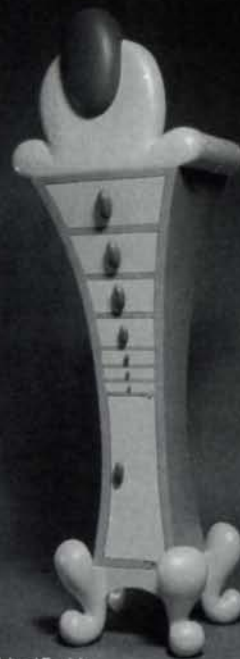
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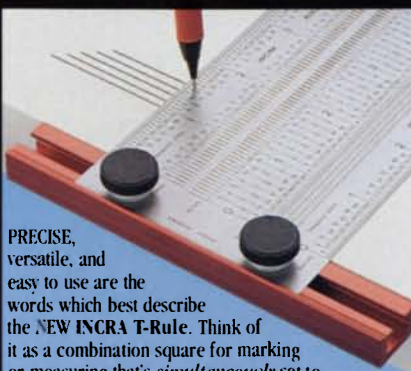
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Tools & Materials

Emerson launches new line of woodworking machines



Ridgid TS2424 10-in. table saw. This U.S.-built table saw comes with a mobile base, a 1.5-hp motor and will sell for about \$680.

Could you be persuaded to buy a contractor's table saw if it came with a lifetime warranty? Emerson Tool Co. is betting that it can woo woodworkers by backing a new line of stationary and benchtop power tools with a lifetime guarantee against defects in materials and workmanship.

The line, which will bear the Ridgid brand name, includes two 10-in. contractor's table saws, a 14-in. bandsaw, a 10-in. miter saw, an abrasive cutoff saw, a 1/2-hp lathe, a scrollsaw, a drill press and a combination oscillating spindle/belt sander. Many of these tools will be available in the fall and will be carried exclusively by national home-center giant Home Depot. Already on the market is a line of Ridgid shop vacuums. (Ridgid is a division of Emerson that makes professional-quality plumbing tools.) Most of the new tools are made in the United States.

Emerson used to supply national retailer Sears with a lot of power tools under the Craftsman label. When Sears decided to go elsewhere for many of these tools, Emerson was faced with laying off part of its workforce. Instead, the company embarked on an ambitious program to launch its own line of woodworking tools, entering an already crowded playing field. The tools will be priced to compete with Craftsman, Delta and Jet products.

Some of the tools, such as the table saws, bear a resemblance to the saws Emerson made for Sears. The new saws have some refinements, such as poly-V belts, which are more efficient and reduce noise and vibration. For more information, call (800) 474-3443, or visit the company's Web site (www.ridgid.com).

—Anatole Burkin

Easy-to-read, accurate table saw miter guide

There are many aftermarket miter guides to choose from, and several are better than the stock guides found on most table saws. But all the guides I've used have one thing in common: a protractor-like gauge that's hard to set precisely without the use of additional measuring tools.

With the Osborne miter guide, you can put away your precision protractor or drafting triangles or whatever you use to set miter angles on your table saw. That's because the Osborne guide is dead accurate, easy to read and a snap to adjust.

If you imagine a right triangle hinged on all three corners, you'll get the idea. The length of the hypotenuse or movable extension arm determines the angle.

Degree marks are laser-etched in black on the aluminum extension arm. There are 1° graduations spaced about 1/8 in. apart, making fine adjustments possible. Detents let you know you're on the money when searching for 45°, 30°, 22½° and 90°. I checked the guide against a Starrett protractor and found both in complete agreement, no matter what angle I set.

The gauge can be purchased with a solid



Reinventing the miter guide. Two types of fences are available with the Osborne Manufacturing miter guide: a 15-in. nylon fence and a 25-in. aluminum fence with a flip stop. Detents in the underside of the extension arm provide positive stops for frequently used angle settings.

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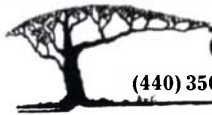
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Tools & Materials (continued)

or adjustable 3/4-in. bar guide, the standard slot size for most tablesaws. (Craftsman and Jet tablesaws require a slightly narrower guide, which Osborne also sells.) Attached to the tip of the guide bar is a disc for T-slotted saw guides. It is easily removed if your tablesaw doesn't have a T-slot.

Guides are available with two types of fences. The original is 15 in. wide and made

of stiff nylon. The second style is a 25-in. model made of aluminum, fitted with a movable flip stop. The back face of the fence has a place for a stick-on rule, which seems like an afterthought because the flip stop doesn't have a pointer for indexing. But the flip stop works well and attaches securely to the fence. The miter guide can be used on either side of the blade. To

make a switch, reposition the fence and index bar—a two minute operation.

Osborne miter guides come in three versions: a solid guide-bar model costs \$139.95; the adjustable guide bar adds another \$10; and the newest model with the aluminum fence and flip stop costs \$154.95. For a distributor, contact Osborne Manufacturing at (717) 368-1493. —A.B.



The first plunge-router base for motorized tools. Guitar maker Bishop Cochran sells an extruded aluminum plunge-router base for Dremel, Ryobi and Foredom motorized tools.



Precision router base for Dremel tools. The Waverly fixed router base has a wide notch cut in its base, which makes it easy to see the workpiece.



Redesigned router base from Dremel. The new base features one flat edge and a pair of handles.

Three router bases for Dremel tools

Dremel tools have a lot of uses in the workshop. They're great for sharpening cutting or chopping tools. Many woodworkers, model makers and instrument makers use them for fine detail work, including routing inlays in wood.

Because of their popularity, there's a booming cottage industry in aftermarket router bases to fit Dremel and other similar tools. Dremel, after studying how people use the tool, introduced a redesigned router base this year. Here's a look at three choices.

A plunge-base invented by a guitar maker

Although there are dozens of accessories for Dremel tools, the manufacturer doesn't make a plunge-router base. Guitar maker Bishop Cochran has invented one for the Dremel tool, the Ryobi Multi-Tool and the Foredom flex-shaft tool.

Cochran has designed a top-notch base made of machined and anodized aluminum. Cochran's beefy tool is stable and has micro-adjusting capability—both horizontally and vertically. The base has a depth stop and locking vertical and horizontal levers. The base is also pre-tapped for templates or other accessories intended for Dremel bases.

Cochran's base makes it easier to control a Dremel tool when routing freehand or with a fence. The base costs more than a Dremel tool itself, but this is an accessory that turns your moto-tool into a precision mini-plunge router. Bases for Dremel or Ryobi tools cost \$147.50 each; the Foredom base costs \$142.50. To order, call Bishop Cochran (503-231-5694). More information is available on his Web site (www.bishopcochran.com). —Jim Moline

A metal fixed base for Dremel tools

If you don't need the plunge base, consider a less costly alternative from another guitar maker. The Waverly router base, a fixed base machined from aluminum, brass and steel, has a wide V-shaped cutout in the base, which provides an excellent view of your work.

The Waverly's height adjustment consists of locking brass thumbscrews, which turn on a pair of threaded steel posts. Each turn of a thumbscrew equals 0.035 in. or 0.889mm. The posts also act as comfortable handles that provide good control when routing small hinge mortises and inlays. The base, which costs \$45.90, is available from Stewart MacDonald's Guitar Shop Supply (800-848-2273). Accessories, including a circle jig and roller-edge guide, are also available. —Niall Barrett

Dremel upgrades its router base

Dremel updated its own router base and the most significant change is the addition of a pair of handles. These handles are mounted low, directly on the lowest portion of the base, which gives you good control. Another change includes the shape of the base: one flat edge (the rest is round), which gives you better feedback when guiding the tool along a straight edge.

The model 330 shares many similarities with the old model 230, including a black plastic (5% glass-filled ABS) body and an identical edge guide. The height-adjustment mechanism is similar except for the addition of graduated marks in millimeters and 1/16-in. increments. For general routing, Dremel's base works well, although the height-adjustment mechanism is a bit sloppy. For high-tolerance work, I'd go with one of the above-mentioned bases, which are stiffer and built to closer tolerances. —A.B.

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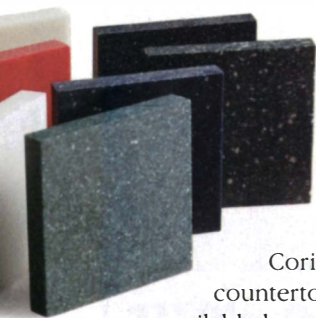


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Corian, the solid-surface countertop material, is now available by mail order in a range of colors and sizes slightly smaller than needed to make countertops. DuPont, the maker, limits the sale of larger pieces to licensed professionals to ensure proper installation.

Corian comes in handy for all sorts of craft projects and furniture. It makes a good substitute for granite or stone tabletops, and it can be used for smaller projects such as boxes, pens and drawer pulls.

You can pick from 68 colors and patterns when buying 1/2-in.-thick stock. A more limited selection is available in 1/4-in. and 3/4-in. stock. The maximum size available to consumers is 15 in. by 72 in.

To get newcomers going, the distributor, Art Specialties International, offers tip sheets on cutting, drilling, attaching and polishing Corian. Basically, Corian can be shaped and cut with woodworking tools. Cyanoacrylate works well for gluing.

Corian averages about \$25 a square foot for 1/2-in.-thick stock. It's available from Art Specialties International, P.O. Box 215, Depew, NY 14043; (800-724-4008).

—Sven Hanson

Abrasive belt cleaner with a bold, smoky flavor

If you've had problems with your sanding belt cleaner breaking apart or clinging to the abrasive, try Nu-Life abrasive belt cleaners, which are made of smoked natural rubber. They aren't immune to shredding, but they don't disintegrate quite so rapidly as crepe-style cleaners and work just as well. Nu-Life cleaners also have a distinctive odor, redolent of heavily smoked beef jerky. A standard-sized cleaning stick is 1 5/8 in. by 1 3/8 in. by 8 1/4 in. (other sizes are available) and costs about \$7. You won't find the belt cleaners at the hardware store, only at specialty cabinet shop suppliers. For a distributor, call the manufacturer at (860) 584-2091.

An unusual circular saw with many good features

The name Festo is unfamiliar to most U.S. woodworkers, but the company is well-known in Europe where it has been in the power-tool business for about 70 years. A distributor began selling Festo tools here last year, and I recently tried out a plunge-cut circular saw, which comes with a carbide-tipped blade, aluminum guide and case.

Out of the box, the ATF 55 and guide were ready to go, no assembly required. I used the tool on a job trimming laminate-covered doors. The tool had power to spare, but what really surprised me was how little noise it produced.

The saw is equipped with an electronic speed control and soft start. When you press the trigger, there's no wrist-jerking roar. The machine has six speeds, which allows you to dial down the rpms when cutting easy-to-melt materials such as plastics. The saw also has an electric brake system that brings the blade to a stop within two seconds. And the tool is equipped with a retractable splitter, which helps prevent blade binding and kickback.

In use, you set the base on the workpiece, press the trigger and push on the handle. The spring-loaded base retracts, and the blade plunges into the stock. Depth of cut is adjustable. Because the saw is made in Germany, it's built on a metric framework. The number 55 in the model name refers to the depth of cut in millimeters, or about 2 1/4 in. The blade is 160mm dia., or about 6 1/4 in. Because the tool's arbor is 20mm, you have to get a replacement blade from Festo.

It takes some getting used to the tool's design. It suffers from a problem common to many circular saws: It's difficult to see where the blade meets the pencil line when cutting freehand. A plastic window is fitted in the side of the saw guard, but I found it of little use. Although this saw is not designed for the task, I tried cutting some 2x4s, framer style, with the stock resting on my foot. It's awkward because of the downward pressure required to retract the base. Festo also makes circular saws without the plunge feature, suitable for framing work.

But the guide system is the best I've ever used. The saw's base is slotted to fit over a rail on the guide body, which has an anti-slip sole. An elastic strip on the edge of the guide serves as an anti-splinter device, and it really works.

The Festo saw does a lot of things better than most saws, but with performance comes a big price. At \$463, the ATF 55 and guide is the most expensive circular saw I've ever put my hands on. For more information, call the distributor (888-337-8600).

—Gary Katz



Circular saw from Germany. Festo's plunge-cut circular saw is equipped with speed control, an electronic brake and an efficient dust-collection design.

Porter-Cable launches new variable-speed jigsaw

Porter-Cable's new jigsaw is a variable-speed, 6-amp machine with a tilt base and tool-less, quick-release blade changer that's expected to be available in September. But what's unique about the model no. 9543 is that it comes with a blade guide that works with the base tilted. (The saw also has a blade-follower, found on all high-quality jigsaws.) The base-locking screw has a self-storing lever and requires

no additional tools. The retail price of the jigsaw is expected to be about \$179.

Anatole Burkin is an associate editor of *Fine Woodworking* magazine. Jim Moline is a clinical psychologist from Monument, Colo., and enjoys building guitars and furniture. Niall Barrett builds custom furniture in Narrowsburg, N.Y. Sven Hanson works wood in Albuquerque, N.M. Gary Katz, a carpenter, lives in Reseda, Calif.

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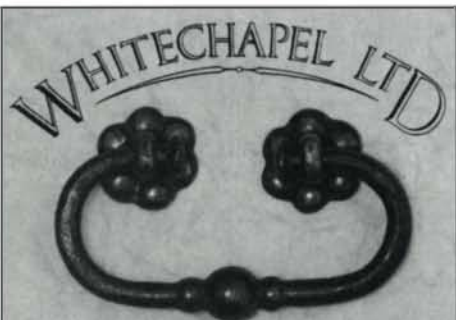
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Varnish

Achieve a traditional look with multiple, thin coats and lots of elbow grease for the final polish

BY THOMAS E. WISSHACK

The use of a bristle brush for applying varnish is so commonplace that many woodworkers don't realize there is any other way. We tend to think of varnish as a traditional finish that must be applied in fairly heavy coats, usually with a brush. This is actually a myth. Some of the oldest and most beautiful finishes relied on numerous, thin coats of varnish that were rubbed onto the wood surface with a soft cloth and then polished to a delightful shine. I believe wiped-on varnish is an important addition to any wood finisher's arsenal of methods. I also think it's the most useful and versatile technique for



creating a beautiful finish. The advantages of using a wiped-on finish are all related to the fact that the individual coats are extremely thin and dry quickly. Let's look at a few of these positive features.

- **Minimal dust contamination**

Dust contamination is a major drawback for people brushing varnish; it dries so slowly foreign particles have plenty of time to land in it. But when the varnish is wiped on, the individual coats of varnish dry rapidly, so dirt doesn't have much chance to adhere. This is an enormous advantage for the wood finisher, because most of the time spent perfecting a varnish finish is a direct result of dust and foreign particles becoming embedded in it.

- **Minimal application marks**

Though varnish can be made to flow and level nicely when brushed on, it's hard to achieve a flawless surface without some sanding. If applied properly, a wiped-on varnish virtually eliminates runs, sags and application marks. The marks that do exist are much easier to remove because the finish layer is thin.

- **Less buildup**

It's rarely necessary to build a thick layer of varnish. Aesthetically, a thinner application is more appealing. By wiping on the varnish, you have infinite control over the final thickness because you can apply as many or as few coats as you want.

Candidates for a wiped-on finish

It's difficult to build up a wiped-on varnish finish to a thickness suitable for a much-used kitchen table or bar top. I've used it on small tables, chests of drawers, frames, boxes, woodwork and numerous other projects that don't normally receive hard use and aren't exposed to spillage or constant moisture. But I don't want to give the impression that wiped-on varnish is not durable. I've used it, with multiple coats, on dining room tabletops where an elegant finish was required. A wiped-on finish will hold up remarkably well, provided a certain amount of common sense is used in caring for it. For example, a wiped-on finish resists mild abrasion and occasional spillage, but if you plan to place a hot dish on the surface or expect it to resist deep scratches, you'd be better off with some other type of finish.

Remember that the number of coats you wipe on has a tremendous effect on the durability of the finish. One or two coats will afford only marginally more protection than several applications of a Danish-type oil finish. Six to 10 wipe-on coats begin to approach the durability of a single thickness of varnish applied with a brush. Determine whether you are willing to spend the time a wiped-on varnish finish requires. The very nature of the process causes you to slow down and approach the finishing of your project with care.

Most varnishes can be wiped on

Virtually any kind of varnish can be applied with a cloth. It's simply a matter of learning a particular varnish's characteristics and



FIRST STEP IS THE SEALER

The important thing is to work the sealer—two parts thinner to one part varnish—into the wood. A natural bristle brush works well. After the surface is completely coated, wipe off all the sealer with a rag.

developing a technique for applying it successfully.

Polyurethane is a good example. Strikingly beautiful finishes can be created by wiping on some polyurethanes, but polyurethane is normally thicker than standard varnish, and it takes a little more practice to master. Waterborne varnish can be built up in many layers with a cloth and rubbed to a lustrous sheen, though it tends to dry very quickly when wiped on, which limits its use to relatively small projects. Certain tung oil varnishes, sold as wiping varnishes, are actually designed for cloth application and have a consistency that makes them appropriate for a good finish.

The real prerequisite for a varnish that is to be wiped on is the hardness and durability of the film it leaves on the wood's surface. Because the final layer of finish is much thinner than a brushed-on varnish finish, it only makes sense for you to

For the finish coats, make a finisher's ball. Make a pillow of cotton cloth filled with cheesecloth, and hold the ball together with a rubber band. A shallow pan makes a good vessel for dipping varnish.



SECOND STEP IS THE VARNISH COATS



Start with the intricate details, and finish the top last. For the detailed parts of furniture—pedestals, legs, carved pieces—it's not always possible to wipe on the varnish with the grain of the wood. Quick coverage and a gentle touch with the finisher's ball are what's important to avoid drips and runs.



Cover surface quickly, and then go with the grain. For the finish coats of wiped-on varnish, you have to work fast before the varnish dries. After you've covered the surface with varnish, land the ball at one edge, taking a light stroke with the wood grain. Lift the ball from the surface just before you get to the far edge. It takes a little practice.



work with a high-quality, brand-name product.

Certain precautions should be taken to reduce dust in your finishing area. If at all possible, do the finishing in a separate room of your shop. This is not always practical, but you can still minimize the problem by raising your work off the ground, cleaning the area and sprinkling the surrounding floor with water. Wet a 10-ft. area around your project, as well as the path you will be using to exit the shop. For small projects, you can build a cardboard hood over the finish area, or you can place a cardboard box over a small object while it dries. Vacuum the cardboard box, and mist the inside with water before placing it over your project.

Brush on the sealer

The first step in a wiped-on finish is sealing the wood. The sealer coat makes the finish coats glide on more smoothly, and it results in a smoother, more professional-looking final product. Whatever varnish you plan to use will make a good sealer. Thin the varnish with two parts of high-quality mineral spirits or turpentine. Avoid thinning varnish with naphtha because the naphtha will cause the sealer to dry too quickly.

Apply the sealer with a natural bristle brush to one section of your project at a time. Use the product liberally, making sure everything is covered. Work it into the pores of the wood in all directions. Let it soak in about one minute, and then remove all superfluous varnish with cloths.

It's wise to let this sealer coat dry overnight—two days is even

better—before attempting to apply subsequent coats of finish. This ensures that the surface you're working with is completely dry. A distinct advantage of the sealer coat is that it stabilizes the moisture content in the wood, allowing the subsequent coats to level and dry much more reliably.

The dance of the finisher's ball

The ideal applicator for wiping on varnish is a wood finisher's ball made from a soft cotton cloth filled with cheesecloth, forming a small pillow. A rubber band holds the ball together and makes a convenient handle.

Before you use the varnish, be sure to strain it through a cone-shaped painter's strainer or a piece of lint-free cheesecloth stretched across the top of an empty can. Dilute the varnish to a 50/50 mixture with the same thinner that you used for the sealer. Then pour the mixture into a thin aluminum pan such as the type pot pies come in.

Dip your finisher's ball into the mixture, and then tap the sides of the pan lightly so that nothing is actually dripping from your cloth. I always start with the smaller more intricately detailed parts of a piece of furniture before I finish the large planes. When I applied finish to the table shown in the photos, I started with the pedestal and legs and finished the tabletop last.

Apply the finish in a circular motion, and don't worry about neatness at first. You will need to work quickly because the thinly applied coats dry rapidly. Next use long, gliding movements, holding the wood finisher's ball in the air and landing it lightly on the wood's surface.

Work with deft strokes in the direction of the wood grain. At the far end of a flat surface, lift the ball from the surface just as you come to the edge. Repeat until you have deposited a smooth, continuous layer of varnish. Dip into the pan for fresh varnish when your cloth becomes dry or begins to drag. When you are finished with a large flat surface, such as a tabletop, dip the ball into the varnish mixture, and gently apply a coat of varnish to the top's edges.

It's a good idea to let a coat of varnish dry overnight before applying the next coat. Here's a quick test for dryness: Lightly stroke a surface with your finest paper. If the paper produces a white powder on the surface of the wood, it's dry enough and ready for the next coat.

Possible pitfalls

Here are a few of the common problems that can occur when applying varnish with a cloth, along with appropriate solutions.

● Varnish dries before a coat can be successfully applied

You may need to practice on small boards before attempting a large piece of furniture. It takes a little time to learn to apply the finish quickly and evenly. It's also possible that your varnish is drying so quickly that you don't have enough time to apply a thin coat. Try thinning the varnish slightly, increasing the amount of solvent in very small increments until it seems to be easier to work with. If a particular finish continues to give you trouble, switch to another brand.

● Finish appears streaky and uneven or has rough areas

Roughness usually means you have overworked the varnish and portions of it have begun to dry. Don't go back in and tamper with it. If an application is

extremely rough, remove it right away with solvent rather than attempt to sand it smooth when dry.

● Varnish takes several days to dry or stays gummy

Chances are, the sealer coat was not given ample drying time, and trapped moisture is affecting your finish. This is common in damp weather, but it can also be caused by wood moisture. Put the object in a warm, dry place. If it does not begin to dry after 24 hours, scrub the piece with 0000 steel wool and naphtha. Wipe off all bad finish, let the piece dry overnight and reapply the sealer. Wait several days; then apply the wiped-on coats as usual.

How many coats?

For wiped-on finish to be at all durable, four coats should be thought of as a minimum; beyond that, it depends upon the look you are trying to achieve. I sometimes apply six to 10 individual coats to a small project, such as a box made of exotic or unusual wood. I have applied as many as 20 coats to very special projects. More coats give greater depth to the wood surface and are ideal when you want to show off a particularly handsome piece of wood. Keep in mind that with practically any varnish, regardless of whether it is marketed as semigloss or satin, the gloss will increase, and the grain will begin to fill when multiple coats are applied.

The final rub

Let the final coat of varnish dry about two days before attempting to do any rubbing. Less time could cause a too-soft finish to be



THIRD STEP IS LEVELING

After the last coat of varnish and before the final polishing, the author levels the surface with 600-grit paper, a foam sanding block and a little water. It takes a light touch. The intent is to knock off dust or debris that might have dried into the varnish despite precautionary measures.

FINAL STEP IS POLISHING



Unfold a pad of 0000 steel wool, and dry rub all surfaces to a dull sheen. Then mix mineral oil and powdered rottenstone into a slurry, and rub the steel wool for several minutes more. If the slurry seems dry and too abrasive, add more oil.

Wipe with cotton cloths to remove oil and rottenstone. Continue changing soiled cloths until the cloth stays clean when you wipe the surfaces.



ruined; more time could cause it to harden to the point where it's difficult to rub out. There are two very important steps to the rubbing-out process: leveling and polishing.

Even a flawlessly applied wipe-on finish will need a little sandpaper leveling to remove the tiniest specks of dust that might have accumulated in the finish when it was drying. If you attempted to rub such a finish with steel wool alone, the abrasive would ride over high spots caused by debris and create a superficially smooth, yet bumpy surface. Leveling cuts through these high spots and prepares the finish for the polishing of the surface.

I use new 600-grit wet-or-dry sandpaper, lubricated with a few drops of water. A soft rubber sanding block keeps fingers from digging in and aids in the leveling process. Keep in mind that a few strokes is often enough to do the job. Avoid too much pressure on the ends of boards. It's fairly easy to damage a thin finish, though using the 600-grit paper makes this less likely.

Polishing is the final step in producing a superior wiped-on finish. Open a pad of 0000 steel wool to maximum size, and begin rubbing dry along the wood grain in long, even strokes. Stop before you run over the edge of the surface you are rubbing to avoid

going through the finish where it is vulnerable. Rub until the surface has been uniformly dulled down, using only moderate pressure. The process will take several minutes per section. Stop frequently to examine your progress using a light held obliquely to the surface.

When the surfaces have a dull sheen, lubricate the steel wool with mineral oil and rottenstone to make a slurry, and continue rubbing in the direction of the grain for two or three minutes. This evens out any streakiness that is a result of the dry rubbing. Also, it leaves the surface, when wiped down, with a very attractive semidull sheen that will not smudge or remain oily. Special rubbing lubricants for wood finishing are made, but after trying them all, including paraffin, I find mineral oil the least greasy and easiest to remove completely.

After a few minutes of rubbing, use a clean cotton cloth to remove the rottenstone and the oil, wiping with the grain and changing cloths when they get soiled. When the cloth remains clean, picking up no more oil or rottenstone, the finish is, at last, finished. Beautiful! □

Tom Wisshack makes and restores furniture in Galesburg, Ill.

Break Out of the Bathroom Vanity Box

Think table when building this Shaker-inspired design

BY IAN INGERSOLL

Lately I've grown tired of vanity cabinets. Apparently I'm not alone, because in catalogs and showrooms, I see more and more bathroom furniture: table-like vanities, stand-alone cabinets, little stands for serving up towels. But I didn't arrive at my design from the ranks of the avant-garde; rather, this vanity, with its gently tapered and splayed legs, is an outgrowth of years of working in the Shaker tradition.



I see it as a forward-looking nod to the Shaker washstand. I've also grown tired of cherry, a wood I feel furniture makers have worked to death. I made this vanity out of walnut, and a cheap grade at that, oxidized a deep, mocha brown with potassium permanganate (see the box on p. 49). The vanity base fits comfortably under a solid-surface top and relies on a few simple design moves and the striking ebony-like finish. With this design, you won't need a fat wallet to make your bathroom look like a million bucks.

In designing the vanity, I had to consider a few issues particular to the genre. For height, I went with a fairly standard 33 in. For width, a 34-in. top felt right, and it allowed for two narrow drawers, one to either side of the bowl. The one caveat is that 34 in. is not a standard top size. You could adapt my design for either a 31-in. top or a 37-in. top, the two standard sizes closest to 34 in. Or you could have the top custom fabricated (see the box below), as I did. Regardless of the width you choose, you may need a custom top to get one without the standard-issue integral backsplash.

All vanity tops are 22 in. deep, so to determine the overhang and the ultimate width of the table, I had to work back from 22 in. The key is to allow enough overhang in the rear so that the backsplash will sit flush against the wall and the legs will leave room for baseboard molding (see the drawing on the facing page).

Even a vanity-as-table benefits from storage space. So I insisted on the two drawers, and I included a grate for a shelf. I'd used a similar floating grate on a kitchen island, and it seemed just right for this vanity.

To accommodate plumbing, I made the aprons deep enough to hide the sink bowl

THE FRONT APRON



Rip and reglue to craft a front apron with flush drawers. Rip the apron at the top and bottom of the drawers (top left). After jointing the ripped edges, cut the middle piece to make two drawer fronts; then glue and clamp the apron pieces together again (top right). Cut the apron to length after glue-up. With a saw set to cut at 2°, mark the length at the top of the apron (center). After the apron is glued in place, mark the upper outside corner of the drawer fronts, and cut them to length with the saw set at 2° (bottom).



and most of the trap; a little chrome plumbing showing underneath keeps the vanity honest. You or your plumber can relocate the supply lines to run through or just below the rear apron. Either way, you won't see them from the front. As for moisture, a few coats of polyurethane over the permanganate finish should protect the wood surfaces for years. And compared with a closed-in cabinet, the open design of the legs and grate allow plenty of air circulation.

Constructing the vanity requires a trick or two, but it isn't difficult or especially time-



Choosing a solid-surface vanity top

Solid-surface tops, such as Corlan, are seamless, nonporous and highly stain-resistant, but the reason I like them is that they look and feel good. You can order solid-surface tops from local hardware stores, building supply centers or kitchen and bath shops. Corlan is probably

the best-known solid-surface top; others, all roughly the same, include Swanstone, Fountainhead and Plonlte.

For the vanity, I chose a Plonlte solid-surface top in ice white, with an integral 16-in. oval bowl. Plonlte sheets are nominally ½ in. thick; I specified double-thick edges. Most fabricators will drill

holes for the faucet and handles free of charge. I selected a Kohler Coralals polished chrome faucet (model no. K15886KPC) and Kohler Coralals polished chrome lever handles with white porcelain inserts (model no. K158504PPC), which together cost roughly \$200. The Plonlte top (standard 22 in. depth, custom cut to 34 in.) cost roughly \$550. For more information on Plonlte, contact the manufacturer, Pioneer Plastics Corp., at (800) 746-6483 or at www.plonltesolld.com.

Regardless of the top you choose, be sure to have it on hand or know its dimensions with absolute certainty before you determine the exact dimensions of your base. —J.J.

BATHROOM VANITY WITH LEGS

The walnut base is designed for a 34-in. solid-surface top. To accommodate a wider top, you could stretch the distance between the legs and widen the drawers.

Solid-surface top with 16-in.-dia. oval bowl, $\frac{7}{8}$ in. thick x 22 in. wide x 34 in. long

Backsplash, $\frac{3}{4}$ in. thick x $7\frac{3}{4}$ in. high x 34 in. long is chamfered 45° and adhered to top with silicone.

Block, $\frac{3}{4}$ in. x $\frac{3}{4}$ in., secures drawer side guide, front and rear

Apron, $\frac{3}{4}$ in. thick x 9 in. wide x $27\frac{3}{16}$ in. long at top, ends angled 2°

Leg, $1\frac{3}{4}$ in. x $1\frac{3}{4}$ in.

Apron, $\frac{3}{4}$ in. thick x 9 in. wide x 15 in. long at top, ends angled 2°

Grate, 1 in. thick x $19\frac{3}{4}$ in. wide x 32 in. long

Slats, $\frac{3}{4}$ in. wide, spaced 1 in. apart

Mitered tenon, flush to inside face of apron, $\frac{3}{8}$ in. thick x $1\frac{3}{8}$ in. long, pinned with $\frac{1}{4}$ -in. dowel

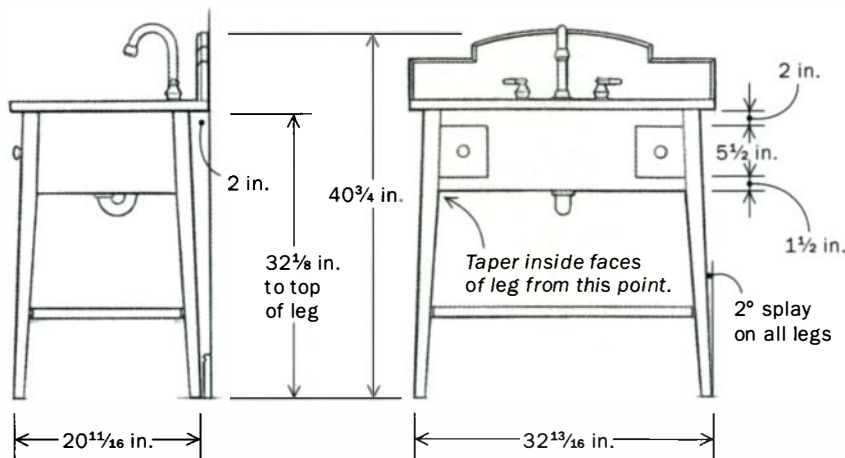
Leg is $1\frac{1}{8}$ in. sq. at bottom.

Drawer box, $4\frac{3}{4}$ in. high x $5\frac{3}{16}$ in. wide x $14\frac{1}{2}$ in. long

Dowel, $\frac{3}{8}$ in., located 9 in. on center from ground

GETTING THE REAR OVERHANG RIGHT

The solid-surface vanity top needs to overhang the base at the rear by 2 in. to allow $\frac{3}{4}$ in. between the leg and the wall for a baseboard.

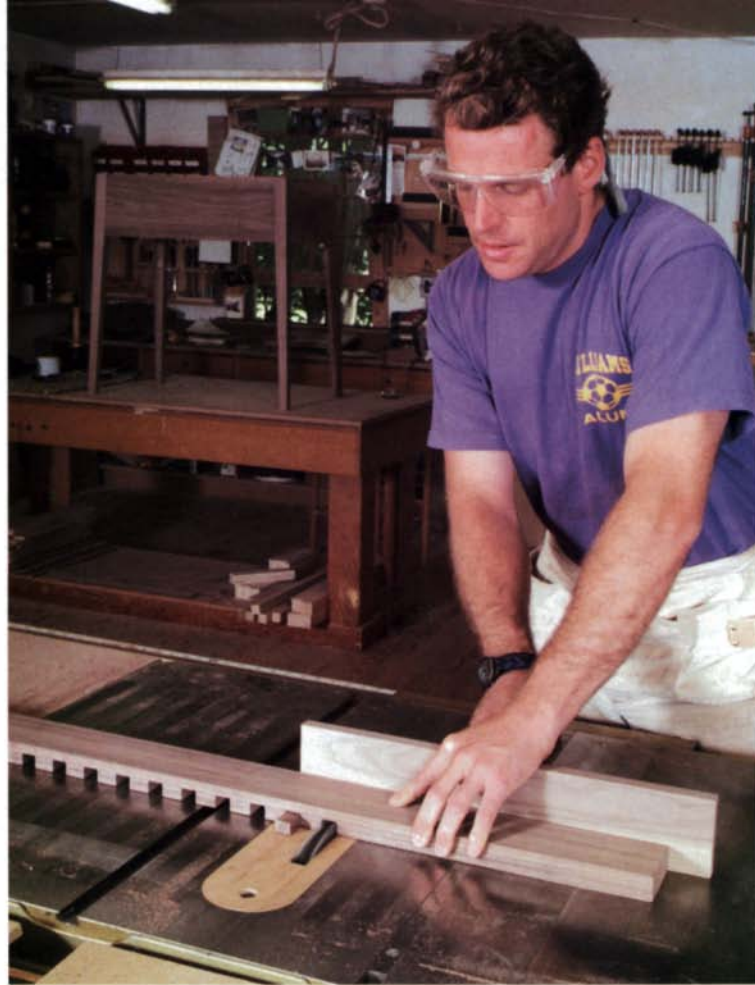
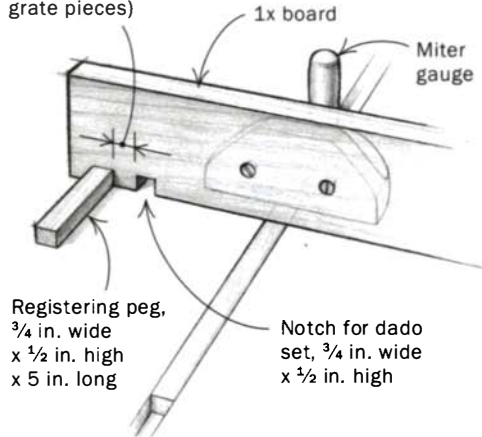


MAKING THE GRATE



First cross-dado a long blank using a simple jig. With this jig, you'll be able to index a series of consistent dados across a 1-in.-thick by 3-in.- or 4-in.-wide board.

Space, 1 in. (equal to distance between grate pieces)



consuming if you take it in stages. Easy for me to say, since Pieter Mulder, one of the craftsmen I employ, built the prototype for me. But I think Pieter would agree.

Vanity is a table

Not counting the floating grate (see the box below) or the backsplash, the essence of the vanity is four legs and four aprons, plus the two drawers. Make them in that order.

I needed to leave a full 16 in. for the sink bowl, which necessitated pushing the drawers against the tapered legs. An angled drawer front is scarcely harder to make than a straight-sided drawer front, and the slim line between the drawer front and the leg helps you read the legs as splayed,

even though the angle is a mere 2°. I had a guy working for me a while back, and his first run of supposedly vertical tables turned out splayed: He called it his fat-boy line of furniture, because it looked like someone heavy had sat on the tables. With the vanity, I intended the splay.

Mill the legs square, and then cut the tapers. The taper on both the inside faces of the legs runs straight from the bottom of the apron to the foot of the leg (see the drawing on p. 47). Save the scraps from your ripcuts, and use them later as clamping pads when gluing the aprons to the legs. Cut the mortises perpendicular to the inside faces of the legs.

Mill the aprons long, and cut them to

length with a chop saw set at 2° off vertical. To figure the finished length of each apron, determine the distance between the legs at the top, and add 1 $\frac{3}{8}$ in. on each side for tenons; for instance, Pieter cut the side aprons 17 $\frac{3}{4}$ in. long.

Before cutting the tenons, you need to rip and reglue the front apron for the two flush drawers. The front apron needs to begin a bit wider and longer than the other aprons because you'll lose two sawkerfs when you cut out the drawer fronts (see the photos on p. 46). Rip the apron proud of your lines, so you can joint the fresh edges before glue-up. The reglued apron will have a very close grain match despite the missing kerfs. Once the front apron has



A clever way to float a wood grate

I considered several ways of attaching the grate to the legs, but settled on resting the grate on four dowels, one protruding from each leg (see the photo at left). With a $\frac{1}{2}$ -in. reveal between the grate and the legs and with the dowels half-hidden in notches in the underside of the grate, anyone walking up to the vanity will perceive the grate as floating.

(Those who get down on their hands and knees and crawl around on your bathroom floor will have earned the right to know how the grate is attached.) Use $\frac{3}{8}$ -in. wood or metal dowels, set $\frac{5}{8}$ in. into the leg and protruding 1 in. Be sure to drill the hole for the dowel parallel to the vanity top, not perpendicular to the splayed and tapered leg. —J.J.



Rip the blank into notched strips. When you rip a really wide board into narrow strips, you have many chances to kick the board off square as you pass it through the saw, resulting in tapered strips that don't fit well together. You're better off ripping boards that are 3 in. or 4 in. wide.

been glued together again, you can joint all four aprons at the same time.

Now you can cut all the tenons. Use a tablesaw with a dado set, cutting the shoulders first with the board flat over the dado set. Then cut the cheeks using a miter gauge, with the boards standing on edge. Because the shoulders are cut 2° off vertical, cutting the cheeks on edge will leave a triangle that must be pared out by hand.

Once you've cut the legs and aprons, you're ready to glue up the table. Leave the aprons a touch proud of the legs, and scrape and sand them flush. If, instead, the leg is proud of the apron, you'll run into trouble because you'll lose the crisp line of the leg as you sand it down. The 2° taper on the aprons will transfer to the legs, so you may want to beltsand or plane the tops of the legs flush with the top edges of the aprons. Sanding the legs flush with the apron will help the vanity top to sit flat. One thing nice about the splayed legs and the floating grate is that you don't have to include the grate in the glue-up.

You can build the two drawer boxes any way you like; just be sure the inner sides avoid the sink bowl. Wait until the table is

glued up to cut the drawer front to length. Mark the length of the top edge against the drawer opening, and use this mark to make a 2° cut.

Making the wood grate takes less time than you might think, as long as you don't attempt to cut and notch each piece individually. The trick is to cut a series of dados, half the thickness of the board, across a wide 1-in.-thick board. Then rip the board, which results in several identically notched strips indexed to fit together when arranged in a grid.

For a grate that appears to float around the legs, first make a full rectangular grid and then cut away the corners with a jigsaw. Chisel the inside faces clean. The assembled grate can be sanded with a belt sander or sent through a thickness sander.

Putting a lid on it

Once you've assembled the legs and aprons, fitted the drawers and built the grate, you're almost done. The next-to-last step is to install the solid-surface top onto the wood table. It's almost a non-event, a task best left undone until you're actually plumbing the vanity. A solid-surface top is quite heavy—it tends to stay where you put it—and the wood table needs to move under it, so the barest of connections is required. Simply run a bead of silicone along the top edge of the front apron, and lay the solid-surface top in place.

The backsplash is shaped from a 7/8-in.-wide piece of walnut. Cut it with a bandsaw, clean it up and then use a chamfer bit on your router to bevel the edge.

The final step, I promise, is to attach the backsplash to the solid-surface top. With the vanity in place, affix the backsplash to the rear wall with silicone, and run a bead of caulk between the backsplash and vanity top. Now you can admire your work, and then wash your hands. □

Ian Ingersoll designs and builds furniture at his shop in West Cornwall, Conn.

A rich finish for poor wood

There are any number of disaster stories associated with the use of potassium permanganate as a finish, most having to do with turning something black that wasn't supposed to be.

A chemical that oxidizes wood to change its color, potassium permanganate is sold in water-soluble salt form. It is considered a toxin, though it is neither volatile, flammable nor listed as a carcinogen. You should wear a res-

pirator when mixing the salts and gloves when applying the finish. You may have luck purchasing potassium permanganate from a local water conditioning company, such as Culligan. One mail-order supplier of potassium permanganate is Olde Mill Cabinet Shoppe (717-755-8884). Ask for a Material Safety Data Sheet (MSDS), and expect to pay a hazardous-materials shipping charge.

Potassium permanganate reacts differently to different woods and at different dilutions, so always test it on some scrap. It dries in one to two hours, and it is

very forgiving and uniform in darker shades, making it a good choice for inexpensive, poor quality woods, such as sappy walnut.

For the vanity, David Blakey, one of the finishers at my shop, applied three coats of potassium permanganate (1 tablespoon mixed with 1 quart of water) and then two coats of Minwax Polyshade, a urethane with a tint to prevent UV damage to the oxidized finish. —J.J.



Going Over Edges



Understanding the design implications
of edge treatments will improve the look
and feel of your work

BY WILL NEPTUNE

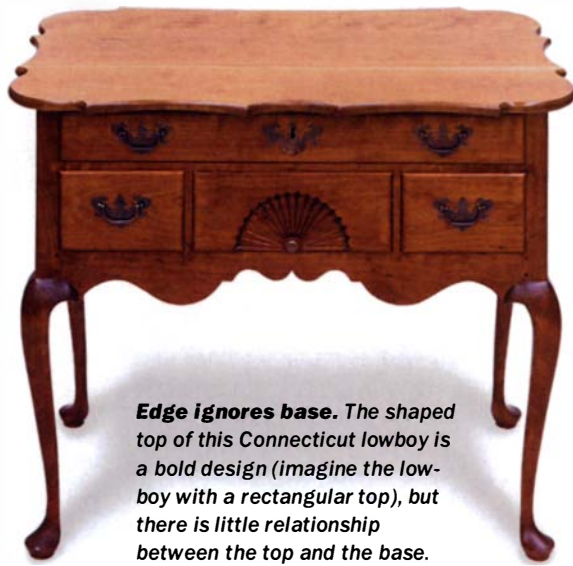
Top edges are an opportunity, a chance for a furniture maker to reinforce and enhance the overall design of a piece: to emphasize the horizontal or vertical aspect, to draw attention away from the base and toward the top or vice versa, to repeat an element or quality of the base, or to take the piece in a new direction. But a top edge, whether on a table, a desk or a case piece, is not experienced in isolation. Rather, the edge affects you in concert with the rest of the piece.

An edge is a kind of hot spot, a place where the top and the base come together. An edge is also just one part of the top. When you design an edge, you must consider the size and the

shape of the top, as well as the edge profile itself.

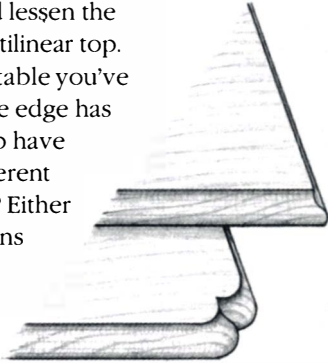
I'm going to look at 18th-century edges because they're the ones I'm most familiar with and because the 18th-century furniture makers worked out most of the moldings and edge profiles we're still working with today. If edges themselves are an opportunity, so too is the study of edges. Whether you build 18th-century reproductions or your own contemporary creations, a close look at edge treatments offers you a chance to add another set of options to your designer's tool kit.

The game of edge design is one in which little moves often have big consequences. Imagine two Queen Anne lowboys,



Edge ignores base. The shaped top of this Connecticut lowboy is a bold design (imagine the lowboy with a rectangular top), but there is little relationship between the top and the base.

similar in size and overall design. Both have rectangular tops with simple ogee moldings, but one has dimpled corners (see the drawing at right). In the latter, the small, curved creases in the molding soften the edge and lessen the severity of the otherwise rectilinear top. Or imagine that the top of a table you've made looks too thin once the edge has been molded. Should the top have been thicker or would a different molding have looked better? Either way, the slightest of alterations might have made all the difference.



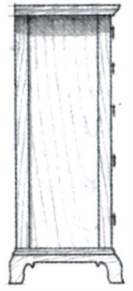
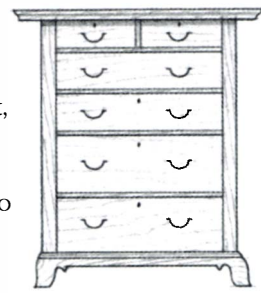
Sizing the top

When designing a tabletop, you should consider the size of the top before the shape of the top or the treatment of its edge. This is because you first take in the overall stance of a piece. You register the thickness of the top and the degree of its overhang long before you take in small-scale details such as the profile of the edge. From a distance, the elevation (front) view dominates the plan (top) view. A thin top tends to make the entire piece seem more delicate; a thick top tends to have the opposite effect. Large overhangs emphasize the horizontal; small overhangs allow you to grasp the relationship between the top and the base.

But the interaction of overhang and base is rarely so simple. As you come closer, a large overhang will block the view of the base. This limits opportunities for small edge details to tie the base and top together. So large overhangs tend to put a premium on plan-view design ideas. It may be enough for a large rectangular top to be made of beautiful wood: a single wide board or well-matched, figured wood. On such a table, a simple edge treatment will hold the viewer's gaze to the center of the top, emphasizing the wood itself.

Now consider a table or case piece for which you want to emphasize one elevation over the others, say a chest of drawers that will be viewed mostly from the front. The side overhang can be large, creating a strong horizontal effect from the front, and

the front overhang can be small. The benefit of the small front overhang is that, as you come closer, your view of the base isn't cut off. Lowboys (see the photo at left) and block-front bureaus (see the photo at left on p. 53) are both good examples of this design idea. Even up close, the scrolled apron of the lowboy shows as well as the top. With the bureau, the focus on the stack of shaped drawers is reinforced by having a shallow front overhang shaped to match the curving pattern of the drawers.



If the overhang is kept small on all sides, a curious thing happens. The horizontal quality of the top is suppressed, and the overall visual effect is one of compactness, which can be seen in the Newport block-front desk (see the photo on p. 52). A small overhang on the desk contributes to a compact stance and places the emphasis on the elevation.

Shaping the top

In addition to the size of a top, the shape of a top in plan view provides another level of information to read along with the edge treatment. A top with a visually active shape leads the eye around its edge. If the edge itself has an interesting profile, the shape of the top can intensify the effect of the profile. Tripod pie-crust tables (see the photo below) are a perfect example of this phenomenon.

Historically, shaping the tops of tables and case pieces was an expensive and desirable alternative to the more common rectangular top: embellishment equaled sophistication. However, I believe shaped tops proliferated due, as much as anything, to their dramatic visual effect. In many instances, a simple four-legged rectangular base would receive a shaped top to dress it up. Another approach was to have the base and top share a common form. The top becomes an extension of the base: The shaped

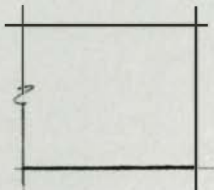


Edge amplifies top. In this pie-crust table, the top is intricately shaped in both plan view and in elevation. The concentric curves of the concave and convex edge carvings produce a pattern of inside and outside corners, enhancing the effect of the top's shape.

A glossary of edge profiles

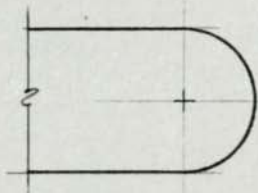
SQUARE

This most basic edge shape is bold and simple. The single vertical surface will light up as a uniform plane or be uniformly in shadow.



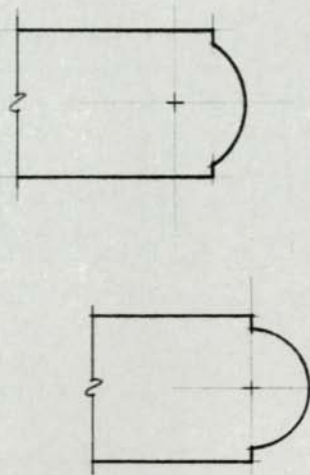
HALF-ROUND

The curve of the half-round (or bull-nose) flows smoothly into the flat surfaces, softening the appearance of the edge. There are no hard surfaces or corners to interrupt the flow, but the price is the lack of clear boundaries. Though still a simple shape, the half-round seems more complex than the square edge because as you move around it, bars of light travel across its curved surface.



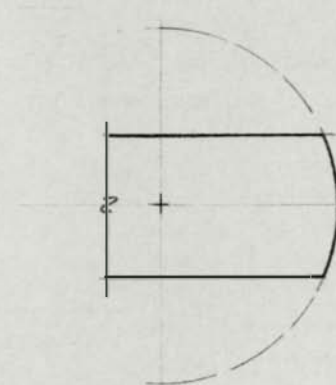
ASTRAGAL

The astragal begins as a soft half-round, but adds fillets to both sides. The combination of flats and a curve creates a bolder and more severe border than that of the segmental (at right). The added complexity of the flats makes the top appear thinner.



SEGMENTAL

The segmental produces the same softness and sense of movement in light as the half-round, but the corners formed where the curve breaks at the flat win back some hardness and provide a definite border. Moving the compass point inward makes the edge a smaller piece of a larger circle; if the circle gets too large, the segmental appears as a square edge. But if the circle gets too small, the edge becomes, in effect, a half-round because the corners are less distinct.



edge functions as one more layer of concentric information.

By itself, a shaped top shows only in plan view; it essentially disappears in true elevation. But when moldings are introduced to the edge, a new effect develops. Patterns of shaped miters occur at every break from flat to flat, curve to curve or curve to flat. Often a shaped top develops a rhythm of inside and outside corners. This rhythm has a powerful visual effect on the edge. The more complex the molding, the more complex the

intersections, and the more powerful the effect. If either the top or the molding was square, the effect would be lost.

Molding the edge

Once you've looked at the way the size and shape of the top interact with both the top edge and the overall piece, you are ready to consider the edge itself. The design of an edge profile is all about curves or the lack of them. When it comes to designing curves (whether they're an aspect of an edge or of some other furniture element), there are those who prefer freehand curves and those who prefer compass-based constructions.

I certainly work with freehand curves, but I find myself reaching for a compass more often than not. I typically begin with either a tracing of an edge profile from a period piece or a rough freehand sketch of an edge profile I like. Then by careful observation and some guesswork, I try to find compass settings that will pass a line along the original. Many times two or three compass points will get me very close.

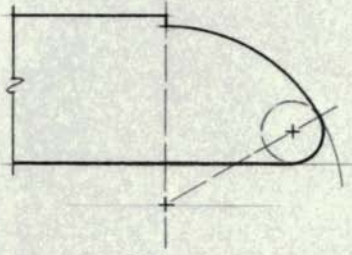
A curve that is pleasing to the eye is said to be fair. I've found that experimenting with a compass gives me a good sense of the character of fair curves. You can't kid yourself with a compass: either the radius lines of the two arcs share a common line or



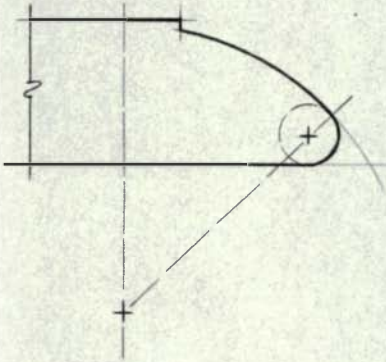
Edge emphasizes elevation. The molded top edge and submolding on this Newport knee-hole desk read as one wide molding. The vertical quality of the wide molding emphasizes front elevation over plan view, directing the eye to the shells, which terminate the blocked design.

THUMBNAIL

In a thumbnail edge, the curved surface is tipped, blurring the distinction between vertical and horizontal, yet the small top fillet provides a crisp border.



Moving the compass point down and to the left, as in the thumbnail below, generates a larger curve, flattening the edge profile.



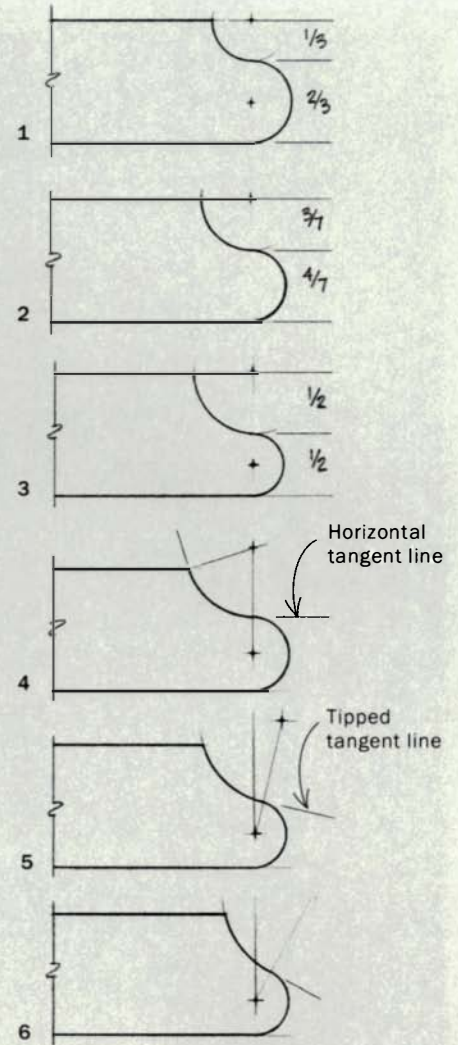
OGEE

The reverse curve of the ogee breaks the thickness of a top into several horizontal bands. This layered effect makes the top look thinner and more delicate. The concave and convex parts of the curve are perceived as separate elements, but because the transition is fair, there is no hard line to interfere with the feeling of softness. And yet, the crisp top corner provides a distinct border.

Ogees 1 to 3 have similar curves but different proportions. Increasing the radius of the upper, concave curve changes the overall proportions of the profile, making the half-circle nose appear pointier.

In ogees 4 to 6, the compass point for the concave curve moves upward. As the compass point moves up, the arc becomes less than a quarter-circle, and the top corner becomes more obtuse, making it softer and less defined.

A more subtle effect occurs where the concave and convex curves meet. If the convex curve completes a half-round, as in ogees 1 to 4, you sense the horizontal tangent line at the top of the curve. This comes across as a shelf, and gives the edge a harder, even harsh, look. Moving the compass point both upward and to the right, as in ogees 5 and 6, allows you to begin the upper, concave curve before completing the half-circle of the nose curve. This tips the tangent line away from horizontal and gives the resulting S-curve a more gentle feel. —W.N.



they don't. Flats or dead spots on a curve show up quickly with a compass because you can't get the curves to meet.

As a practical matter, designing edge profiles by using sections of circles enables you to use common, in-stock cutters to mold the edge. For short runs, I often find it quicker to cut an ogee with two router bits rather than to grind a large cutter. Using part of the curve of a core-box bit and shortening the wings of a quarter-round bit will allow you to mold ogees with little cleanup.

Over the years, I've observed a few fundamental principles for designing edge profiles: Round surfaces are softer-looking than



Edge reinforces base. The blocking in this Boston block-front bureau is worked out through the entire elevation. The top edge is molded following a pattern of curves concentric to the drawer-front plan. The blocking design is reinforced by the top-to-base relationship.

Edge repeats base. The carefully matched veneer pattern on this Biedermeier tripod table leads the eye around the edge, making a direct visual connection between top and apron.

flat surfaces; vertical lines and horizontal lines have a more severe effect than angled lines; 90° corners have a harder look than obtuse corners; the viewer of an edge reacts to shadow and light as much as to volume and shape.

In the glossary shown above, I look at six basic edge profiles. The trick for the designer is to manage all the variables of the edge treatment while keeping an eye on the rest of the piece as well. A hands-on approach is the only way, ultimately, to discover the edge treatments that make sense for your work. □

Will Neptune is a furniture maker and a woodworking instructor at the North Bennet Street School in Boston.





An Inspired Tool Chest

Duncan Phyfe's personal tool chest begets a handsome adaptation

BY BILL CROZIER

Between my freshman and sophomore years at the Rhode Island School of Design, I was looking ahead to the fall when I would begin studying woodworking under Tage Frid. That same summer, my father mounted a show of illustration at the New York Historical Society. The exhibition was a pretty big deal—but with precious little relevance, you might think, to woodworking. However, one evening as my father entered the Historical Society by the usual after-hours route—through a basement area stuffed with holdings in storage—he stumbled upon an extraordinary find: the tool chest of Duncan Phyfe, the New York

City cabinetmaker who gave his name to an elegant style of furniture in the first decades of the 19th century. My father said he'd try to get permission for me to see it. A week later, I got my chance.

If I had seen the chest closed, I might have walked right by it. Typical of Old-World style joiner's tool chests, it was essentially a ruggedly built blanket chest with drawers and compartments inside for tools. This box had the usual simple, scuffed exterior, but when the lid was lifted, I was in for a treat. The drawer box, or till, had rows of shallow, beautifully proportioned drawers veneered with crotch Cuban mahogany and filled with scores of exquisite tools, with handles of bone or ebony or rosewood, all well used but in superb condition. The drawers were joined with flawless, tiny dovetails and sported pulls turned from elephant ivory. Below the drawers, dozens of molding planes were nested in neat compartments.

I wasn't permitted to touch the chest or the tools, but the curator who agreed to let me see them said that if I wanted anything moved I could ask the guard on duty nearby. Well, I gave the poor guy a workout. I was there the better part of a day, absorbing and drawing every detail. After sketching the cabinet construction and layout, I noted which tools were contained in each of the drawers. I took particularly careful notes because I knew that the first project in Tage Frid's curriculum was to build a tool chest,

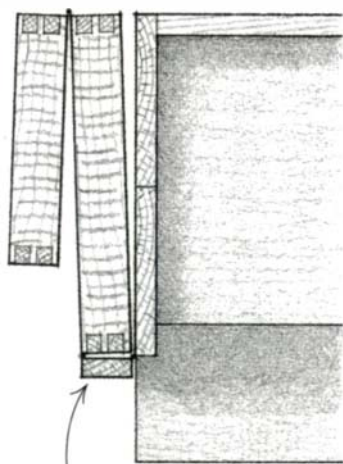
One fine chest leads to another. Bill Crozier (left) found an idea worth emulating when he came across Duncan Phyfe's tool chest (right) in a museum. Scottish-born Phyfe (1768-1854) established himself in New York as the pre-eminent cabinetmaker. Almost synonymous with the Federal style, Phyfe's furniture was typically made of mahogany and often finely carved with lyres, reeding and swags. Phyfe left an estate of a half-million dollars—a sum that testifies to his popularity, his craftsmanship and his business acumen.





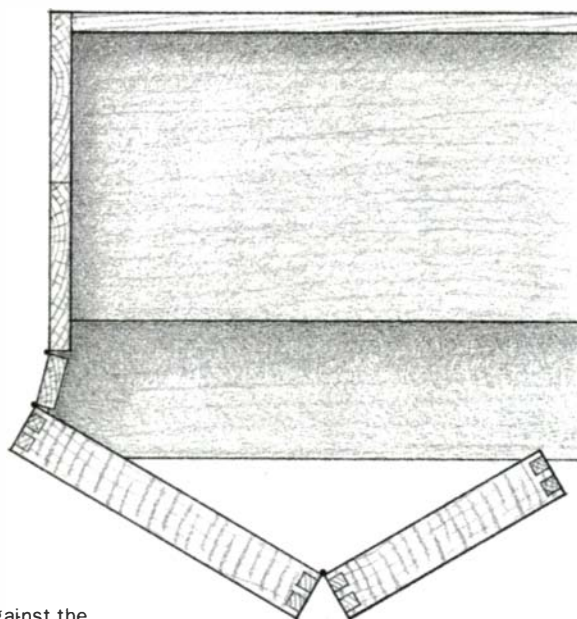
ARTICULATED DOORS FOLD QUIETLY AWAY

Triple-hinged accordion doors fold up at the ends of the case during use and can be pulled across to lock it shut. The author built deep doors to accommodate hanging tool storage, but hasn't used them that way.



Swinging stile

To permit the deep doors to fold flat against the cabinet, the author hinged a narrow strip of wood to the cabinet side, creating a swinging stile.



and I figured I had found a pretty good starting place for the design of mine.

In the following weeks, I worked to design my own tool chest, using Duncan Phyfe's as inspiration. What appealed to me most about his chest was the drawer till, with its pleasingly slim and perfectly proportioned drawers. I decided to make a fairly direct copy of it, adding one row of drawers. But I didn't like the idea of having to bend over to fetch my tools, and I didn't want to have to root around in a dark box, moving one tool to get to another. So for my design, I essentially lifted Phyfe's drawer till out of the big blanket chest and put it on an open stand at a comfortable height.

I followed Phyfe's lead again in turning drawer pulls in a range of sizes—larger ones for the bigger bottom drawers and smaller ones to suit the smaller drawers. I turned mine from rosewood instead of ivory. And although I loved the way the crotch mahogany looked on his drawer fronts, I chose to have solid fronts on my drawers and made them from a mixture of bird's-eye maple and tiger maple.

I admired the way Phyfe used his chest as well as the way he made it. He arranged things so tools with similar functions were in adjacent drawers. I did the same thing: I keep layout and marking tools in the first row of drawers, with squares in one drawer, marking knives and pencils in another, compasses and dividers in a third. The second row is reserved for chisels, with paring chisels in one drawer, mortising chisels in the one beside it and Japanese chisels in the next. This has made it easy to remember where things are even in a bank of 20 drawers. To protect the tools, I lined the top two rows of drawers with upholstery velvet. For the bottom three rows, I glued sheet cork in the bottoms.

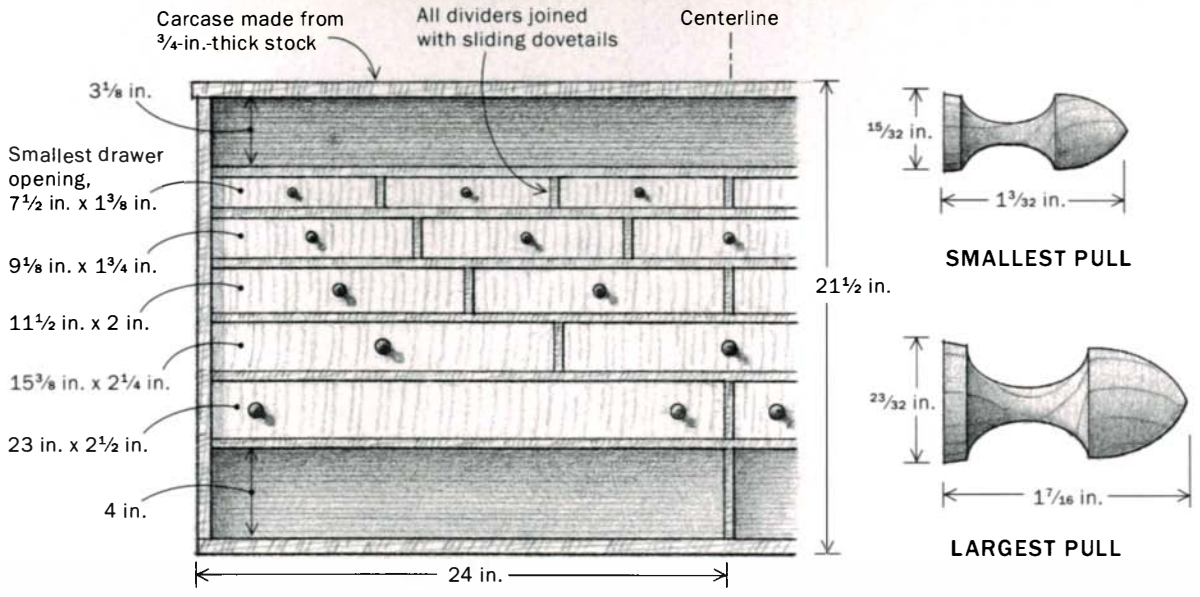
I still wanted to be able to lock the chest, so I gave it a lid and built accordion-style doors that fold out of the way at the ends of the drawer box, but can be pulled across to engage the lid and lock the whole thing shut. As it turns out, I never close them. But I suppose when you design something like this you are just guessing how the future will go, and you are not always right. I also left cavities below the bottom drawers for trays I envisioned as holding the day's tools. They would be easily removable so I could take them to the bench or wherever I was working. That still sounds like a good idea, but I've never made the trays. I also



Organizing your drawers. The author noticed that Duncan Phyfe organized his tools by rows of drawers and followed suit. Having all the various chisels, for instance, in adjacent drawers makes it easier to keep track of them.

HOW BIG ARE ELEGANT DRAWERS?

The author based the layout of drawers in his chest on Duncan Phyfe's, but added a fifth row of drawers. Phyfe jumped from six drawers in the top row to four in the second. The author made rows of six, five, four, three and two. As Phyfe did, the author turned pulls that graduate in size to suit the drawers.



left a space on the stand below the drawer box because I intended to build a case of larger drawers for power tools. Maybe I'll build it next year.

So far, I've gotten two decades of service from my tool chest. But it would have served me well even if I'd never used it, because making it was like a double apprenticeship—one in joinery and the other in

design—under a pair of masters. We were asked to build our boxes using either all mortise-and-tenon joinery or all dovetails. I chose dovetails because I'd never cut them and was eager to try. Cutting all the dovetails in the stand, the doors, the drawer box and the drawers themselves with Tage Frid's guidance was a real dovetail apprenticeship. And as I made my way through my

first attempt to design and build a major piece, I was also serving a design apprenticeship under the eye of Duncan Phyfe. □

Bill Crozier designs and builds furniture in Providence, R.I. Carlyle Lynch's measured drawings of the Duncan Phyfe chest (FWW #53) are available from Garrett Wade (800-221-2942). Also, see our Web site (www.taunton.com).

The Spin on Random Orbit Sanders

Recent innovations improve the machines that revolutionized sanding

BY LON SCHLEINING



When random-orbit sanders first hit the woodworking market, they offered some perks that you couldn't find in other machines. Eight years and many improvements later, they threaten to turn even the belt sander into an antiquated tool.

The classic example of a tough sanding job is a face frame where two pieces of wood come together at right angles. It's difficult, even in experienced hands, to sand a face frame well with any other portable sander. But with a random-orbit sander, even a novice can do a good job.

Whether you need an aggressive machine or one for finish-sanding, the right

random-orbit sander will make sanding an easier and more enjoyable task.

Over the last few months, I've used an array of the latest machines. I also took them to Cerritos College, where I teach woodworking, so the students and a few instructors could put the various machines through their paces.

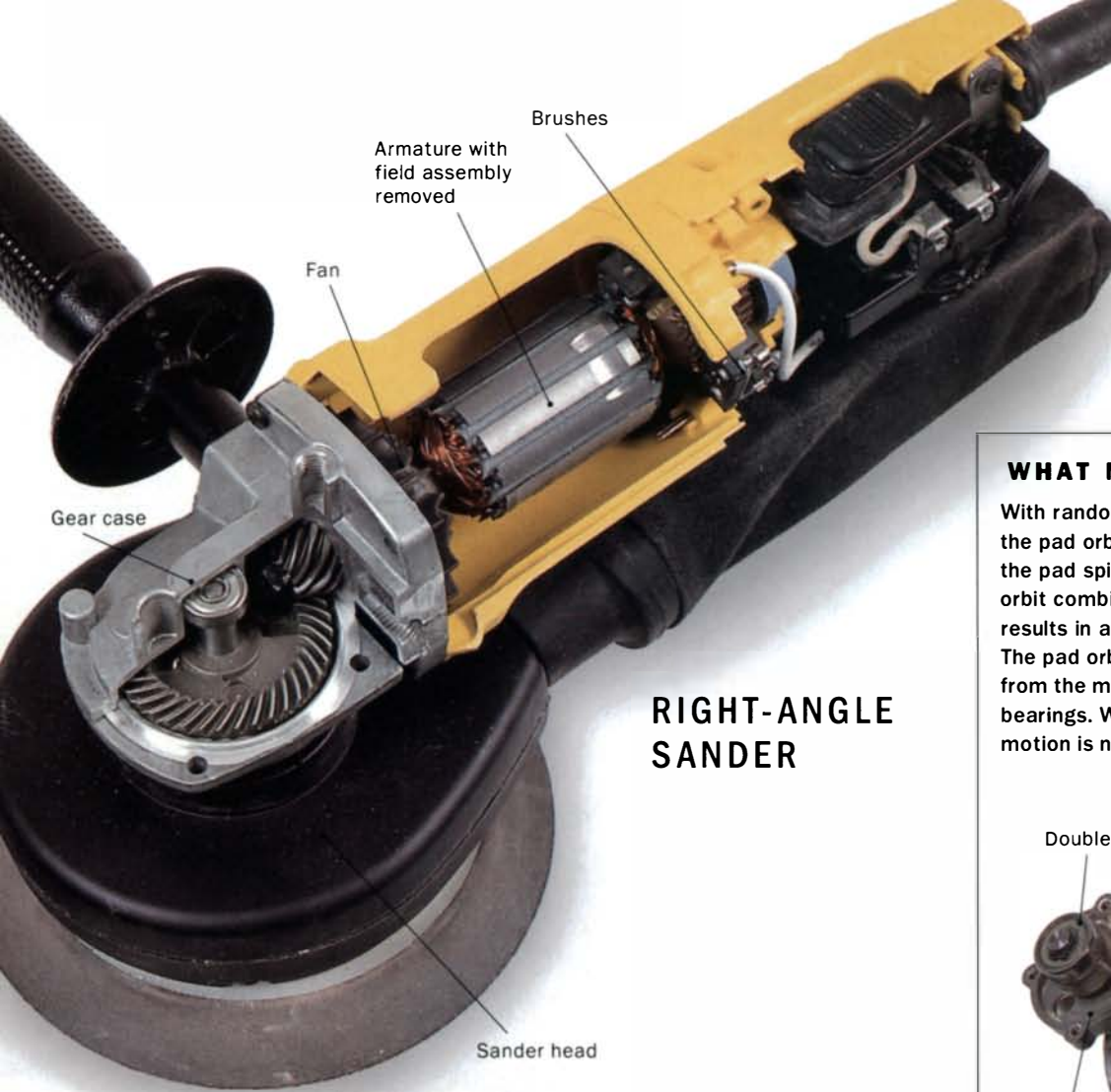
We all contributed our observations on such things as dust collection, noise and overall performance. We also evaluated all the advertised improvements—variable-orbit patterns, more power, less vibration, slow-starting motors and pad dampeners, which keep the sander from scarring the work—to see whether the bells and whis-

tles were real innovations or just gimmicks.

What we found was an amazing range of quality between essentially identical looking machines. There are some great values and some fine but pricey tools. There are also a few duds to steer clear of.

What is a random-orbit sander?

If you pick up a sander that has a square pad or a round pad that you cannot rotate, chances are it's a conventional orbital or finishing sander. On these sanders, the sanding pad is mounted slightly off-center on the shaft of the motor. When the motor runs, the disc orbits but does not spin. This pattern is consistent, producing a tell-tale



Brushes
Armature with field assembly removed

Fan

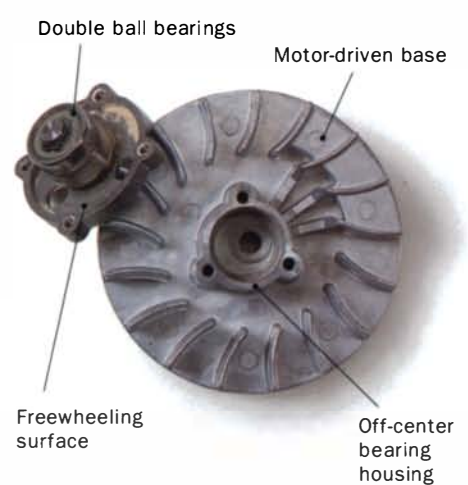
Gear case

Sander head

RIGHT-ANGLE SANDER

WHAT MAKES THEM WORK

With random-orbit machines, not only does the pad orbit around the shaft of the motor, the pad spins as well. This dual motion—the orbit combined with the spinning of the pad—results in a random-orbit sanding pattern. The pad orbits because it is housed off-center from the motor. But it also spins freely on ball bearings. With a few exceptions, this spinning motion is not powered by the motor.



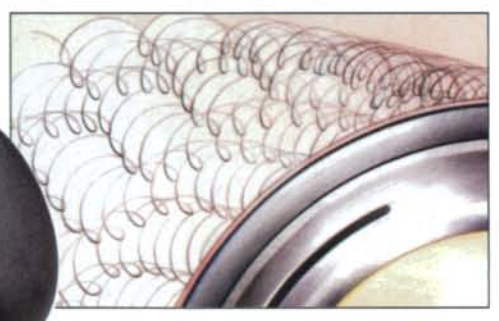
Double ball bearings

Motor-driven base

Freewheeling surface

Off-center bearing housing

The scratch pattern of random-orbit sanders is almost indiscernible on the face of the work.



Drawing: Bruce Maser



Field assembly

Front handle

Switch assembly

Variable speed

Dust chute

PISTOL-GRIP SANDER

PALM SANDERS

Palm sanders are light, familiar-looking tools designed for one-handed use. They are mostly used for fine sanding and finishing—where a delicate touch is needed and not much stock is to be removed. The best in this category is nearly a toss-up between the Porter-Cable 333VS and the DeWalt DW423. The DeWalt is more comfortable and quiet, but the Porter-Cable offers more power.

Ryobi RS 240 STREET PRICE: \$50

For the price, the Ryobi RS 240 palm sander has to be considered an entry-level sander. It performs pretty well considering the low cost, but it has severe vibration, not much power and poor dust collection. One innovative feature is the pressure-sensitive adhesive/hook-and-loop adapter. It sticks on like any other PSA disc and allows you to use hook-and-loop discs without buying another pad. It should work with any PSA pad.

DeWalt DW423

STREET PRICE: \$90

You could run this sander all day. It's a very quiet machine with a small profile that makes it easy and comfortable to hold. It's a variable-speed machine with a soft start and efficient dust collection. The only problems are that it is one of the most expensive palm sanders and could use a bit more power.

Bosch 1295DH

STREET PRICE: \$90

This sander has lots of power and good dust collection. At high speeds, it's capable of some aggressive sanding. It was the noisiest palm sander reviewed. The vibration is excessive, and the dampener barely works. The switch was awkward to use, and the machine became tiresome to operate after a few minutes.



Porter-Cable 333VS

STREET PRICE: \$80

The latest version of this sander is a smooth, well-balanced workhorse. It has variable speed and with 2.4 amps, a lot more power than the old model at 1.7 amps. The real innovation on this machine is that a groove milled into the pad allows you to use sanding discs of any hole pattern, without sacrificing dust collection.

Black & Decker R0100

STREET PRICE: \$40

A decent entry-level sander. It works almost as smoothly as some of the more expensive models. One nice feature is that it easily hooks up to standard vacuum hoses. But it could use variable speeds and a better dampener—it barely slowed the spinning of the disc.

Makita B0 5010

STREET PRICE: \$75

A real nice machine with plenty of power. It has very little vibration, an excellent dampener and good dust pickup. It's quiet and lightweight to boot. The only drawback is that it doesn't have variable speed.

MODEL	Black & Decker R0100	Bosch 1295DH	DeWalt DW423	Makita B0 5010	Porter-Cable 333VS	Ryobi RS 240
PAD STYLE (H & L= hook & loop)	5 in. 8 hole H & L	5 in. 8 hole H & L	5 in. 8 hole H & L	5 in. 8 hole H & L	5 in. 6, 8 hole H & L	5 in. 8 hole H & L
WEIGHT	3.5 lbs.	3.5 lbs.	3.2 lbs.	2.6 lbs.	3.5 lbs.	3 lbs.
AMPS	2	2.4	2	2	2.4	2.4
ORBIT DIAMETER	3/32 in.	1/16 in.	3/32 in.	1/8 in.	3/32 in.	5/32 in.
DECIBELS	88	89	81	84	87	88
SPIN CONTROL DAMPENER	Yes Poor	Yes Poor	Yes Excellent	Yes Excellent	Yes Excellent	Yes Good
SPEEDS (orbits per minute)	12,000	12,000, 14,000	7,000- 12,000	12,000	5,000- 12,000	12,500
DUST COLLECTION	Cloth bag Good	Canister Good	Cloth bag Excellent	Cloth bag Good	Canister Excellent	Cloth bag Poor

pattern of identical circular scratches on the surface being worked. A random-orbit sander starts with this same orbit mechanism but houses the pad on ball bearings so that the pad also spins (see the box on p. 59). This is how the random pattern is achieved.

Think of someone using a Hula Hoop. The person's hips are orbiting their body in a circular pattern like the pad on a conventional orbital sander. The Hula Hoop itself is like the pad on a random-orbit sander—it's being propelled by the regular motion of the person's hips, but the hoop is also spinning in a random pattern like the pad on a random-orbit sander.

With the pad both spinning and orbiting, the scratch pattern on the surface of the work is more random and less repetitious—almost imperceptible. Because of the sanding pad's unique motion, you don't have to worry about the grain orientation.

What to look for in a random-orbit machine

Within the general category of random-orbit sanders, there are three configurations: palm, pistol grip and right-angle sanders.

The palm sanders are very light, one-handed machines that are great for fine and finish-sanding. They are a pleasure to use, but they wouldn't be my first choice for aggressive stock removal.

The pistol grips are smooth running with the least vibration and generally a little more power. These machines are a good choice if you're looking for a sander to do a little bit of everything. I thought that they would be awkward to use, but some of the handle designs proved wonderfully comfortable.

Right-angle sanders were the first random-orbit sanders to enter the woodworking field. Based on the automotive trade's angle grinder, right-angle sanders are two-handed machines that are capable of removing a lot of stock quickly. But they are loud and can be hard to control—

Air-powered sanders

For those who have pressurized air in large quantities—at least a 5-hp compressor—pneumatic sanders are a light and affordable option. Their performance is as good as most of the electric models, and the cost is comparable. They have good dust-collection options, and many are quiet enough to run without ear protection. Their speed and power are easy to control.

The Dynabrade 57030 air palm sander is light, powerful and has as little vibration as any machine tested. Its small shape feels better in your hand than the larger Fein or the much larger electric Fein sanders. Even without a dampener, this air sander is a fine machine, especially for its \$270 price. Fein also makes a vacuum (model no. 9-88-13) to accompany its air sander.



Not just blowing air. Pneumatic sanders are comfortable palm-style machines, with more power than their electric cousins.

PISTOL-GRIP SANDERS

Compared to palm sanders, pistol-grip sanders are generally heavier, more powerful tools designed for use with two hands. Some are more aggressive or have more features than the palm sanders, but others are just palm sanders with different handles. Bosch proved to be the pick of the pistol-grip litter, with Metabo coming in a pricey second.

Bosch 3725DVS

STREET PRICE: \$150

One of my students called this a “kinder, gentler sander.” It has excellent dust collection, and the dampener works great. It has handles that allow a number of different grips. And the soft rubber coating on the top of the motor housing feels good in your hand. It’s also light enough to be used in one hand like a palm sander. It is quiet, aggressive and has the least vibration of all of the sanders. With variable speeds, this easily is the most sander for the money.

Metabo SX E 450 Duo

STREET PRICE: \$190

Although expensive, this quiet, powerful and comfortable machine ran a close second to the Bosch pistol grip for smooth operation and sanding speed. Its unique feature is its ability to change from a wide, ¼-in. orbit diameter for aggressive work to a smaller ⅜-in. orbit for finer work. This coupled with variable speed makes this the choice for fine work like sanding finishes. One problem is that it’s a heavy machine for anything other than horizontal sanding.

Skil 7435

STREET PRICE: \$65

For the money, this sander is comfortable, easy to control and quiet. The adjustable front handle helps accommodate different hand positions. This sander also has a large bag for dust collection that stays out of the way and is easy to empty. If the bag is removed, the dust port is made to fit a standard vacuum hose.



Milwaukee 6020-02

STREET PRICE: \$160

This 6-in. European-made sander (as well as its 5-in. brother) is innovative in its design. It is lightweight and has a lot of power but little vibration. This is a comfortable machine to use. The variable-speed control on the trigger is handy. One drawback is that the 6-in. sander requires a unique hole pattern, so the discs might be hard to find.

Wen 18

STREET PRICE: \$60

A lightweight sander with good dust collection and a convenient variable-speed switch on the handle. The grip was more comfortable than most of the lower-end pistol-grip sanders, but it proved short on power and could use a spin-control dampener.

Craftsman 315.277170

STREET PRICE: \$70

The Craftsman, made by Ryobi, lacks the heft and performance of the more common commercial models. It is lightweight, and the dampener works well. It has ample power and good dust collection. But using it quickly becomes a chore, thanks to severe vibration.

MODEL	Bosch 3725DVS	Metabo SX E 450 Duo	Skill 7435	Milwaukee 6020-02	Wen 18	Craftsman 315.277170
PAD STYLE (PSA = pressure-sensitive adhesive)	5 in. 8 hole H & L	6 in. 5 hole H & L	5 in. 8 hole H & L	6 in. 16 hole H & L	5 in. 8 hole H & L	5 in. 8 hole PSA
WEIGHT	5.1 lbs.	6 lbs.	3.8 lbs.	5.1 lbs.	3 lbs.	3.5 lbs.
AMPS	3.3	3.8	2.8	4	2	3
ORBIT DIAMETER	3/32 in.	1/8 in., 1/4 in.	3/16 in.	9/32 in.	5/64 in.	5/32 in.
DECIBELS	82	84	84	90	83	87
SPIN CONTROL DAMPENER	Yes Excellent	Yes Fair	Yes Good	Yes Good	No	Yes Excellent
SPEEDS (orbits per minute)	4,500- 12,000	4,000- 10,000	7,000- 12,000	4,000- 5,500	0- 12,000	14,000
DUST COLLECTION	Cloth bag Excellent	Paper bag Excellent	Cloth bag Good	Cloth bag Good	Canister Good	Membrane Good

too much machine for finish-sanding.

Besides what you'll use a sander for, there are a few features you should understand.

Dust collects through holes in pad—Most woodworkers I know are still using pressure-sensitive adhesive (PSA) sanding discs. But more and more woodworkers, myself included, are switching to the Velcro hook-and-loop pads. With PSA, taking the disc off the sander, even after brief use, usually means throwing it away—not necessarily because it is dull or clogged but because it's just about impossible to get it to stick again. But with hook and loop, you can easily go from one grit to another, and then reuse the discs. Before buying anything, make sure you locate a supplier for discs with the specific hole pattern you'll need.

No matter what disc you choose, dust is collected through holes in the discs and, with some models, through collection hoods or ports around the perimeter of the disc. They have an internal fan that vacuums up the dust and deposits it into a container attached to the sander. Some need an external vacuum hookup to work effectively. Others will operate with either a vacuum or collection bag.

I would definitely look for an efficient dust-collection system. The porous canister collectors work very well, as do some of the cloth bags. However, paper containers are the best; they let air flow but still keep the dust in the bag. Find a machine that has both a bag for dust and a vacuum hookup. You might not always want to use the vacuum, but you'll always want dust collection of some kind.

A good pad dampener can save your work—A pad dampener allows the pad to rotate but prevents it from freewheeling. A good dampener will enable you to lift the sander from the surface and place it back on the workpiece without hav-

Vacuum systems

I looked at three vacuum systems designed with sanders in mind. When the sander is turned on, the vacuum automatically starts. When the tool shuts off, the vacuum continues to run for a few seconds then shuts itself off. The Festo SR 201 EAS and Fein 9-88-13 (not pictured) operate this way with either air or electric tools.

The Festo was the only one

tested with adjustable suction, and it proved to be useful. Without it, the Porter-Cable and Fein machines would suck so hard they applied too much sanding pressure.

If you're sensitive to dust, Festo is the machine to have. The only drawback is it was made specifically to fit Festo tools and won't work easily with most other machines.—L.S.



Dustless sanding. For better dust pickup, these dedicated sanding vacuums keep the shop from becoming a fog of dust.

RIGHT-ANGLE SANDERS

Right-angle sanders are the most powerful, noisy and aggressive machines. They are definitely two-handed tools and are more difficult to control, but you do get used to them. Some remove stock as fast as a belt sander. The Festo Rotex RO 150 E angle sander costs more than \$500—one of the most expensive sanders in the test but also the one the author would most like to own.

Festo Rotex RO 150 E

STREET PRICE: \$512

At the turn of a knob, this sander goes from an aggressive but smooth sander into a machine so ferocious it is like having a well-mannered lion on a leash. Coupled with the Festo SR 201 EAS vacuum, this sanding system is as sophisticated as they get.

DeWalt DW443

 STREET PRICE: \$150

The dust bag on this machine picks up well and stays tucked out of the way under the machine, but if you want to use this with a central vacuum system, you'll have to buy an adapter. This sander has a quality slow start and very little vibration. Buy some ear muffs; this is a loud machine. A fine tool for the price.

Fein Msf 636-1

STREET PRICE: \$500

This machine can be a handful, and you'll spend a lot of money for what you get. It is one of the noisiest sanders tested and has the most vibration as well. It has a considerable amount of power and is lightweight. The dust collection worked well. But because of its vibration, it's quite tiring to run this machine even for short periods of time. It sands quickly, but so do other less expensive machines.

Milwaukee 6126

STREET PRICE: \$140

This is Milwaukee's standard high-speed right-angle grinder with a random-orbit attachment. This machine would be a good buy for someone who does not already own a right-angle grinder. But you get a lot of noise, little control and no spin dampener. The \$50 random-orbit attachment will fit any 5/8-in. angle grinder and may be purchased as a separate accessory. A dust-collection kit is available.

Porter-Cable 7336

STREET PRICE: \$150

This is a lot of sander for the money. This machine is capable of aggressive sanding, but still manages to be the quietest of the right-angle lot. The dust setup would work with almost any vacuum system, but it's too bad the kit doesn't contain a dust bag for those times you don't want to use the vacuum.

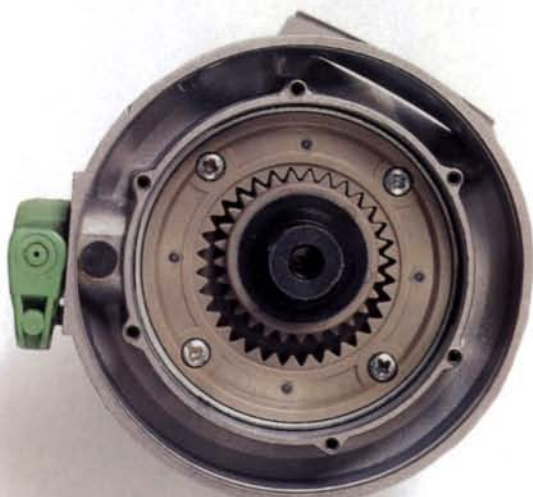
Bosch 1370 DEVS

STREET PRICE: \$260

This is a powerful and aggressive machine with impressive dust control. The soft start works well, and the pad will accommodate either six- or eight-hole discs. Although lightweight with two orbiting options, it is somewhat unwieldy to hold.

MODEL	Festo Rotex RO 150 E	Porter-Cable 7336	Milwaukee 6126	Bosch 1370 DEVS	Fein Msf 636-1	DeWalt DW443
PAD STYLE	6 in. Unique 8 hole H & L	6 in. 6 hole H & L	6 in. 6 hole PSA	6 in. 6, 8 hole H & L	6 in. 8 hole H & L	6 in. 6 hole H & L
WEIGHT	5 lbs.	5.7 lbs.	5 lbs.	5.3 lbs.	3.7 lbs.	5.7 lbs.
AMPS	4.2	3.7	5.5	5	3.6	4.3
ORBIT DIAMETER	3/16 in.	3/32 in.	9/32 in.	11/64 in.	5/16 in.	3/16 in.
DECIBELS	97	90	99	92	98	96
SPIN CONTROL DAMPENER	Yes Excellent	Yes Excellent	No	Yes Excellent	Yes Good	Yes Good
SPEEDS (orbits per minute)	4,000-11,200	2,500-6,000	10,000	4,800-11,000	7,500	4,000-6,800
DUST COLLECTION	Vacuum hookup	Vacuum hookup	Kit available	Cloth bag Good	Vacuum hookup	Cloth bag Good

Teeth that bite. Most random-orbit sanders rely on a counterweight to rotate the disc, but the right-angle machines from Festo and Bosch have a gear-driven option. The pad rotates in constant motion and isn't slowed by pressure applied to the work surface. The result is a more aggressive machine.



ing to wait until the pad stops spinning. Without a dampener, you either let the pad stop spinning completely or put scratches in your work.

It takes more than one speed—Variable speed is a feature I would look for. Even if you run the sander at full speed most of the time, there likely will be times when a slower speed will be useful, especially when sanding finishes.

Keep it steady—High vibration makes a sanding project much more tiring and stressful on hands and arm joints. The more well-balanced the machine is, the less vibration. Some of the smallest and cheapest sanders had the worst vibration, but most had acceptable vibration levels. Some, like the Bosch 3725DVS and the air-powered Dynabrade, had almost no perceptible vibration.

What to buy?

The sander you'd choose for your situation would probably be different from my choice, but here are my personal favorites from each category.

There were a number of really good palm sanders. The Porter-Cable 333VS, newly revamped with extra power, variable speed and a channel cut in the pad for the more common eight-hole discs, is a real workhorse. The canister dust collector on my old 333 still works as well as it did when new. That feature remains unchanged. For \$80, it's hard to go wrong with this one.

I loved the smoothness of two of the pistol-grip sanders, the Metabo and the Bosch 3725DVS. The Bosch pistol grip was the hands-down favorite with students. It was as smooth as glass, powerful, and because there was so little vibration, it was comfortable to use for long periods. It had great dust collection, and at about \$150, it's an excellent value. Though a bit on the heavy side, it is one sander I will miss and may have to buy.

As aggressive as some of the right-angle sanders are, there are times when they could take the place of a belt sander or even a large disc sander. At \$512, the Festo is pricey but worth the money if you have a use for it. I liked the Festo's ability to change from a *very* aggressive configuration back to a more controllable conventional random orbit simply by moving a lever. Coupled with an amazingly quiet, efficient and powerful triggered vacuum system, the Festo is now a must for my future boatbuilding projects.

No single sander will meet everyone's needs, but if you don't own a sander, you can't go wrong with a nice random-orbit palm sander with a dampener, good dust collection and a hook-and-loop pad. □

Lon Schleining works wood in Long Beach, Calif.

The Bold Charm of Southern Yellow Pine

This old standby is good for more than framing lumber

BY JON ARNO

MANY SPECIES, MANY USES

Close to a dozen species make up what the lumber trade calls southern yellow pine. The bulk of the wood marketed comes from the four species shown here, and it's used for exterior siding, flooring, furniture stock, ladders, millwork, pressurized framing lumber, sash and stair parts.



LOBLOLLY
(PINUS TAEDA)

LONGLEAF
(PINUS PALUSTRIS)



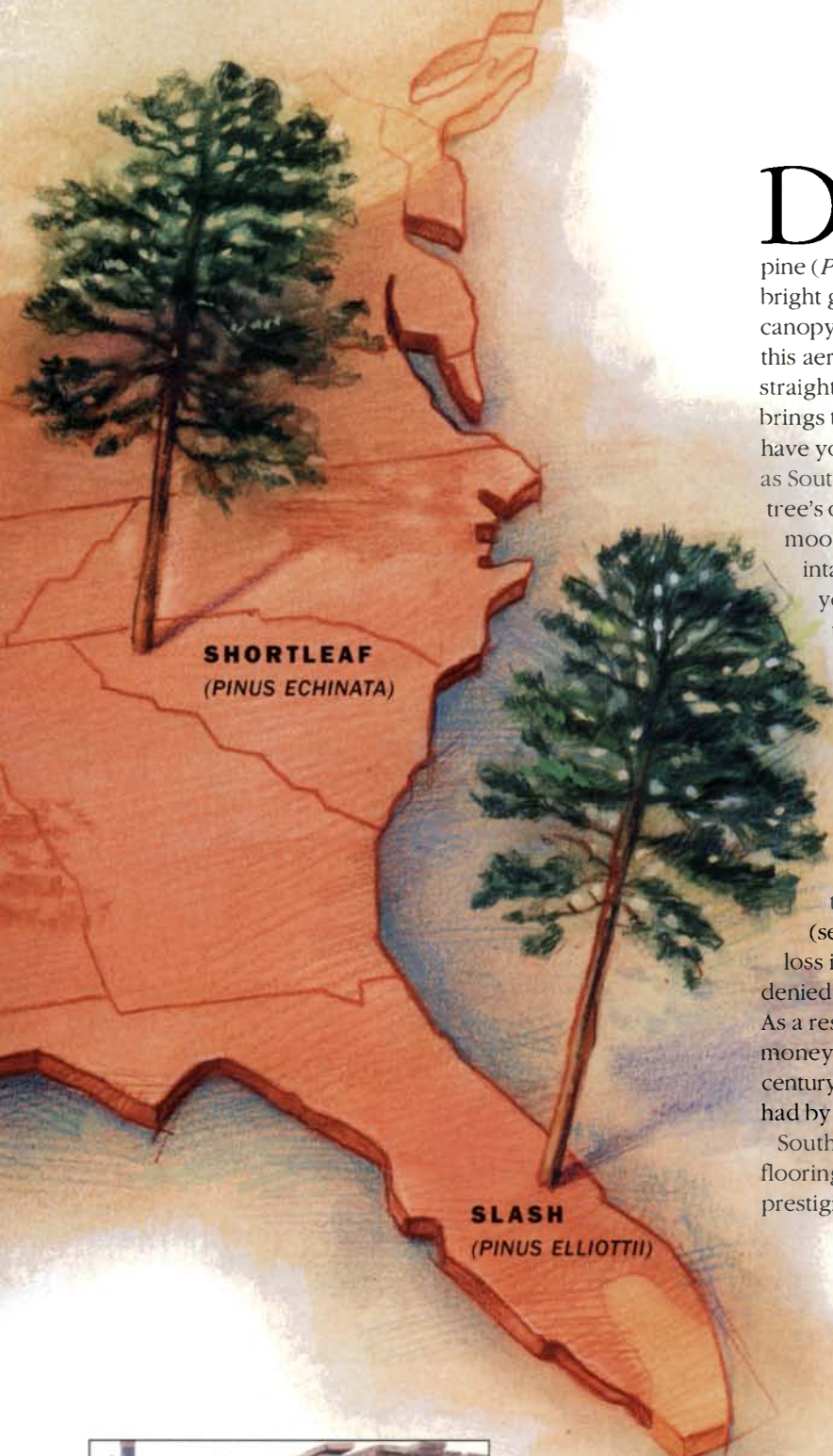
Photo: Southern Forest Products Assoc.

An environmental success story. Long after the demise of the original old-growth pine forests, plantation-grown stock—with a regeneration cycle as short as 25 to 30 years—grows at a rate that has kept up with demand.



Photo: Museum of Early Southern Decorative Arts collection

North Carolina country furniture. This kitchen cupboard, circa 1770, was built by a German-American craftsman. The design was adapted from a British form popular at the time, and the piece was originally painted.



Deep in the heart of Dixie, from Louisiana to North Carolina, grows a species of southern yellow pine that gives this region a special character: the longleaf pine (*Pinus palustris*). In dense, old-growth stands, the tree's bright green needles—sometimes as long as 18 in.—adorn the canopy high overhead with a lacy, shimmering look. Although this aerial mat of fragrant foliage is held aloft high above the tall, straight trunks, each whiff of a breeze in the moist summer air brings the scent of Christmas. To experience this setting is to have your memory forever stamped with something equally as Southern as grits, greens and gracious hospitality. If this tree's only contribution was its great beauty and the pleasant mood it evokes, it would be a role well-played. However, intangibles such as these are mere subtleties. Southern yellow pine is, and always has been, extremely important to the economy.

A strategic resource

In Colonial times, truly the age of wood, it was the strong, highly resinous and durable southern yellow pine lumber that served the same role steel I-beams do today. It was the preferred timber for joists and for posts and beams in building bridges, factories and warehouses. Of even greater strategic importance were the naval supplies processed from southern pine resins (see the bottom right photo). England's most vital immediate loss in the American Revolution was that the country was denied access to the tars used to waterproof the hulls of its ships. As a result, the British navy was forced to spend more time and money to clad its warships with copper. Not even king cotton, a century later, would give the South the same international clout it had by virtue of the resins tapped from its pines.

Southern yellow pine also played a role in furniture making, flooring and interior trim work. Although it was never a prestigious cabinet wood in international commerce, its great



Old timbers, new uses. Original heart pine posts and beams provided the skeletal framework for factories up and down the East Coast. The pile on the back of this flatbed truck was salvaged from an old mill building in Lewiston, Maine, and made into flooring.

Sorting out the pines

Of the more than 90 species of pines worldwide, more than 40 are native to North America. The timbers they produce are anything but similar. Botanists

and loggers agree in dividing the pines into two groups: whites, or soft pines; and yellows, or hard pines. It is in old Dixie, from the mid-Atlantic

states south to Florida and west through the Gulf states to eastern Texas, where yellow pines truly dominate the commercial supply. Of the four main species that are called southern yellow pine, all possess densities that are more

comparable to the popular hardwoods used in cabinetmaking than they are to other pines. Loblolly (*Pinus taeda*) and shortleaf pine (*P. echinata*), soft by southern yellow pine standards, have an average specific gravity (the ratio of



The difference between old-growth and newer lumber. Original heart pine—as seen on top, at left and in the wardrobe above, built around 1785—has annual rings that are much more closely spaced than the newer lumber underneath.

strength, low cost and ready availability made it a worthy choice for drawers and interior panels. It was also used as a low-cost primary wood in the production of regional, utilitarian furniture, such as antebellum armoires, hutches, beds, dry sinks and hunt boards (see the bottom right photo on p. 66). These quaint old pieces are now much sought after by antique collectors. From construction lumber to furniture, yellow pine is so pervasive that the South would not be the same without it.

Old timbers have new uses

Although it seems a shame to see noble old structures torn down in the name of progress, the South is a vibrant and growing region. As century-old mansions, warehouses and factories make way for skyscrapers and expressways, their heavy pine beams, sheathing and flooring are often recycled. Far from spent in terms of strength and utility, this recovered wood is finding a ready market among woodworkers (see the bottom left photo on p. 67).

Salvaged lumber is economical, sometimes even free for the taking. Its reuse is an ecologically sound and socially responsible form of conservation. And for woodworkers with a reverence for the past, there is a certain nostalgia in reworking old timbers. It is surprising how a little research often reveals that many old buildings have played at least some brief role in history.

But there are more tangible rewards in working with old-growth pine. The salvaged wood is actually superior to that produced from more recently harvested lumber: The annual rings are more closely spaced, giving the wood greater density and an attractive pin-striped figure (see the photos at left). Years of gentle seasoning have allowed the abundant resin to crystallize, and any propensity for checking has long since revealed itself. This means that the old pine is far less likely to clog sawblades, and by cutting the wood to avoid existing checks, the resulting lumber has a much-improved stability.

Working properties, good and bad

Well-aged, old-growth lumber is definitely better than the newer timber, but it is still southern yellow pine, a wood well-known for its sometimes cantankerous working characteristics.

In all southern yellow pines, the cellular anatomy of the wood poses a challenge. Each annual ring is composed of an inner band of earlywood that is as soft as basswood and an outer band of latewood that is even harder than hickory. The transition between the two bands is extremely abrupt (see the bottom photo at left). As a result, sawblades tend to develop an annoying chatter when crosscutting. To avoid this, it is important

their weight compared to that of water) identical to that of cherry (0.47). The harder slash (*P. ellottii*) and longleaf pines (*P. palustris*) have an average specific gravity of 0.54, making them harder than walnut (0.51) and almost as

hard as sugar maple (0.56). These latter two species—especially the majestic, tall, straight-boled longleaf pine—set the stereotype for southern yellow pine as a highly resinous wood with nail-bending hardness and great strength. —J.A.

to keep blades sharp and to maintain a slow, even feed rate in all milling processes. Pilot holes are a wise precaution when driving nails or screws, because the difference in density between the two bands leaves the wood very prone to splitting. Also, special care is required when sanding. Unless a rigid sanding block is used, the soft earlywood tissue tends to cut more quickly, leaving the surface looking like it was sandblasted.

The chemical makeup of southern yellow pine also presents a challenge. Because of the high resin content, sandpaper becomes clogged very quickly. This problem is less severe when working with old timber, where the resin has hardened as brittle as amber.

Although the high resin content does give the wood a certain measure of decay resistance, it can interfere with oil-based finishes. The solvents in the finish soften the resin, slowing the drying time. In the worst case scenario, the resin may actually bleed through the varnish years after the piece was finished. Brushing on a barrier coat of shellac before applying a topcoat of varnish is the time-honored solution to this problem, but modern synthetic finishes such as polyurethane and waterborne acrylics provide new options.

Given these potential problems and special precautions, why would anyone consider using southern yellow pine in a fine woodworking project? Because some rewards are not obtainable with any other wood. The boldly striped figure provides stunning variegation that is especially attractive in turnings such as bowls, vases and spindles. The simple yet flamboyant figure is only produced by the anatomically less complex softwoods, or conifers, and very few other species in this entire botanical order produce woods that are strong enough to match southern yellow pine in rugged furniture applications (see the photo at right).

And southern yellow pine ages with amazing grace. The amber-gold patina it develops is unique—especially true of that achieved by the heartwood of old-growth longleaf pine with its additional and very subtle pinkish highlights. Whether these benefits provide adequate compensation for the patience required to overcome its sometimes cantankerous nature is, of course, a value judgment. □

Jon Arno is a wood consultant who lives in Troy, Mich.

TIME LINE OF A 230-YEAR-OLD LONGLEAF PINE

The Goodwin Heart Pine Co. recently felled this 50-ft., 36-in.-dia. tree in southwestern Georgia, growing in one of the few remaining virgin stands of longleaf pine. After it was killed by lightning, the sapwood was attacked by worms, termites and fungal decay, but the dense heartwood survived intact.

1768 Seedling emerges from a grassy ground cover in a vast longleaf-forest belt that stretched from Virginia to Texas.

1800-1850 The production of turpentine and a large population of wild hogs began to take its toll on the original longleaf forests.

1920-1930 Intense logging operations virtually wiped out the last of the longleaf forests along the Gulf Coast.

1996 Tree is killed by lightning.



Southern yellow pine for furniture? It depends on how it's kiln dried

BY WILLIAM DUCKWORTH



The Southern Forest Products Association, a trade organization, is actively promoting southern yellow pine as a viable furniture wood. To date, it has been more successful promoting sales to Europe, but it hopes to increase the level of that sold for domestic furniture and case-goods production.

Toward that end, the association's efforts have been to improve the way yellow pine is kiln dried. Experiments have shown furniture-grade pine can result from a controlled drying schedule over a period of about five days. A steam-kiln process works best—including a tightly regulated temperature and air flow regimen—to prevent the checking and case-hardening that results from less diligent efforts. A load of furniture-grade lumber should equalize to between 6% and 12% moisture content, as opposed to the 19% average for construction-grade and pressure-treated stock. □

William Duckworth is an associate editor of Fine Woodworking.

Pegged Post-and-Beam



Skeleton-and-skin construction is adaptable to a range of styles

BY CHRIS GOCHNOUR

The trouble with most armoires is that if they're big enough to fit all your clothes—or electronic gear, board games or books—they're too big to fit through the door. This was brought home to me forcefully on several occasions when I received distress calls from people who, knowing I was a furniture maker, thought I might have a trick for shrinking the armoire they just bought to get it through their doorway. I soon found myself amputating a foot here, prying off a glued-on crown molding there.... When I decided to build an armoire myself, I discovered that a fine solution to this doorway dilemma has been around for centuries: the post-and-beam

cabinet with pegged mortise-and-tenon joints.

Dutch and German *kasts*, Spanish *trasteros*, French armoires and Chinese *gui* all were large storage cabinets designed around a straightforward post-and-beam structure, a system sturdy enough to have been employed as well to construct the very houses these cabinets resided in. Post-and-beam cabinet construction—vertical posts and horizontal beams connected by large mortise-and-tenon joints—creates a framework that, once secured with drawbore pegs, is very rigid and durable. Yet it can be easily disassembled into small, maneuverable components.

I particularly admire the beau-

ty and grand scale of antique French armoires, and I've made several of them. But I've also built armoires in the Southwest style and the Arts-and-Crafts style, and I have found that the post-and-beam structure is adaptable to a range of styles.

Inside-out design

Designing a post-and-beam cabinet begins with its primary skeletal structure: four corner posts connected by wide rails top and bottom. The strength of the cabinet is derived mainly from these members and the joinery that connects them. For maximum stability in my large country French armoire—90 in. high, 57½ in. wide and 24 in. deep—I used posts a beefy

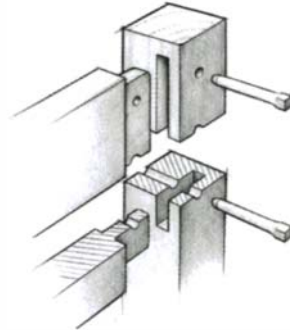
Three skins, one skeleton. The author's armoires in an array of styles all use a centuries-old cabinet structure originally borrowed from post-and-beam houses. The post-and-beam structure makes a cabinet that is strong and handsome and perfectly accommodates wood movement. If the major joints are pegged instead of glued, the cabinet can also be knocked down for transport or repair. In the photo at right, the skeleton of a country French armoire in knotty alder stands dry-assembled with all its parts and panels leaning against it.

Armoire Knocks Down

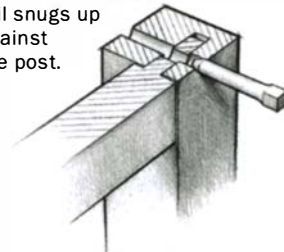


GOT IT PEGGED

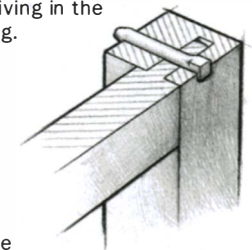
The mortise-and-tenon frame joints in the cabinet at left are held fast with drawbore pegs instead of glue, allowing easy disassembly for transport or repair.



Drawbore pegs actually pull the tenon home. The hole through the tenon is offset slightly toward the shoulder so that when the peg is pounded in, the rail snugs up against the post.



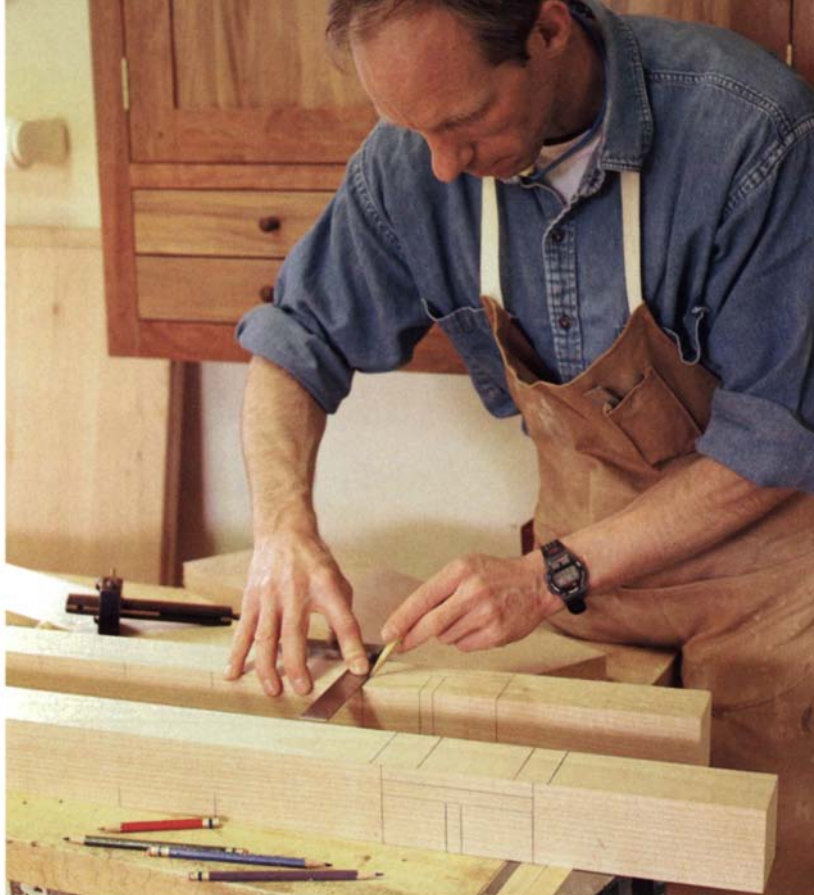
The shaft of the peg is waxed to make driving it easier. The square head bites in the round hole. To prevent splitting harder woods, square the hole with a chisel before driving in the peg.



The peg extends through the post. Disassembling the joint requires just a few taps from inside with a hammer and a drift pin to knock out the peg.

Color-coded layout.

Post layout is the most complex and crucial aspect of preparing to make a post-and-beam cabinet. To keep track of all the different parts that meet at the posts as well as the joints that secure them, the author uses a different colored pencil for each element.



2 $\frac{5}{8}$ in. sq. with rails ranging from 4 in. to 8 in. wide. Posts this big can accommodate large mortises without being unduly weakened; rails this wide have room for substantial shoulders along with wide tenons. On the widest rails, I used two tenons and left a bridge between them because a single large mortise

would eliminate too much material and compromise the strength of the post.

After the basic skeleton is designed, I subdivide the cabinet sides and back using rails and muntins. The subdivision creates smaller, more manageable panel sizes, has a strong visual effect and contributes to the

overall strength of the cabinet.

Embellishing the framework is the final step in the design process. Because the primary skeletal structure doesn't differ much from piece to piece, it is largely the details that distinguish one post-and-beam cabinet from another. These can include decorative panels,

doors, crown and other moldings, turnings and carvings.

Layout is the linchpin

Laying out the joinery on the posts is the most complex and critical aspect of building a post-and-beam cabinet, because it is here that all of the components come together. On just one post there will be as many as eight mortises, 14 peg holes, two panel grooves, two notches for the top and bottom, and a dozen or more half-round notches for shelf supports. To make sense of this blizzard of joinery, I use a different colored pencil for each operation—one for mortises, another for peg holes and so on. I lay out the joinery in this order:

- mortises for the rails
 - notches for the cabinet top and cabinet bottom
 - holes for the pegs
 - rounded notches for adjustable shelf supports
 - grooves for the panels
- And then I set about machining all the joinery, following the same sequence.

Machining the legs

I use a horizontal boring machine to cut the mortises and a benchtop hollow-chisel mortis-



Notch it. After cutting the mortises for the rail tenons, the author uses a hollow-chisel mortiser to notch the posts where they accept the corners of the cabinet top and cabinet bottom.



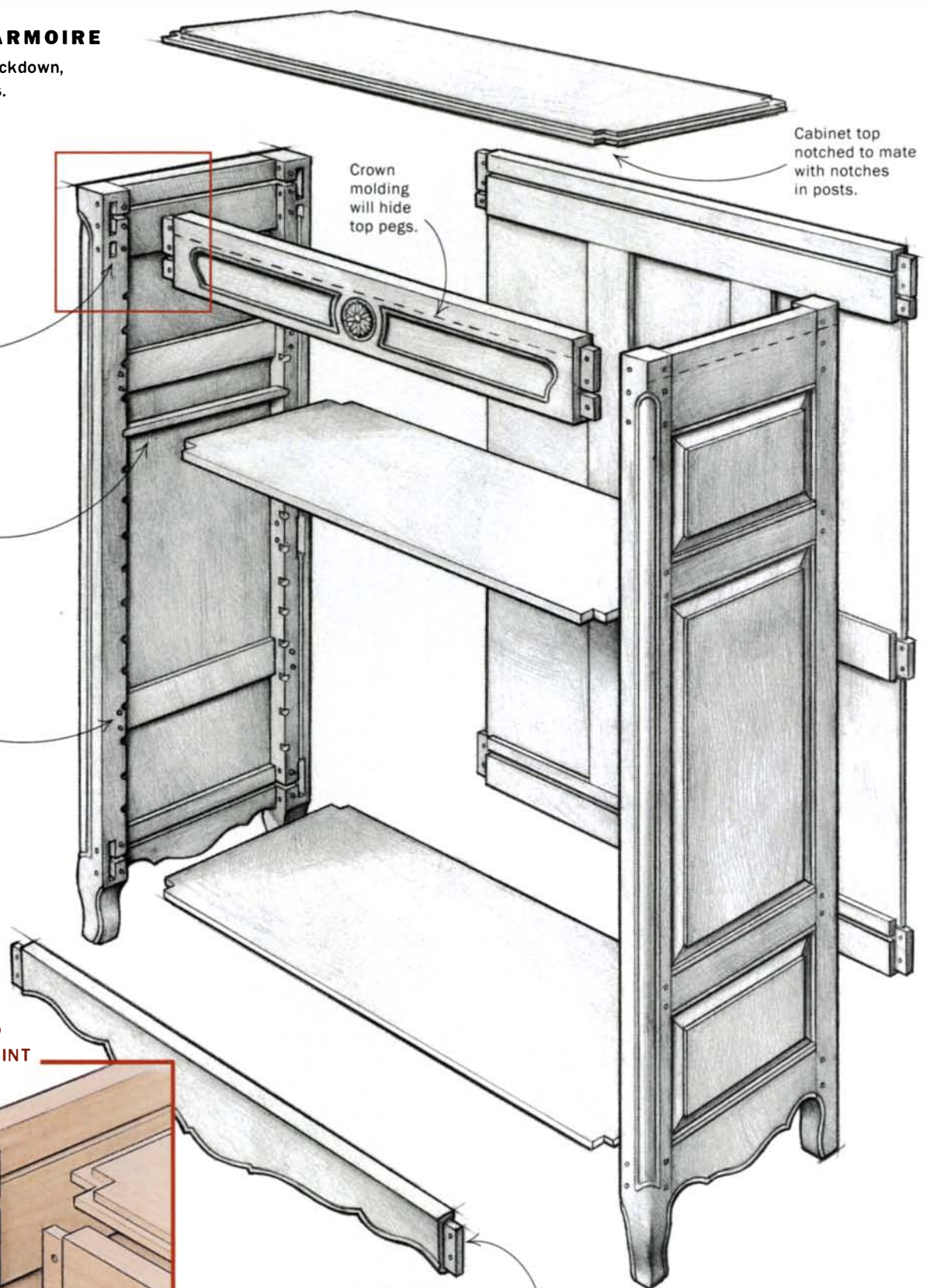
Temporary tenon. A scrap the same thickness as the tenon fills the mortise to prevent tearout as the holes for the pegs are drilled.



Double drilling. Pairing up the posts makes it easy to cut the half-round notches for the shelf-support bars. It also ensures the notches will correspond exactly in height.

POST-AND-BEAM ARMOIRE

Main carcase joints are knockdown, secured with drawbore pegs.



Cabinet top notched to mate with notches in posts.

Crown molding will hide top pegs.

Cutting two mortises with a bridge between them prevents weakening the post with one large mortise.

Shelf supports are press-fit in half-round notches.

Joints in ends and back can be glued up.

DESIGNING THE PEGGED MORTISE-AND-TENON JOINT

Peg placement must be planned to avoid intersecting.

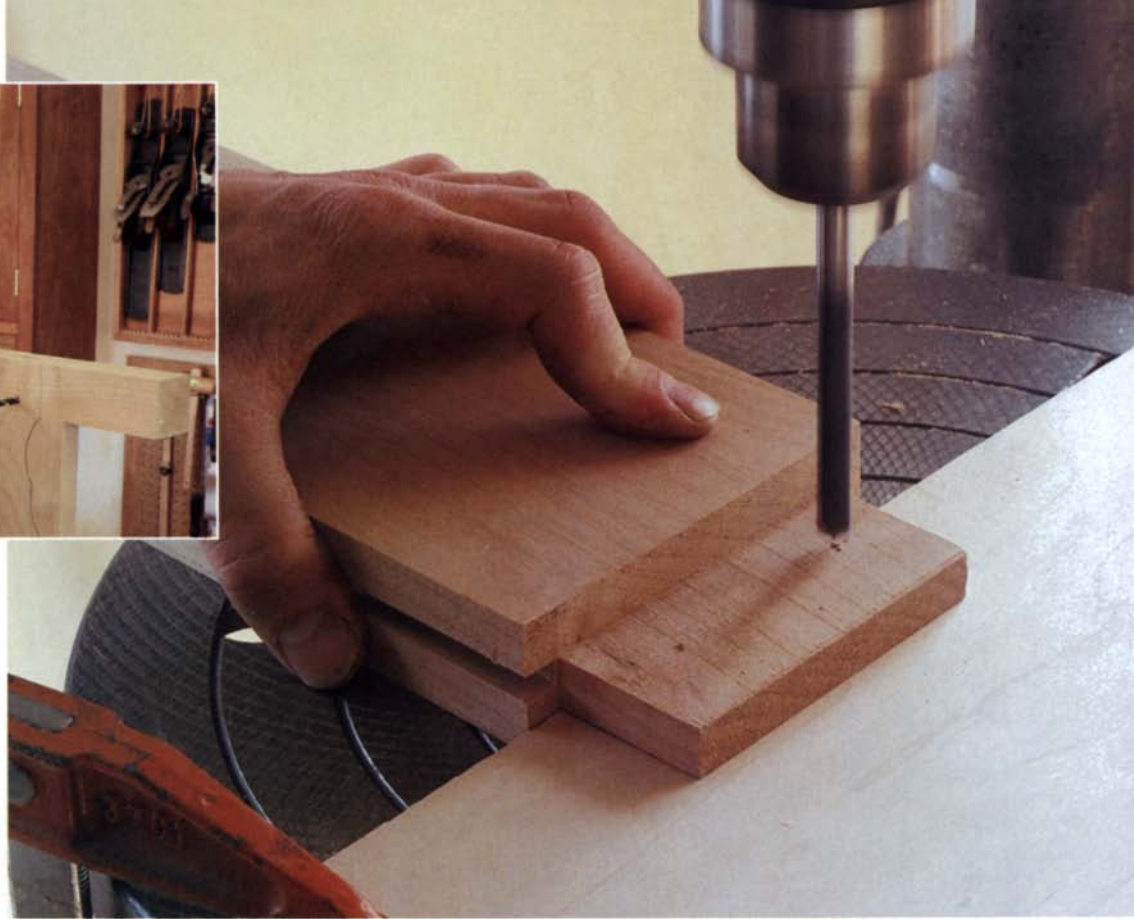
Peg is placed at least $\frac{1}{2}$ in. from edge of post to avoid bulging or splitting.

Holes for pegs placed at least $\frac{1}{2}$ in. from end and side of tenon to avoid splitting.

Tenon is offset toward inside of rail, which keeps mortise farther from face of post.



Precisely off-center. To give the drawbore peg its pull, the hole through the tenon must be offset toward the tenon's shoulder. The author marks the post hole's center point on the tenon with a brad-point bit (above). Then, using a low fence registered off the tenon shoulder (right), he sets up to drill the holes $\frac{1}{32}$ in. from the center point. The fence also backs up the cut to eliminate tearout.



er to square up the ends. But you can cut the mortises in several different ways (see *FWW* #130, pp. 58-63) as long as you lay them out properly, size them correctly and mill them cleanly. I cut the tenons on the tablesaw with multiple passes over a dado head and adjust to a piston-fit with a shoulder plane.

Because the cabinet top and cabinet bottom float in a groove in the rails, I must make corresponding notches on the inside corners of the legs. I use a hollow-chisel mortiser to make these notches (see

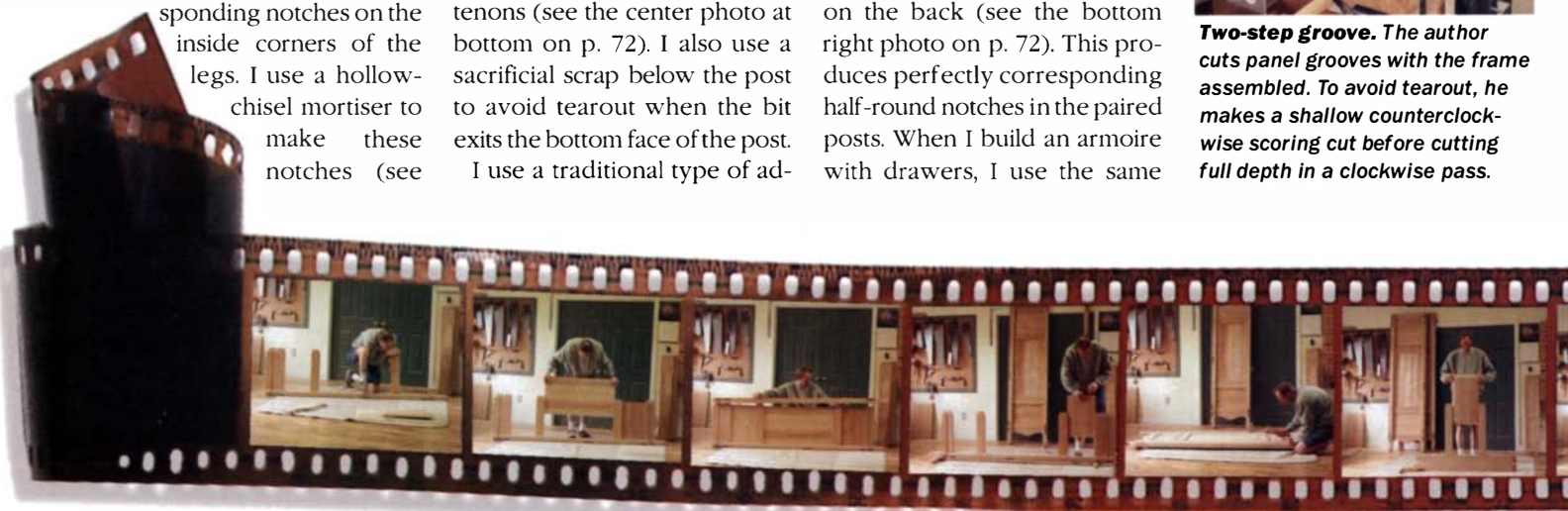
the bottom left photo on p. 72), but simply drilling a series of holes and then squaring them up with a chisel works fine.

After the peg locations have been laid out, I drill the holes for them on a drill press. I use a fence to ensure a consistent location of the holes on each leg. To eliminate tearout as the drill bit pierces the mortise, I fill the mortise with a scrap of wood the same thickness as the tenons (see the center photo at bottom on p. 72). I also use a sacrificial scrap below the post to avoid tearout when the bit exits the bottom face of the post. I use a traditional type of ad-

justable shelving, one suited both to the style and the structure of post-and-beam cabinets. For shelf supports, it uses wooden bars, which are press-fit into rounded notches in the posts. To make these notches, I clamp the front and back legs together, being careful that they are aligned at the ends. Then I drill a series of holes with a Forstner bit so that half of each hole is on the front leg and half on the back (see the bottom right photo on p. 72). This produces perfectly corresponding half-round notches in the paired posts. When I build an armoire with drawers, I use the same



Two-step groove. The author cuts panel grooves with the frame assembled. To avoid tearout, he makes a shallow counterclockwise scoring cut before cutting full depth in a clockwise pass.



notches to house side-mounted wooden drawer runners.

Clamp up the side frame for more machining

The next two steps are best accomplished with the cabinet's sides assembled, without panels. Later, I will disassemble the sides, assemble the back and repeat these steps.

I groove the legs and rails for the panels they will hold and cut the grooves with a router. Using a slot cutter with a bearing wheel, I just run the router around the frame. The one drawback to routing the grooves this way is that you wind up with rounded corners, but a sharp chisel makes quick work of squaring them up.

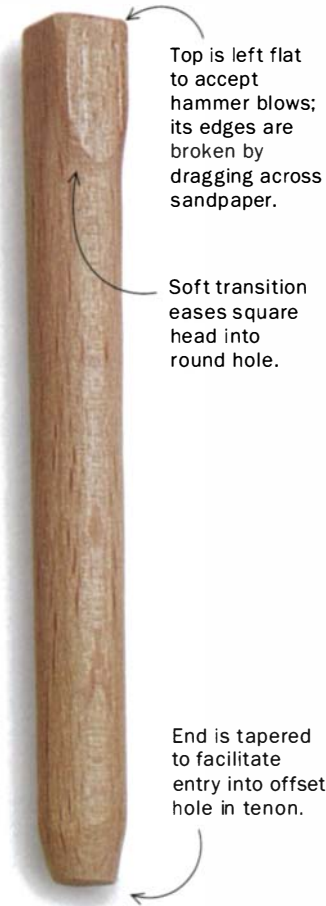
With the frame still clamped snugly, I insert a brad-point drill bit into each peg hole and, with a twist of my fingers, mark the hole's center point on the tenon. Then I disassemble the cabinet side and drill the peg holes through the tenons on the drill press. I don't drill right on the center-point marks, but $\frac{1}{32}$ in. toward the tenon's shoulder. When the peg is driven through, this vital $\frac{1}{32}$ in. offset draws the tenon home tight and keeps the joints from loosening over time. In a cabinet built of soft wood, I would make the offset a shade more than $\frac{1}{32}$; in the hardest woods, a shade under.

The humble peg

Holding all this work together is a handful of little pegs. I always make them of hardwood, and whatever wood I choose, I make sure it is as hard or slight-

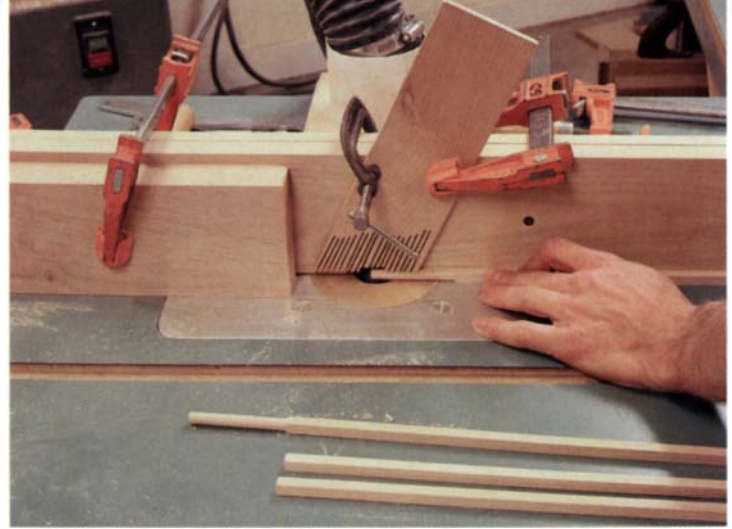
PROFILE OF A PEG

This cabinet uses a 3-in. peg for its $2\frac{5}{8}$ -in. posts. The pegs start out as $\frac{7}{16}$ -in. square blanks. For this alder cabinet, the pegs are made of beech because it is a harder wood.



ly harder than the wood the pegs will be driven into.

I make the pegs by first milling square blanks 2 or 3 ft. long. I round $2\frac{1}{2}$ in. or so at either end of the stick using a beading bit on a router table. Because the center section of the blank remains square, I still



Pegs' parents. The author starts with long, square blanks and rounds a section at each end with a beading bit on the router table. He tapers the ends against a belt sander and then cuts the pegs to length on the tablesaw.



Don't forget to steer when you drive. An adjustable crescent wrench keeps the head of the peg from twisting as it is driven home. The author leaves the peg one hammer tap proud of flush with the post.

get good registration against the router table and fence even after the ends are cylindrical. Next I taper both ends of each long blank. I round $2\frac{1}{2}$ in. or so at either end of the stick using a beading bit on a router table. Finally, I cut a peg from each end of the stick, leaving a $\frac{1}{2}$ -in.-long square section at the head. I repeat the steps to

make more pegs, continuing until the blanks are getting too short to hold safely.

When I'm finished, I wax the peg shafts and get to the fun part—driving them home. □

Chris Gochnour builds furniture in Salt Lake City.





Honing Guides Aren't Just for Wimps

This tool guarantees consistent results when sharpening chisels and plane blades

BY MARIO RODRIGUEZ

When I apprenticed as a carpenter, I was taught to hone my chisels and plane blades without the benefit of a mechanical guide. At first, all I had to show for my intense efforts while hunkered over whetstones were a sore wrist, hollowed stones and uneven convex bevels on my cutting edges. With practice, my honing technique improved. But developing this skill required a great investment of time and discipline.

You may not want to make that kind of commitment when you'd rather spend your time building furniture. So how can a woodworker consistently obtain a razor-sharp edge without the investment of time an apprenticeship demands? Use a honing guide.

I teach a beginner's course in woodworking, and I encourage the use of honing guides. A successful sharpening routine—for intermediate woodworkers as well as novices—is a great way to build confidence.

I have taken a look at four of the most popular honing guides on the market. Whether you use Arkansas, ceramic, diamond or waterstones, these guides will work with all.

How honing guides work

Honing guides are available in a variety of designs, but they all make it easy to hold a tool at a steady angle to the stone. A clamping screw (or screws) secures the cutting tool to the guide, which has a wheel or roller that allows you to move the tool back and forth across a stone.

The trick to getting a uniform bevel on a chisel or plane iron is

maintaining the tool at a consistent angle to the stone. When honing by hand, beginners have difficulty maintaining a tool's angle, which results in a rounded bevel. Or they don't hold the tool square to the stone. A honing guide prevents these mistakes.

The bevel angle can be adjusted on most guides by either advancing or retracting the blade within the holder or by raising or lowering the vertical post supporting the holder.

What to look for in a guide

There are several models available, and each one is very different. Some are better suited to a particular type of tool or sharpening system. Using a honing guide should not involve convoluted motions. It should be easy to adjust and hold blades securely.

Use a firm grip when using a guide

The best grip for honing is a two-handed, six-finger grip (see the photo above). My thumbs rest on the back of the guide, and my fingers press down on the back of the tool. For narrow chisels, I use only my thumbs and one finger of each hand. Your fingers are very sensitive, and will tell you whether the tool slips in the jig and whether you're maintaining firm contact with the stone. Don't place your fingers too close to the cutting edge in case of a slip.

When using a guide, press down with your fingers, and maintain firm, even pressure as you move the guide forward and backward across the stone, which results in cutting action on both strokes.



A good grip is important. A six-fingered grip provides stability and good feedback so that you can tell immediately whether a tool has slipped in the guide.

Be sure to use whatever lubricant the stone calls for. Don't worry, it won't harm the guide. And try to use the entire stone so that it wears evenly.

Some people liken the use of honing guides to training wheels on a bike. But honing guides shouldn't be considered an embarrassing secret. Think of them as tools that make it easier to get good, flat cutting edges with less risk of nicked fingertips, stiff wrists or damaged stones. □

Mario Rodríguez is a contributing editor to Fine Woodworking magazine.

SOURCES OF SUPPLY

Honing guides and stone holders are available from many suppliers, including the following:

Garrett Wade
(800) 221-2942

Lee Valley/Veritas
(800) 871-8158

Woodcraft
(800) 225-1153

General No. 809 sharpening guide



The General honing guide (see the top photo at right) is the only one whose roller wheel does not ride on the stone. Instead, it rides on your workbench and assumes you have a smooth spot somewhere on that beat-up, pockmarked surface. The guide is hinged in

the middle; a large, easy-to-turn knob allows you to adjust the bevel angle. The guide accepts blades up to 2⁵/₈ in. wide and holds them firmly with a spring-loaded bar. In use, the hinged half of the guide, which holds the tool, rests on the stone, and the heel of the guide, which contains a too-small plastic roller, rides off the stone (see the bottom photo at right).

The guide is designed to produce a 30° bevel, but that depends on how much the blade protrudes from the guide, the thickness of the stone and the height of the stone from the benchtop (determined by the stone holder). It's a good idea to use a protractor to check the bevel angle. Because the guide rides so high off the stone and the roller wheels are small, it's not the most stable guide. But the tool's large body does give you a lot to hold on to.

Price: \$21.50

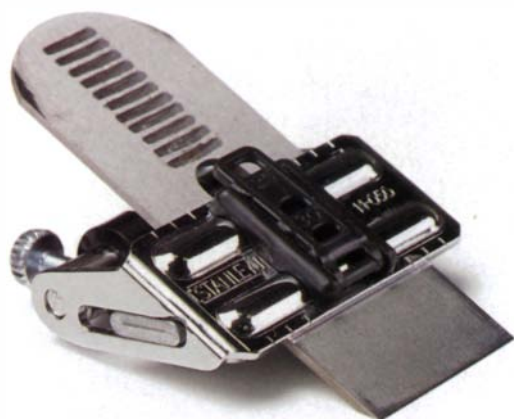


The General is the only guide that rests on and off the stone. The tool is hinged so it can be adjusted for stones of different heights.



You have to be careful not to tip this unit during use.

Stanley No. 14-050 guide



The Stanley has a narrow space between the stamped metal upper body and roller below, which makes it difficult to slip a chisel into position. The roller half of the guide is adjusted by two puny screws (similar to those on a Stanley spokeshave), which must be advanced and retracted equally to keep the works from jamming. You also need to tighten the screws evenly; otherwise, the tool won't be held securely. The guide is small and low, which makes it easy to keep flat on the stone. The best thing about this guide is the built-in bevel gauge (25°, 30° and 35°). The guide accepts tools up to 2½ in. wide. Price: \$15.95



A built-in angle guide makes it easy to position a tool to this guide.

Veritas honing guide



The Veritas has a D-shaped cast-iron frame that accepts blades up to 2¾ in. wide. A large brass screw, topped with a wide, easy-to-turn knob, holds blades securely. The tool glides on an eccentrically set roller wheel. The roller design allows you to dial in secondary bevels of 1° or 2°. The sensible design, good construction and reasonable price make this my favorite.

In addition to the honing guide, Veritas sells an angle-setting jig that has the most common bevel angles arranged around a pentagon wheel. The underside of each segment is ground to one of the five popular grinding angles (15°, 20°, 25°, 30° and 35°). Price: \$24.95 (guide); \$12.95 (angle setter)



A large, easy-to-tighten hold-down knob and a wide roller make a secure, stable honing guide. An angle-setting gauge with five presets can be purchased separately.

Side-clamp or vise-style honing guide



This model has a compact no-nonsense design. It's imported from Taiwan and available from several U.S. companies. The guide splits in the center for loading and can accommodate tools up to 2¾ in. wide. The jaws, because they're parallel, automatically register a tool perpendicular to the stone. A slotted screw on the guide's side opens and closes the jaws, which do a good job of keeping tools from slipping. Because of the narrow roller wheel, the guide is a bit unsteady. The bevel angle is set by the tool's placement in the guide; the more the tool projects forward, the shallower the angle. You should use a protractor to get an accurate setting. Price: \$11.95



Each half of the guide has a pair of jaws: one for wide tools and another for narrow ones.

Making Tabletops Without Coming Unglued



How the pros stay sane when gluing up tabletops and large panels

BY ANATOLE BURKIN

Building a tabletop was once as simple as finding an old-growth plank wide enough to serve six. Boards much wider than 12 in. are uncommon these days, and if you do find them at the lumberyard, they often go for a premium price. When a project calls for wide panels, the solution is to glue up several narrower boards to get the width needed.

Making tabletops or large panels seems simple enough: Plane and joint three or four boards, and edge-gue them. But getting a nice flat tabletop with tight joints isn't a snap. You must mill your lumber flat and square. You need a way of registering the boards to keep them in the same plane during glue-up. And you need clamps that will hold them firmly without cupping.

Even if you think you have all that worked out, bad things happen, says Portland, Ore., furniture maker Gary Rogowski. "You can line up your stock and forget to pay attention to the ends of the



Straight from the heart. Bob Van Dyke builds tabletops with all the boards oriented heart-side up. He says the color on the heartwood side is usually better.

Before gluing, examine the panel. Van Dyke stacks boards on edge and uses a straightedge to make sure everything lines up flat.



boards, leaving them offset. Your extra-long boards that you've just glued up into a single panel are now too short in one section."

We all suffer occasional slipups, but success in woodworking is not accidental. I asked a half-dozen woodworkers to share their experiences and strategies for gluing up large panels.

Heart side up or down?

The first step in building up a tabletop involves selecting and matching lumber. Much has been written about edge-gluing panels and how to avoid cupping. Common wisdom says you should flip-flop adjoining boards so their growth rings alternate up and down. Wood usually cups toward the bark side. Theoretically, flip-flop minimizes the amount of cup across the width of a panel. If one board cups up, the adjoining one will cup down, creating a

slight ripple, not one huge cup. (When using quartersawn material, which is more stable, the risk of cupping is greatly diminished.)

To be safe, you can do what most large furniture companies do: Rip everything into 2-in.- and 3-in.-wide planks, flip-flop them and to heck with nicely matched color, figure and grain. Furniture factories mask these problems using dyes and toners.

Custom furniture makers don't rely so much on chemicals to hide badly matched lumber. Most would agree with Garrett Hack, a furniture maker in Thetford Center, Vt., who stresses the importance of making a good match. "I rarely orient boards based on the direction of the growth rings. I'm more interested in consistency of figure and color. I do try to have consistency of grain direction because I handplane to finish the surface. But at the same time, if figure or color or match is better with a board reversed, then I reverse it, and I'll work around it by scraping along the glue line (where opposing-grained boards meet) and plane the boards in their proper directions." He minimizes the risk of cupping by making sure his lumber is dry and acclimated to his shop.

Manchester, Conn., woodworker Bob Van Dyke goes for the heart (see the bottom photo on p. 79). "I generally orient the boards with the heart side up for two reasons. The first is strictly aesthetic. I find the color of the heart-side face is usually a little better than the bark-side face, and any sapwood left in the board will generally only be on the bark face.

"The second reason has to do with the way wood distorts," he says. "Boards generally cup away from the heart face, so if these faces are all presented up, the top will cup down onto the table base instead of cupping up and looking like a Chinese pagoda. Unfortunately, I have glued up some boards that evidently were not aware of the rules and moved the opposite way!"

Biscuits, splines or none of the above

A good edge-joint requires finesse in milling (for more on edge-jointing, see *FWW* #124, pp. 46-51 and *FWW* #130, pp. 82-85). To

THREE WAYS TO KEEP BOARDS FLAT DURING GLUE-UP



Biscuits won't guarantee a perfect glue-up, but they do make it easier to keep boards in alignment.



A continuous spline will also register adjoining boards. The spline should be of the same species, with the grain running in the same direction as the panel.



Lightweight cam clamps can be used to hold boards flat against bar clamps.

check the edge-joints, stack milled boards on edge, and hold a straightedge against them. If there's a bow or light creeping through the edge-joints, go back to the jointer.

After getting the edge-joints right, you need to keep the boards in the same plane during glue-up (see the bottom photos on the facing page). Biscuit joints are a common way to register boards to one another. You can also use a spline joint, or you can skip the extra joinery and register the boards flat against the bodies of the clamps.

None of these methods are foolproof. Biscuit joints may suffer from inaccuracy brought on by slop in the biscuit joiner's shaft and slight operator error (tilting the tool slightly when making the cut). Spline joints are also affected by imperfections in tooling and machining. Clamps aren't foolproof either. They get bent. Or they bow from too much pressure. Often the wood itself is the culprit. When working with long, wide boards, slight movement is inevitable, and the boards rarely expand and contract the same way.

In Rogowski's experience, biscuits aren't always gravy. "For long, wide boards, I use biscuits, but they sure don't line up perfectly, try as I might. For narrower and shorter stock, I just line up the boards on edge and use a dead-blow mallet and pound everything down against flat pipe clamps on a flat worktable."

Sauk Rapids, Minn., furniture maker and restorer Roland Johnson believes in biscuits. "For nice flat wood, I'll place #20 biscuits 16 in. apart. For more unstable wood, I may go as close as 8 in."

Hack usually glues boards edge to edge without extra joints. "The easiest way to prevent misalignment is to glue up the minimum



When clamping a tabletop, apply light pressure first. Run a finger across the edge-joints, and feel for ridges. A tap of the fist or a dead-blow mallet is all it takes to align boards.



T-supports are made of plywood scrap. With the workpiece lifted a few inches off the bench, T-supports make it easy to slide clamps under the boards without lifting them. Duct tape applied to the supports keeps them from sticking to the workpiece.

CLAMPING VERTICALLY REQUIRES LESS SPACE



Garrett Hack glues up tabletops using his bench vise. With one board clamped in the vise, he applies glue and stacks the remaining boards in place. Next he applies bar clamps, beginning at the outboard side of the workbench. At the halfway point, he repositions the panel in the vise, allowing the clamps to rest on the floor for support. The remaining clamps are applied with only about 1 in. of the panel gripped by the vise.

number of pieces at one time: two or three boards. Ideally, I like to make tables out of three boards; if more boards are required, I divide the glue-up into two parts." Pushing or pulling on the boards while increasing clamping pressure is all there is to it.

There are occasions when Hack will resort to a spline joint. "If I'm gluing up a panel that has to be right on, such as when the stock is too thin to thickness plane afterward, I use a spline of some kind. I make it out of the same species as the rest of the top.

"For a $\frac{3}{4}$ -in. top, I make the spline about $\frac{3}{16}$ in. thick and about $\frac{1}{4}$ in. deep on each side, nearly the entire length of the panel, the grain of the spline going in the same direction as the rest of the wood. But when machining the groove, you have to be careful not to introduce additional inaccuracy."

Whatever method you choose, your fingers are a good tool to check boards for alignment during clamping. Lightly tighten the clamps. Then run a finger across two edge-joints, and feel for a ridge. Use your fist or a rubber mallet to move boards into position; then tighten the clamps some more. Use a long straightedge to check the entire panel for flatness. Don't be dismayed if your surface isn't perfect. Additional planing, scraping and sanding

will be required. But care at this juncture minimizes the amount of material that must be removed to smooth the surface.

Any large surface works fine for glue-ups

Most furniture makers use a flat surface such as a bench or a saw outfeed table for glue-ups. If your workbench is small, enlarge it by placing a sheet of $\frac{3}{4}$ -in. medium-density fiberboard (MDF) over it. Hack has a different strategy (see the photos above). "I'll clamp the first board to a bench vise. That way, the board is vertical, at about eye level, and I can see what I'm doing. I apply glue to one edge, and stack one or two more boards on top of the first.

"Next I place clamps on the half of the panel sticking out of the vise, being sure to place clamps on alternate sides to prevent bowing," says Hack. "Then I loosen the vise and lower the panel until the clamp on the outboard side rests on the floor." With the workpiece supported this way, he clamps just one edge to the bench vise and adds the remaining clamps. He lets the panel sit for about half an hour, then removes the clamps. □

Anatole Burkin is an associate editor of Fine Woodworking magazine.

What woodworkers say about clamps

Pipe and bar clamps are by far the most ubiquitous clamps found in small shops. The reasons are simple: cost and durability. Oakland, Calif., furniture maker David Fay prefers bar clamps. "We have Wetzler bar clamps, and I prefer them over pipe clamps because they have big, sturdy flat surfaces."

Gary Rogowski uses Jorgensen pipe clamps but does not outfit them with black pipe, like most woodworkers. "I don't have to worry about black oxidation marks because I use galvanized pipe, which doesn't stain like black iron pipe."

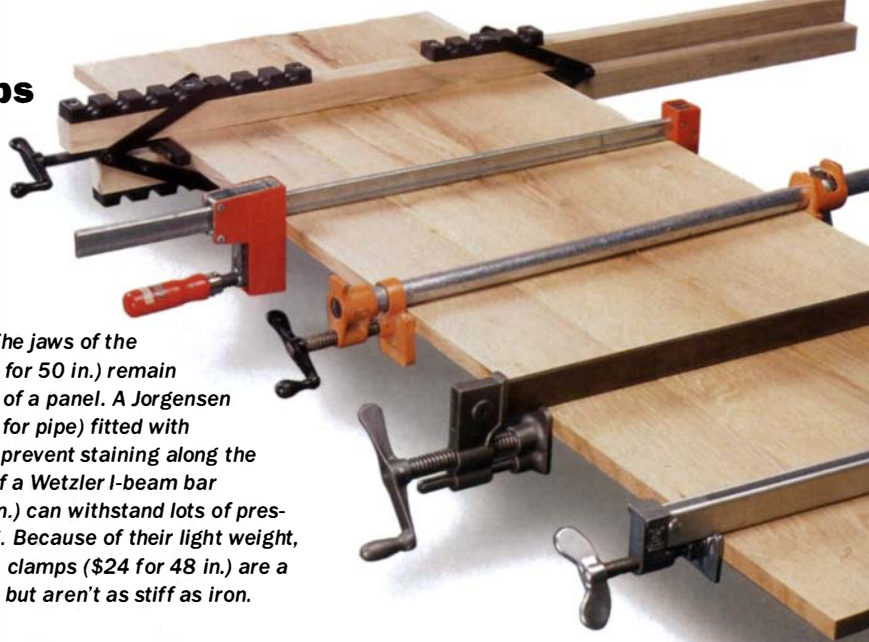
Rogowski registers his panels directly against the pipes. "I check the pipes before gluing with a long straightedge. Any bow or bend and it gets trashed," he says.

Garrett Hack uses bar clamps—he likes the old-fashioned Record brand. The bars are 1/4 in. thick and remain straight under pressure. Bob Van Dyke prefers aluminum bar clamps. "I love the aluminum Universal clamps. They're dead flat, good, medlum-duty clamps. They're more than strong enough." Because the aluminum won't react with the glue like iron, you can lay boards flat upon them for registration. Aluminum clamps aren't as stiff as iron pipe and will bow a bit if overtaxed. But they're lightweight, which you'll appreciate the next time you try moving a clamped-up tabletop off your workbench.

From Switzerland comes a glue press that costs considerably more than the average set of bar clamps. After a few months of use, the Plano Press (reviewed in FWW #90, pp. 126) has become a favorite

Common clamps

(top to bottom): A scissors-style clamp (\$29, from Woodcraft) applies pressure to the edges and top and bottom of a panel. The jaws of the Bessey K-body (\$50 for 50 in.) remain square to the edges of a panel. A Jorgensen clamp (\$10 plus \$5 for pipe) fitted with galvanized pipe will prevent staining along the glue line. The body of a Wetzler I-beam bar clamp (\$38 for 48 in.) can withstand lots of pressure without bowing. Because of their light weight, Universal aluminum clamps (\$24 for 48 in.) are a breeze to maneuver but aren't as stiff as iron.



in the FWW shop. The press consists of adjustable aluminum rails and clamp dogs (see the photos below). You need to buy a basic system consisting of three pairs of bars, clamp dogs and a wall-mounted rail. The system can be expanded.

The Plano is designed to be bolted to a wall, which means you don't need a large work surface to glue up big panels. Also, your press is always stored in one place. But the best thing about the Plano is how it squeezes a panel flat. You don't need splines or biscuits with a Plano. A dead-blow hammer does come in handy to tap balky boards into alignment.

Bessey and Gross Stabil both sell parallel-jaw bar clamps. These are more expensive than standard bar clamps, but they have one advantage: The jaws remain perpendicular to the workpiece. Also, because the screw handles are straight (like chisel handles), you can't exert too

much leverage and bow the panel. The disadvantage is that you can't cinch them extra tight when you have balky lumber.

Another clamp worth considering is the scissors-style screw clamp. Several mail-order companies sell these clamps under a variety of names, but the principle is the same. The clamp applies pressure on four sides: two edges and the top and bottom of the panel. Clamps are sold minus the cauls (a 2x4 ripped in half), which sandwich the panel. One advantage is that you can make the cauls as long as you need.

Overall, the scissors-style clamps work pretty well, but you have to make sure your caul stock is straight. The metal castings of these clamps are thinner than standard 3/4-in. pipe clamps, so I question their durability over the long haul. During the first week of use, the handle fell off the clamp, but it was easy to reinstall with an expansion pin. —A.B.

Unusual clamping system from Switzerland. The Plano Press (\$339 for 49-in. system) includes a rail, which is attached to a wall, and a set of three clamp bars. The bars slide along the rail (length adjustment). Slots cut in the rails lock the lower jaws in position (width adjustment). When the upper jaws are tightened, the bars flatten a panel.



SOURCES FOR CLAMPS

Adjustable Clamp Co.
(Jorgensen clamps):
(312) 666-0640

Advanced Machinery
Imports (Plano Press):
(800) 648-4264

American Clamping
Corp. (Bessey clamps):
(800) 828-1004

Garrett Wade
(Record clamps):
(800) 221-2942

Gross Stabil:
(800) 671-0838

Universal Clamp Corp.:
(818) 780-1015

Wetzler Clamp Co.:
(800) 451-1852

Woodcraft:
(800) 225-1153

Woodworker's Supply:
(800) 645-9292

Safe Procedures at the Tablesaw

Guidelines for preventing problems before they happen

BY HOWARD LEWIN

A tablesaw doesn't have a conscience. It couldn't care less whether or not it cuts off your finger. And it will. If you know this going in, then you can guard against it. What I try to do is arm myself with knowledge of what the machine is likely to do and then stop it before it happens.

Kickback, the main cause of most tablesaw injuries, occurs when the board drifts away from the fence and pushes against the back of the spinning blade. As the teeth come out of the back side of the saw, they will actually lift the board off the table and launch it over the top of the blade. When that happens, the board is propelled with a few horsepower of force behind it.

Splitters are designed to prevent kickback, and they do. Yet they cause a great deal of anxiety to me and most of the woodworkers I know. This is probably because the splitters that are readily available in the United States aren't quite up to par. For a splitter to do its job, it has to be the exact width of the blade. If the splitter is narrower than the blade, then it allows room for the board to slide away from the fence. If it is thicker than the blade, it forces the stock into the front of the blade and jams the board.

European splitters, like those on Inca tablesaws, attach directly behind the blade and are curved to follow the blade's arc. The splitter adjusts and travels with the blade, allowing dado and bevel cuts. It is useful, and it works. The splitters on most American saws have to be removed to make these cuts. Often they are not replaced.

As for blade guards, they work fine, except when you really need them. When you are cutting plywood or long boards with wide dimensions, your hand is nowhere near the blade; therefore, it's pretty safe. It's when you have to do detail work close to the blade

Warning: Fine Woodworking does not recommend the removal of splitters, blade guards or other safety devices from tablesaws. The author of this article believes that many woodworkers choose to operate tablesaws without such devices. Our observations as editors confirm this. We also recognize that many woodworkers own older machines or used tablesaws that came without these safety mechanisms. In all these cases, it is essential that the safety steps outlined in the following article be taken to minimize the risk of injury.

that you need a blade guard but can't use one.

Though splitters and blade guards should work better and should be more widely used, I see little use in pretending that they are.

What is imperative is that you take the necessary measures to ensure safety at the tablesaw. I always use zero-clearance tablesaw inserts, featherboards and push sticks. I keep a well-tuned saw, and I let a few rules guide my work.

- Never stand directly behind the sawblade.
- Make sure the blade is never more than $\frac{1}{8}$ in. above the board being cut.
- Be aware of what the wood is doing at all times. And be ready to react.
- Never back a board out of a cut.
- At the slightest hint that a board is bowing away from the fence, lift it out of the cut and above the blade. Then begin to make the cut again.

To drive a car you have to pass a test. The same is true for flying an airplane or sailing a boat. Most people even take the time to get some kind of computer training these days. But the same people just take a tablesaw out of the box and cut away. It doesn't make much sense. If you make a mistake at the computer, what's the worst scenario—you lose a page, some bookkeeping? But make a

mistake at the tablesaw and the consequences are much greater. Digits don't grow back.

The photos and drawings on the following pages show the basic setups for safe cutting. With these things in mind, you can foresee problems and prevent them before they happen. □

Howard Lewin is a woodworker and woodworking teacher in Hawthorne, Calif.

SHOPMADE TABLESAW ACCESSORIES

PUSH STICKS, PUSH PADDLES AND PUSH SHOES

Push sticks lend leverage when guiding stock through a cut. The notch allows you to hold the push stick at about a 45° angle and keeps your hand about 10 in. above the blade. Wider push sticks give a more solid connection. Just make sure the grain runs lengthwise, so it won't break when the notched end passes through the blade. Cut them in bulk, so there's always one nearby. On narrow stock, push shoes hold the stock flush to the tabletop and afford even more leverage. Push paddles offer the most control. If the lumber is heavy or wide, use push paddles to help ease the way past the blade.

Throw no sparks.

When you build a push paddle with dowels, you don't have to worry about the blade catching an errant screw. A layer of sandpaper over the paddle's face will help it grip the stock.



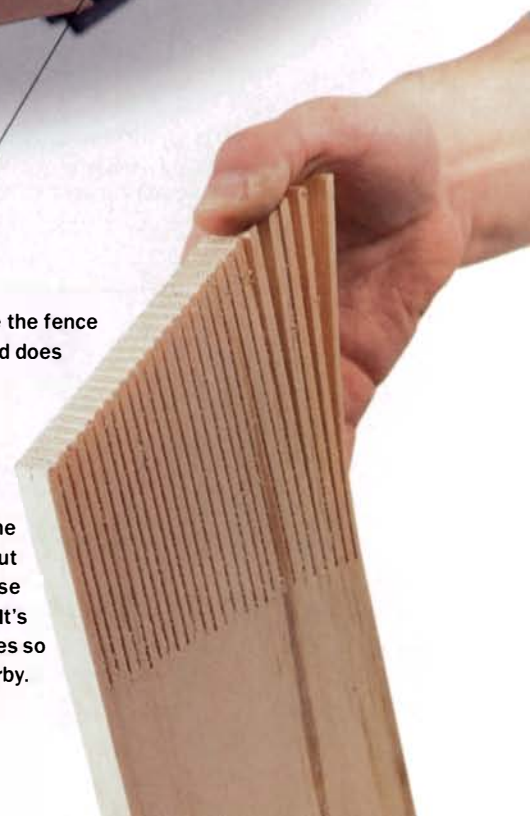
ZERO-CLEARANCE INSERTS

These inserts prevent the loss of thin strips in the wide clearance allowed by most factory inserts.

They also prevent tearout by supporting the stock all the way up to the blade. First make a pattern from the factory cut insert, usually 1/2 in. thick, and then shape it to a press-fit from the pattern. Drill a 3/4-in. hole in the insert to serve as an easy finger pull. Change them when you have to switch blades or make beveled cuts.

FEATHERBOARDS

When clamped to the table saw, featherboards help the board ride the fence throughout the cut. Even if a board does wander from the fence, the feathered end helps prevent it from kicking back. They are easily made with scrap stock and a bandsaw. The angled end should be cut at 30° to 40° and the feathered kerfs bandsawn at about 1/4 in. intervals. For larger stock, use wider and thicker featherboards. It's good to make them in various sizes so an appropriate one is always nearby.



CROSSCUTTING

The safest and easiest way to crosscut is to use a sled. It enables you to keep your fingers at a safe distance from the blade (see *FWW* #128, pp. 66-69 to make a similar sled). A smooth feed rate and a sharp,

pitch-free blade with at least 30 to 40 teeth should allow you to crosscut without a glitch. A crosscut sled can also be set up to cut angles and compound miters.

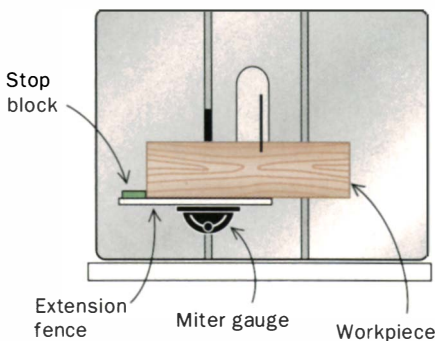


CROSSCUTTING WITH A MITER GAUGE

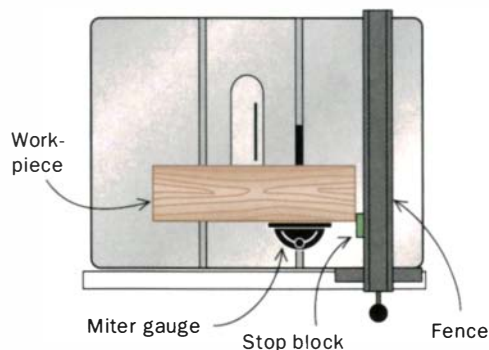
You can also crosscut using a miter gauge with an extension fence screwed or clamped to it. The extension fence will support the board all the way up to the blade.

USING THE RIP FENCE AS A STOP

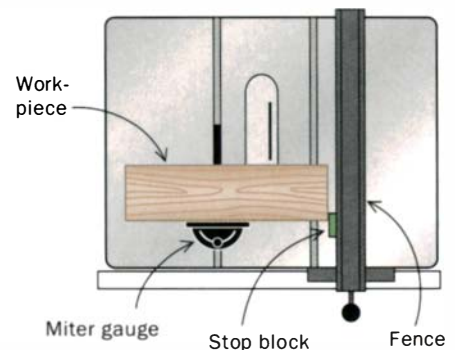
Clamp an extra piece of wood to the fence to act as a stop block. This prevents wood from getting trapped between the fence and the blade, which can cause it to bind and kick back. Never use the fence alone to crosscut boards.



To cut a number of pieces to the same length, attach a stop block directly onto the extension fence.



When possible, use the miter gauge between the fence and the blade.



For trimming smaller pieces to length, move the miter gauge to the left of the blade.

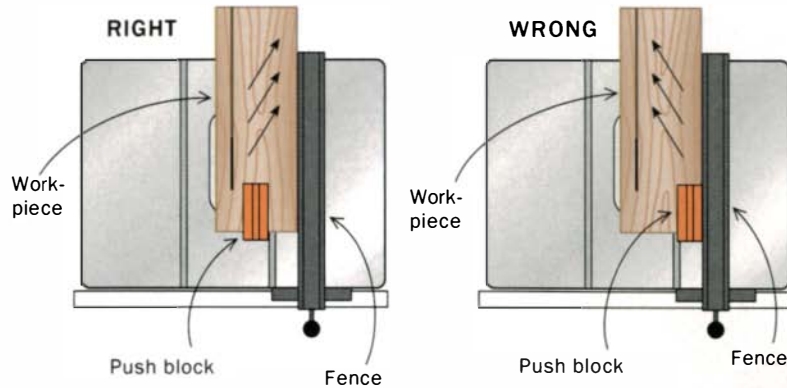
RIPPING

Before ripping a board to size, make sure you have a perfectly flat side against the fence. Do not stop the cut or reduce pressure until you have pushed the material past the blade. If the board begins to drift from the blade or if the board moves in any way that makes you

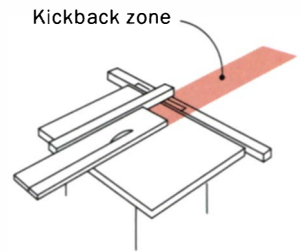
uncomfortable, lift it out of the cut and begin again. A sharp, clean blade goes a long way toward keeping procedures safe. For general ripping, 30 to 40 teeth are adequate. For thicker stock—2 in. or more—use wider kerf blades with fewer teeth.

KEEP TO THE FENCE

When pushing a board through a cut, always apply pressure on the side closest to the blade.



Always stand to the left of the blade, never directly behind the board you are cutting. This is the only way that you can exert the pressure necessary to keep the board against the fence. It also puts you in the best spot if the board does kick back.

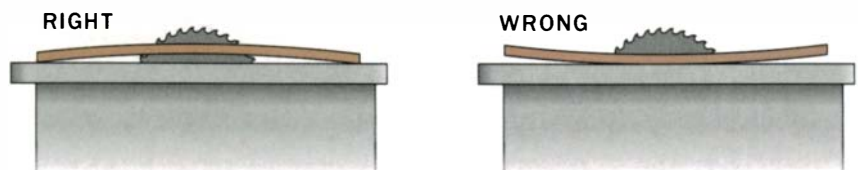


Always use featherboards placed just in front of the blade to prevent kickback.

Extension tables help keep the boards flat on the table and lessen the chance that a board will wander as it moves past the blade.

MANAGING BOWED STOCK

If you must rip or crosscut a board that is bowed or cupped, even slightly, place the board with the concave side facing down.

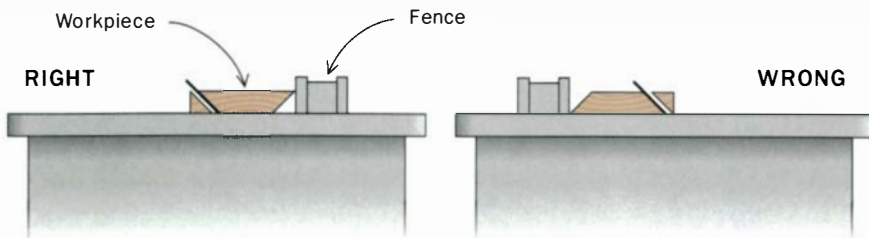


BEVELING

On right-tilting saws, cutting bevels traps the board between fence and blade, which should cause you great anxiety. You can avoid this problem

by moving the fence to the left of the blade. Using zero-clearance inserts is the only way to ensure small cutoffs don't get sucked into the saw.

RIPPING AT AN ANGLE

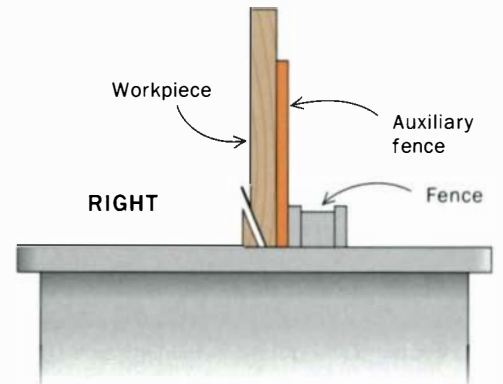


When you move the fence to the left of the blade, the pointy edge of the stock can register off the face of the fence, making for a much safer cut.

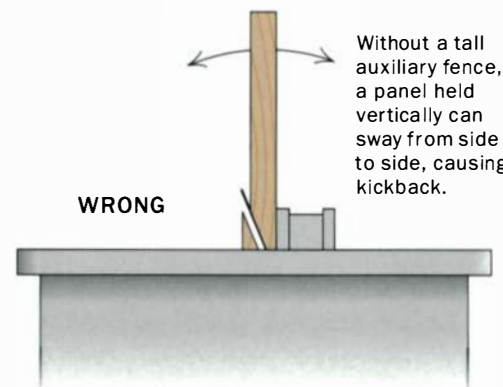
With the fence in its normal position, there is a good chance the point of the bevel will slip down below the fence and twist the board in midcut. This can cause severe kickback.

RAISING A PANEL

To make raised-panel cuts on a right-tilting tablesaw, you must move the fence to the left of the blade. This way, the blade is angled away from the fence. And you must use an auxiliary fence tall enough to allow a firm handhold on the piece being beveled. Because of the small offcuts you're creating, zero-clearance inserts are absolutely necessary.



RIGHT



WRONG

With the fence to the left of the blade, always stand to the right. Though awkward to right-handers at first, it's the safest alternative.

Without a tall auxiliary fence, a panel held vertically can sway from side to side, causing kickback.

When cutting narrow stock, use a push paddle with a slight twisting motion to keep the board against the fence.

With the fence to the left of the blade, the bevel cuts away from the fence, not toward it.

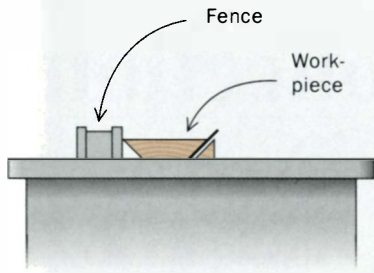


Featherboard

BEVELING WITH A LEFT-TILTING SAW



When you use a left-tilting saw, there is no need to move the fence to the less familiar left side of the saw. For beveled cuts, the blade is automatically angled away from the fence. For most, the result is a safer and much more comfortable procedure.



Needing a left-tilting arbor is probably not reason enough to buy a new saw, but if you're in the market, and right-handed, it's an option worth looking for.

Powermatic and Craftsman have been making left-tilting saws for a number of years, and a few other manufacturers, Delta and Jet among them, have recently introduced these machines.

Rabbets, grooves and dadoes



RABBETS

When cutting rabbets, an auxiliary fence clamped or screwed in place keeps the blade from digging into the primary fence. On wider stock, where there is more than 6 in. against the fence, a miter gauge is not required—simply run the edge of the board along the fence. You can also use a crosscut slide or a miter gauge to cut rabbets. And remember, never go backward across a blade.



GROOVES

To cut a groove on the edge of a board, an auxiliary fence and zero-clearance inserts are essential. Use a featherboard in front of the blade to hold the stock against the fence. On narrower boards, be sure to use a push stick, and apply downward pressure through and past the blade. Cut the groove as close to the fence as possible.



DADOES

Always dado as close to the fence as possible. Narrow stock requires a miter gauge and a stop block. On wider stock, where there is more than 6 in. against the fence and less than a 4-in. gap between the blade and the fence, a miter gauge is not required. Never dado far from the fence even with a miter gauge. You can also use a crosscut sled dedicated to making dado cuts.

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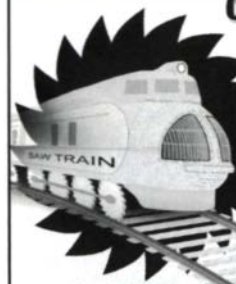
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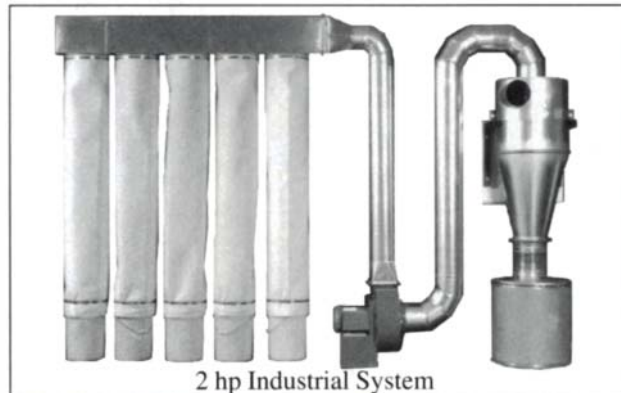
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It is almost impossible to work wood without a workbench. It ranks as one of the most important fixtures in a shop. In fact, the more extensive your woodworking experience the more likely you are to have more than one bench. I have always had at least three benches in my chair-making school's shop—large and small joiner's benches and an assembly bench.

Different types of woodworkers traditionally have had different styles of benches that vary according to the needs of their craft. For example, a joiner's bench is long and narrow with a vise

along the side (known as a side vise) and a vise at one end (known as a tail vise). Chair makers frequently work on a low platform called a framing bench because chair assembly is called framing. All good benches share features you will want to include in any bench you are making or acquiring.

A bench must be sturdy. You frequently place a lot of weight on it. Woodworking, especially with hand tools, creates a lot of force. A bench that wobbles or racks under these forces is frustrating to work on because you waste a lot of energy moving the benchtop rather than working wood. Also, this type of movement is not good for the bench's joints. They wear more quickly, and you may need to replace the bench down the road. All the benches in my shop have 4x4 legs, and the stretchers are joined with 2-in.-deep mortise-and-tenon joints. The top is secured to 2x6 cleats that are mortised to sit on tenons cut into the top of the legs. We have reinforced all the multiple-person benches with cross bracing—both end to end and side to side.

A bench should also be heavy. The forces exerted upon a bench can not only rack it but also make it slide around the shop. Chasing your bench while trying to work wood is very frustrating. A heavy bench is more likely to stay put. A thick top is one way to create weight. The top of my large joiner's bench (see the photo at left) is 2½-in.-thick beech, and all of our multiple-person benches (see the photo below) require four people to lift them safely. Storing some of your tools under the bench is another good way to add weight. I store my working



Low bench for handwork. Planing moldings, chopping mortises and jointing boards all require lots of upper-body strength. A low bench—the one in the photo is 31 in. high—allows the author to put a lot of muscle into his motions.

High bench for machining. Benchtop machines come with their own horsepower, so the operator's strength is almost superfluous. Slipping battens under the plywood has raised the actual working height of the benchtop to almost 36 in. Adding height is easy; lowering it isn't.



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Rules of Thumb (continued)



Get the height just right. To determine the proper workbench height, stand with your arm hanging by your side. Bend your wrist so that your palm is facing down.

handplanes, about 20 of them, on a shelf that spans the side stretchers.

You can also secure the bench to the floor to keep it from moving. My small joiner's bench is lagged to the wooden floor. If you have a concrete floor, you may need to drill holes in it and use lag shields. In this case, be sure to locate the bench in the most desirable location.

Chair making requires a lot of shaping. When a student would pull the draw knife, the bench would follow. We corrected this by placing cleats against the legs and screwing them to the floor. And the cleats have another advantage. Although low—only $\frac{3}{4}$ in. thick—they keep a lot of the shavings produced in the shop from working their way under the bench, making clean up easier.

Your bench should be sized appropriately to your work. A benchtop has three important dimensions: length, width and height. If you work with long pieces of wood, you want a long bench. When I built my joiner's bench, I was doing a lot of house restoration. As a result, I was making a lot of doors and interior and exterior trim. The 8-ft.-long top came in handy for this work.

A bench should be wide enough to handle the jobs you normally do. My joiner's bench is 32 in. wide. This is sufficient for most of the chairs, tables or carcasses I have built.

Bench height is perhaps the most critical dimension. It is one that is also very personal. It varies depending on your methods of work and your height. In a production shop where parts are



An immovable beast. To keep his benches from racking, the author uses dovetailed diagonal braces. Cleats screwed to the floor prevent the benches from moving.

mostly machined, benches are generally used for assembly. These benches tend to have higher working surfaces. However, a high bench makes working by hand very difficult. For example, when planing, you use muscles in your legs and back. On a high bench, you are more limited to your arm and shoulder muscles. I do a lot of handwork, and for that reason, I prefer a low bench. My large joiner's bench is only 31 in. high.

To determine bench height, stand erect with your arm hanging by your side, and bend your wrist so your palm is facing down. This is a good height for your bench. If you do a lot of work with benchtop machines, such as a router or a biscuit joiner, you may want the bench slightly higher. Remember this: It's easy to add temporary blocks or battens if you want to raise the working height of a bench for a particular project, but it's awfully hard to lower it.

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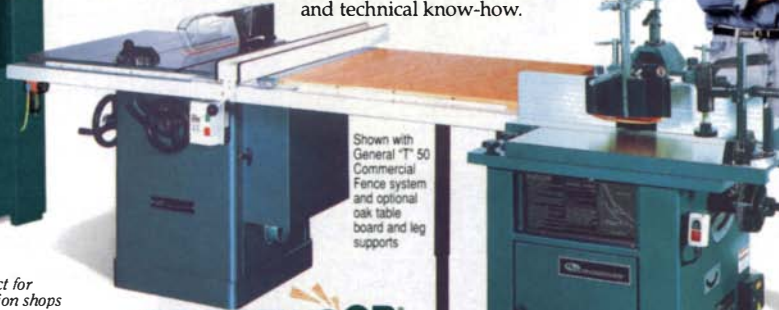
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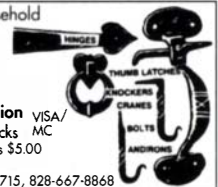
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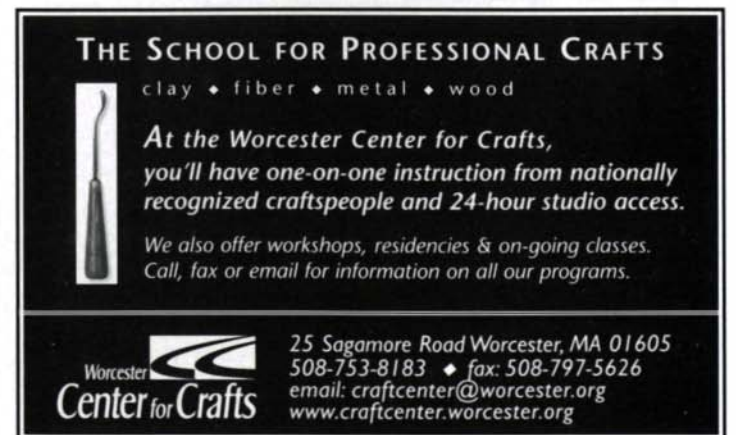


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Q & A

Cleaning up polyurethane glue

Because polyurethane glue has a longer working time, I'd like to use it instead of yellow glue for a white oak table. I'm accustomed to using yellow glue and cleaning up with water before it dries, but I understand that you can't do that with polyurethane glue. What is the best way to clean up with polyurethane glue?

—Zachary Gaulkin, Watertown, Conn.

William Tandy Young replies: A

polyurethane glue would be a fine choice for gluing up the table. Several brands are available, and all perform well when used properly.

Polyurethane glues do allow longer open and closed assembly times than the average yellow (polyvinyl acetate, or PVA) glue. The actual amount of working time you'll have depends on the conditions in your shop and the brand you use. The older brands allow 30 minutes or more of working time, but some of the newer ones allow slightly less.

Once your work is clamped up, don't clean up the glue while it's wet. Instead, let it harden first. Polyurethane glue foams out of joints as it cures, and the spongy cured foam-out is easy to remove with a chisel or a plane. It won't destroy the edges of your tools as you cut through it. Once you pare away most of the cured foam-out, the area around the glue joint should be a breeze to clean up, because polyurethane glue also scrapes and sands easily.

Even though cured polyurethane glue is compatible with many types of finishes, try to keep excess glue off surfaces as much as possible by gluing up neatly and carefully. If you apply the glue liberally, it will foam out all over the work. Apply scant amounts of glue to each half of a joint so that it can wet and penetrate both gluing surfaces. Then clamp tightly, because polyurethane glue only develops full strength when it's forced into thin bond layers.

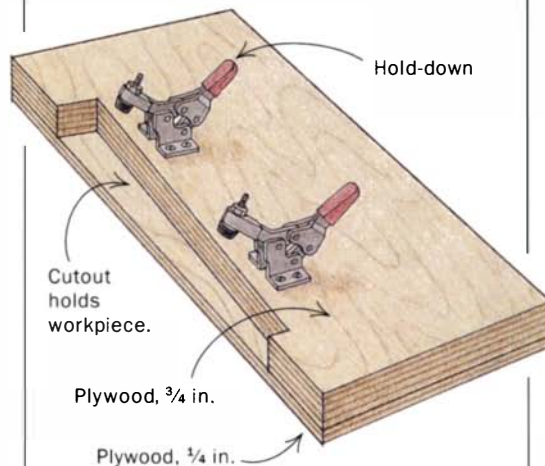
[William Tandy Young is the author of *Glue: The Complete Woodworker's Guide*, which will be published by The Taunton Press in November.]

Tapering small parts

For my current project, I need to cut pieces of pine that are 7 in. long and

A JIG FOR SMALL TAPERS

If the workpiece is too small to maneuver safely, use a jig that holds the work in place.



taper from 3/4 in. down to 3/8 in. I've used a tapering jig (similar to what you'd use on a tablesaw) on my router table, but it feels unsafe. I can't get a featherboard to exert even pressure along the whole piece. How can I do this and still keep all my fingers?

—M. Zazvorkia, Burnbury B.C., Canada

Gary Rogowski replies: Most small taper cuts like you describe require either nerves or fingers of steel. Holding these small pieces is usually accomplished with just a fingertip. Beads of sweat should break out on your brow as you consider this.

My first suggestion is to do this work on the handsaw with a fine 6-teeth-per-inch (tpi) blade or one of the Wood Slicer blades that Highland Hardware carries. The smooth cuts you can get with these blades is astonishing. There should be minimal cleanup, especially in pine. The tip of a pencil will hold your work in a taper jig that runs against a bandsaw fence. You can use the standard taper jig with an infinitely adjustable angling fence or make a dedicated jig out of a piece of plywood. And because all of the blade's force is downward on a bandsaw, it will make your work much safer.

Another method is to make a tapering jig with a hold-down built into it. You can then use this jig on either the tablesaw or the router. Use a plate of 1/4-in. material, such as plywood, medium-density fiberboard (MDF) or Masonite, and mount a fence with a stop on it. This

fence will be either adjustable or set at the appropriate angle to yield the taper you want (for example, a 3/8-in. taper over 7 in.). Then on top of the fence or just behind it, mount a quick-action De-Sta-Co clamp that will hold the workpiece flat to the 1/4-in. plate. You then pass this whole setup past the blade or bit. Keep your fingers on top of the clamp so they're away from the bit and out of danger. For ease and safety, be sure to make this jig longer and wider than what you need. On the router table, be sure you feed into the rotation of the bit, so it does not take your piece and throw it rudely across the shop. And if you have lots of these to make, check the jig every so often to make sure the jig is still accurate and you're safe.

[Gary Rogowski is a contributing editor to *Fine Woodworking*.]

Sanding, scraping and planing

I have often heard that when finishing, it is better to use a smoothing plane or cabinet scraper instead of sandpaper. Is there any truth to this?

—Aaron Ionta, Eden Prairie, Minn.

Garrett Hack replies: Smoothing planes, scrapers or sandpaper can bring wood to a final smoothness that can feel and look polished. Yet there are subtle and distinct differences in the surface each tool cuts that becomes most noticeable when you compare them side by side. A planed surface has the most depth, clarity and shine, a scraped one nearly so and a sanded surface—even one sanded with fine grit—can appear slightly dull. A finish helps hide these differences, but they will still be there.

The chisel-like iron in a smoothing plane is securely held in a cast-iron or wooden body that guides the cut and controls the cutting depth. In the ideal circumstance of a perfectly sharp iron working with the grain, a plane cleanly slices the fibers and cuts the level plane—as the name suggests. Such a surface not only feels perfectly smooth, it also has clarity and shine because of the consistent way it reflects light.

With an ideally sharp edge, a scraper can cut hardwoods as cleanly as a smoothing plane. In reality, the high angle of a scraper's fine hook edge degrades

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quickly, so some fibers get torn, not sliced. The wood feels smooth, but it doesn't have the consistent radiance of a surface cut by a plane.

Sanding both tears and slices the fibers. As the sandpaper dulls, lots more tearing goes on. The wood feels smoother as you move to finer grits, but the surface is still irregular enough so that it doesn't reflect light with quite the same sparkle.

A planed surface is the ideal, but small tearouts are still common. A freshly sharpened scraper is the best tool to smooth these areas and woods too ornery to plane well. Sandpaper is always a reliable last resort.

[Garrett Hack is a writer and woodworker living in Thetford Center, Vt.]

Shaping flared legs

I'm in the process of designing a small table, and I want to make legs that flare

at the bottom. Would you describe the method used to make a leg of this style?

—Robert J. McCluskey, Evanston, Ill.

Barry Newstat replies: Making a flared table leg is not as difficult as it might appear. I use them often in a line of tables I began making early in my career.

I start by making an exact template of the profile of the leg. Be sure to cut the mortises before you shape the legs. Whether you use chisels, a drill press or a mortising machine, square stock is easier to handle and less likely to shift out of line. Marking the position of the mortise on the template ensures that the mortise will be cut in the right spot.

I trace the template onto the blank, making sure the flare at the base of the leg is to the outside in relation to the mortises. I cut two parallel profiles on the bandsaw. Then I use a handplane on the

inside of the leg so that I'll have a flat side to place on the bandsaw table. I trace the template onto the leg and bandsaw out the two remaining sides. I smooth the legs using a jack plane on the flat surfaces and outside curves. A curved bottom spokeshave works well on the inside curves, but you can get the same shape using 80- or 100-grit sandpaper on a slightly curved hard block.

[Barry Newstat is a furniture designer and builder in Chicago, Ill.]

Need a good sunscreen?

I'm looking for a polyurethane finish that will inhibit the darkening of wood caused by light degradation. Are ultraviolet inhibitors effective?

—Will Gleim, Willingboro, N.J.

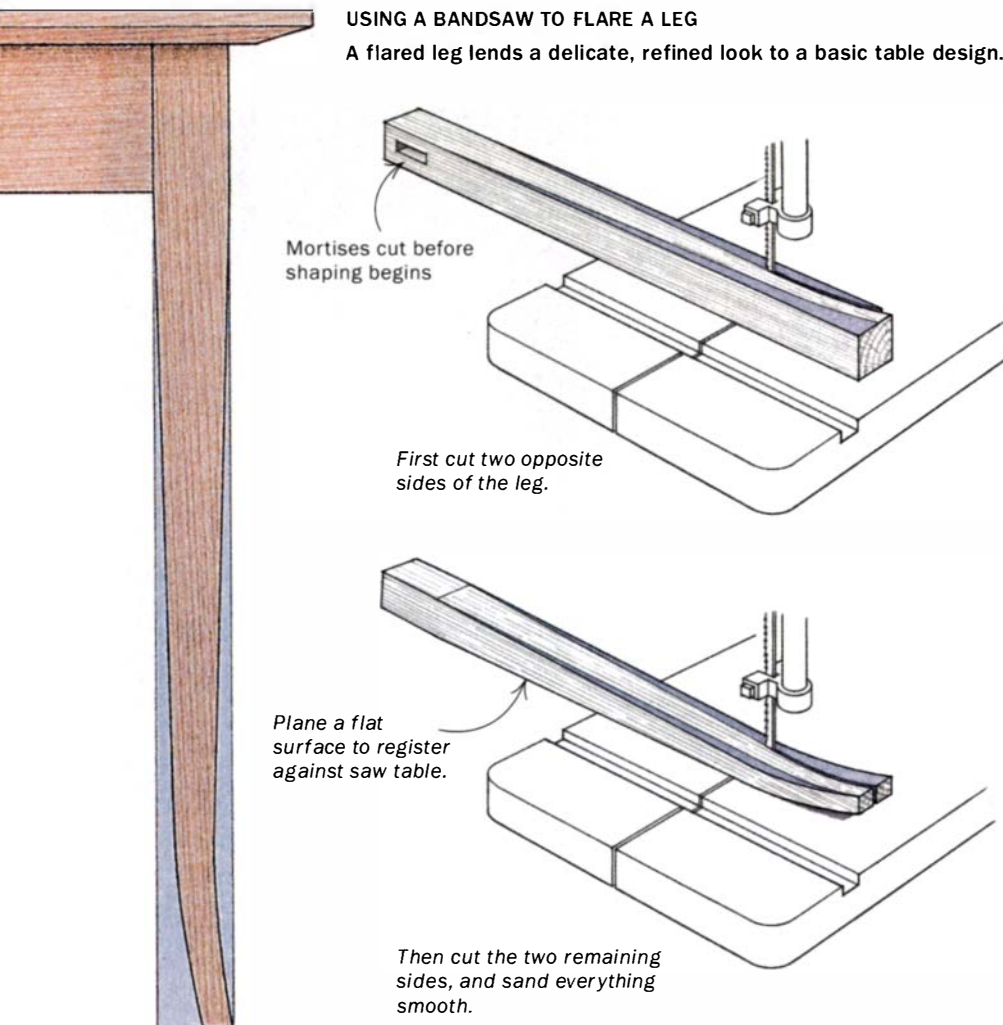
Chris Minick replies: Ultraviolet (UV) light is only one of the many factors that contribute to the darkening of wood. Moisture, heat, visible light and time also take their toll. UV absorbers may marginally slow the wood darkening phenomena, but they are, in a manner of speaking, sacrificial lambs. Depending on molecular structure, UV absorbers either directly absorb UV radiation and dissipate it as harmless heat or absorb the free radicals generated when UV radiation strikes a finish molecule. In any case, the absorber molecules are eventually consumed and unable to protect anything. Some UV absorbers actually accelerate the yellowing of the finish film as they are consumed (they are designed to maintain film integrity not film color).

UV absorbers are great for finishes used indoors. Common double-glazed window glass screens out about 85% of the naturally occurring UV radiation, so little of it reaches inside the house anyway.

UV absorbers aside, a polyurethane furniture finish is not the best choice for minimizing discoloration. A better choice would be an acrylic-based furniture finish. Acrylic finishes resist UV degradation, have good protective properties, are exceptionally clear and remain that way for the life of the finish.

Age darkening of wood is inevitable. My advice is to apply a good acrylic finish, and let your heirloom age gracefully.

[Chris Minick is a contributing editor to *Fine Woodworking*.]



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9"x40T	\$146	\$109	\$98	\$87
30T	\$125	\$99	\$89	\$79
*8-1/4"x40Tx3/32"	\$136	\$99	\$89	\$79
8"x40T 3/32"	\$136	\$99	\$89	\$79
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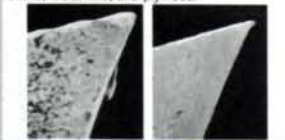
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Demystifying a complex Chinese joint

BY RANDOLPH DEMERCADO

I was first attracted to Chinese furniture by the style. I loved the simplicity and fluidity of it, the way pieces were pared down to their essence. But what has kept me making it, to the exclusion of other types of furniture, is the joinery. Beneath that serene exterior is some of the most challenging joinery a craftsman will encounter.

The joint I make here is a mitered mortise and tenon with dovetailed keys. It may seem needlessly complicated at first glance, but in fact, there is nothing unnecessary about the joint. It was developed centuries ago by craftsmen seeking the maximum mechanical connection to compensate for their weak glues. As with most complex-looking woodworking, it's far more approachable once you've broken it down into steps. Even with the exotic joint I describe here, the steps turn out to be fairly familiar. Probably the most difficult thing is envisioning the joint and properly laying it out. After that, it's mostly a matter of maintaining accuracy and patience.

I learned to make Chinese furniture by looking at books and drawings and giving it a try. The table in these photos is based on one in Gustav Ecke's book *Chinese Domestic Furniture* (Dover Publications).



You look so innocent. Below the serene surface of DeMercado's Ming-style Chinese hall table lurks a double-mitered, dovetail-keyed mortise-and-tenon joint.

RAZOR-SHARP LAYOUT

Steps to laying out the joint

The key to making this joint is careful measurement and marking before starting to cut.

5. Continue the apron and dovetail lines across the top and down the face of the leg to the miter line.

4. Then mark the miter lines on both outer faces of the leg.

3. Draw a line where the bottom of the apron will fall and carry it around the leg.



1. First mark the thickness of the apron on the leg.

2. Next mark the height of the dovetail key.



After the initial marking with a sharp pencil, I use an Exacto knife and marking gauge to lay out the joint. I make sure my layout is accurate because I must rely on it as I cut the joint: There are many intermediate steps when it is not possible to do a trial-and-error fit.

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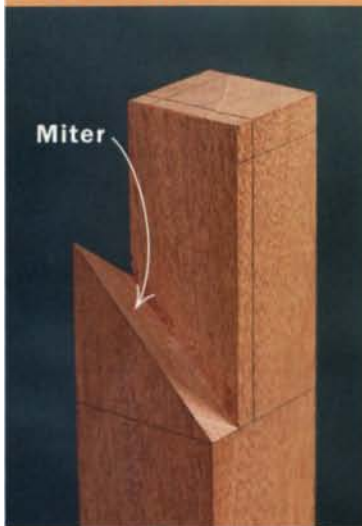
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MITER ME

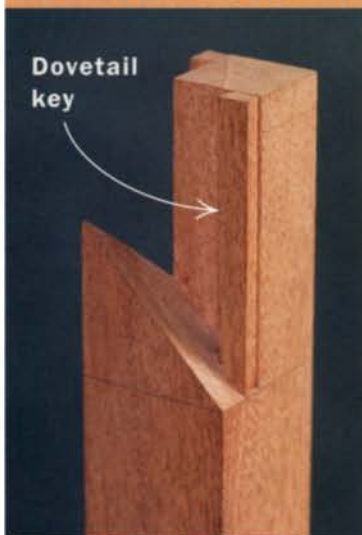


The first cut is along the miter line on the outside face of the leg. Make the cut with a handsaw miter box, a precise tool just right for this job. The cut goes down to the line marking the top of the dovetail key. Do not cut below this line!



The next cut is on the tablesaw. It is a stopped cut into the end of the leg, and it establishes the top of the dovetail key. With the blade raised high, push the leg slowly into the blade. Then withdraw the leg, and snap off the waste piece.

TO THE ROUTER TABLE



The dovetail keys are made on the router table using a dovetail bit. Lay the leg on the table, and set the height of the dovetail bit to the apron thickness line. Set the fence first to cut the outside face and then the inside face of the dovetail key.



After defining the dovetail key with those two stopped cuts, leave the bit set at the same height, and use it to remove waste, establishing a flat beside the dovetail key. Then clean up the cuts with chisels.

CHOP AND DRILL: MORTISE TIME



Cutting mortises in the leg requires two machines as well as hand tools. Start by marking the mortise on the face of the miter. Then use a hollow-chisel bit on the drill press to chop the outer portion of the mortise.



To drill out the inner portion of the mortise (shielded from the chisel by the dovetail key), clamp the leg upright in a vise, and drill a series of holes from above with a hand-held drill. Then clean up the mortise with chisels.



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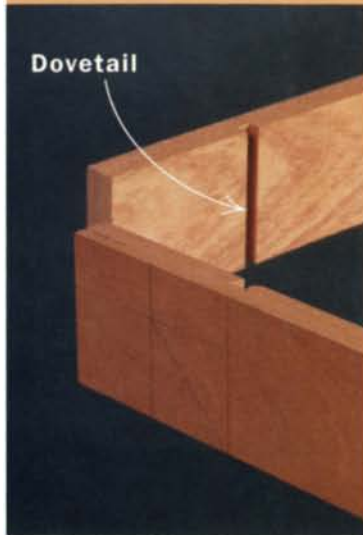


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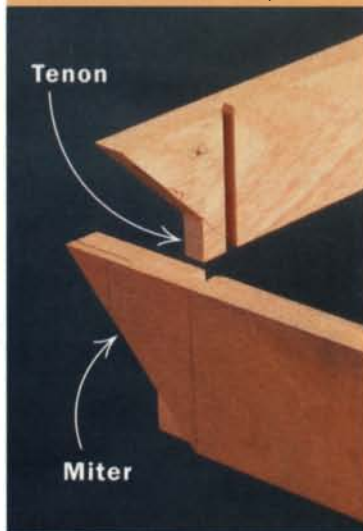


With the leg joint cut, I go back to the router table to cut the dovetail housing in the aprons. To get a close fit, leave the dovetail bit at the height set for cutting the dovetail key on the leg. Use a squaring jig along the fence to feed the apron squarely.



Next trial-fit the apron to the leg's dovetail key.

THREE SAWS, ONE MITER

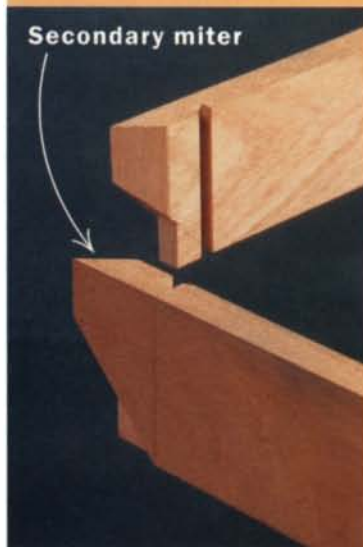


Begin the apron miters by cutting into the outside face of the apron with the miter box. Stop the cut at the line for the tenon. Next comes a stopped tablesaw cut into the end of the apron. This establishes the face of the tenon.



Bandsaw the miter the rest of the way through. Using the bandsaw permits me to stop shy of the tenon. I cut a little to the waste side of the miter box kerf and clean up with chisels at the final fitting.

ONCE MORE TO THE MITER BOX



The secondary miter on the aprons is the most delicate part of the joint and must be cleanly cut. I do the job on the miter box. Then I use chisels and planes to adjust the miters until I get a clean, tight line between them. To make fitting easier, undercut the miters so they only make contact along the outer $\frac{1}{8}$ in.

STUB TENONS LOCATE THE TOP



After the aprons are fitted, mark the top of the legs for stub tenons that register the top frame over the leg. These tenons typically straddle the miter joining the frame of a frame-and-panel top.

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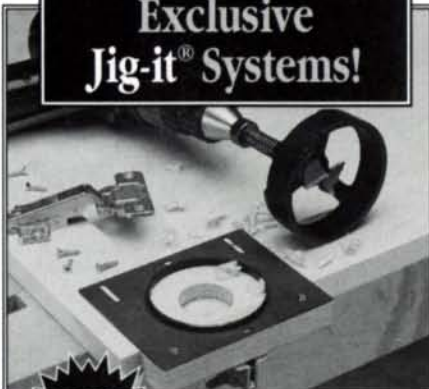
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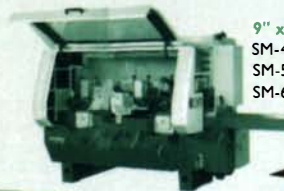
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Model	Description	List	Sale
50-860	NEW 850 CFM Air Cleaner	239	239
31-695	6" Belt/9" Disc Sander	441	299
23-710	New Sharpening Center	217	145
23-680	6" Bench Grinder 1/4 HP	80	69
31-460	4" Belt/Disc Sander	198	119
40-560	16" 2" speed Scroll Saw	230	155
40-540	16" var/spd Scroll Saw	249	179
11-990	12" Bench Drill Press	255	184
11-090	32" Radial Bench Drill Press	405	279
43-055	1/2" Bench Router/Shaper	398	299
22-540	12" Bench Top Planer	359	259
28-195	10" Band Saw	390	300
22-560	12-1/2" Planer w/extra knives	389	259
36-865	Versa Feeder Stock Feeder	259	199
36-220	10" Compound Mitre Saw	294	199
28-185	Bench Band Saw	213	168
36-240	10" Sliding Mitre Saw	589	339
37-070	6" v/spd Bench Joiner	351	265
14-650	Hollow Chisel Mortiser	380	239
33-990	10" Radial Arm Saw	981	799
17-900	16-1/2" Floor Drill Press	490	349
37-190	6" Deluxe Joiner	603	445
36-285	8-1/4" Builders Saw w/stand	268	189
36-210	10" Compound Mitre Saw	344	249
34-555	Sliding Table	487	289
36-250	10" Slide Compound Saw	825	449
31-780	Oscillating Spindle Sander	253	194
31-780K1	780 w/ 31-781 spindle set	209	369
46-700	12" Wood Lathe	575	465
40-650	Q3 18" Scroll Saw	389	289
36-905	30" Unifence	346	255
36-906	50" Unifence	444	325
34-444	10" Contractors Table Saw	579	379

The following tools have a \$50.00 rebate! Price shown is before rebate.

36-455	10" Contractors Table Saw w/ 30" unifence, cast iron wing, 34-914 table board, & carbide blade	839	789
22-675	DC380 15" Planer	1175	995
28-275	14" Band Saw 3/4 HP	585	575
28-280	14" Band Saw 1 HP motor with enclosed stand	739	739
28-280Z	14" Band Saw 1 HP w/ 50-274 mobile base, 28-843 rip fence, & 28-266 cool blocks	839	839
31-280	Sanding Center w/ stand	789	789

NEW Single Stage Dust Collectors			
50-850	1-1/2 HP, 1200 CFM	Sale	309
50-851	2 HP, 1500 CFM	Sale	455

MILWAUKEE TOOLS			
6527	NEW Sawzall with case	343	169
6537-2	6527 w/quick lok blade change	224	175
4072-22	1/2" Drill w/kyis 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	142
0244-1	1/2" Drill 4.5A mag 0-600 rpm	255	134
0222-1	3/8" Drill 3.5 amp 0-1000 rpm	213	119
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	cdls Scrdvr 200 & 400 rpm	150	89
6547-6	6546-1 w/bits, 1/4" chuck & cs185	108	89
5399	1/2" D-handle Hammer Drill Kit	256	219
5397-1	3.8" w/ spd Hammer Drill Kit	375	145
5371-6	1/2" w/ spd Hammer Drill Kit	360	194
3107-6	1/2" v/spd right angle Drill Kit	234	129
3300-1	1/2" w/ spd right angle Drill	378	219
6142	4-1/2" Grinder w/case & acc.	224	129
6490-6	10" Mitre Saw	496	265
6491	6490 w/ carbide blade & bag	594	328
6494-6	10" Compound Mitre Saw	585	315
6266-6	Top Handle Jig Saw	315	159
6496-6	10" Slide Compound Saw	1050	569

FREUD CARBIDE TIPPED SAW BLADES			
5/8" Bore - Industrial Grade			
Item	Description	Teeth	List Sale
LU72M010	Gen Pur. A.T.B. 10"	40	69 42
LU82M010	Cut-off 10"	60	93 44
LU84M011	Comb 10"	50	78 45
LU85M010	Super Cut-off 10"	80	115 59
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	Compound Mitre 10"	60	88 54
F410	Quiet Blade 10"	40	95 49
SD308	8" Dado - Carbide	230	119
SD508	8" carbide w/case & shims	344	168
FB100	16 piece Forstner Bit Set	338	194
94-100	5 pc. Router Bit Door System	202	109
FT2000E	Plunge Router	Sale	265
JS102	Biscuit Joiner	Sale	119

HITACHI TOOLS			
CF82	8-1/2" Slide Compound Saw	169	449
C10F	10" Slide Compound Saw	1627	699
C15F	15" Mitre Saw	1346	645
NV45AB	Coil Roofing Nailers	935	379
C10RA	NEW 10" Table Saw	632	319

MAKITA TOOLS			
Model	Description	List	Sale
5090DW	3-3/8" Saw Kit 9.6 volt	280	155
DA391D	3/8" angle Drill 9.6V	166	114
DA391DW	3/8" angle Drill Kit 9.6V	341	189
ML902	Incandescent Flashlight 9.6V	14.95	
6095DWE6	6 volt Drill Kit w/2 batt.	Sale	125
6095DWE2	6095DWE w/flashlight	Sale	139
6095D	6095DW Drill only & cse	Special	65
632007-4	9.6 volt Battery	47	30
632002-4	7.2 volt Battery	39	28
6203DWA6	9.6V 3/8" Drill Kit w/2 batt	351	159
6211DWEH	12V 3/8" Drill Kit w/2 batt	368	175

CORDLESS DRILLS			
WITH 2.0 AMP HIGH CAPACITY BATTERIES			
6213DWA6	12V 3/8" Drill Kit	325	269
6233DWA6	14.4V 3/8" Drill Kit	358	205
9900B	3"x21" Belt Sander w/bag	347	179
9924DB	3"x24" Belt Sander w/bag	360	189
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
DA3000R3/8"	R3/8" 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	235
5007NBK7-1/4"	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	209
3612C	3 HP Plunge Router	492	269
LS1040	10" Compd Mitre Saw	460	259
LS1013	10" Dual Compound Slide		
LS1013	Miter Saw	1088	599
BO5010	5" Random Orbit Sander	142	72
LS1220	NEW 12" Compound Mitre Saw	379	219
9227C	NEW 7/9" Polisher	350	195
SJ401	NEW 16" Bench Scroll Saw	300	175

SENCO AIR NAILERS			
SFN1+	Finishing Nailer 1" - 2" w/ cs448	299	
SN325	Nailer 1-7/8 - 3-1/4"	665	365
SLP20	Pinner w/cs 5/8 - 1-5/8"	422	229
SKS	Stapler 5/8 - 1-1/2"	390	279
SN70	3 HP Compd Miter Saw	725	449
SN65	Framing - Full Hd 2 - 3-1/2"	709	379
SN600	NEW Framing 2 - 3-1/2"	699	369
SFN40	Finish Nailer 1-1/4 - 2-1/2"	569	349

NEW Accuset Nailers by SENCO			
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	Super	Sale 325
RN45	Coil Roof Nailer 9/4 - 1-3/4	945	359
N60FN-2K	Finishing Nailer w/ case	557	275
BT35-2K	Brad Tacker 5/8" - 1-3/8" with case, oil, & brads	279	125
CWC100	1 HP Pancake Compressor	440	305
MIIIIS	Finishing Stapler 15 gauge	902	529
S32SX-1K	Floor Stapler 1/2" - 1-3/8" with case & oil	269	145

JORGENSEN ADJUSTABLE HANDSCREWS			
Item#	Jaw	Opening	List Sale
	Length	Capacity	
#1	8"	4-1/2"	20.35 12.10
#2	10"	6"	23.30 12.90
#3	12"	8-1/2"	26.75 14.90
#4	14"	10"	33.85 18.55

PONY CLAMP FIXTURES			
Model	Description	List	Sale of 12
50	3/4" Black Pipe	15.45	8.50 92.50
52	1/2" Black Pipe	12.65	6.95 74.95

PANASONIC CORDLESS			
Model	Description	List	Sale
EY6100FKW	12V 3/8" Drill Kit w/ 2 Ironman batteries, 15 min. charger, & case	379	179
EY6101FKW	12V 1/2" Drill w/ 2 Ironman batteries, 15 min. charger, & case	324	199
EY6230FKW	NEW 15.6V Drill Kit with 2 Ironman batteries, 30 minute charger & case	425	209
EY3503FQW	NEW 5-3/8" 12V Wood Cutting Saw Kit	500	259

BIESEMEYER FENCES			
B-50	50" Commer. Saw	443	325
T-SQUARE 52	52" Homeshop	360	275
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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
DW411	K1/4 sheet Palm Sander w/ cse	688	58
DW682K	Biscuit Joiner with case	444	199
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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 recip saw, & case	375	
DW995KC-2	DW995K 18V drill kit, DW938 18V recip saw, & case	395	
DW997KC-2	DW997K 18V drill kit, DW938 18V recip saw, & case	415	

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All good finishes begin with sandpaper



I know. This department is called “Finish Line,” and you’re probably wondering why I’m talking about the mundane subject of sandpaper instead of some fancy finishing method. Because good surface preparation is essential to a good finish, it seems appropriate to kick off this new department with a discussion about sanding.

Nobody really likes to sand—me included—but when I face this inevitable stage of a project, I keep four things in mind:

- grit selection (called sanding schedule)
- speed I move sander (or my hand) across surface
- shop lighting
- finish I’ll be using on my project

To minimize my work and maximize the results, I’ve developed a ritual that takes these four factors into account.

Choose the right grit to start

If I’ve glued up a lumber panel for a tabletop or a cabinet door, I sand first with a belt sander—before any wood has been cut to size. It may seem a bit odd to sand before milling the wood to its final dimension, but experience has taught me that this is the best time to sand out planer marks and excess glue and to flatten the surface. A drum sander would be ideal for this step, but I don’t own one.

I’ve experimented with different grits and belt types and found that an 80-grit, purple-ceramic, aluminum-oxide belt is the best choice at this rough-sanding stage. Hold the belt sander at about a 30° angle to the grain direction. Angling the sander across the grain removes wood faster and produces a flatter surface than sanding with the grain. After one or two passes, you should have an even scratch pattern over the entire surface. Don’t fret over those deep cross-grain scratches: They’ll disappear in later sanding steps. Switch directions to a 30° angle running the other way on the panel, and repeat the process to knock off any high spots.

After milling the panels to size, I switch to a random-orbit sander with 120-grit aluminum-oxide sandpaper. Stick with the 120-grit, and change the discs frequently until all the 80-grit cross-grain scratches are removed. (Silicon carbide discs will make finer, more consistent scratches, but at this stage, I prefer aluminum oxide because it’s tougher and removes the stock more aggressively.)

When you’ve gone over the surface thoroughly with 120-grit, change to 180-grit sanding discs, and repeat the whole random-orbit sanding process to remove the 120-grit scratches.

Sanding bare wood past 180-grit is usually wasted energy: The

finish can swell the wood surface, negating all your hard work. Besides, sanding some woods with too fine a grit can cause finishing problems. For example, maple sanded to 400-grit will not absorb a pigmented stain, because there are no scratches large enough for the pigment to adhere to.

My final sanding is done by hand with 180-grit garnet sandpaper. This stage, using the same grit as the last pass by machine, doesn’t refine the scratch patterns—it only straightens them out. Compared to other mineral grains, garnet is rather soft and dulls quickly, which is precisely why I use it for my final sanding step. When garnet dulls, it burnishes the wood surface. That burnishing action rounds over the sharp edges of previous scratches, resulting in a beautifully smooth surface, ready to finish.

Some people may question the wisdom of sanding by hand after using 180-grit by machine, but think about it. Random-orbit sanders cut into the wood fibers in a circular pattern, so they leave tiny cross-grain scratches, regardless of the grit size used on the sander. Hand-sanding with the grain removes these cross-grain scratches and improves the look of the finished project. It’s a subtle change, but one that’s definitely worth doing.

Sandpaper tech talk made plain and simple

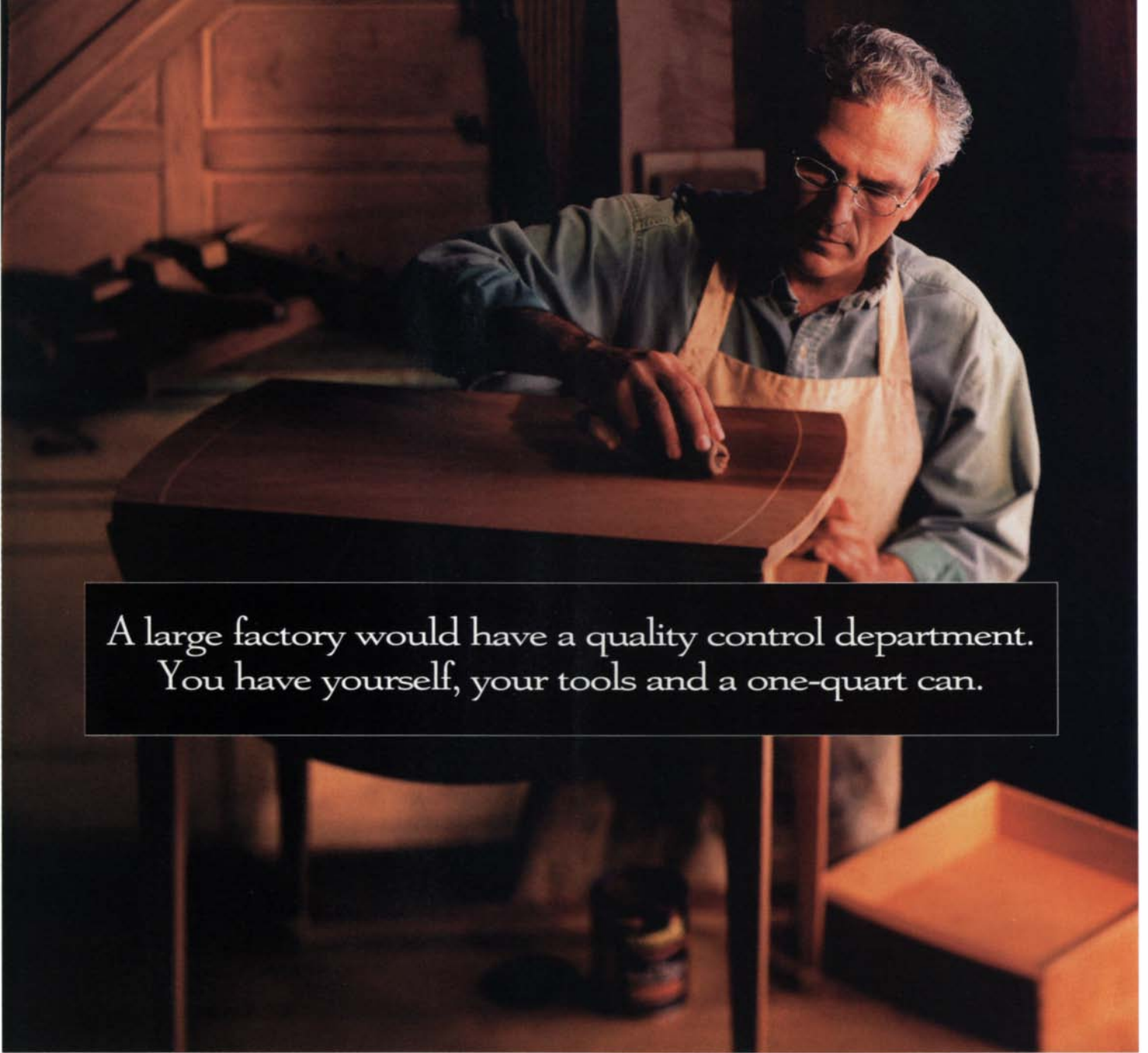
Woodworkers are faced with a bewildering array of sandpaper choices and unfamiliar terms: garnet, silicon carbide, open coat, closed coat, nonloading, resin bond, glue bond, paper, film,

cloth, A-weight, X-weight, P-scale, CAMI-grade—just to name a few. How’s a woodworker to know which sandpaper is right for the project at hand? Short of becoming an abrasives engineer, here are a few things to keep in mind when buying sandpaper:

Remember, sandpaper is a cutting tool. The mineral type, grain size and grain spacing affect how well the sandpaper works and the final appearance of the sanded project. It’s obvious that bigger mineral grains will leave larger scratches. What may not be so obvious is that the space between the mineral grains plays the same role as the gullet of a circular sawblade, a

I keep four things in mind when I’m sanding:

- grit selection
- shop lighting
- type of finish
- speed I move sander (or my hand) across surface



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temporary storage place for wood dust. Open-coat sandpaper will usually remove wood faster and load up with less debris, but it will leave deeper scratches than the same grade in a closed-coat version. Therefore, open-coat sandpapers are great for initial sanding of bare wood, and closed-coat versions are best suited for the last step in the sequence.

The type of mineral in the sandpaper has a big effect on the abrasives you choose for any given job. Hard, tough minerals such as ceramics produce deep V-shaped scratches. Friable, or soft, minerals such as garnet, produce shallow U-shaped scratches. V-shaped scratches are desirable when you want to remove a lot of stock quickly. U-shaped scratches are best for surfaces that will be stained and finished. They show up less under a film finish such as lacquer, polyurethane or shellac.

From most to least scratchy, my rule of thumb regarding the scale for the various minerals used in the manufacture of sandpaper is ceramic, aluminum oxide, silicon carbide and garnet. You can see that starting a project with ceramic belts and ending it with garnet paper begins to make sense. Those choices give me the best possible sanded wood surface in the least amount of time. (For more on sandpaper, see *FWW* #125, pp. 62-67.)

Don't go fast, and don't push down hard

The scratch pattern produced by a random-orbit sander is influenced by downward pressure and speed. It seems intuitive that pushing down on the sander will remove more wood and make the job go faster. In practice, the opposite happens. Power sanders are designed to operate at maximum efficiency under their own weight. Excessive downward pressure slows the rotational speed of the sanding pad. The machine loses its random motion, and reverts to a strictly circular path. The net result is deep, circular scratches, or swirl marks.

Moving the sander too quickly across the wood surface also contributes to swirl marks because the sander simply doesn't have enough time to refine the scratch pattern. I get the best results when I guide my random-orbit machine slowly across the surface with a minimum of downward pressure. A rate of approximately 1 ft. every



Let there be light. A strong, raking light illuminating the workpiece from a low angle, works best to reveal scratches that need attention. The author uses a tripod-mounted, 1,000-watt quartz halogen light.

10 seconds works well for me. That may seem painfully slow, but it's not nearly as painful as sanding out swirl marks after the wood has been stained.

Illuminate your work from the side

One of best finishing-equipment purchases I ever made was an inexpensive, tripod-mounted, 1,000-watt quartz halogen light. I position the light at a low angle directly across the bench from where I sand. The strong, raking light accentuates sanding scratches and other small imperfections, allowing me to see scratches and eliminate them. As an added benefit, this light makes a nice secondary heat source on cold winter days.

Tailor your approach to the finish

The finish selected for a project has a big bearing on how thorough the sanding job must be. Nonfilm-forming oil finishes, also called Danish oil finishes, are the most forgiving. Projects that are random-orbit sanded to 150-grit will usually look fine.

Waterborne finishes are the most demanding. Scratches that are normally undetectable under solvent-based finishes will show up as glaring mistakes when coated with a waterborne finish. Why? Because waterborne finish films tend to "bridge over" deep sanding scratches, rather than fill them up, leaving a minute quantity of air trapped beneath the dried finish film. The difference between the way the finish film and the air trapped inside the scratches refract light makes the scratch very visible. As you may have suspected, solvent-based varnishes and lacquers fall between these two finish extremes.

Sanding bare wood past 180-grit is usually wasted energy.

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