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Fine WoodWorking

Foldout project plans, p. 50

June 2004
No. 170

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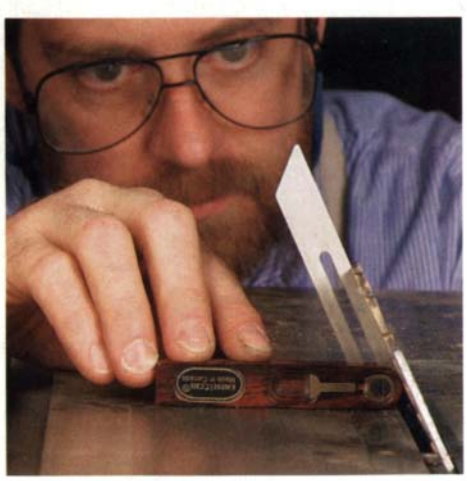

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On the Cover: *Michael Pekovich builds a cherry chest of drawers using dovetail joinery and carefully chosen lumber. See p. 50*
Photo: Matt Berger

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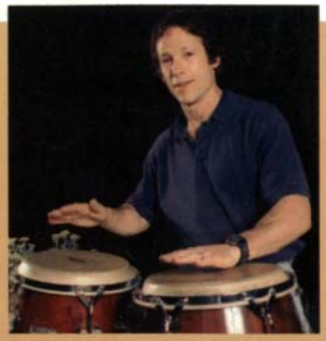

David Marks (Master Class) hosts the TV show *Wood Works*, which airs on both the HGTV and DIY networks. A New Jersey native, Marks began building furniture in 1972, and opened his own business in 1981 after moving to Santa Rosa, Calif. By the 1990s his interest gravitated toward turning and sculpture. The patination process Marks writes about on pp. 100-104 is a trademark of his more recent work. When he can find a rare moment of spare time, he enjoys playing the drums. For more information about Marks, visit his Web site: www.djmarks.com.

Doug Peterman ("Templates Guide the Way") is a self-taught furniture maker. He works out of his home studio in Stratford, Ont., Canada, doing work mostly for clients in the greater Toronto region. After university, Peterman spent 20 years in the Canadian Navy. In 1999 he started his craft business. Aside from making furniture, he is vice president of the Ontario Crafts Council and volunteers with local craft groups.

Miguel Gomez-Ibañez ("Scaling Furniture From Photos") is an architect and furniture maker in Boston. A graduate of North Bennet Street School's fine furniture and cabinetmaking program, Gomez-Ibañez has taught drawing workshops at the school. He also is a contributing author to the *Furniture Studio* book series published by The Furniture Society and currently serves as president of the society.

Boyd A. Hutchison (A Closer Look) was raised in Ohio, where his early passions included forests and wood. He holds four degrees in forest-related subjects, including a doctorate in forest meteorology from Yale University. After retiring from a 26-year career in forestry research, Hutchison developed his woodworking hobby into a full-time business, specializing in reproductions and adaptations of period furniture. He also serves part-time at the Shaker Museum and Library in Old Chatham, N.Y., where his responsibilities involve maintenance and repair of artifacts in the museum's collection. He lives in Sheffield, Mass., with his wife and three golden retrievers.

Mladen Vranjican ("A Spit-Shine Wax Finish") immigrated to the United States from Yugoslavia. While in high school, he developed an interest in astronomy. That led to the hobby of making his own telescopes, which, in turn, carried him further into a more theoretical fascination with the optics at the heart of telescopes—a hobbyist's passion he indulges to this day. When the time came to go to college, he deliberately chose pharmacy as a course of study, reasoning practically that it offered a secure employment opportunity. Vranjican took up woodworking about five years ago, when he needed a bookcase and couldn't find one he liked. For fun, he also makes model airplanes that fly. He has worked as a pharmacist for the U.S. Navy for the past 18 years.

Jerry H. Lyons' ("Fine-Tune Your Shop") passion for woodworking began as a freshman at Western Kentucky University in Bowling Green in 1967. Inspired by great teachers, he not only learned the necessary skills for woodworking but also went on to study furniture design, drafting, wood science, and industrial finishing while completing his master's degree in education. He spent 21 years at Western as an assistant professor teaching furniture making. He then moved on to become a training consultant for several organizations. Lyons recently built his dream shop near his home and devotes any spare time to woodworking. He hopes to open a small woodworking school in the future. He can be contacted at 270-646-5300 or jlyons@lyonscompany.com.

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Letters

Choosing the best tools

Tool tests are among the most difficult articles to produce. The process begins with deciding which tools to review, then figuring out how to test them, and finally editing down the mountain of data so that it fits into a few magazine pages.

As our longtime readers know, when we write about tools, we try to put our observations in perspective, based on the kind of woodworking we think a tool is best suited for and the type of woodworkers who might purchase that tool (amateur, pro, budget-conscious or not). And yet, despite our best efforts at being clear and fair, readers often call or write to ask, "Okay, so which one would you buy?"

It's a legitimate question. And we have a solution. Beginning with this issue, we will identify top-performing tools with two visual icons: Author's Choice: Best Overall and Author's Choice: Best Value. The Best Overall designation is given to the tool that performed best among comparable tools in a particular category. Best Value represents a tool that, in the author's opinion, provides above-average performance at a moderate price.

We won't always use the icons, especially in the case of a tool review that is more general in scope or one that compares tools whose wide-ranging prices create an apples vs. oranges comparison (such as "Sliding Bevels" on pp. 46-49).

Our author's opinions are by no means the last word on a subject. We look forward to hearing from you, too. Our online discussion forum, Knots, at www.finewoodworking.com, is a great place for us and other woodworkers to hear your voice.

—Anatole Burkin, editor

Golden clarification

In "A Guide to Good Design" (*FWW* #168, pp. 48-51), regarding the golden ratio, Graham Blackburn states: "If you bisect any given line using phi, the longer portion is 1.618 times greater than the shorter portion." The words "greater than" should be omitted, because the length of the longer portion is 1.618 times the length of the shorter portion, making the longer portion actually "0.618 times greater than" the length of the shorter portion.

I did enjoy reading this well-presented and valuable article.

—Dan Frasciello, Media, Pa.

Another way to build Windsor chairs

Eighteenth-century Windsor-chair makers used wet/dry joinery to make the typical H-stretcher understructure described by

Christopher Baumann, 1968-2004

Fine Woodworking tragically lost a dedicated member of our staff this past winter. Chris Baumann, our editorial assistant, died suddenly at his home at the age of 35.

Chris was the front line for the magazine, taking care of the phone calls and e-mails from readers and handling the tons of paperwork required to publish a magazine—letters, copyright agreements, and something very dear to our authors, paychecks. To say Chris kept the trains running on time is an understatement. He was one of the most organized people I know. If an editor forgot to request a check for an author's article, Chris would always come forth with a reminder. If I needed to find a particular document, Chris knew exactly where it was. Blame it on his German roots or his stint in the Navy, Chris could not help but be organized. Even his pencils were put away at the end of the day, the points all sharpened, pointing skyward like rockets ready to launch. For laughs, some of us occasionally would rearrange one or two items on his desk when he was away. Upon his return—and often without saying a word—Chris would right things before getting back to work.

Chris also worked closely with the staff on selecting pieces that appear in Current Work and assisted in the editing of numerous magazine features. We all will deeply miss his presence and his contributions to our lives and to *Fine Woodworking*.

—Anatole Burkin, editor

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Mike Dunbar in Master Class ("Windsor leg system stands the test of time," *FWW* #168, pp. 108-112). In wet/dry joinery, tenons at the ends of legs and stretchers (collectively referred to as "rounds") must be bone dry at assembly, though they were turned from wood containing substantial moisture content. At the same time, the wood to be mortised must be sufficiently moist, but not too moist, to swell the dry tenons into a powerful bond. Dunbar rejects the use of wet/dry joinery because "...drying tenons over a cauldron of hot sand..." is burdensome.

If you want to use and learn more about traditional wet/dry Windsor-chair joinery, there is another solution. Make a simple kiln from a box, lightbulb, and oven thermometer. Dry the rounds, tenons, and all, at 125°F. When the tenons cease shrinking, they will be decidedly oval in cross section, bone dry and ready for assembly. The interior of the wood to be mortised in the same round will still be moist for two reasons. First, end grain (the ends of the tenons) will dry about 12 times faster than edge grain. Additionally, the wood to be mortised has at least twice the diameter of the tenons and will dry more slowly.

But you have to be careful. If the interior of the wood to be mortised is still too moist after assembly, the tenon will swell too much and overcompress and permanently deform the mortise's end-grain fibers. In time, the joint will fail.

–John Alexander, Baltimore

More measuring tips

Robert W. Lang's Rules of Thumb on measuring accurately (*FWW* #169, pp. 86-88) called to mind a tip that my father gave me, which he had taught his fellow craftsmen at the Boeing Co. in WWII. When marking off multiple points along a line (or a board), leave the ruler's reference point stationary and calculate the distances of each needed point from the reference. For example, if you want spindles 1⅛ in. on center, with the center of the first spindle 3½ in. from the edge, add 1⅛ to 3½ to locate the second spindle, then add 1⅛ to that point to locate the third, and so on. If you move the ruler from point to point to make the measurements, even minor variations from dead center will accumulate to yield major inaccuracies by the time you're finished.

My father didn't dispense much advice, but when he did, it was choice. I've used his measuring technique in my own drawing and woodworking and always been satisfied with the results. One other tip: If you're measuring with a ruler, hold it perpendicular to the board, lest the thickness of the ruler produce an error of parallax, as Lang described in his third tip.

–David Heim, New York

Don't take the fun out of *Fine Woodworking*

You seem to constantly get letters regarding your editorial content. My two cents is that your editorial content is just great; leave it alone. I love your magazine just like it is. There is no such thing as a beginner, and nobody writes for them. There are amateurs who take up the hobby, and they may move on, or maybe they don't. Amateurs may have zero experience, or 30 years like me.

My wife says I'm a tool collector, not a woodworker. As always, she's mostly right. People like me buy all the stuff you advertise, and lots of it, and never use it much. Your advertisers love people like me. We never have warranty claims, we never complain, we just keep buying and collecting and experimenting. If fun for us is collecting tools to play with, and loving the challenge of trying to figure out if we really understand what some of your writers are saying, then so be it.

If I ever get to where I don't like your magazine, I won't be writing some stupid letter about it—I'll be diverting the money to another tool, and I'll be in my garage having FUN. That's what this is all about.

–Tom Hartford, Grand Junction, Colo.

A preference for handwork

Thanks to you and Chris Gochnour not only for a classic woodworking project,

Writing an article

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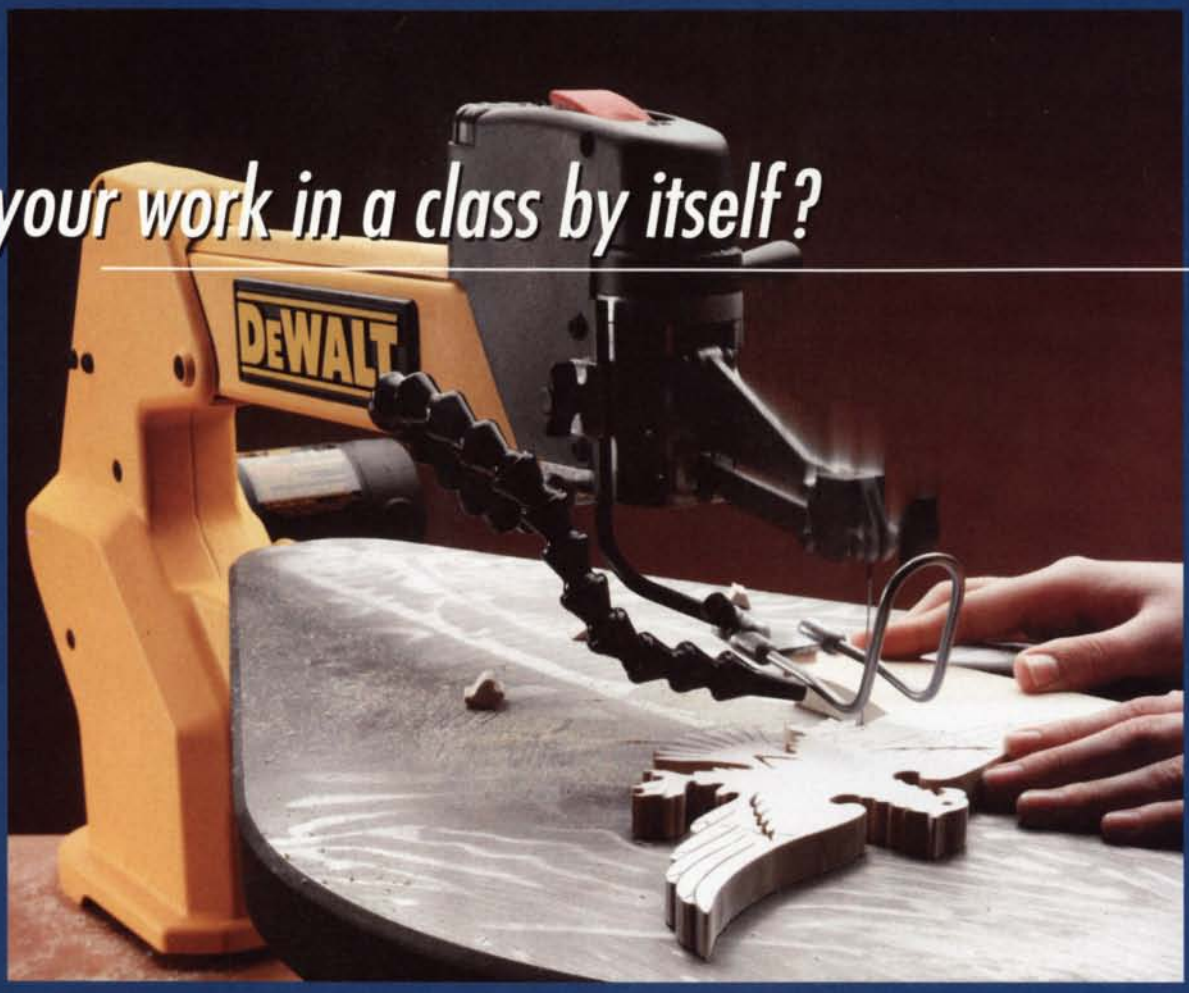

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but also for describing how to make the chest using hand techniques (*FWW* #169, pp. 36-43). Over the past six years, I have been trying to learn to do most of my projects with hand tools—no easy task when every woodworking magazine is filled with articles about the newest and most powerful machinery for the job. How about making a handmade project a regular feature for those who want to get "back to basics" (or who never left in the first place!)?

—Steven Samuel, Yardley, Pa.

Another way to tame tearout

Steve Latta's article about taming tearout (*FWW* #168, pp. 92-96) was quite informative, but he did not mention the method most commonly used in cabinet shops when cutting sheet goods. The method is to raise the blade slightly above the table and pass the sheet over the blade in order to score the underside. Then, raise the blade and make the final cut. Since the fence remains in the same position for both cuts, this method is infinitely more accurate than scribing with a knife. This method can also work for solid wood, including scoring the back edge, if one uses a miter square to support the board. Large, industrial saws are made with a built-in scoring blade to accomplish this method in one pass.

—Greg Lima, Fall City, Wash.

See even better in the shop

Regarding Jeff Miller's excellent article on "Seeing Better in the Shop" (*FWW* #168, pp. 57-61), I thought I would add a tip for those readers in their 40s and older who are now reliant upon bifocals and trifocals. How often have you found yourself working in close quarters underneath a machine, or inside the carcase of a cabinet where it is difficult to bring a small object into focus without uncomfortably craning your neck? On several occasions I found myself turning my glasses upside down to line up a screw head with my retina through the trifocals at the bottom of my lenses. Unfortunately, unless I am lying on my back, there is very little that holds my glasses in place when they are upside down on the bridge of my nose.

A trip to my optometrist found a solution known within the eye world as "occupational lenses." Any optometrist can order lenses with a strip of your prescription refraction at the top as well as the bottom. While these lenses are not cheap, the mistakes, slips, gouges, and scraped knuckles that formerly occurred "overhead" have virtually disappeared, and shop safety has been immeasurably enhanced.

—John M. Kunst Jr., Cincinnati

Clamping force defined

The otherwise excellent article by Chris A. Minick, "How yellow glue works" (*FWW* #166, pp. 94-98), contains some inaccuracies. In several places, the author confuses pressure and force. A woodworking clamp does not apply pressure, only force. Only when the clamping force is divided by the area of the glue surface does one arrive at the actual pressure (Pressure = Force / Area).

The example given on p. 96 shows two boards being edge-glued. The author states that each clamp is applying 2,000 lb. of pressure. He doesn't state how he derives this number, but I will assume it is correct. I estimate that each board is about 16 in. long and ¾ in. thick. This gives a glue area of 12 sq. in. There are two clamps being used, so a force of 4,000 lb. is being applied. Thus 333 lb. per sq. in. of pressure is being applied, considerably more than the intended pressure of 200 lb. per sq. in.

The formula can be rewritten so that the number of clamps required can be calculated. Assuming that 200 lb. per sq. in. is the optimal pressure for gluing and that each clamp can apply up to 2,000 lb. of force, the equation becomes:

Number of Clamps = (200 × Glue Area in square inches) / 2,000.

Of course, the result of this calculation must be a reasonable number and, as in the author's example, more clamps may be needed and each clamp then tightened to a correspondingly less force than normal to achieve the desired pressure.

—Tom Rosenbusch, Salt Lake City

Uses for router planes

I disagree with Mario Rodriguez's response to Nick Stowell's inquiry about the usefulness of router planes (*FWW* #169, p. 100). I have an old Stanley No. 71½ that I got 30 years ago and later picked up a No. 71 in beautiful condition at a flea market. Despite the usefulness of routers and the obvious advantages they provide, I still have an occasional use for a handheld router plane.

For one-time cuts, clearing out inset spaces or corners, and for situations where the time it takes to measure and set up the fences and jigs would outweigh the motorized speed, the handheld router plane is still the tool of choice for the task.

Additionally, when shaving-by-shaving accuracy is required, and when the conventional router-bit size increments aren't adequate, the router plane provides the necessary control and flexibility.

—David Pavlick, Litchfield, Conn.

Dangers of grinding metal

Grinding metal tools with a disc sander as illustrated in *FWW* #168 (p. 16) has

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

—Anatole Burkin, editor

Drawing, p. 14: Vince Babak

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potential dangers. Because the typical woodshop has a lot of sawdust, the sparks created by grinding can set off a fire. In the 1990s the dust-collection system at the California College of the Arts was gutted by fire when a student tried this kind of grinding. The same warning applies when using a sanding disc on the tablesaw.

–John Grew Sheridan, San Francisco

Women in woodworking

I'm an avid reader and woodworker who also happens to be female. Back in the early 1960s, when I was in high school in Virginia, I was forbidden to take shop class by a local law that established school policy.

A few years later, my new husband and I bought a derelict house to renovate. As the on-site supervisor for the contract phase of our renovation, I learned carpentry on the job, and took on the trim and window restorations myself. I made plenty of mistakes, but little by little, and a couple of house restorations later, I developed skills which I now employ to build furniture and musical instruments.

I also teach an introductory course in woodworking for the local adult recreational education program. Public agencies may not discriminate, so it is not limited to women, but I've only had one male student. My students are almost always women like myself who had been denied the opportunity to take shop class, or who had been so intimidated by their male teachers or the men in their lives that they didn't really learn anything.

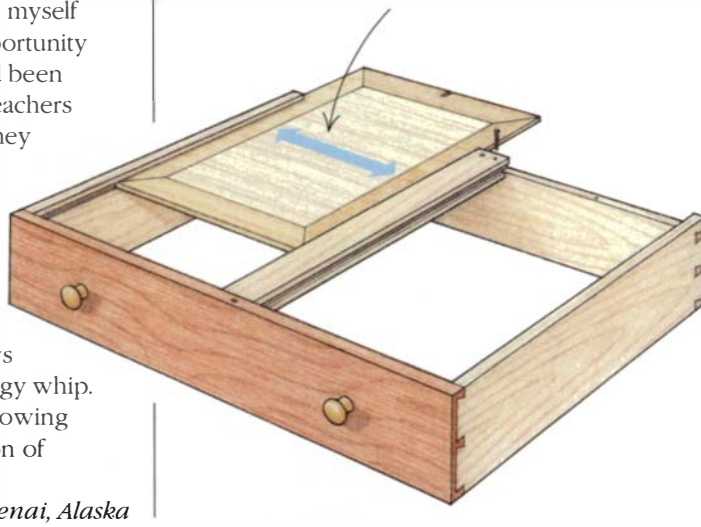
I always tell the ladies in my class that I've never met a woodworking tool that cared a whit about the gender of its operator. I'm glad that those old, stupid laws have gone the way of the buggy whip. Thanks for spotlighting the growing and long-overdue participation of women in the craft.

–Louise Heite, Kenai, Alaska

Correction

The grain direction on the drawer bottom of an item in Q&A (*FWW* #169, p. 100) was drawn incorrectly. When using a solid-wood drawer bottom, the grain direction should be parallel to the drawer front and back.

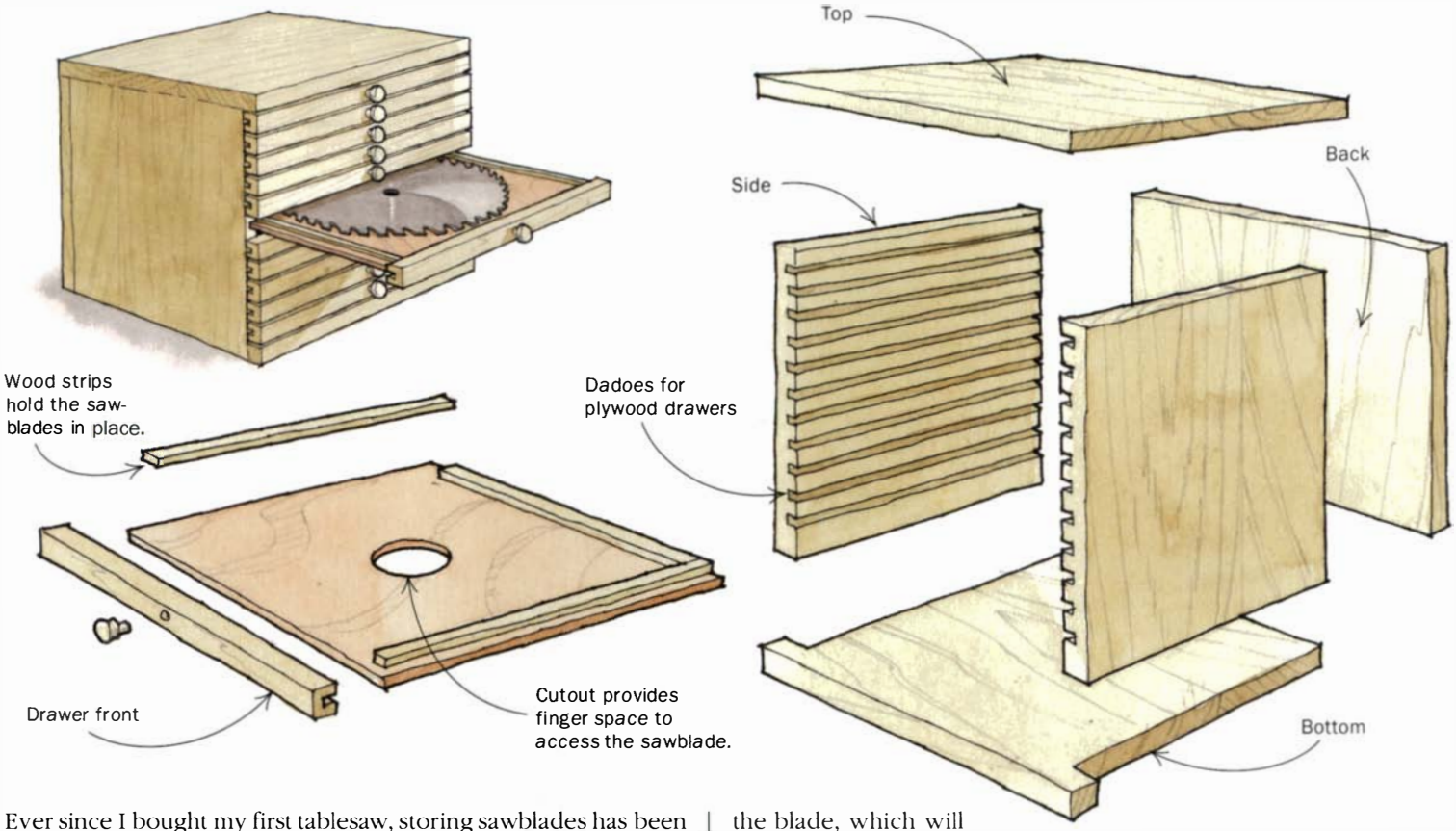
Orient the grain parallel to the drawer front and back.



Methods of Work

EDITED AND DRAWN BY JIM RICHEY

Sawblade-storage box



Ever since I bought my first tablesaw, storing sawblades has been a problem. I tried keeping blades in their original cardboard folders, which soon wore out. Then I stored the blades in slots in a piece of wood, which forced me to stick my fingers into a cluster of sharp teeth to retrieve one blade. I finally solved the storage problem by constructing this box with drawers. The box minimizes the space required to store a bunch of blades, and it makes accessing them safe and easy. Each drawer is ¾ in. high and holds one blade. To retrieve a blade, I simply open a drawer, put my finger through the arbor hole in the blade, and lift it out. An added benefit is that one blade never contacts another, thus avoiding the problem of chipped or dulled teeth.

The box I built holds eleven 10-in.-dia. blades. It stands about 13 in. wide by 12 in. deep by 12 in. high. I made the carcase and drawer fronts from scraps of ¾-in.-thick lumber and the drawer bottoms from ¼-in.-thick plywood.

Begin by making the two sides of the box first. Cut the sides a bit larger than needed, and set up your saw to cut 5⁄16-in.-wide dadoes, ⅜ in. deep. Set the fence on your tablesaw 1 1⁄16 in. from the edge of the blade, which will provide 1⁄16-in. clearance between the bottom of the bottom drawer and the carcase, and cut the dadoes at the bottom edge of each side first. Those dadoes will be the slides for the bottom drawer. Move the fence over 13⁄16 in. (the width of the drawer plus 1⁄16 in. for clearance), and then cut the next dado in each side. Repeat until you have cut all of the dadoes; then trim the sides to the desired height and width, and run sandpaper inside each dado to ensure that it is smooth and clear so that the drawers will slide freely.

Cut the top, back, and bottom of the box to size and assemble it. Biscuit joinery works well to align the carcase pieces where they belong. You also can chamfer the top, front, and side edges of the box with a router, or by hand with a block plane or sandpaper, just to soften them a bit.

To make the drawers, mill ¾-in.-square strips of wood, and then cut a ¼-in.-wide groove down the middle of one side of each piece. Cut the strips to length for the drawer fronts, each as long as the box is wide. Next, cut the drawer bottoms from ¼-in.-thick

A reward for the best tip

Donald F. Cooley is a retired engineer who took up woodworking as a hobby 40 years ago. Space is limited in his basement shop, and he was frustrated with the problem of storing his growing collection of sawblades, so he solved it with a storage box that tucks neatly into a shelf near the saw. Each blade resides in its own drawer, and the hole cut out of each drawer bottom makes it easy to lift a blade up and out. For his winning tip, he'll receive a set of hand-forged chisels (www.barrtools.com). Send your best tip, along with any photos or sketches (we'll redraw them), to Methods of Work, Fine Woodworking, *PO Box 5506, Newtown, CT 06470-5506.*

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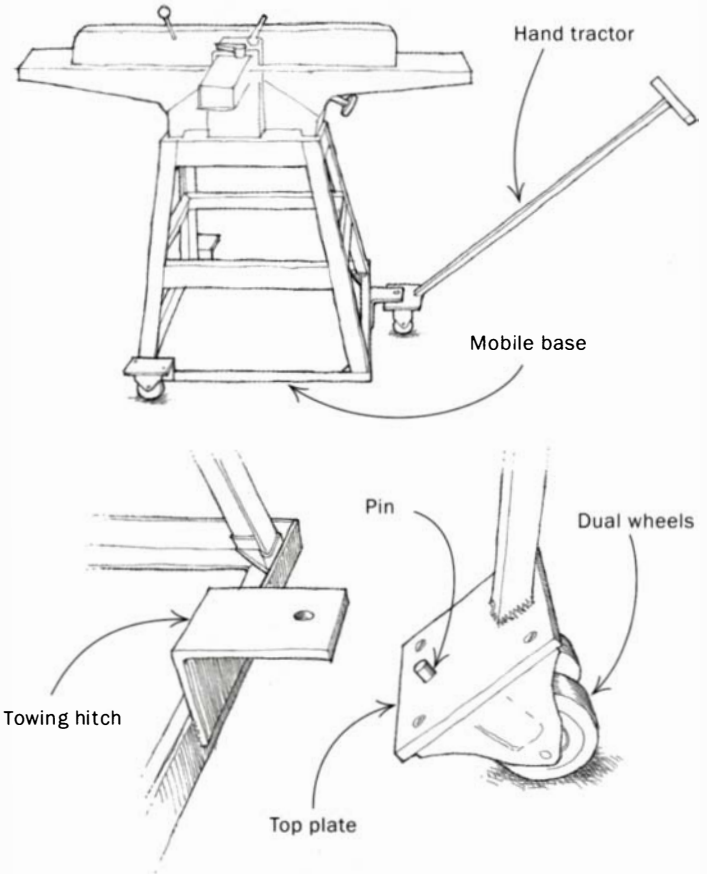
birch plywood and use a hole saw to cut a 2-in.-dia. hole in the center of each drawer. The holes will allow you to insert your finger into the arbor hole of each sawblade to lift it from its drawer. Glue the plywood bottoms into the grooves in the drawer fronts. To complete the drawers, glue 3/16-in.-thick by 3/8-in.-wide strips to the sides and back of each drawer bottom as shown in the sketch on p. 16. The small strips will hold the blades in place, and they'll also help keep the drawers from racking as they slide in and out.

Finally, install a small pull knob on the front of each drawer. Round off all of the outside corners of the carcase and the back corners of the drawer bottoms with sandpaper so that they won't catch on anything. Sand all outside surfaces and apply a couple of coats of finish if you're so inclined, and you'll be ready to store your sawblades out of the way.

—Donald F. Cooley, Kansas City, Mo.

Tractor-and-hitch system for moving machines



My shop is small, so if I am to have any space in which to work, I must keep machines that are not in use tightly packed along the wall. Because I found the commercial mobile bases to be difficult to use, I came up with a tractor-and-hitch mobile tool system.

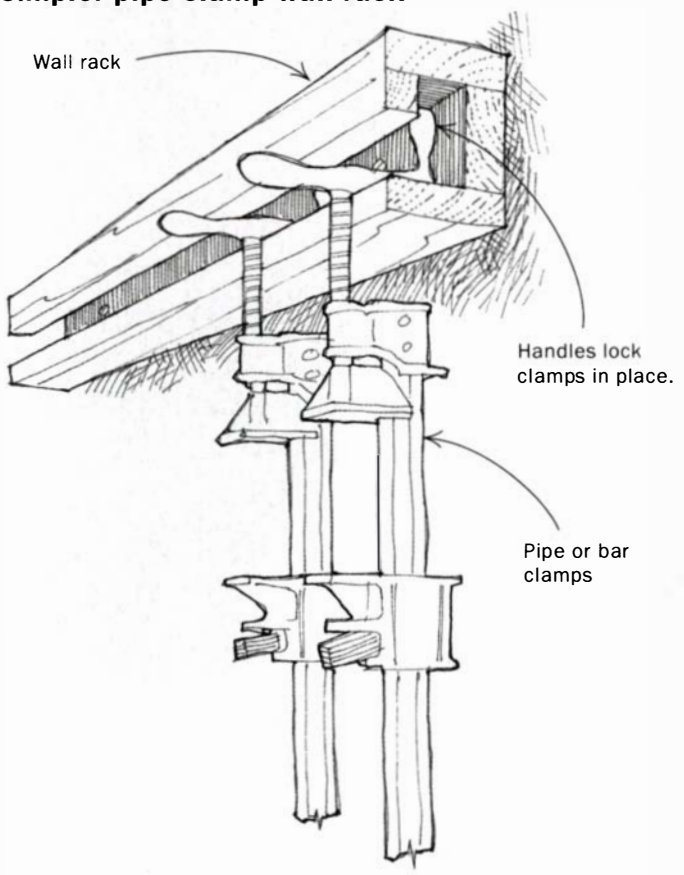
My system requires two parts: a mobile base and a hand tractor. The mobile base is welded together using scrap angle iron, and each base is made to fit each machine. Each base is fitted with a pair of wheels at the back and a towing hitch at the front. The hand tractor simply is a wheeled handle that has a ½-in.-dia. pin mounted to a top plate. I welded 1-in. steel channel for the handle to the ¼-in.-thick steel top plate. Then I bolted two rigid casters (butting them together) to the underside of the top plate. When parallel with the floor, the tractor's top plate is slightly higher than the underside of the towing hitch (4 in. high for the tractor and 3½ in. high for the towing hitch). When a machine has to be moved, I insert the tractor under the towing hitch on the machine, align the pin with the hitch hole, and push down the tractor handle, lifting the front of the machine slightly.

My tractor has a handle that is 38 in. long, and when it has engaged a machine, the handle is at about a 50° angle from the floor. Lifting up the handle sets down the machine and rocks the pin out from under the hole in the towing hitch.

Moving machines with the tractor is a joy. They maneuver just the way a child's wagon does. They can turn on a dime, and it's easy to steer them into their parking spaces along the wall.

—Lary Shaffer, Scarborough, Maine

A simpler pipe-clamp wall rack



Here's a pipe-clamp wall rack that is simple, compact, and elegant. It's just four boards glued together along their lengths and then screwed into wall studs.

What makes the system unique is how quickly clamps can be stored and removed. To store a clamp, you just slide the handle in at an angle, which allows the pipe to hang vertically. Angling the pipe away from the wall frees the head in one easy motion.

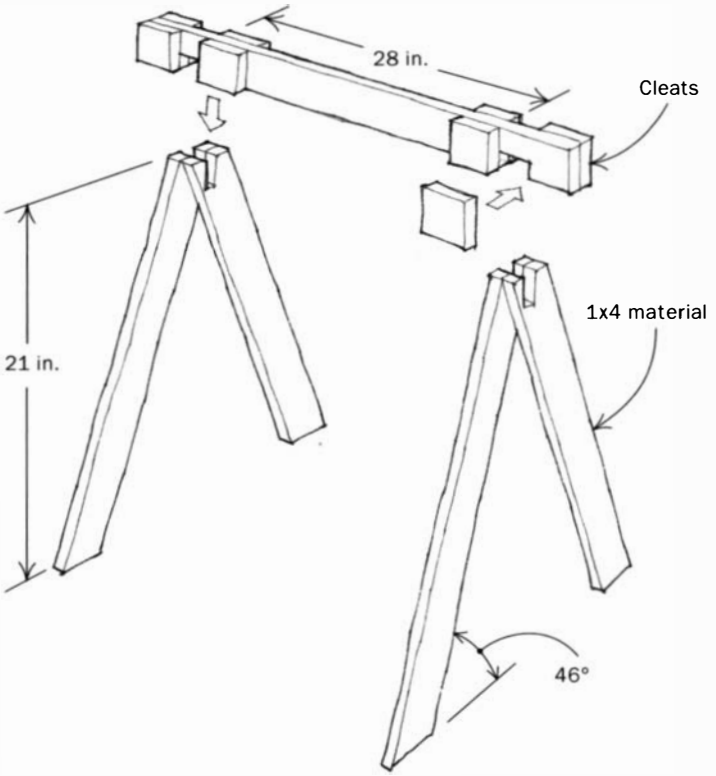
—Jeff Sales, Tucson, Ariz.

Quick tip: I dip the working ends of my clamps in Plasti Dip (www.plastidip.com), a rubber coating that generally is used for tool handles. With three coats on the pad area of my clamps, I can

clamp up lumber without worrying about marring or denting the work. I've had the coating on my clamps for about 10 months, and it's still working fine.

—Elizabeth A. Friedrich, San Diego, Calif.

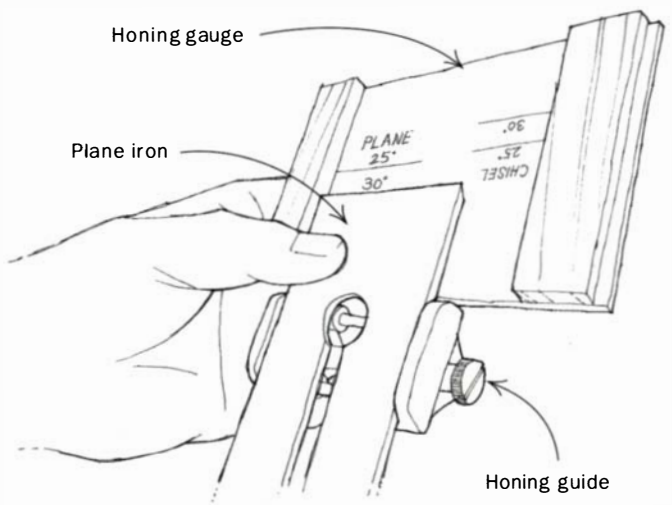
Small knockdown sawhorse



This knockdown sawhorse is light, strong, and can be assembled quickly and easily from scrap 1x4 material. The sketch shows most of the details. To ensure a tight joint at each leg, fit the notched legs to the notched crossmember before attaching the cleats.

—John Williams, Bellevue, Wash.

Gauge for setting tools in a honing guide

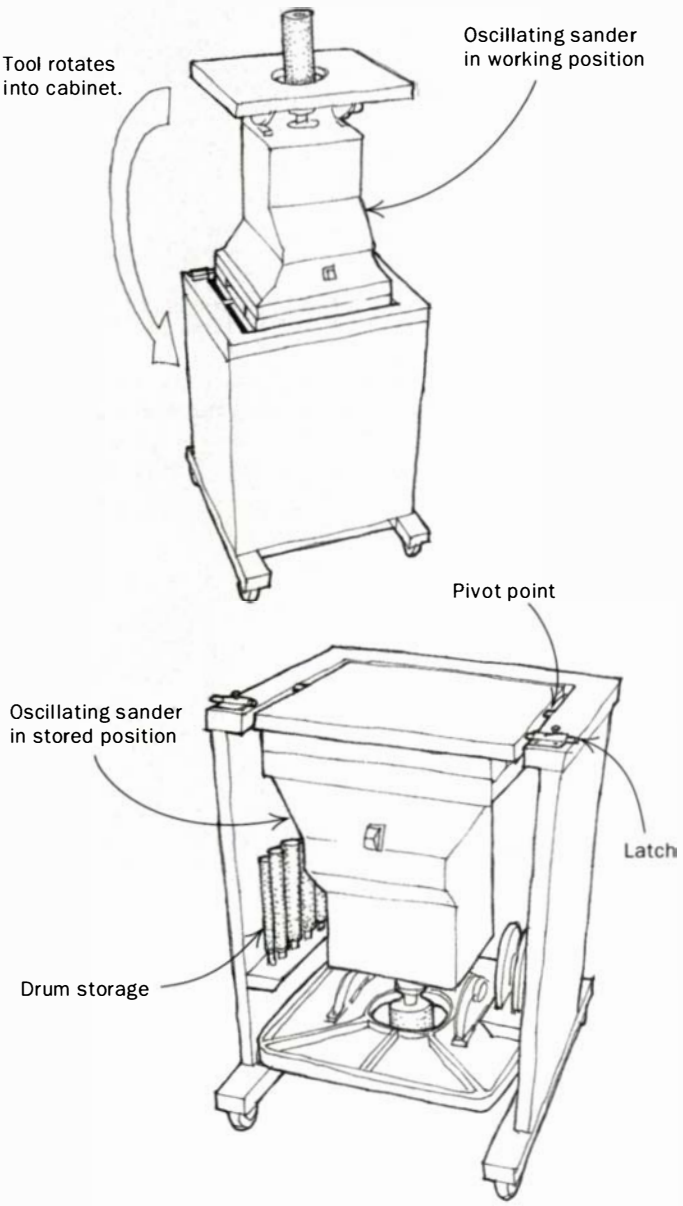


Here's a gauge that I use to consistently set my honing guide to the correct sharpening bevel for chisels and plane irons. It eliminates the tedious measuring and squaring that accompanies most honing-guide setups. The gauge is just a piece of plywood with a wood fence attached to each edge. Make sure the fences are perpendicular to the top and bottom edges of the plywood. I use one side of the gauge for plane irons and the other for chisels. Marks on the gauge show the correct projection for 25° and 30°. Intermediate marks would allow setting precise microbevels.

To use this gauge, butt the honing guide against the bottom edge of the plywood and extend the cutting iron to match the line you've marked for the sharpening angle needed. The side fences automatically square the blade to the honing guide.

—Thom Trail, Powder Springs, Ga.

Space-saving machine-storage stand



I recently purchased an oscillating spindle sander. Although I'm happy with the sander's performance, I discovered that the machine is too tall to use on my workbench and too low to set on

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the floor. I needed a stand on which to place the machine at the optimum working height, but I couldn't commit any of my valuable floor space to it. So I designed a pivoting stand that becomes a storage compartment when the sander is not in use (see the drawings on p. 20).

Here's how it works: A platform screwed to the sander's base pivots in the stand, allowing the sander to rotate easily from working to stored position and back. Two barrel latches secure the sander in the working position. With the sander stored, the stand fits underneath my lathe, and I also can store assorted spindles and table inserts inside the stand.

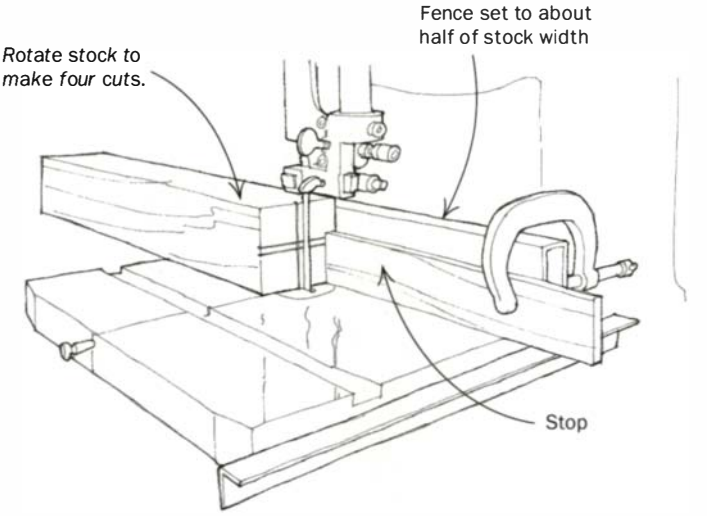
Building the stand was pretty straightforward. One key to this design working smoothly is to install the pivots for the platform dead center, up and down and front to back, so that when the platform flips, it remains flush with the base and square in the opening.

—Dwayne Intveld, Hazel Green, Wis.

Quick tip: Those translucent plastic sheets sold as disposable cutting boards work as well in the shop as they do in the kitchen. You can use them to protect your workbench when paring dovetails or chopping mortises. The sheets are perfect for mixing a batch of epoxy because the dried residue peels right off. You can cut a sheet into strips for spreading glue or applying filler to nail holes. And they are a ready source of stock for shimming everything from tablesaw-blade inserts to mortised cabinet hinges.

—Ross D. Sackett, Memphis, Tenn.

Finding the center of a spindle



To find the center of square spindle stock, set the bandsaw to about half the width of the stock—there is no need to be exact. Clamp a stop to the fence to limit the cut to about 1/16 in. deep. Make four cuts on the end of the workpiece, rotating it 90° after each cut. Four cuts will compensate for any stock that is slightly out of square, and you will be able to eyeball the exact center of the spindle easily.

—Frank S. Bowman, Boonsboro, Md.

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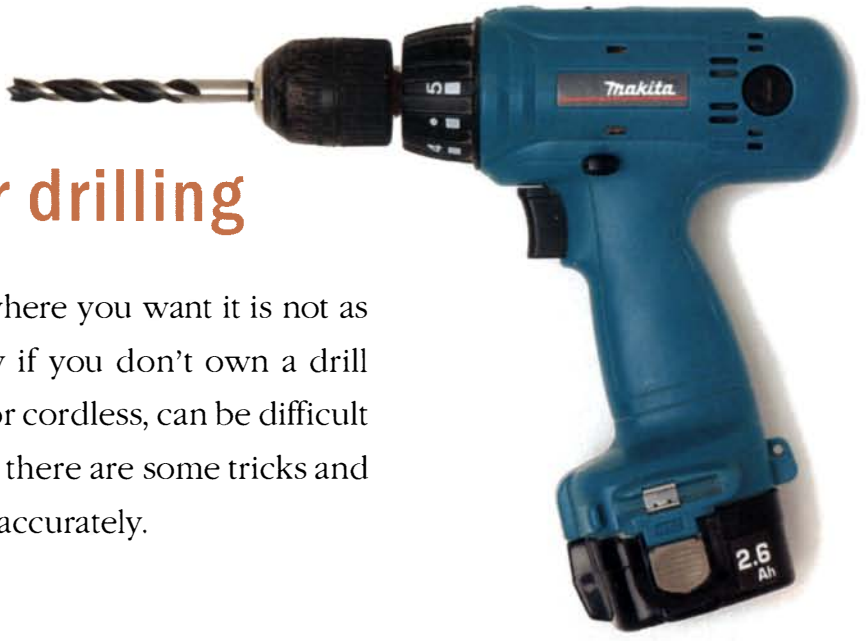
BY ERNIE CONOVER



Best practices for drilling

Sinking a hole straight and exactly where you want it is not as easy as you would think, especially if you don't own a drill press. A handheld drill, be it corded or cordless, can be difficult to control. As with all shop practices, there are some tricks and tools that can help you to drill holes accurately.

FIND THE CENTER TO DRILL ON TARGET

Layout is the first step in drilling a hole. To determine the precise location of a hole, draw or scribe cross lines. Then use a center punch to make a 90° dimple in the wood at the intersection of the lines. The dimple will prevent the bit from wandering when you start drilling.

Another way to drill in an exact location is to use a self-centering bit. These bits most commonly are used to drill holes when installing hardware that needs flat-head screws, such as hinges. The bit is housed inside a metal casing, which has a tapered end. To use it, fit the tapered end of the housing into the hole on a piece of hardware. The tapered end automatically centers itself in the hole. As you apply pressure to the bit and begin drilling, the housing retracts and exposes the bit, allowing it to drill centered into the workpiece.

Before drilling, mark and center-punch. *The dimple punched into the workpiece will guide the bit.*

Self-centering bits help when installing hardware. *Drilling for hinge screws requires precision. Self-centering bits have a tapered end on the metal housing, which centers the bit in the hinge's machined hole.*

BACK UP THE WORKPIECE TO PREVENT TEAROUT

The best way to prevent tearout when drilling through-holes is to place a sacrificial backer board underneath the workpiece to support the wood fibers where the bit exits (photo below).

When using a bit with a brad-point tip, you can prevent tearout by drilling until the point just peeks through the back side of the workpiece. Then turn over the work and use the resulting pinhole as the center point to finish drilling.

A power drill with a variable-speed motor can be especially useful when it comes to drilling without tearout. Drill slowly at first, and increase the speed as the bit finds center and starts to bite in.

Position a sacrificial board underneath the workpiece. *When wood fibers are supported, they don't tear as the bit exits the workpiece.*

CLEAR THE CHIPS OFTEN

If the flutes of a bit get clogged with wood chips, they can cause the bit to burn or wander, to create oversize holes, or even to get jammed completely in the workpiece. It is important to withdraw the bit from the work periodically to clear the chips. This also is a matter of safety, as impacted bits are more prone to spin the work or the drill motor in the hands of the operator.

Photos: Matt Berger

SQUARE THE BIT FOR PERPENDICULAR HOLES

If your shop lacks a drill press, it can be a challenge to drill a perpendicular hole in a workpiece. Some power drills have embedded bubble levels on them that can be used to help align a bit. If your drill doesn't, one simple trick is to place two squares on the workpiece next to the area where a hole is to be sunk. Use the squares to sight your bit (photo, near right). If it is parallel with the squares when looking from all sides, the bit should drill perpendicularly into the workpiece. Continue sighting the bit until the hole is complete.

When you want to be more precise than is possible by sighting a bit, there are several commercial jigs that can be used to keep a bit square to a workpiece. Many of these jigs convert a handheld drill into a miniature drill press (photo, far right).

You don't need a drill press to make straight holes. *Sight the bit against two squares to ensure that the hole is drilled perpendicular to the workpiece (left). Or you can use an accessory, like this drill guide from General (above), which turns the handheld drill into a mini drill press.*

USE A SHOPMADE JIG FOR ANGLED HOLES

For drilling angled holes, I like to use a shopmade jig that consists of a block of wood with a hole drilled through its center. The end of the wood block that makes contact with the workpiece is crosscut at an angle so that it can rest on the workpiece in the correct position. Glue two support blocks to the sides of the jig to create a larger base. Finally, mark the bottom of the jig with lines that intersect at the center of the hole. Continue the lines around the sides of the jig so that they will be visible when drilling.

To use the jig, line up the cross lines on the jig with the cross lines that mark the location of the hole on the workpiece. If your lines are accurate, the hole in the jig should line up dead center with the desired location of the hole on your workpiece. Hold the jig steady with your hand or with clamps, and drill through the jig and into the workpiece.

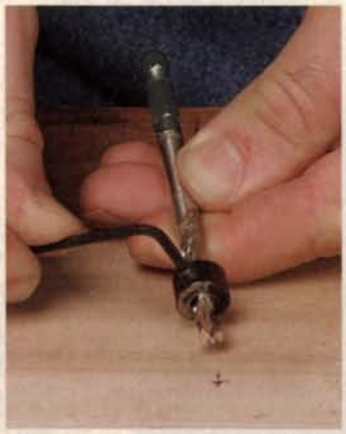
Make a jig for drilling at an angle. *A block of wood cut at an angle helps guide the bit into the workpiece at a consistent angle.*

DRILL IN THE RIGHT ORDER

When countersinking for bolts or screws, you often need to drill stepped holes. In most cases, you must drill the biggest-diameter hole first and then follow that up with the smaller-diameter hole. The smaller bit can be centered in the larger hole using the dimple created by the tip of the larger bit as a center point. Common twist bits are the exception. They can be used in the opposite sequence; large twist bits will self-center in a hole drilled with a smaller bit.

Lag bolts require stepped holes. *When using brad-point bits, drill the larger hole before the smaller one.*

USE A STOP TO CONTROL DEPTH



Sometimes it is necessary to control the depth of a drilled hole. A variety of drill stops can help you do this. For example, you can buy a locking collar that fits over the drill bit. Once the bit cuts into the wood to the desired depth, the collar prevents it from going any deeper.

A wood block also can be used as a drill stop. Drill a hole in a small block of wood so that the bit is completely buried in the block. Then cut the scrap to length so that the bit protrudes from the block equal to the desired depth of the hole. When you drill into a workpiece, the block will stop the bit from going in any deeper than you intend.

In many situations I have found that wrapping a piece of masking or duct tape around the bit at the desired depth works fine. However, the tape will become unreliable after drilling five to 10 holes.

Three ways to control hole depth. *A commercially available collar (above left) is one type of depth stop. A block of wood cut to a precise length and fitted over a drill bit (above) will prevent overdrilling. A piece of duct tape (right) also can be used; stop drilling when the tape brushes away the chips.*

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Tools & Materials

Senco pin nailer leaves barely visible holes

Micro is the right word to describe the size of the pin you can shoot with the new FinishPro 10 nailer from Senco. The tiny, headless (23-ga.) pin, available in ½-in., ⅝-in., ¾-in., and 1-in. lengths, leaves a nearly imperceptible hole that pretty much eliminates the need for putty.

Because they are headless, the pins don't have a lot of holding power, but they are perfect for tasks such as securing delicate trim while glue dries or holding a glazing bead in place. The headless pins also are ideal for attaching small moldings with little worry of splitting.

The FinishPro 10 is both compact and lightweight (2.25 lb.). The handle has a comfortable, soft grip. A rear exhaust directs dust and possible contaminants away from the worksurface.

I found the carriage easy to operate and load. However, when changing nail lengths, an adjustment slide must be moved, something that took a bit of getting used to.

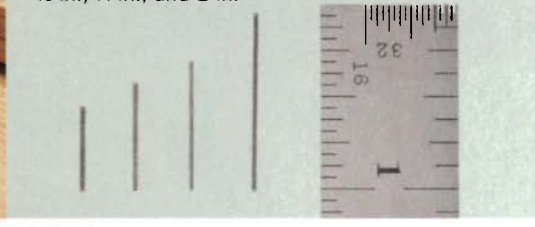
The FinishPro 10 sells for around $130. For more information, contact Senco (800-543-4596; www.senco.com).

—Roland Johnson is a contributing editor.

Headless nails are easy to hide. *Senco's new pin nailer drives small headless pins, leaving holes that hardly can be seen.*

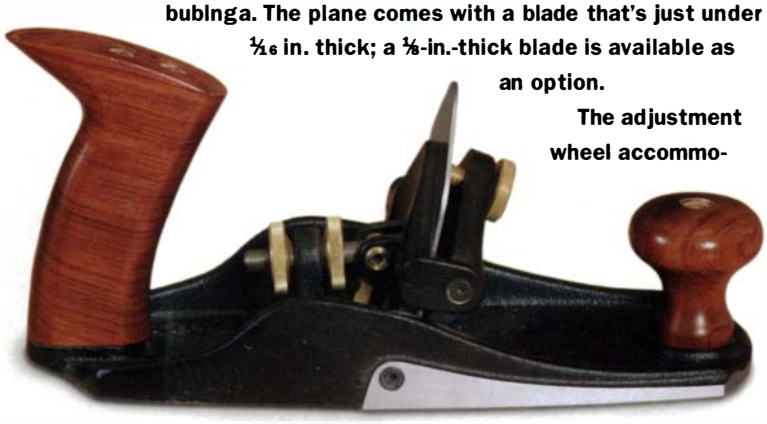
TINY NAILS, TINY HOLES

The 23-ga. headless pins used in the Senco FinishPro 10 nailer are available in lengths of ½ in., ⅝ in., ¾ in., and 1 in.



Veritas scraping plane picks up where bench planes leave off

An effective tool for smoothing difficult or highly figured grain, the new scraping plane from Veritas features a 10-in.-long body made from ductile cast iron and a handle and knob made of bubinga. The plane comes with a blade that's just under 1/16 in. thick; a ⅛-in.-thick blade is available as an option.



The adjustment wheel accommodates a variety of cutting angles and allows the depth of cut to be micro-adjusted. There's also a thumbscrew at the back that bows the thin blade slightly, much like the curve that results in a flexed card scraper. The blade produces a shaving that feathers to nothing at its edges, eliminating blade tracks. The flexed curve also keeps the blade in tension, reducing chatter and vibration.

I used the plane on a benchtop laminated from figured honey locust. After flattening the top with bench planes, I turned to the Veritas, which quickly eliminated any torn grain, aggressively cutting shavings when I worked the grain in either direction. And, thanks to the large sole of the plane, the workpiece surface stayed flat and true. In short, this scraping plane outperformed any other that I've ever used. The Veritas scraping plane sells for about $130 and is available from Lee Valley Tools (800-871-8158; www.leevalley.com).

—Chris Gochnour builds furniture in Murray, Utah.

Photos, except where noted: Tom Begnal; this page (top three): Rodney Diaz

Scraping plane tames figured wood. *When it comes to smoothing highly figured grain, the nearly square cutting angle on the Veritas takes light shavings with no tearout.*

Roughing-out gouge vacuums chips as it makes them

Roughing out is a messy operation that quickly can produce a mountain of chips. Over the years, I've tried to fight the problem using a variety of vacuum-hose setups that would make even Rube Goldberg envious. However, all those efforts proved largely unsatisfactory. So I was instantly intrigued when I heard about the CleanTurn Tools roughing-out gouge, a product that promises to get those chips under control.

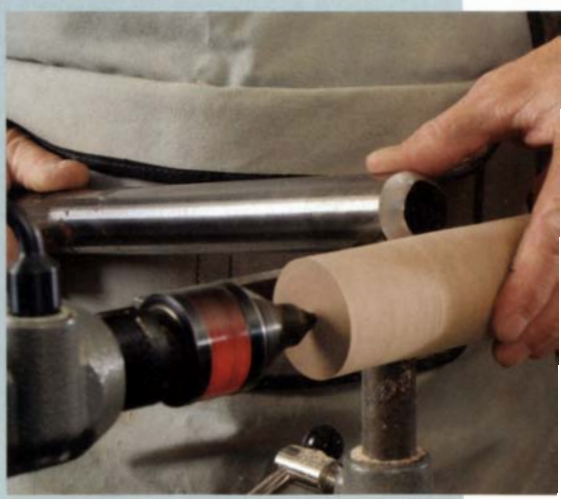
Unlike the traditional U-shaped gouge, CleanTurn's tool is made from a 24-in.-long, rubber-coated steel tube with an outside diameter of 1⅜ in. Affixed to the business end is a 2½-in. length of 1-in. inside-diameter M2 high-speed steel (HSS) tubing. One end of the tubing is the cutting edge, while the other end connects to a vacuum hose. Lacking a suitable adapter to connect the gouge to the vacuum hose, I ended up joining the two with duct tape.

When I made light cuts on a 2-in. square of dry wood, the device worked splendidly. But when I began cutting more aggressively, the vacuum couldn't remove the chips fast enough, and the gouge clogged up. I also found that green wood, which produces long, stringy strands when turned, tended to plug up the gouge quickly.

If you make mostly light to moderately heavy roughing-out cuts and don't mind the added noise of a nearby vacuum cleaner, you might find this a must-have tool. But if you do a lot of aggressive cutting or turn a lot green wood, I suspect the time you spend unclogging the tool is going to outweigh its chip-collecting advantage.

The CleanTurn roughing-out gouge sells for about $78. For more information, contact the company at 800-883-4077 (www.cleanturn.net).

—Ernie Conover teaches wood turning in Parkman, Ohio.



Vacuum while you turn. *The Vacuum Gouge from CleanTurn Tools is both a turning gouge and vacuum port, so chips are sucked up right at the source.*

Photos this page (top right, bottom right): Matt Berger

A quick-change aftermarket tablesaw splitter

A splitter helps prevent kickback. Yet when Excalibur introduced the Merlin last year, its entry into the market brought to only four the number of aftermarket tablesaw splitters.

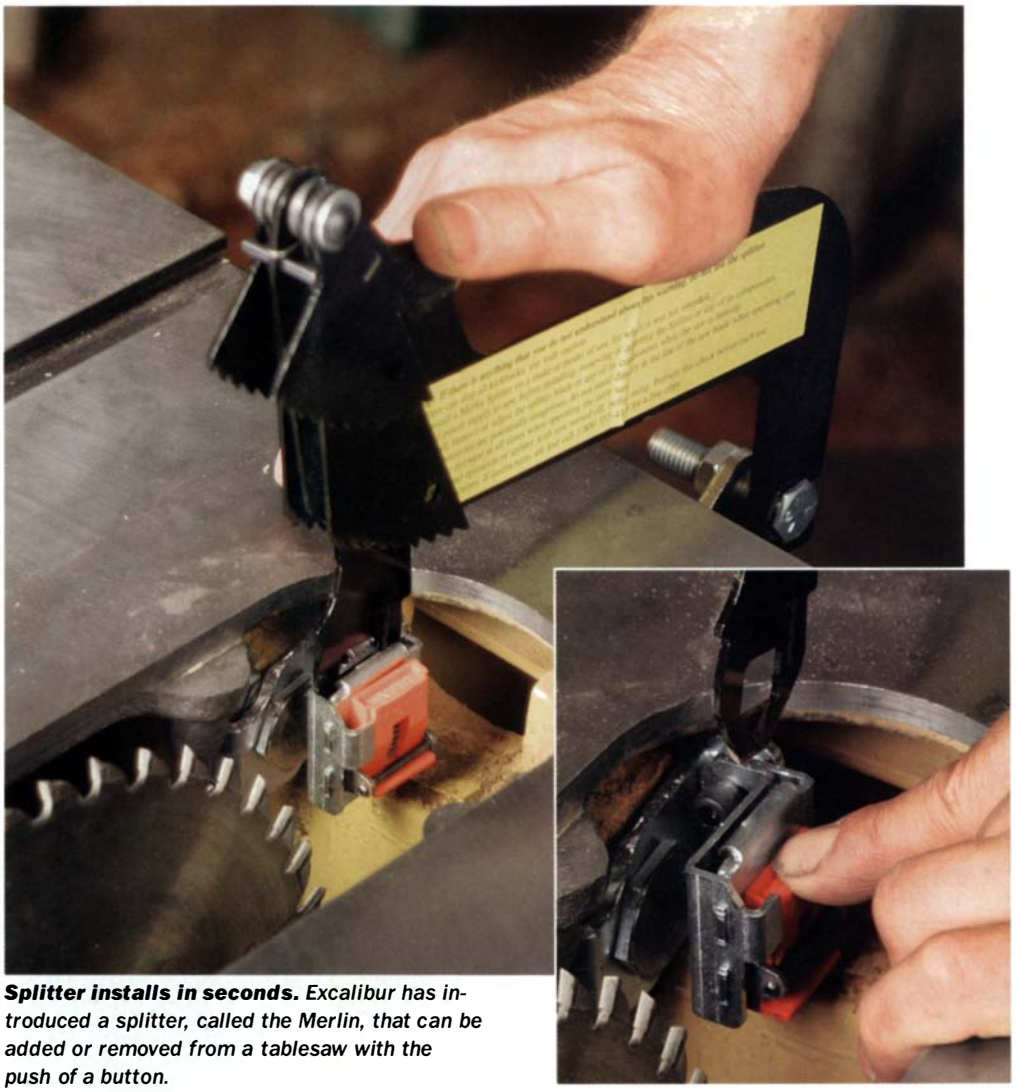
The Merlin, which includes antikickback pawls, attaches to the tablesaw trunnion assembly. One of its biggest advantages is that it can be removed in seconds to accommodate a cut that doesn't go all the way through the thickness of the workpiece, such as a rabbet or a dado. Just push a button on a receiver below the insert plate to remove the splitter. To reinstall the splitter, push it back into the receiver, where it will lock in place, aligned with the blade. No tools or realigning are required.

The Merlin is available in a number of models to fit the most popular tablesaws. I tried four Merlin splitters on four different cabinet saws and had installation problems on three of them. But Excalibur was quick to send replacement receivers that fit.

When using the Merlin splitter, you still need a blade cover. However, with minor modifications, the Merlin can work with the aftermarket blade covers reviewed in *Fine Woodworking* (#152, pp. 76-81). It also works with the stand-alone cover sold by Excalibur.

The Merlin splitter sells for about $110. For more information, contact Excalibur at 800-357-4118 (www.excalibur-tools.com).

—Kelly Mehler runs the Kelly Mehler School of Woodworking (www.kellymehler.com).



Splitter installs in seconds. *Excalibur has introduced a splitter, called the Merlin, that can be added or removed from a tablesaw with the push of a button.*

Peg board clips that grip. *A simple and inexpensive system keeps hooks from slipping out of peg board and falling into the black hole that's behind most workbenches.*

Pegmate keeps peg board hooks in place

I suspect that hooks made for mounting tools to peg board have been annoying woodworkers since they first showed up in hardware stores many years ago. Based on my experience, the hooks are designed to pop out of the peg board when you remove the tool they are holding. At that point, of course, the hook falls to the floor, usually in a hard-to-reach place.

There's a new product that solves the problem. Pegmate metal clips take only a few seconds to mount, and unlike some other hook-mounting systems, they can be repositioned easily. Although the hooks still wiggle in the holes, I can live with that, knowing they won't fall out.

Pegmate is sold in packages of 25 and 50 clips, priced at about $5 and $9, respectively. For more information, contact Hartville Tools (800-345-2396; www.hartvilletool.com).

—Tom Begnal is associate editor.

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Fine WoodWorking

Choosing and Using Belt Sanders

These aggressive tools are unmatched at rapidly flattening panels and shaping curves

BY SCOTT GIBSON

Different sizes for different tasks

4 IN. BY 24 IN.

If much of your work involves sanding flat panels, consider this size, the biggest available. Because of their weight, these machines require a bit more muscle to control them.

3 IN. BY 24 IN.

The narrower platen on these machines may provide more control than larger sanders (left) for even stock removal on flat panels.

Portable belt sanders have been a woodworking mainstay for more than 75 years, ever since Art Emmons invented the Take-About Sander for Porter-Cable in 1926. Cabinetmakers of the day forked over $130 to own one, the equivalent of nearly $1,300 today. The belt sander truly was a breakthrough. These machines rapidly flatten glued-up panels, remove mill and burn marks, and even out rail-stile connections on doors and cabinets.

The surge of random-orbit sanders in the mid-1980s took a bite out of the belt-sander market. Ever more powerful random-orbit sanders can remove stock almost as quickly, and they are less likely to gouge the worksurface. As a result, some furniture makers have all but abandoned their belt sanders. I won't argue with them. But when my belt sander succumbed to old age and frozen bearings not long ago, I started thinking about a replacement.

Belt sanders still have some advantages. Their ability to remove stock rapidly makes them the tool of choice for flattening glued-up panels or for knocking down the lip on a breadboard end. They strip layers of old paint, smooth curves, and scribe cabinets and countertops to uneven walls. Clamped upside down or on its side to the bench, a belt sander can be used to shape small pieces of wood or to grind a bevel on a plane blade. Try doing that with a random-orbit machine.

Wondering what the market had to offer these days, I borrowed a variety of belt sanders from four manufacturers. After looking closely at each tool, I found a lot has changed since I last bought one. There are more models to choose from, ranging from light machines with narrow (just over 1 in. wide) belts to behemoths with 4-in. by 24-in. belts, and they may be had with variable speed and optional accessories that increase their versatility.

With assistance from the staff of *Fine Woodworking*, I also evaluated seven 3-in. by 21-in. machines (see "Tool Test" on pp. 38-39) to compare their performance.

Choosing a size: Bigger is not always better

Portable belt sanders are grouped by the size of their belts. There are four common sizes—4 in. by 24 in., 3 in. by 24 in., 3 in. by 21 in., and 3 in. by 18 in.—as well as a narrow size that is more popular with those who work metal or glass.

The smaller the belt size, the lighter and more nimble the sander. But the smallest machines have less mass and small motors; consequently, they run at slower speeds and won't remove material as quickly as the larger machines.

The biggest seller these days, according to industry sources, is

3 IN. BY 18 IN.

Light and easy to maneuver, these entry-level machines are suitable for smaller projects, where big power and aggressive stock removal are not necessary.

3 IN. BY 21 IN.

This is the best-selling type of belt sander, so we tested seven popular models head to head (see pp. 38-39)

Narrow belts for tight places

Bosch and Makita both make special-purpose sanders with very narrow belts that can reach into places inaccessible to conventional belt sanders.

Bosch's model 1278 VS (below) has a 1½-in.-wide belt and a roller tip that's only 5/16-in. in diameter. Belt speed can be adjusted from 590 to 950 ft. per minute, and the sander's triangular head has two steel platens.

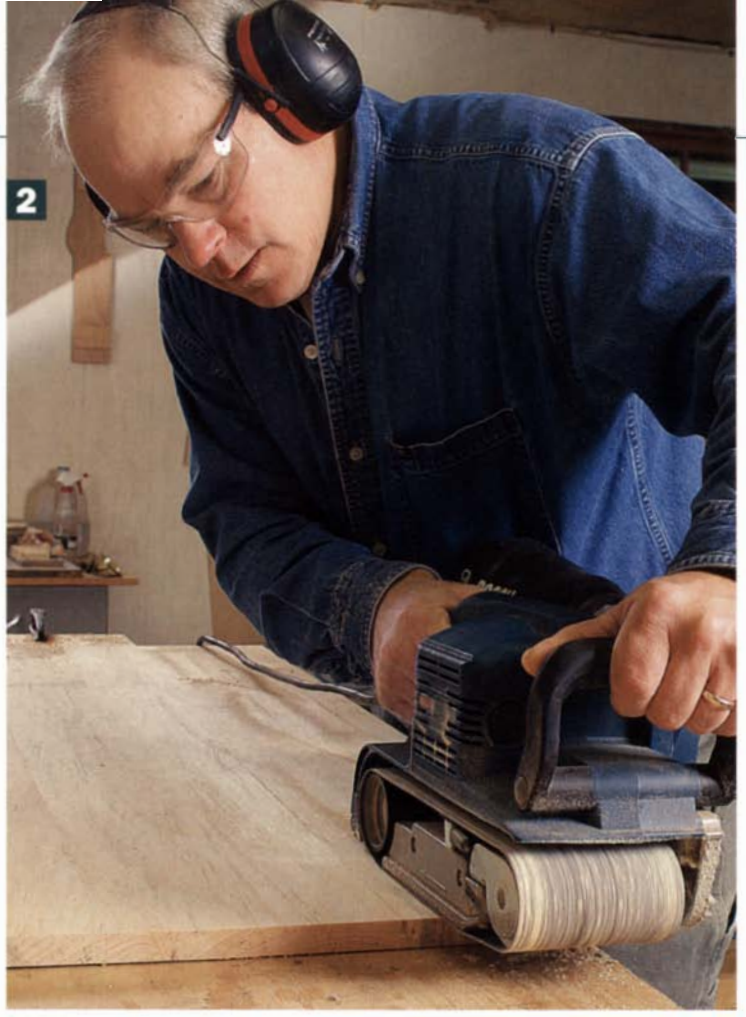
Makita's model 9031 (above) has a 1⅛-in.-wide belt and a wider roller at the top that extends 6 in. (model 9032 has a ⅜-in.-wide belt). Belt speed can be adjusted from 656 to 3,280 ft. per minute. A handle on the end of the sanding arm makes it easy to steer or to apply pressure at the tip. The sander is popular in metal and glass shops, and because the belt can flex, it also can be used on irregular surfaces. These sanders are light and easy to maneuver, useful for spot sanding and deburring metal.

NARROW BELT SANDERS

A small-diameter tip makes these machines good at shaping tight-radius curves in workpieces or templates.

Photos, except where noted: Anatole Burkin; photos, this page and facing page (bottom row): Rodney Diaz

FLATTENING STOCK



Three steps to a flat panel. *Begin by sanding diagonally, using a 50-grit or 60-grit belt (1). Then sand with the grain (2), changing belts to successively finer grits. Keep a portion of the platen in contact with the panel as the machine nears the edge to avoid diving off the workpiece. Check your progress with raking light (3), which will help you see dips and scratches.*

the 3-in. by 21-in. sander, a tool designed to appeal to both professionals and occasional users. These sanders weigh as little as 7½ lb., making them much easier to use on vertical surfaces than 4-in. by 24-in. sanders, which may weigh twice as much. The 3-in. by 21-in. models also cost less.

Abrasive belts are cheaper, too, and over the life of a tool the savings will add up. Woodworker's Hardware sells a 120-grit 3-in. by 21-in. aluminum-oxide belt for $1.28, a nickel cheaper than a 3-in. by 24-in. belt, but 87¢ less than a 4-in. by 24-in. belt of the same grit.

The 3-in. by 18-in. models weigh only a third as much as many 4-in. by 24-in. models, making them extremely maneuverable and easy to handle. However, the motors on 3-in. by 18-in. belt sanders are proportionally smaller, and lower belt speeds mean these models won't remove material very quickly. Their very small bases, or platens, make them unsuitable for trying to flatten a large surface.

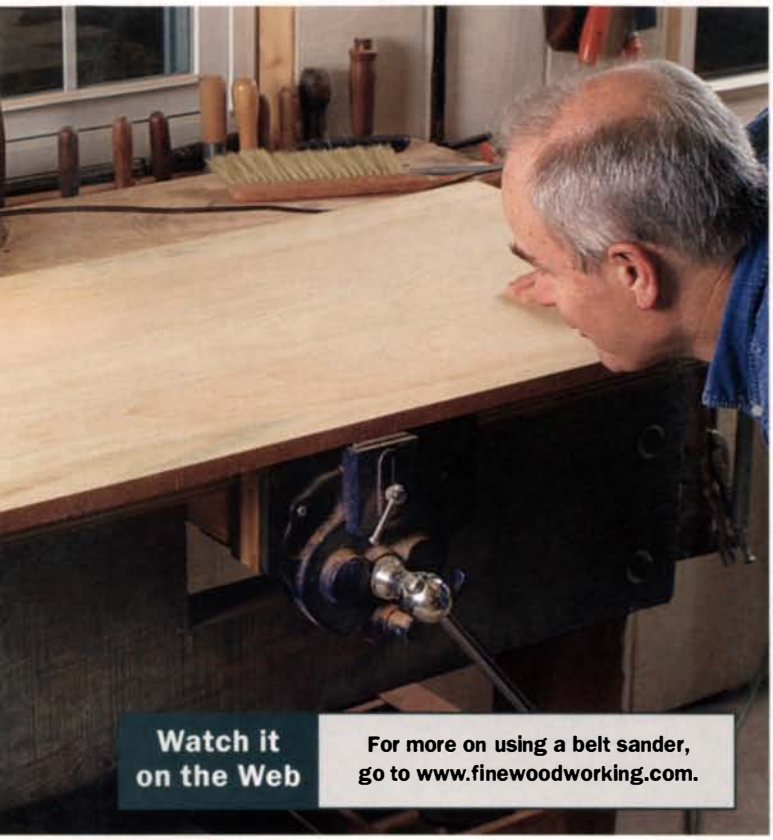
When the principal use for a belt sander is to flatten horizontal surfaces, it's hard to beat a 4-in. by 24-in. sander. At 13 lb. to 15 lb., these sanders are the heaviest of the lot, although Makita does make a lighter 4-in. by 24-in. variable-speed model that weighs

SHAPING CURVES

Stands, available as an accessory with some sanders, add versatility. *Inverted and with a fence in place, a belt sander becomes a stationary tool, ideal for shaping curved work.*

Concave curves are possible, too. *The nose of the tool allows for shaping inside curves.*

Shape cabinets scribed to fit uneven walls. *A belt sander makes quick work of shaping a cabinet to fit an irregular surface.*



Watch it on the Web

For more on using a belt sander, go to www.finewoodworking.com.

just over 10 lb. With their wide platens and robust motors, the larger sanders remove material in a hurry—sometimes too fast if you are not vigilant. Although expensive, Porter-Cable's model 503, a heavy-duty 3-in. by 24-in. machine, is an excellent alternative to the larger 4-in. by 24-in. models.

Variable speed is an option worth considering

A number of manufacturers now offer belt sanders with variable-speed controls, allowing belt speed to be slowed to a virtual crawl. Not all belt sanders have this feature—some of the larger ones still use simple on/off switches—and the control adds marginally to the cost of a new tool. But a variable-speed control makes a sander more versatile and less likely to damage delicate or heat-sensitive surfaces.

Belts traveling at lower speeds remove less material. Dialing a speed control back to its lowest setting makes the tool a good deal less terrifying when working on thin veneers, such as those found on plywood, the edges of a laminate countertop, or in any area where rapid stock removal is exactly what you don't need.

Slower speeds also produce less heat, so finishes such as paint and varnish are less likely to melt and fuse with the belt as they're being removed. The range of the variable-speed control is proportional to the capacity of the motor: The smaller the motor, the lower the potential speed.

Making sense of belt speed and amp ratings

Belt speeds top out at about 1,600 ft. per minute on large sanders with the most powerful motors. As motor capacity decreases, so

Sanding frames help with flat work

A sanding frame improves stability. *Several companies offer sanding frames as an accessory. The frame attaches to the base of the machine, providing a wider footprint to help avoid tipping the sander and gouging the workpiece.*

If you're not careful, a belt sander can produce dips, gouges, and deep scratches on a workpiece. Several manufacturers—including Bosch, Makita, Hitachi, and DeWalt—make sanding frames that fit on the bottom of the machine. These accessories are designed to make the sanders more stable and to prevent one side of the belt from digging into the surface of the wood.

Sanders are attached to the frames by means of a bracket and alignment pins that fit into slots cast into the sander's base. A height-adjustment knob controls how much material the sander can remove. Once the frame has been set up, inserting or removing the sander takes only a few seconds.

Although different in a few respects, the frames seem similar. Those from Makita and Hitachi have slippery plastic bases on the bottom. Bosch uses a series of short, stiff bristles to keep the frame off the work. Bosch also offers the most sophisticated system of aligning the sander level with the frame, a process that requires a little fiddling.

Sanding frames make big sanders even bigger and more unwieldy, and because the frames project beyond the edge of the tool, they limit how close the sander can get to an edge. If you are sanding flat panels on a bench, that's not a problem. I found that the frames did provide better control, helping me avoid tipping the sander and gouging the wood.

Designs of sanding frames vary. *Makita (left) uses a low-friction solid material that slides easily. Bosch (right) uses bristles to keep the frame from scratching the workpiece.*

TOOL TEST:
3-in. by 21-in. belt sanders

According to belt-sander manufacturers, the biggest sellers are the 3-in. by 21-in. models, so we decided to take a close look at what's available and give you an idea of which one is Best Overall and Best Value among that size. The good news is that we did not find any glaring performance problems, which made it difficult to pick clear winners.

The DeWalt had a lot going for it—an innovative design, aggressive stock removal, good ergonomics, and accessories—but we were disappointed with its dust-collection system. The Makita impressed us with its overall performance, coming in a close second for stock removal, and had excellent dust collection (though the bag occasionally got in our way). It's a toss-up, so we rated them both Best Overall.

If price is a factor, consider the Ryobi, which is a light machine but did a decent job at stock removal and performed very well at collecting sawdust. We rated it Best Value.

—Scott Gibson and Matthew Berger

BOSCH 1274 DVS

Compact, well-balanced machine with a convenient variable-speed control and comfortable front handle; fairly slow stock-removal rate; can sand flush to an adjacent surface on right side of machine.

CRAFTSMAN 315.117270

Large, easy-to-grasp lever made for smooth belt tensioning; variable-speed control was easy to adjust without releasing the trigger; dust bag is small and effective, but its rigid support arm sometimes got in the way.

MODEL	SOURCE	STREET PRICE
Bosch 1274 DVS	www.boschtools.com 877-267-2499	$170
Craftsman 315.117270	www.craftsman.com 800-697-3277	$99
AUTHOR'S CHOICE BEST OVERALL DeWalt DW433K	www.dewalt.com 800-433-9258	$190
Hitachi SB-75B	www.hitachi.com/hpt 800-829-4752	$160
AUTHOR'S CHOICE BEST OVERALL Makita 9903	www.makita.com 800-462-5482	$200
Porter-Cable 352VS	www.porter-cable.com 800-368-1487	$155
AUTHOR'S CHOICE BEST VALUE Ryobi BE-321 Type II	www.ryobitools.com 800-525-2579	$99

THE SCALE TELLS THE TALE

To rate stock-removal and dust-collection effectiveness (see the chart at right), each sander and sample board were weighed before and after a timed run. At the end, the difference between the weight of the board and machine (plus dust bag) indicated how much sawdust was collected, expressed as a percentage.

does the top belt speed. A difference in motor capacity of an amp or two won't affect performance very much. But you will notice a jump from a 6-amp motor to a 10-amp motor.

On flat work, such as when sanding a tabletop or smoothing floorboards, quick stock removal is an advantage, so consider a sander with a high belt speed. For scribing a countertop or cabinet to an irregular wall, ultrafast stock removal isn't the objective; instead, you want good control and the ability to work carefully toward the scribe mark.

For all of their advantages, big belt sanders sometimes can remove too much material. Some woodworkers avoid them because

Photos, this page (top): Rodney Diaz

DEWALT DW433K

Most innovative design of the machines tested; tool has three belt rollers, including a 1-in.-dia. wheel at the nose of the tool for scribing tight curves; fastest stock-removal rate, but dust collection was the least effective.

HITACHI SB-75B

Narrow steel belt-tensioning lever was stiff and uncomfortable to use; aggressive stock removal; sanded flush on right side, but the belt must be shifted off center due to an extrawide platen.

MAKITA 9903

Features a comfortable front grip; easy-to-use belt-tensioning lever; aggressive sander with excellent dust-collection efficiency; sanded flush on the right side of the machine; variable-speed control was easy to adjust.

PORTER-CABLE 352VS

Well balanced and comfortable to use; pivoting dust bag is convenient and equipped with a zipper; machine sanded flush to an edge; the speed control couldn't be reached without taking hand off the trigger.

MOTOR	NO-LOAD BELT SPEED	WEIGHT	STOCK REMOVAL	DUST-COLLECTION EFFECTIVENESS
6.6 amps	550 to 1,100 ft. per minute	7.1 lb.	56g	89%
8.5 amps	800 to 1,300 ft. per minute	11 lb.	71g	88%
8 amps	850 to 1,400 ft. per minute	12 lb.	110g	70%
8.7 amps	1,180 to 1,475 ft. per minute	9.7 lb.	96g	86%
8.8 amps	690 to 1,140 ft. per minute	9.5 lb.	102g	94%
8 amps	850 to 1,300 ft. per minute	10.75 lb.	79g	83%
6 amps	755 to 1,148 ft. per minute	7.9 lb.	77g	94%

RYOBI BE-321 TYPE II

A compact, well-balanced tool; belt-tensioning lever was comfortable to use; speed-control adjustment was easy to reach; dust bag is side-mounted and has a zipper.

a moment's inattention can damage the surface; however, a sanding frame can help (see "Sanding frames for flat work" on p. 37).

If possible, heft before buying

The incredible breadth of the Internet has made tool shopping easy, as long as you know exactly what you want. But there is no substitute for taking a sander out of the box and looking it over carefully before you buy it. Not everything is apparent in product photos or descriptions, and preferences will vary by user. For instance, I found swiveling dust-bag connections more convenient than those fixed in a single position. But dust connections on the top of the machine also make it more difficult to flip the sander on its back and clamp it to the bench. Those trade-offs are hard to weigh without handling the machine.

Overall ergonomics—such as how balanced the sander feels, where the power cord is attached, or whether the variable-speed control dial can be adjusted without taking your finger off the trigger—can prove important, and are difficult to judge without handling the tool. In the end, nothing beats a firsthand look. □

Scott Gibson, a contributing editor to Fine Homebuilding, *is a freelance writer, photographer, and woodworker living in Maine.*

Photos, this page: Rodney Diaz

A Spit-Shine Wax Finish

This polishing technique gives you a glasslike surface that is easy to repair

BY MLADEN K. VRANJICAN

Polishing is one subject that's familiar to me. Since adolescence, one of my hobbies has been making telescope optics, and, having been in military service for 18 years, I've put a spit shine on my shoes and boots on many occasions. So naturally, when I first took up woodworking as a hobby, the art of putting a French polish on furniture piqued my interest.

After some experimenting, I concluded there are two things about a French polish that I don't like: It's extremely time-consuming to apply, and the finished surface damages easily. Then it occurred to me that it might be possible to create a high-gloss, French-polish-like finish using just paste wax instead of shellac, denatured alcohol, boiled linseed oil, and naphtha. After all, wax requires only a little bit of water to produce an exquisite shine, and it's a lot less messy.

Like shellac, a wax finish also is subject to damage from water, heat, and scratches. But there's a world of difference in the repair process. A new coat of wax simply will blend in with the older, damaged surface. The result is a seamless repair in a very short time, without the need to move damaged furniture back into the shop.

Seal the surface first

The key to making a wax finish durable and easy to repair is what goes on the surface of the wood before wax is applied. On the mahogany end table shown here, I sealed the surface with Danish oil and then applied several coats of a wiped-on polyurethane. I filled the grain on the tabletop between the sealer coat

Wipe on a durable topcoat. *An oil-based varnish or polyurethane makes a good topcoat for furniture because the film finish greatly enhances moisture resistance. The tabletop shown here received seven coats of wipe-on polyurethane before the wax finish was applied.*

and the topcoat, but I've experimented since and have achieved almost comparable results without using any filler. Many layers of a built-up wax finish have essentially the same effect of leveling out the surface of woods such as mahogany or walnut, but I'm not sure the built-up wax would work as well on oak or ash.

Apply the wax with a little water

The key to a successful wax finish is to apply only a very small amount with each coat and to use a spritz of water. To make the applicator pad, wad up a paper towel into a ball, spray it with a plant mister, and cover it with a clean cotton cloth. Then load up the pad with a slight amount of wax for each application, working it first against the grain and then in small circular patterns. It is essential to keep the pad moist, but not wet, throughout the process.

A shine begins to come up almost immediately. As the pad starts to grab more of the surface, friction causes the small amount of moisture present to evaporate quickly. You can feel the pad's slight resistance as the shine develops. Lightening the pressure will carry the polish one step further, and you can achieve an almost glasslike surface if you keep at it. □

Mladen K. Vranjican works as a pharmacist for the U.S. Navy. He's currently stationed in Japan.

Photos: William Duckworth

APPLY THE WAX SPARINGLY

The single, biggest mistake many people make with wax is to apply too much, too fast. Apply many thin coats with only moderate pressure.

Keep the pad damp but not dripping wet. A clean cotton cloth wrapped around a damp paper towel works well as a wiping pad (1). Load the pad sparingly with wax (2). Apply the first two or three coats by wiping quickly back and forth against the grain, allowing each coat to dry a few minutes before moving on to the next. Then work the wax into the surface in small circular motions (3). You can feel a slight resistance as the heat generated by rubbing evaporates the moisture, and a sheen develops (4). Recharge the pad with a misting of water as necessary.

Fine-Tune Your Shop

Ingenious carts, tables, and storage solutions improve your work environment

BY JERRY H. LYONS

I had longed dreamed of creating a perfect shop and using it to teach woodworking. I reached that goal five years ago when I purchased a 3,000-sq.-ft. ranch-style log cabin near my home. I converted that space into a shop where I do woodwork and offer classes on the subject.

Two words describe my workshop environment: clean and organized. As long as I can remember, I have needed a place for everything and everything in its place. I may have inherited the trait in school woodshop as the student who cleaned up after every class. Or perhaps my most recent career as a training and safety consultant, declaring the benefits of organization and systemization, has rubbed off on me.

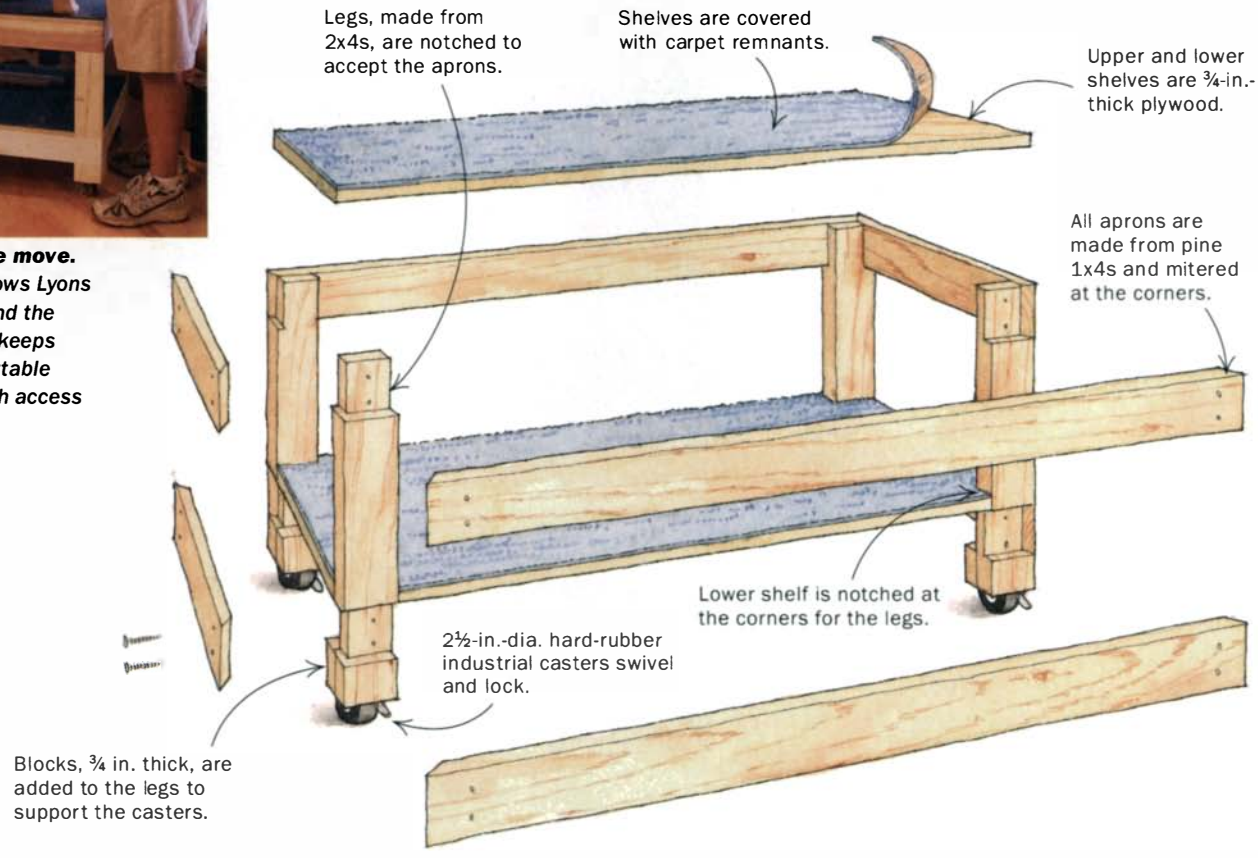
Working in such a large space, I needed to keep hand tools organized, so I designed wall-mounted storage panels that make it easy to see and access tools. To make the workspace more efficient and adaptable, I also employ a variety of work tables and rolling carts, which do double duty as storage for project parts, related hardware, and even hand tools and jigs.

Jerry H. Lyons, who taught furniture making for 21 years, recently built his dream shop near Glasgow, Ky.

A secretary on the move. *This rolling cart allows Lyons to move work around the shop easily. It also keeps a piece at a comfortable working height, with access to all sides.*

ASSEMBLY CART RAISES WORK

This shopmade cart provides a comfortable working height (about 24 in.) and easy access to the back and sides of a large project, like this slant-top secretary (left). Also, the cart makes it easier and safer to roll a piece around my shop to take advantage of natural light. Both shelves are carpeted to protect the edges of the workpiece, and the lower shelf provides storage for components and hardware.



Drawings: Jim Richey

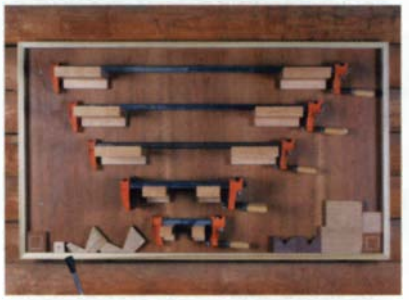
WALL PANELS ORGANIZE HAND TOOLS

Like many woodworkers, I have lots of hand tools, and I want to be able to find a tool when I need it. I would rather spend my time working than looking. To organize my hand-tool collection, I built four tool panels near my workbenches. Each tool, regardless of its size, fits into its own space within one of these panels. The panel backs are made of ¾-in.-thick seven-ply oak plywood. The edging is solid oak rabbeted to receive the plywood and mitered at the corners.

To accommodate the needs of several students at once, all panels include common tools such as handsaws and planes. Whenever possible, I grouped tools—such as those for measuring, layout, and cutting—according to use.

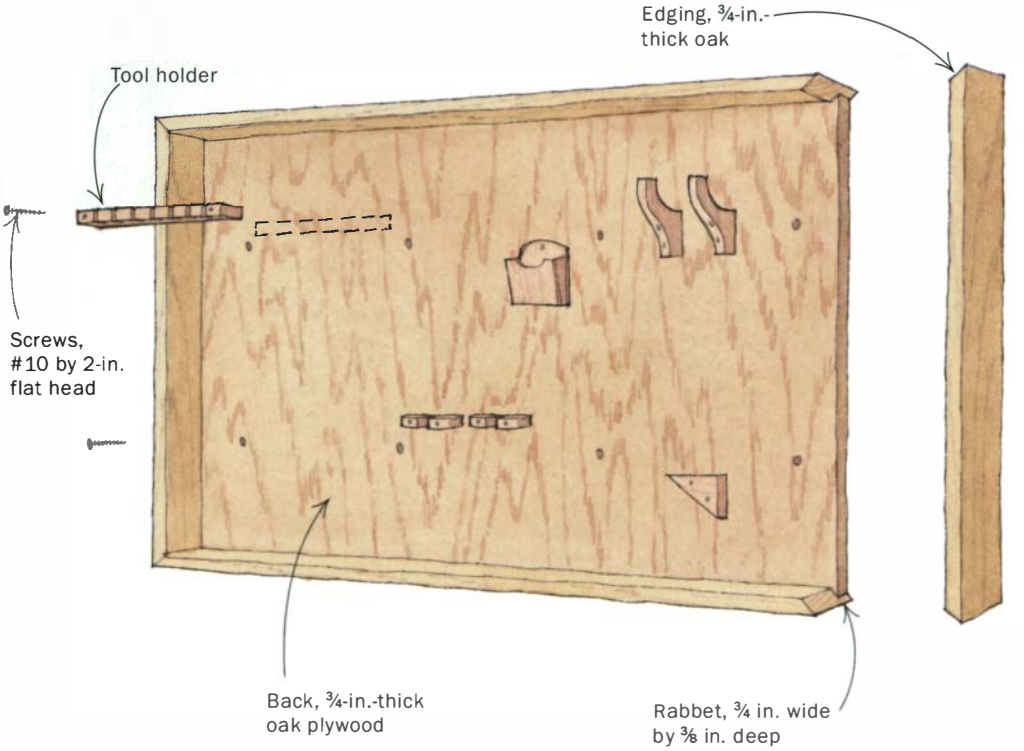
I used a bandsaw, handplanes, and sanders to shape and mold each tool holder's unique configuration. I glued the tool holders in place and used screws and dowels for reinforcement.

Designs on display. *Lyons finds it helpful to keep plans for his current project displayed so that he can reference them easily but not get them damaged.*



Tools are grouped according to use. *Layout tools and clamps are gathered on this tool panel.*

A place for everything. *Wall panels display hand tools, making them easy to find and access.*



Photos: Mark Schofield

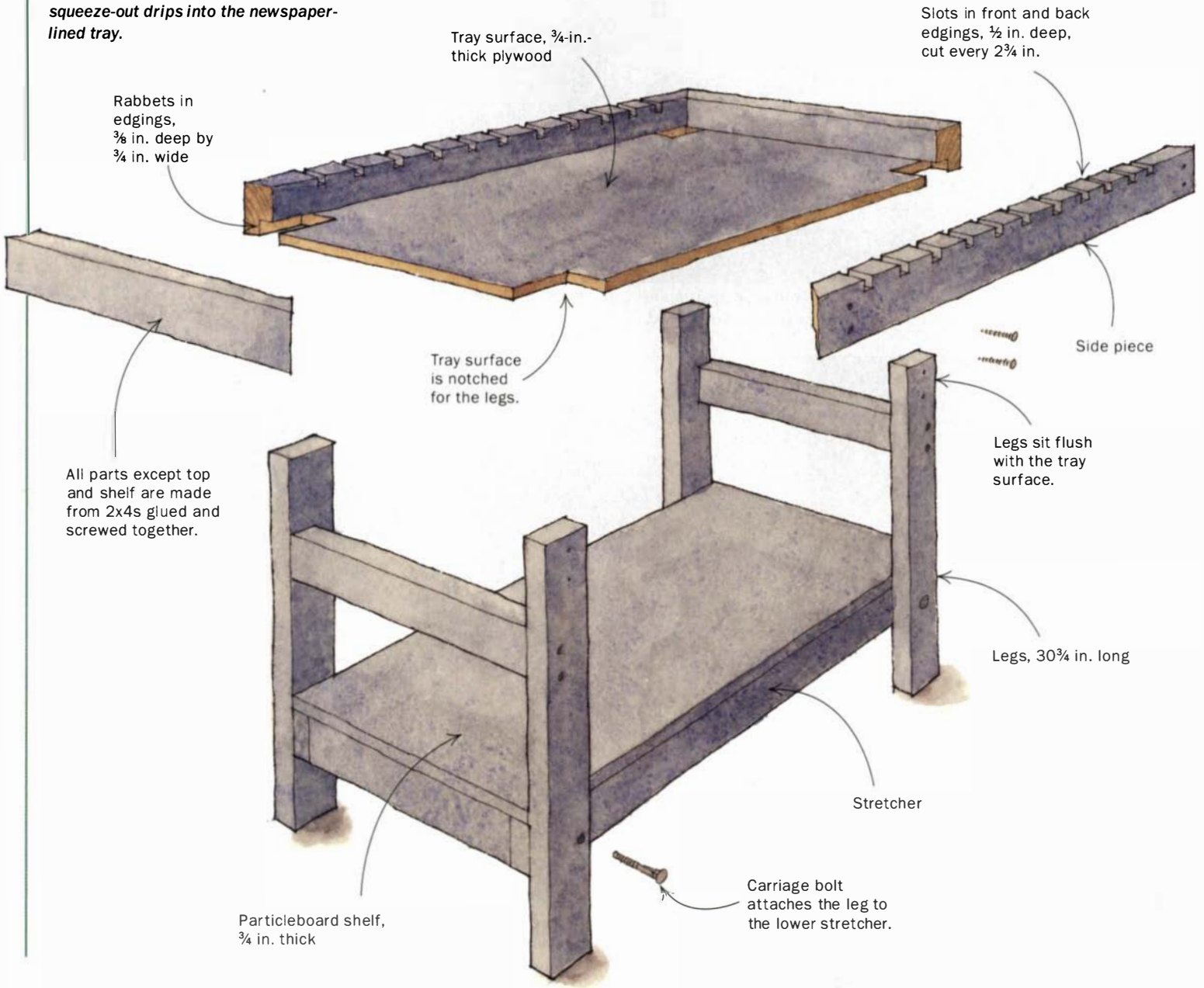
CLAMPING TABLE TACKLES GLUE-UPS

Gluing boards into panels often calls for at least three pairs of hands: one to keep the boards aligned, one to stop the clamps from falling over, and one to clean up the surplus glue. I solved this problem by making a dedicated clamping table.

The front and back edgings of the table are slotted to position I-beam bar clamps in an upright position. The tray below is covered with newspapers to catch glue squeeze-out. When done, I simply fold up the newspapers and discard them. This table also has a lower shelf to hold extra newspapers, several jigs, and occasionally used items.

I used a variety of scraps of plywood and solid stock to build the table, then I painted the whole piece with leftover floor paint. This has the bonus of making glue cleanup easier. Size the table based on what scraps are available and the kind of work you do. My table is 30½ in. deep by 65 in. wide by 32 in. tall.

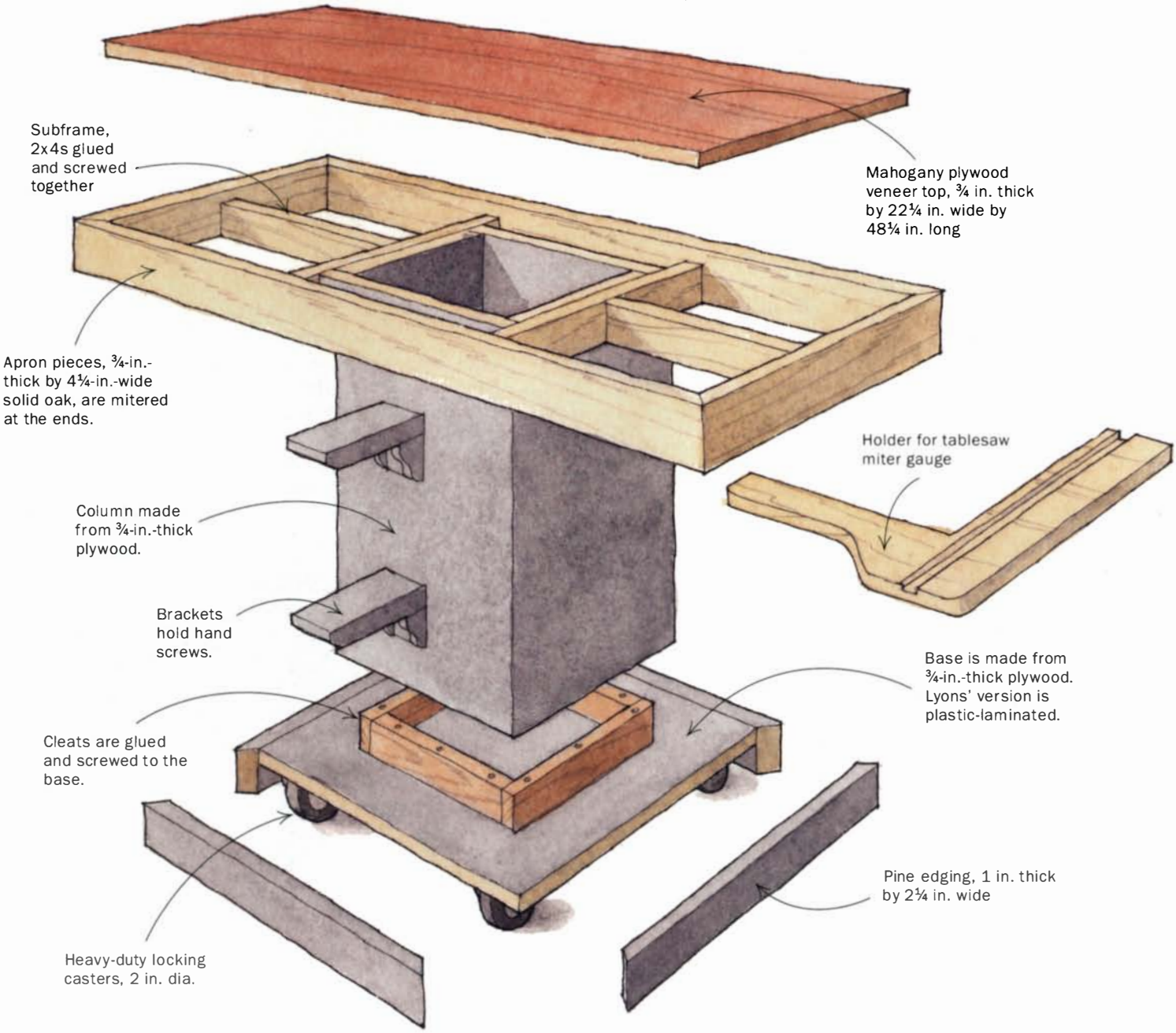
Less stress and less mess. *The slotted table frame holds clamps in position while gluing up boards. Any glue squeeze-out drips into the newspaper-lined tray.*



MOBILE TABLE SERVES MANY NEEDS

This table is my heavyweight shop assistant: With a 1,000-lb. capacity, it never complains of backache; four wheels means it can move anywhere on the heavy-machinery floor; and because its wheels lock, the table never backs out when I need it most. The table is ⅛ in. below the height of the tablesaw to eliminate boards getting caught on it when being ripped. It can be positioned either lengthwise or widthwise, depending on the shape of the board being cut. It also makes a nice outfeed surface when planing long parts. In addition, it is a handy table for layout work as well as a good place to store clamps and other accessories. As with the clamping table, the dimensions of your table will differ based on your tools and the work you do.

A multipurpose support table. *This table can be wheeled to support operations at the tablesaw or the jointer, while the base stores clamps and jigs.*



Sliding Bevels

Prices range from dirt cheap to downright expensive, but does cost reflect value?

BY STEVE LATTA

Laying out angles is a fundamental part of woodworking, and for most of us, the sliding bevel is the tool of choice for tackling this operation.

A sliding bevel consists of a body (sometimes called a stock) and a slotted blade that pivots on a machine screw or steel pin on one end of the body. A thin opening along much of the body accepts the blade. Manufacturers employ a variety of methods to lock the blade in place (see the photos on the facing page).

By pivoting the blade, you can adjust it to any inside or outside angle between 0° and 180°. And because it slides, you can control the distance the blade extends from each edge of the body, a feature that makes the tool easy to use in tight spots.

A search of mail-order and online woodworking catalogs quickly produces a list of nearly a dozen companies that sell sliding bevels. Some of these companies carry just one size or style, others offer two or more, and the prices vary considerably, from as low as $5 to as high as $90. To find out how such similar tools can be priced so differently, I ordered several and put them to use in my shop.

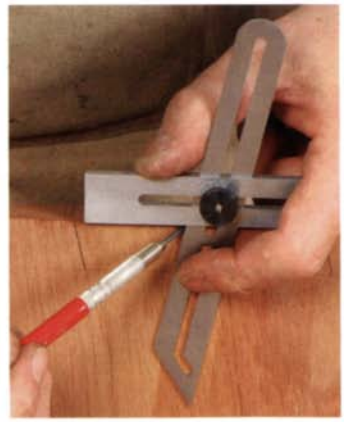
Although sliding bevels are not complicated tools, I learned that there are differ-

A TOOL WITH MANY USES

Use a sliding bevel to set, transfer, or mark any angle between 0° and 180°. Keep in mind, though, a sliding bevel doesn't have a built-in degree scale, so any angle that must be measured requires the help of a protractor.

Get an angle from a drawing. *A block of wood aids in taking an angle directly from a drawing.*

Set an angle on the tablesaw. *With the tongue of a sliding bevel butted against a sawblade, it's easy to set the blade angle.*



Mark a dovetail angle. *A small sliding bevel is perfect for marking dovetails.*

Photo, this page (top): Kelly J. Dunton

ences among them. Some of the differences are immediately obvious, others are more subtle, but all have an effect on the quality of the tool.

Body and blade should be flat and straight

The body of a modern sliding bevel can be made of plastic, metal, or wood. Rosewood has been the traditional wood species of choice, but in recent years maple and mahogany have been substituted because they cost less and are commonly available. One company uses laminated wood to produce a body that's more dimensionally stable.

The large aluminum body on the Shinwa gives the tool a comfortable heft. Starrett, capitalizing on the properties of steel, went smaller rather than larger to design the most delicate, precise, and versatile body of the lot.

The brass body of the Kell sliding bevel consists of two parts: a rectangular plate and a smaller, tapered plate. The brass blade slides between them. Unfortunately, because of the tapered plate, you can't simply flip the tool to mark a reverse angle or to lay out a dovetail, two routine tasks most users expect from a sliding bevel.

The body on the Bridge City is somewhat of a hybrid: brass with a rosewood infill. The result is a beautiful-looking tool.

Check it yourself—No matter what it's made of, the body should have surfaces that are flat and straight, with opposite sides that are parallel. Check for flatness and straightness with a try square. A caliper can help you check for parallel.

How the body feels in your hand is important, too. Granted, you rarely hold this tool for long, but a comfortable fit is a plus.

Like the body of a sliding bevel, the blade should be smooth and straight with parallel edges. It also should slide easily. To check the blade for straightness, butt the edge of a try square against the blade edge. Also, lightly run a finger along the edges of the blade to detect any burrs or general roughness. To flatten or smooth an edge, place it on a flat sharpening stone and work the edge back and forth as needed. Check for parallel with a caliper.

Locking mechanisms should be strong yet unobtrusive

A good sliding bevel will have a locking mechanism that holds the blade securely to

LOCKING MECHANISMS VARY

The locking mechanism should be easy to use and should hold the blade securely in place. Any lock that extends beyond the working edges of the body can interfere with the tool during use.

Wing nut. *The sliding bevel from Crown uses a wing nut to lock the blade.*

Knurled knob. *On several sliding bevels (Craftsman is shown), the blade is locked by tightening a knurled knob.*

Locking lever. *The Gladstone tool uses a lever that sits below the side of the body and is easy to use.*

End screw. *To allow the body to lie flat on both sides, Shinwa (shown) and Bridge City lock the blade from the end of the body.*

Cam lock. *Veritas builds a cam lock into the body, a system that holds the blade securely.*

Photos, except where noted: Tom Begnal

the body once positioned. That's not to say that you won't be able to move the blade once it's locked—all of the ones I looked at slipped a bit when enough force was applied—but you don't want a blade to move easily when accidentally given a bump. It's both frustrating and expensive when pieces are milled incorrectly because a blade has wandered.

On most sliding bevels, the blade lock is created by threading a wing nut or knurled knob onto the machine screw. As the wing nut or knob is tightened, it pinches the blade between the sides of the body to hold it in place. Wing nuts and knobs generally work okay, although the locking mechanism on the Kell proved to be an exception. The strongest student in my class, a burly 20-year-old, couldn't tighten the knob enough to lock the blade adequately.

Wing nuts and knobs have one potential drawback: Because the wing nut or knob extends from one side of the body, you can't use the tool easily when that side must butt against a flat surface.

Craftsman tackled this problem by using a large, disc-shaped knurled knob that is recessed into one side of the body. However, the relatively thin knob was somewhat difficult to grip, so I couldn't lock the blade as securely as I would have liked.

The wing nut on the Crown presented another problem. After tightening, the end of the wing nut sometimes extended past the edge of the body, preventing the tool from sitting flat against the workpiece.

Shinwa has attacked this shortcoming by using a mechanism that threads from the end of the body and allows either face of the tool to rest against a workpiece when registering an angle. Not only was this system more convenient than any other, but it also was best at locking the blade.

The Bridge City also has a system for locking the blade from the end of the body: You simply turn a knurled knob that is attached to a threaded rod. But the locking knob was uncomfortable to use because it was somewhat small and didn't turn smoothly. This shortcoming is uncharacteristic of Bridge City, as its other products I've used, while expensive, were well thought out and beautifully made.

The lock on the Gladstone bevel is a lever positioned below the side of the body. It worked okay, but to tighten the blade, the lever had to be rotated to the point where it extended past the edge of the body.

SLIDING BEVELS

CRAFTSMAN 39582

Price: $4.50
Contact: 800-697-3277
Body: 5⅝ in.
Blade: 9 in.

Least expensive of the lot; locking knob was fairly difficult to grip and tighten securely.

BRIDGE CITY TB-6

Price: $89
Contact: 800-253-3332
Body: 4½ in.
Blade: 6¾ in.

Won "most handsome" award as well as most expensive; smallish locking knob didn't tighten smoothly, making it uncomfortable to lock and unlock.

CROWN TOOLS

Price: $20
Contact: 800-509-0081
Body: 5 in.; Blade: 7½ in.

Blade locked securely; brass wear plates fit unevenly; wing nut extends past blade, making for awkward machine setups, and allows only one side to lie against a flat surface; Crown also offers a model with a 3⅞-in.-long blade that sells for about $12.

Veritas solved that problem by revamping a side-mounted cam method originally used in the early 1900s. When locked, the device is flush with the tool's side. This mechanism worked well and held the blade quite securely.

It's easy to find a tool that fits your budget

In the $5 to $20 range, the sliding bevel made by Crown Tools would be suitable for most applications, but I was disappointed by its overall fit and finish. The Craftsman, meanwhile, made my fingers work too hard to tighten the locking knob.

In the same price range, the Shinwa stood out. It felt good in my hand and had the best locking mechanism.

In the $20 to $30 range, the Gladstone tool would have been serviceable if the

Photos, this page and facing page: Kelly J. Dunton

RICHARD KELL

Price: $50
Contact: 800-221-2942
Body: 3⅝ in.
Blade: 3⅛ in.

Easily fits into apron pocket; very good blade lock; because of tapered design, it can't be flipped to mark reverse angle.

GLADSTONE 10½

Price: $22
Contact: 800-243-0713
Body: 7⅜ in.
Blade: 10½ in.

Easy-to-use blade lock, but lever extends past body when locked; Gladstone also offers a model with a 7½-in.-long blade that sells for about $16.

SHINWA 780

Price: $21
Contact: 800-426-4613
Body: 6 in.
Blade: 10 in.

Heavy-duty tool appropriate for larger applications; good fit and finish; very good blade lock; Shinwa also offers a model with an 8-in.-long blade that sells for about $19.

STARRETT 47

Price: $70
Contact: 978-249-3551
Body: 3½ in.; Blade: 6 in.

Expensive; easily fits into apron pocket but is large enough for most applications; blade slides and pivots along body, making for easy joinery layout; very good blade lock.

VERITAS 05N44.01

Price: $32
Contact: 800-871-8158
Body: 6½ in.; Blade: 10 in.

Smooth working and attractive; cam-style locking mechanism worked well; Veritas also offers a model with a 4-in.-long blade that sells for about $28.

locking mechanism didn't extend past the body. The Veritas model, though, was both aesthetically pleasing and efficient in use. I'd welcome one in my toolbox.

Among the tools in the higher price range, the Starrett sliding bevel stood out. Its compact size made it exceptional for any task, ranging from setting machine angles to laying out cuffs on card-table legs. Also, unlike any of the other models, the Starrett's blade can pivot and slide along the length of the body, a feature that makes it ideal for marking dovetails.

The Kell sliding bevel, which was not cheap at $50, was a disappointment. Although this brass tool is beautiful to look at, it's less than practical because the tapered plate limits its use to only one side. Plus, the locking knob didn't secure the blade adequately.

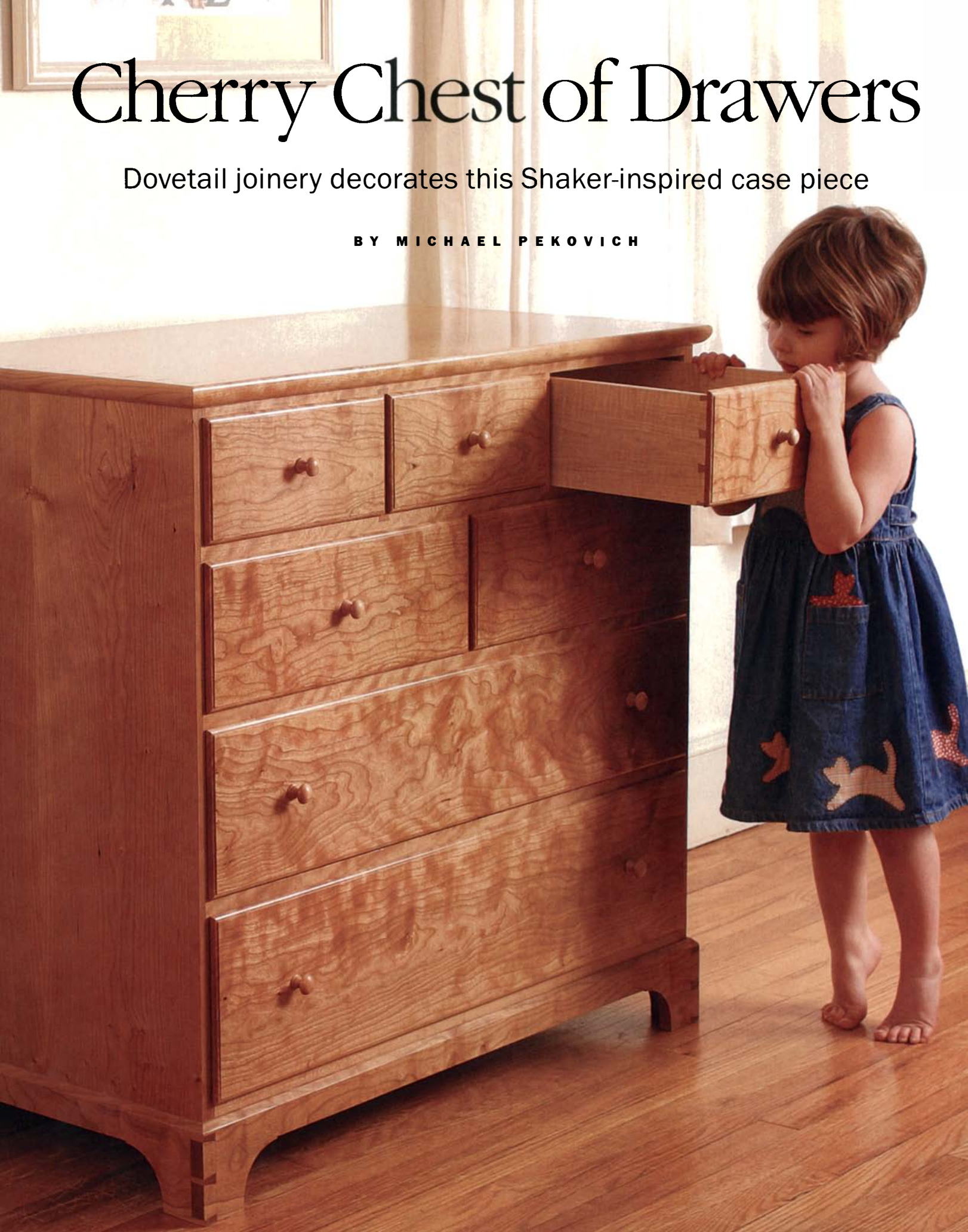
All that considered, if I could have only one sliding bevel out of all the models I looked at, it would be the one made by Starrett, which was, by far, the most versatile and satisfying to use. Plus, it's small enough to fit in one of my apron pockets, so it's always within easy reach. Were I to need a sliding bevel for working with larger workpieces, I'd go with the Veritas model. □

Steve Latta teaches woodworking at Thaddeus Stevens College of Technology in Lancaster, Pa.

Cherry Chest of Drawers

Dovetail joinery decorates this Shaker-inspired case piece

BY MICHAEL PEKOVICH



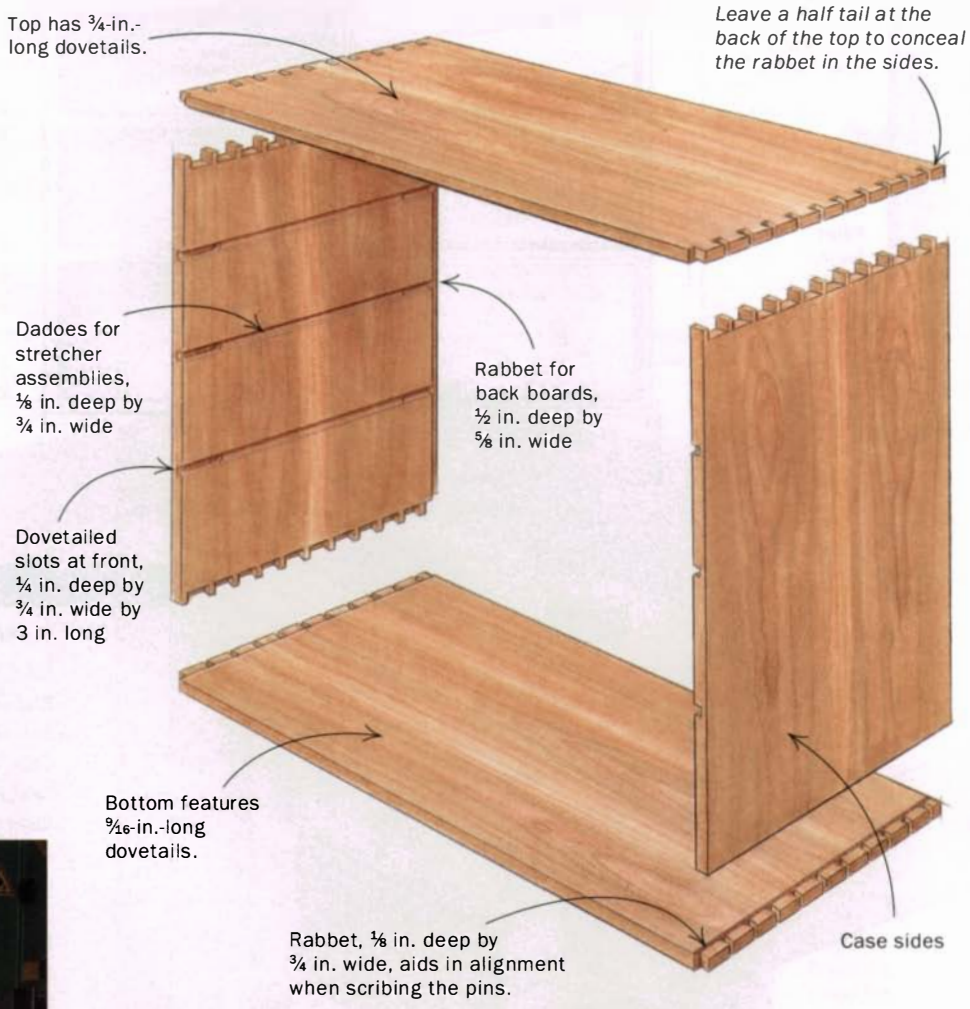
My daughter Anna, going on 3 years old, loves to dress up. But picking out her own clothes means she has to deal with the cumbersome drawers of the flea-market dresser in her room.

After she had an especially frustrating day wrestling with those drawers, I decided she needed a new place for her clothes. So I made her a simple dresser with seven drawers in four rows, with each row graduated in size and each drawer outlined with a thumbnail profile. The bracket base is decorated with dovetails at the corners, which echo the exposed dovetails at the top of the case. These small details, along with some carefully chosen lumber, complete the ornamentation.

There's a lot to consider when designing a chest of drawers, and the look you choose will affect your construction method (for various approaches, see "Anatomy of a Chest of Drawers" in *FWW* #163, pp. 36-43). In this case, my decision to expose the dovetails at the top of the case required a molding applied around the edges of the top, which in turn required an extra drawer stretcher attached behind that top molding. When it comes to design decisions, this domino effect is common, and it's a big

THE CARCASE BEGINS AS A DOVETAILED BOX

The top is joined to the sides with through-dovetails, which will be partially concealed by molding. The bottom is attached with half-blind dovetails.



The tablesaw saves time. *The tails on the top and bottom panels are cut using a tablesaw blade with the teeth ground to the angle of the dovetail.*

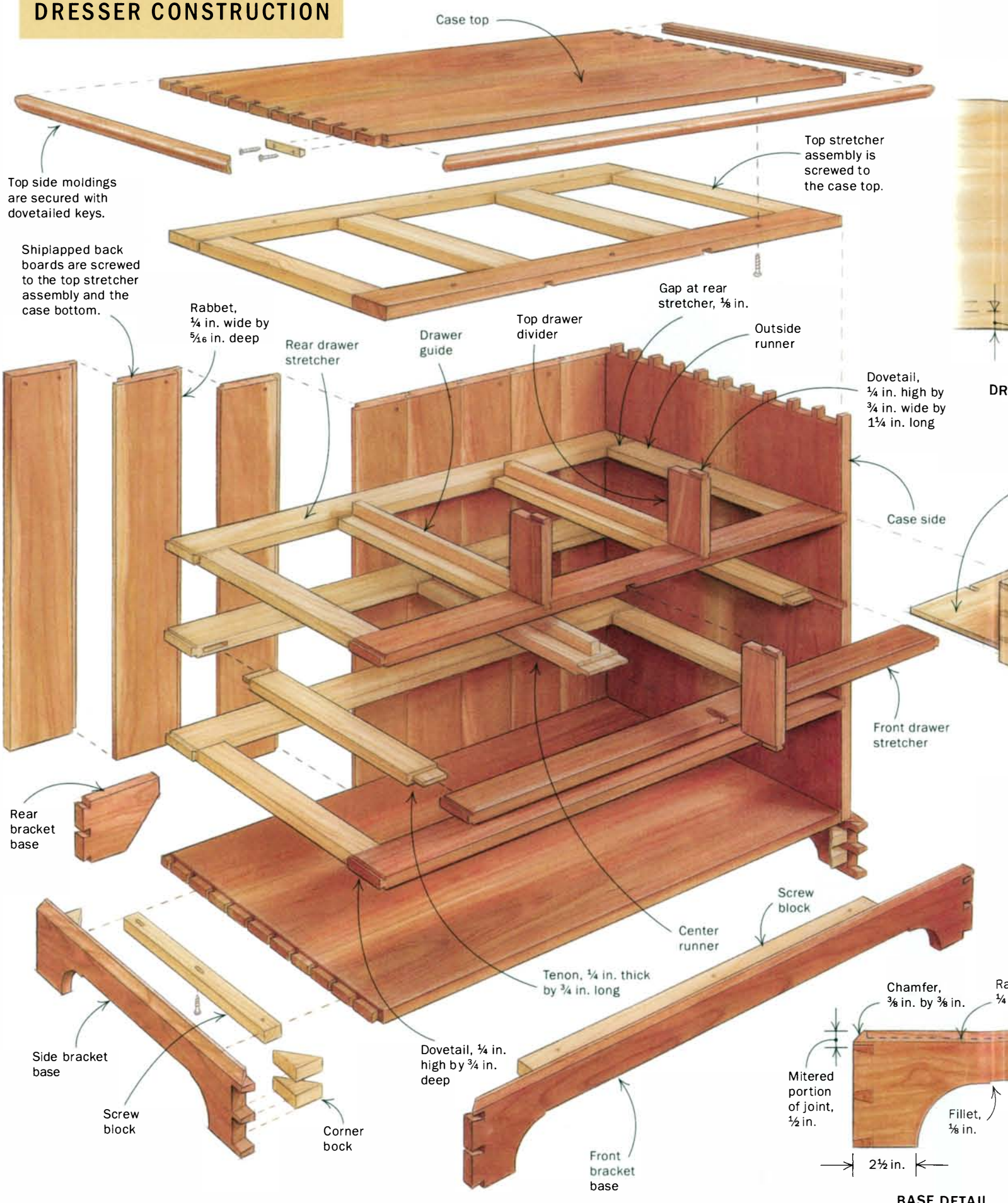
DOVETAIL SHORTCUTS ON THE TABLESAW

The carcase top and bottom require dovetails of different lengths. To save time and reduce the number of setups, Pekovich cuts dovetails of equal lengths on both pieces, then trims the bottom dovetails later.

Rabbet helps align the dovetails during marking and assembly. *The ⅛-in.-deep rabbet extends to the baseline of the tails.*

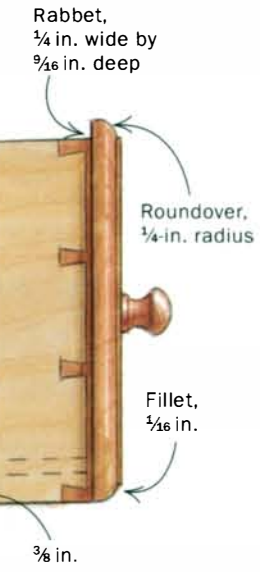
Finally, trim ⅛ in. from each end of the case bottom. *Shorter tails are necessary for the half-blind dovetail joint at the bottom of the case.*

DRESSER CONSTRUCTION

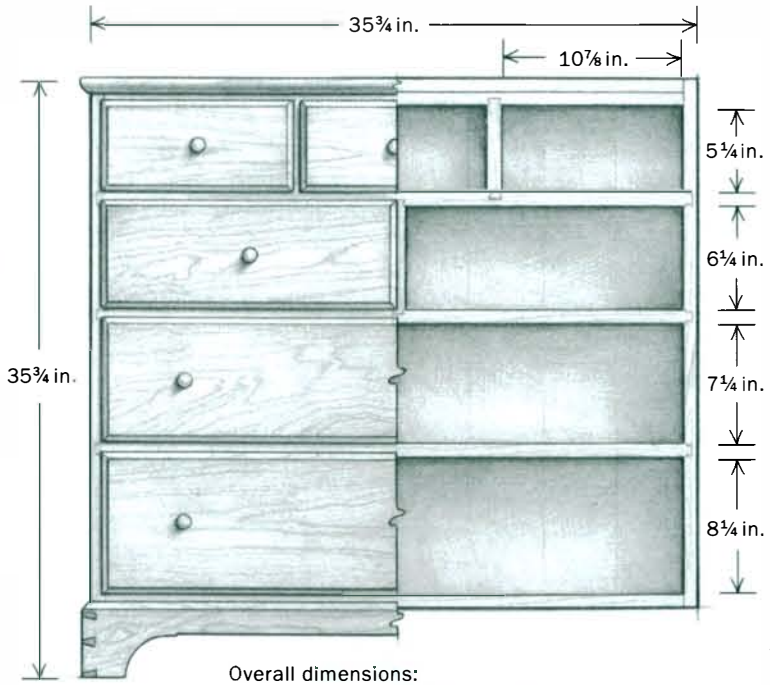


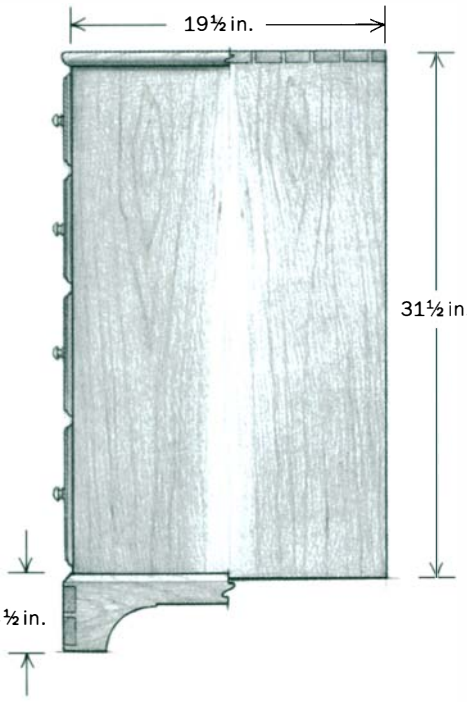
BASE DETAIL

Drawings: Bob La Pointe

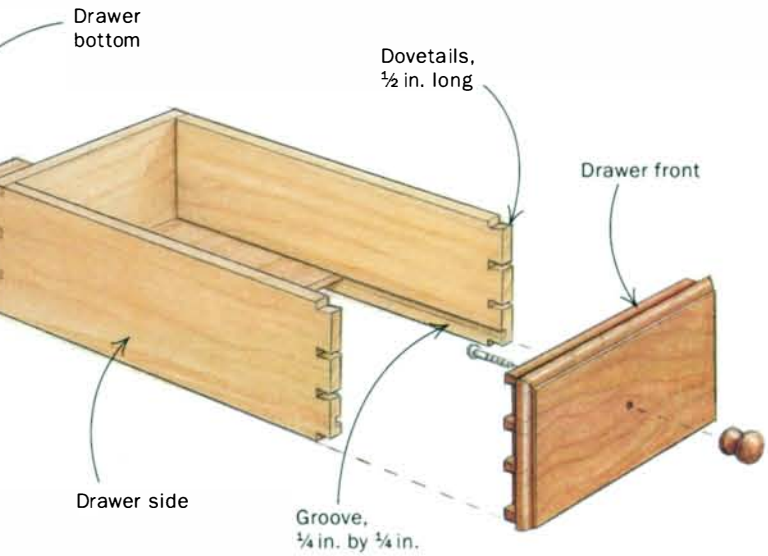


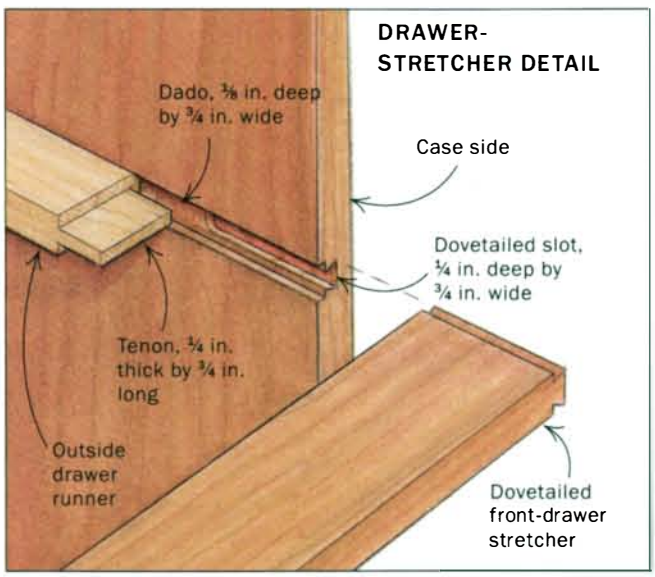
RAWER DETAIL





Overall dimensions:
20¼ in. deep by 37¼ in. wide by 35¾ in. tall



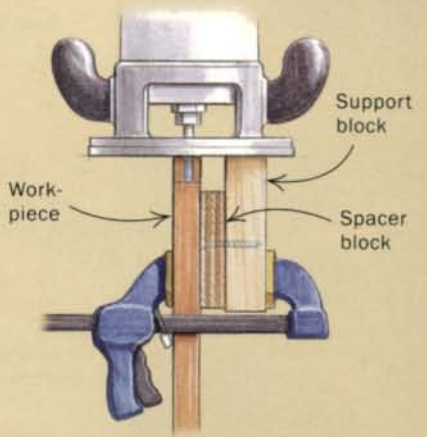


CUT LIST

WOOD	PART NAME	QUANTITY	DIMENSIONS
CHERRY	Back boards	8	⅝ x 4½ x 30¾
	Bracket base, front	1	¾ x 4½ x 36¾
	Bracket base, sides	2	¾ x 4½ x 20
	Case bottom	1	¾ x 18⅞ x 35⅜
	Case sides	2	¾ x 19½ x 31½
	Case top	1	¾ x 19½ x 35¾
	Drawer divider, second row	1	¾ x 2½ x 6¾
	Drawer dividers, top row	2	¾ x 2½ x 5¾
	Drawer fronts, top row	3	⅞ x 5⅜ x 11⅜
	Drawer fronts, second row	2	⅞ x 6⅜ x 17¼
	Drawer front, third row	1	⅞ x 7⅜ x 34¾
	Drawer front, bottom row	1	⅞ x 8⅜ x 34¾
	Drawer stretchers, front	3	¾ x 2½ x 35
	Molding, top front	1	¾ x 1 x 37¼
	Moldings, top side	2	¾ x 1 x 20¼
	Stretcher, top front	1	¾ x 2½ x 34¼
SOFT MAPLE	Bracket base, rear	2	¾ x 4¼ x 6
	Drawer backs, top row	3	½ x 4½ x 10⅞
	Drawer backs, second row	2	½ x 5½ x 16¾
	Drawer back, third row	1	½ x 6½ x 34¼
	Drawer back, bottom row	1	½ x 7½ x 34¼
	Drawer guides	3	¾ x 1 x 13¾
	Drawer sides, top row	6	½ x 5⅛ x 18
	Drawer sides, second row	4	½ x 6⅛ x 18
	Drawer sides, third row	2	½ x 7⅛ x 18
	Drawer sides, bottom row	2	½ x 8⅛ x 18
	Drawer stretchers, rear	3	¾ x 2½ x 35
	Runners, outside	8	¾ x 2 x 15¼
	Runners, center	5	¾ x 3 x 15¼
	Stretcher, top rear	1	¾ x 2½ x 34¼
PINE	Drawer bottoms, top row	3	½ x 17¾ x 10⅜
	Drawer bottoms, second row	2	½ x 17¾ x 16¼
	Drawer bottom, third row	1	½ x 17¾ x 33¾
	Drawer bottom, bottom row	1	½ x 17¾ x 33¾
	Misc. screw and corner blocks		¾ in. thick

CUT PINS ON THE CASE SIDES

Mark the pins with a knife. *The rabbet helps align the large panels for marking. Cut along the scribe lines with a backsaw.*



Cope and rout out the waste between the pins. *Clamp a support block to the workpiece and rout close to the sawkerf with a ¼-in. straight bit. Chisel away any remaining waste.*

Add a fence to the router for half-blind pins. *The bit depth establishes the dovetail depth while the fence sets the height (left). A pair of skew chisels help clean out the corners (above).*

reason why I try to figure out the details on paper before I begin to build.

Top-quality lumber is square one

Like many woodworkers, I've made the mistake of trying to save money by choosing lesser-quality lumber, working around knots and sapwood and gluing up lots of narrow boards. I've come to realize that the investment in materials is small compared with the investment in labor.

For this piece, I purchased lumber from Irion Lumber Co. (570-724-1895; www.ironlumber.com), a mail-order dealer in Pennsylvania. The supplier found multiple boards from the same tree, saving me the trouble of dyeing or staining mismatched boards. The total cost of the roughly 125 bd. ft. of lumber, including shipping, was $685, about $20 more than what my local lumberyard would have charged.

Dimension lumber as you go

Things go wrong when I follow strict measurements. For this project, I started with the overall dimensions in the cut list and adjusted some of the measurements as I worked. To this end, you must be careful not to dimension all of the parts ahead of time, because some parts, such as the drawer stretchers, may change in dimension slightly as you go. When sizing the case, the important thing is that corresponding parts match. The pieces also must be cut square and glued up square. The foundation of the dresser is its carcase; as it goes, so goes the rest of the project.

Flat panels are a must—The carcase of the dresser may be just a dovetailed box, but it's big and cumbersome. The various parts must be glued up into panels and surfaced before you can work on the joinery. Begin with 4/4 rough stock and shoot for a finished thickness of between ¾ in. and ⅞ in. Glue up the boards into larger panels, and take the time to get the panels as flat as possible. It will save time later.

When it comes to surfacing the case parts, I don't mind getting out a handplane and scraper and working up a sweat. But you might want to think about locating a cabinet shop or lumberyard in your area that will rent time on a wide belt sander. These big machines can flatten panels in a hurry; the cost for sanding these four panels would have been around $40.

Router jig aligns carcase dadoes. *The simple jig made from ¾-in.-thick poplar is sized to fit your router's base. Align the jig with layout marks on the case side and clamp it securely. Use a ¾-in. straight bit to rout the ⅛-in.-deep dadoes for the drawer runners.*

USE A JIG TO ROUT DADOES AND DOVETAILED SLOTS

The same jig is used for dovetailed slots. *After routing all of the dadoes, use a ¾-in. dovetail bit to cut slots for the front and back drawer stretchers.*

Once the case sides, top, and bottom have been surfaced, it's time to start building the carcase.

Assemble the carcase with dovetails

I normally cut dovetails by hand, but the large number required for this project prompted me to look to machines for help in speeding the process.

I cut the tails in the carcase (as well as in the drawer sides) using a tablesaw blade ground especially for the purpose (*FWW* #152, pp. 56-61). Then I removed most of the waste with a coping saw and pared to the baseline with a chisel. I scribed the pins with a knife and cut them with a backsaw, but I used a router to remove most of the waste. The final result has the look of handsawn dovetails but without the drudgery.

In this dresser, the case top is joined to the sides with through-dovetails, while the bottom is joined with half-blind dovetails. This design requires that the top and bottom have dovetails of different lengths, which means that the bottom will be shorter than the top but must be precisely the same length between the bases of the dovetails. To ensure that everything ends up square, you need to crosscut the case top and bottom to the same size and cut tails of equal length on each piece. The bottom tails will be trimmed later.

To accommodate the shiplapped back, the sides are rabbeted. So you must exercise care when laying out the dovetails along the top to avoid exposing the rabbets in the case sides.

After cutting the tails, run a shallow rab-

INSTALL DRAWER FRAMES AFTER GLUE-UP

Rout dovetails on the front and back stretchers. *Use the same bit that was used for the slots in the case. A horizontally mounted router allows the workpiece to remain flat on the router table.*

Installing the drawer frames. *Begin by gluing the front stretchers in place (left). Then flip over the case and insert the runners into the front stretchers, applying glue only at the front tenons (right). Finally, glue the back stretchers into place.*

MOUNT THE CARCASE ON A BRACKET BASE

The corner joints combine dovetails with a miter at the top (above). The miter allows for the rabbet on the inside edge that supports the case, as well as the decorative chamfer along the outside edge. To mount the base, glue on blocks that can be screwed to the carcase (right). Elongate the middle and rear screw holes to allow for seasonal movement.

bet (about ⅛ in. deep) the length of the tails along each end of the case top and bottom. This shallow rabbet helps keep the case parts in alignment while you scribe the pins on the case sides. Now trim ⅛ in. off each end of the bottom piece. This method ensures that the distance between the base of the dovetails on the top and the bottom is equal.

To lay out the pins, clamp the case side to be scribed in the front vise of a bench, and clamp the other case side along the rear apron of the bench; this serves to support the top and bottom panels while marking. Snug up the rabbet on the case top (or bottom) to the case side and use a marking knife to scribe the pins. Then saw right along the line. Remove the waste between the pins using a router equipped with a ¼-in. straight bit, and clean up with a chisel.

Rout dadoes for drawer partitions before gluing up the case

Prior to gluing up the case, you need to rout the dadoes and the stopped-dovetail slots for the stretchers, runners, and dividers. Rout all of the dadoes the full width of the sides using a ¾-in. straight bit. A simple jig can help guide your router (see the top left photo on p. 55). The base of my router is not perfectly concentric to the collet, so I marked an X on the base, making sure the X sat on the right side of the jig while routing. This ensured that the dovetail keys would align with the dadoes. Rout 3-in.-long stopped dovetails at the ends of each dado using a ¾-in. dovetail bit.

To prevent clamps from marring the case during glue-up, make a set of cauls for each corner. Notch the cauls to fit around the dovetail pins and secure them to the case using double-faced tape to prevent shifting. After the case is clamped, check for square with a tape measure.

Stretcher systems support the drawers

Once the case has been glued up, mill the parts for the stretcher systems that support the drawers. The front and back drawer stretchers are dovetailed to the case. The drawer runners are mortised into the stretchers. The runners are housed in shallow dadoes in the case sides and are cut ⅛ in. short and glued only at the front tenon to allow for seasonal movement of the case sides.

Because the molding around the top of the dresser is thicker than the top, I screw what is basically another drawer-stretcher assembly to the underside of the top to fill the gap. The front and back stretchers on this upper assembly don't need to be dovetailed to the case sides, and the runners are glued only at the front stretcher.

Molding and base require dovetails

The molding is glued along the case front and attached with dovetail keys along the case sides to allow for wood movement. I learned this method from Christian Becksvoort (*FWW* #165, p. 49). A dovetail slot is routed along the side moldings, and matching keys are screwed to the case side. The molding slides on from the rear and is glued only at the front corner.

The bracket base is dovetailed at the front with the upper portion of the joint mitered for a clean look. Run a rabbet along the top of the bracket base for setting in the car-

case. Glue the carcase to the base along the front, and attach the base to the sides with screw blocks that are glued to the base and screwed to the carcase in elongated holes to allow for seasonal movement.

Size and fit lipped drawer fronts

The drawer fronts on this dresser are rabbeted along the top and sides to create a lip. This adds visual interest to the piece and does away with the need for stop blocks inside the case. However, it does make fitting and dovetailing the drawer a bit tougher.

Normally, when making drawers I start with a snug fit and plane the sides until they fit the opening on the carcase. But the lipped front makes planing the sides difficult, so it's important to get the dimensions right the first time. I do this with the help of a story stick. Before making any cuts, note the widths and heights of all drawer openings and adjust your cut list accordingly.

Begin by ripping all of the drawer parts to width. The sides are ⅛ in. narrower than the height of the opening. The backs are ⅝ in. narrower than the opening, as they also must provide clearance for the drawer bottoms. The fronts are cut ⅛ in. wider than the height of the opening.

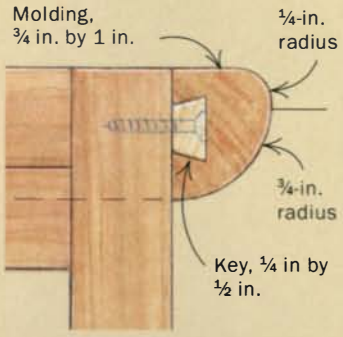
Next, crosscut all of the drawer parts to length. The sides are cut so that they reach just short of the case back. Size the drawer backs to fit snugly in the opening. The fronts are cut ½ in. longer than the drawer back. Once all of the pieces have been dimensioned, run a ¼-in.-wide by 9/16-in.-deep rabbet along the top and on the end of each drawer front. Don't profile the lipped edges yet.

Dovetail the drawer parts—Now you are set to cut the dovetails for the drawer parts. Begin by cutting the tails on the drawer sides using the same tablesaw method used for the carcase. The through-dovetails on the drawer backs are straightforward. However, the half-blind dovetails on the drawer fronts pose a challenge. The rabbeted lip prohibits you from sawing the full length of the pins. Instead, scribe the pins with a knife and use a router equipped with a fence to remove the waste. Then use a chisel to pare to the scribe lines where the router bit can't reach.

Before assembling the drawers, you must run a groove along the inside bottom edges of the drawer sides and drawer

ATTACH THE MOLDING

The front molding is glued on but the side moldings are held in place with dovetailed keys. To position a key, insert it into the molding, leaving a few inches exposed at the front. Align the molding flush with the case top and screw the key to the case. Gradually slide the molding back, exposing more of the key.



Slide the molding into place. *After attaching the key, cut it apart at 3-in. intervals to allow the case to expand and contract with seasonal humidity changes. Apply glue at the front corner of the case and slide the molding onto the case from the back.*

DOVETAILING LIPPED DRAWER FRONTS

Begin by routing a rabbet along the sides and top of the drawer front (1). After scribing the pins with a knife (2), remove the waste with a router equipped with a fence (3). A platform clamped to the benchtop makes it easy to secure the drawer front while routing. Then pare to the scribe line with a sharp chisel (4). After assembly, use a shoulder plane to trim the pins flush (5).

fronts to accommodate the drawer bottoms. You also must trim 1/32 in. off the bottom edge of each drawer front with the jointer. This will allow you to do the final fit of the assembled drawers by trimming only the bottom edge of the drawer sides. Trimming also prevents the bottom of the drawer front from scraping the stretcher when closing the drawer.

Next, rout a thumbnail profile along all four edges of the drawer fronts using a ¼-in. roundover bit. Finally, glue up the parts and flush the front dovetails with a shoulder plane and the back dovetails with a block plane.

Turned knobs top off the drawers— Turned cherry knobs are available through catalog retailers. However, I turned my own to ensure that the wood color matched. Making them by hand also allowed me to graduate the size of the knobs to match the graduated drawers.

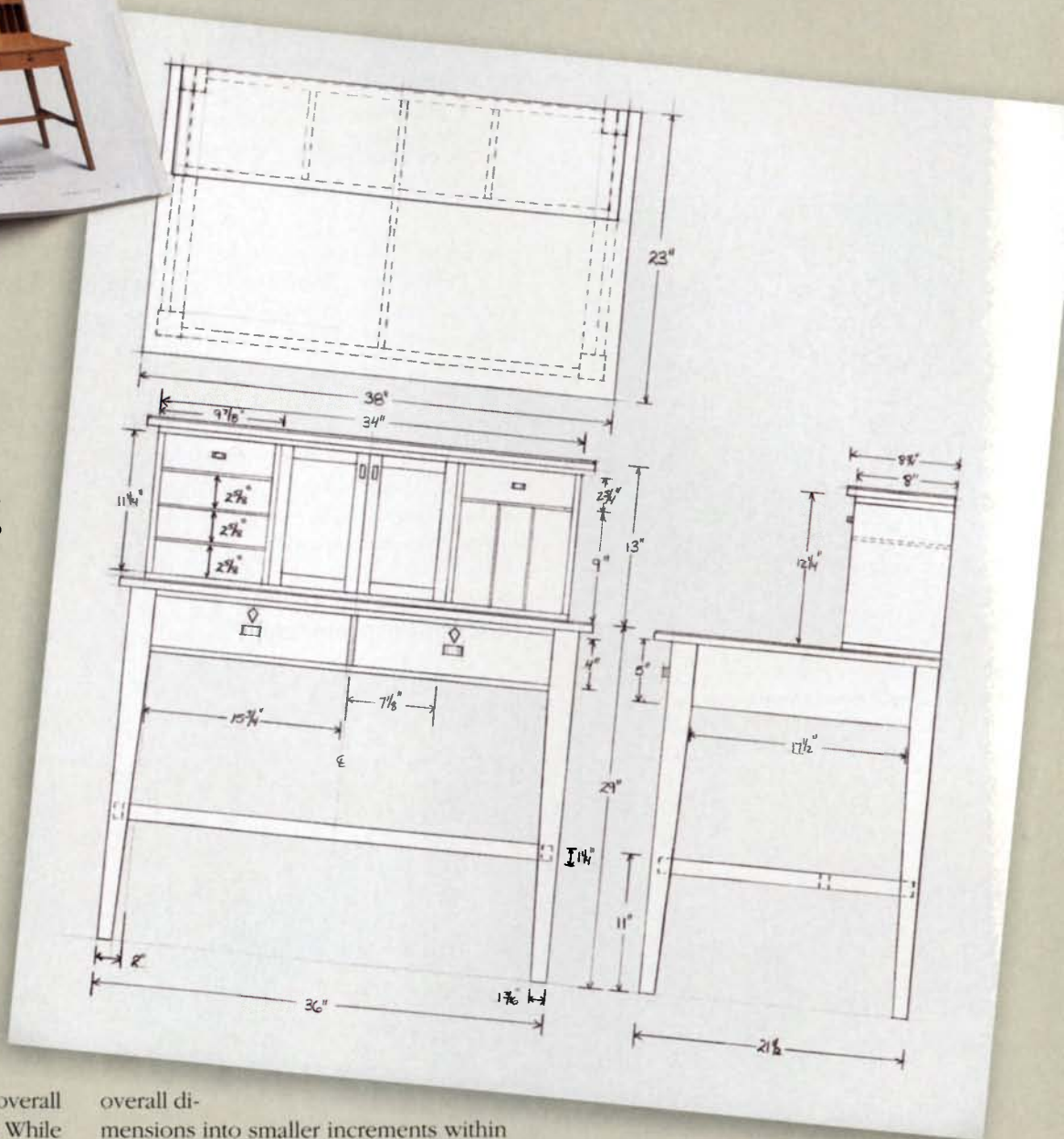
Oil finish highlights the wood

I finished the dresser with Waterlox, a wipe-on oil-based finish. Wipe-on oil finishes are easy to apply, they don't mask the beauty of the wood, and they don't depend on a dust-free environment for application. The biggest key to success in using an oil finish is surface preparation. Many finishing experts will insist that sanding with an abrasive greater than 150 grit is a waste of time. I'm certainly not a finishing expert and I'm no big fan of sanding, but I've learned that if I want a blotch-free oil finish, I have to sand to at least 400 grit before applying the first coat of oil.

Start by wiping on two heavy coats, letting each dry thoroughly, not worrying about raised grain or dust nibs. Apply a third coat and, with 600-grit sandpaper, sand the dresser while it's still wet; then wipe off the excess oil with a dry rag. After this coat has dried, apply two to four very thin coats of oil using a circular motion to work the oil into the surface, followed by long strokes with the grain. Finish by applying paste wax with steel wool. Buff with a soft cloth for a smooth, satin luster. □

Michael Pekovich is Fine Woodworking's *art director and an avid furniture maker.*

Scaling Furniture From Photos



Apply the laws of perspective to create working drawings from photographs

BY MIGUEL GOMEZ-IBANEZ

Thumbing through magazines and books, you may see furniture that you would like to make. But to do that, you need a set of working drawings. To evaluate proportions and details accurately, you need to draw the piece to scale.

Published photos usually provide overall dimensions: depth, width, and height. While helpful, they do not provide enough information on which to base a detailed drawing.

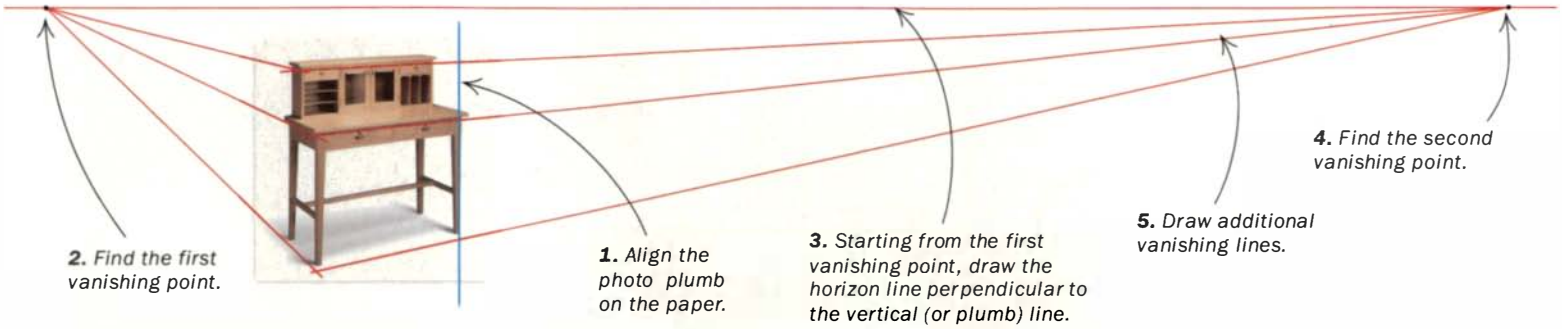
Using a copy of the photo of the furniture piece, string, a straightedge, an architect's scale, a sharp pencil, a bench or table with a sheet of plywood, and a T-square, it's possible to generate lines on each plane of the image beginning with one known dimension. Then you can break down the overall dimensions into smaller increments within that framework. This technique opens up a lot of opportunity to build projects without plans yet remain faithful to the originals.

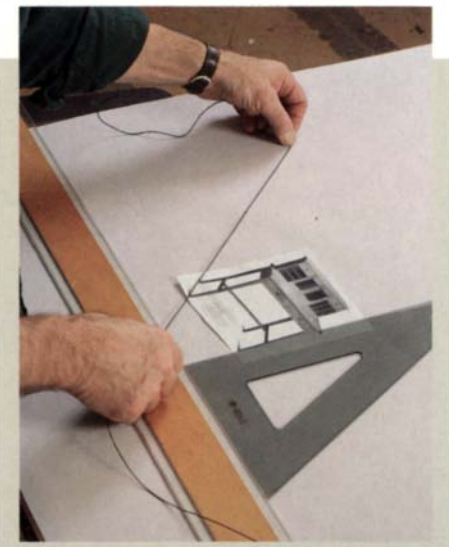
Perspective-drawing basics

During the 15th century, artists in Florence, Italy, developed a process for perspective drawing that allowed them to depict accurately three-dimensional objects on a two-dimensional canvas using simple principles. These artists realized that objects that are closer to you appear larger than those that are farther away. Additionally, parallel lines on each face appear to converge as they recede into the distance and, ultimately, appear to vanish altogether at a single point on the horizon. The viewer's

LOCATE THE VANISHING POINTS

Take the time to locate the vanishing points accurately. Hurrying at this stage will result in many inaccuracies down the line. Begin by taping a photocopy of the piece to the drawing paper, making sure that it is plumb to the baseline. The front and side each has a vanishing point.





Locate the first vanishing point. *Pivot a taut string from your thumb until it aligns with the top and bottom of the piece.*

eye level then is denoted by a horizon line. Finally, lines constructed to form (or partially form) an image will converge to a point on the horizon line—known as the vanishing point.

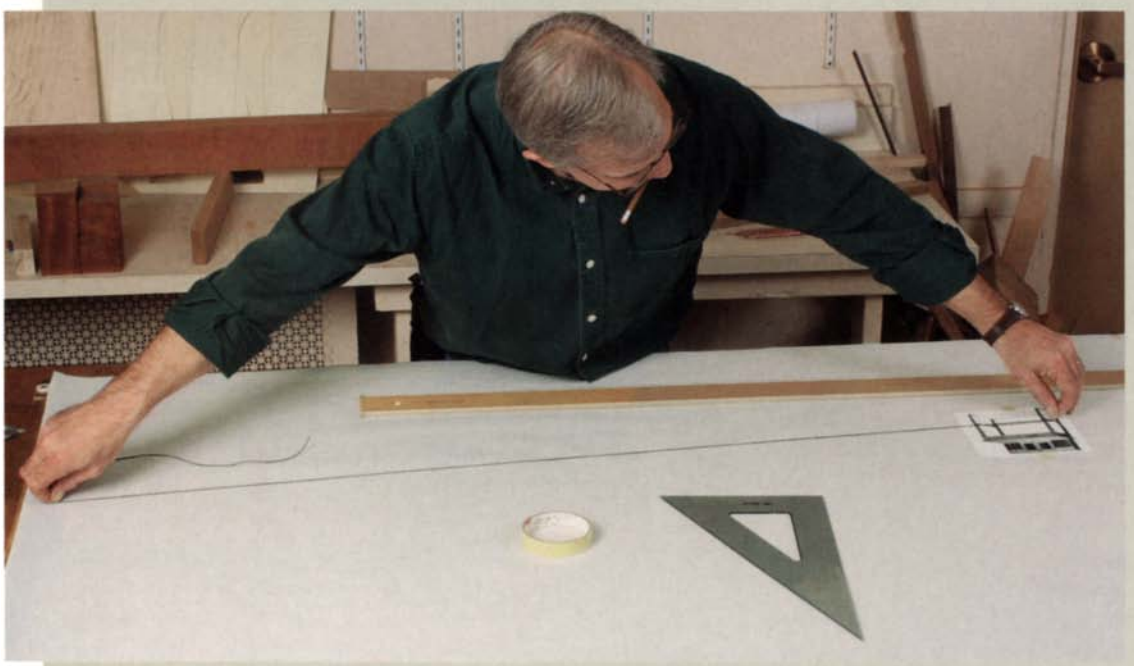
Applying perspective-drawing principles to photographs is perspective drawing in reverse. Here, you begin with a completed drawing (the photocopy of your photo), and the task is to determine the horizon line and vanishing points.

Draw the vanishing points based on the photograph

Start by taping paper onto your drafting table, making sure the paper extends to both ends of the table. You'll need the room because the vanishing points of the perspective drawing will carry well beyond the photograph on each side.

Next, think about where the vanishing points will land. Usually, one will be close by, and the other much farther away. If the vanishing points are too far apart to fit on the drafting table, bring them closer together by reducing the scale of the photocopied image. Then, situate the photocopy so that the vertical lines that define the sides of the piece are perpendicular to the parallel rule or T-square, and tape the photocopy to the paper.

Establish the first vanishing point—To the front and sides of the piece of furniture



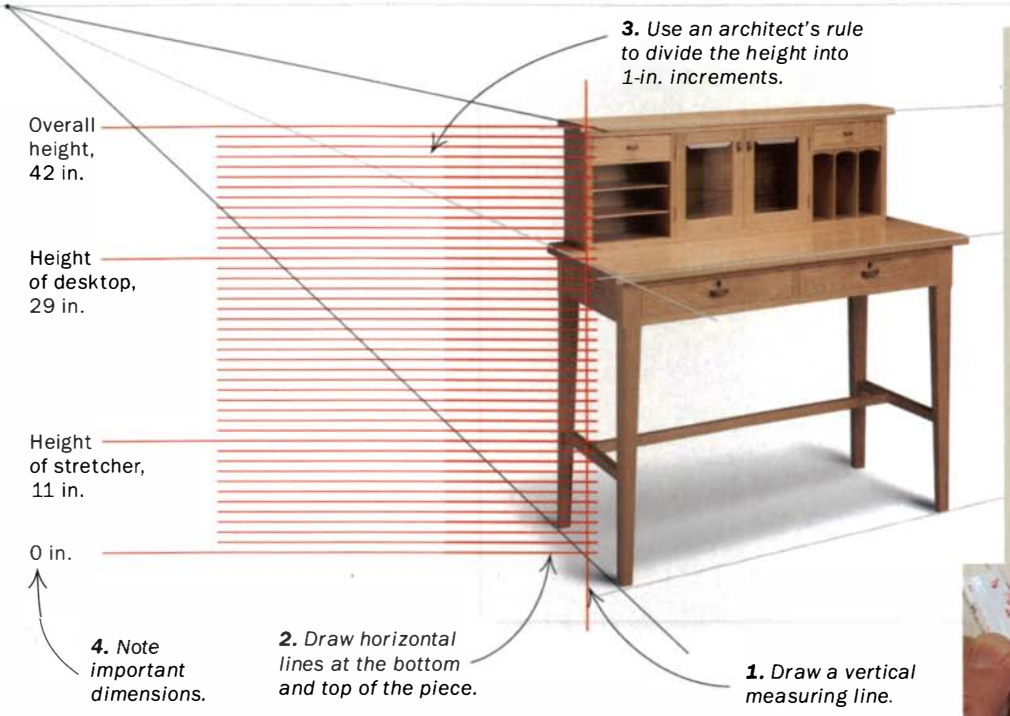
Find the second vanishing point. *Once the horizon line has been drawn from the first vanishing point, use the string method to find the second vanishing point upon the horizon line.*

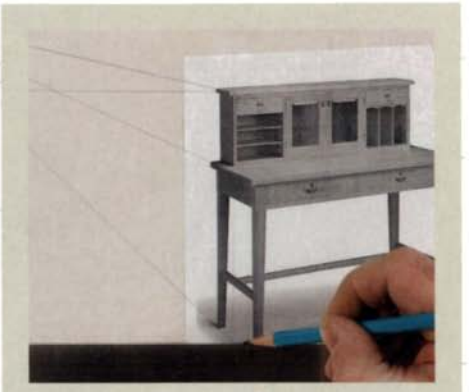
Push-pin pivot. *Stick a push pin into each vanishing point and use it to pivot a straightedge to draw accurate vanishing lines.*

Photos: Karen Wales

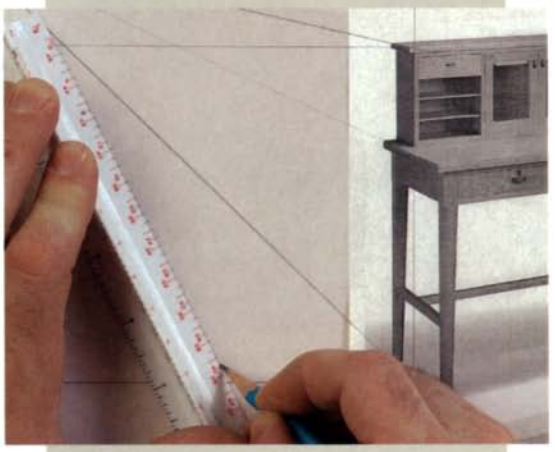
CONSTRUCT A VERTICAL SCALE

Because the upper case holds crucial information to be measured, it's best to strike the vertical measuring line on the front corner of that plane.

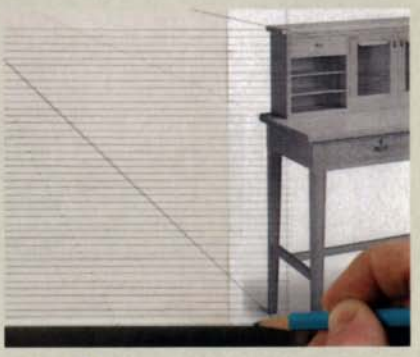




Mark the top and bottom of the piece. *Draw horizontal lines outward from where the vertical measuring line intersects with the top and bottom vanishing lines.*



Mark 1-in. increments. *Find a face on the architect's rule that divides the overall height of the piece into the same number of increments as its height in inches. You will need to skew the rule to do so.*



Complete the vertical scale. *Use a T-square to draw horizontal lines from each mark back to the vertical measuring line to complete the vertical scale.*

are planes that recede to a vanishing point in the distance—one to the right and one to the left.

A string is a handy tool for finding a vanishing point. Hold down one end of the string with your thumb, pull it taut, and then pivot from that point. Move the string across the photocopy until it lines up with the top and bottom planes of the piece of furniture. The point at which the string aligns with the top and bottom of the piece, as well as with the other horizontal planes in the piece, is the vanishing point. Stick a push pin in that spot.

Draw the horizon line—Now draw a horizontal line through the first vanishing point to represent the horizon. The horizon is eye level—the point of view of the photocopy. The line drawn from the first vanishing point will be perpendicular to the vertical lines that describe the sides of the piece of furniture.

Find the second vanishing point—Once the horizon line has been established, finding the next vanishing point is easy because you already know it has to occur at some point along that line. Use the string and your thumb to find the second vanishing point, just as you did to find the first one. Place a push pin at that point.

Once you have established both vanishing points, draw lines from each one, across the photocopy to define the top and bottom of the image. Use the push pin placed in each vanishing point to serve as a pivot for the straightedge. Maintaining contact with the pin as you swing the straightedge will keep the vanishing lines accurate as you draw. Once you've drawn the vanishing lines around the perimeter of the image, you are ready to determine the vertical dimensions of the piece.

Scale for the vertical dimensions

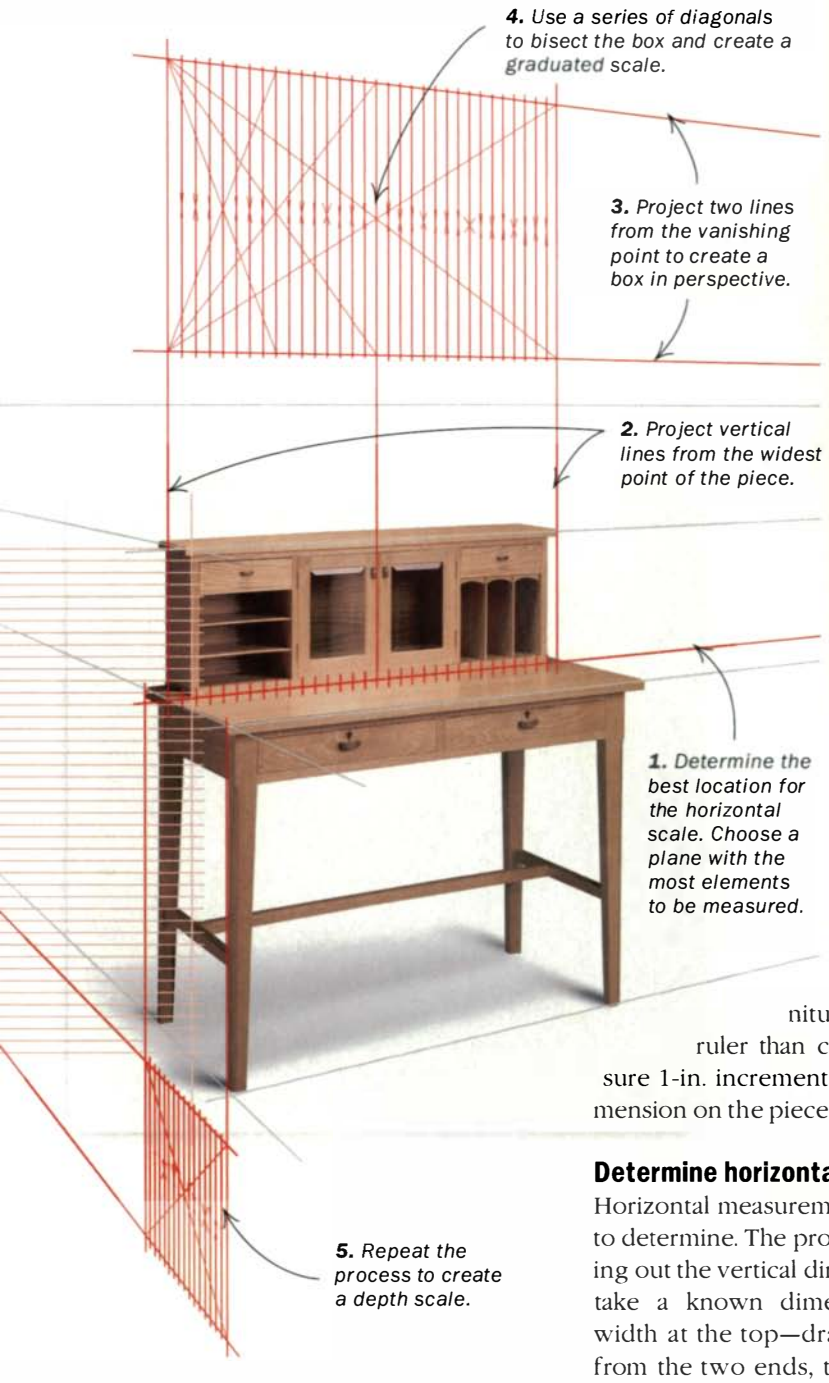
Establish a vertical measuring line on one of the corners of the piece of furniture in the photo. The line should extend beyond the top and bottom of the photo.

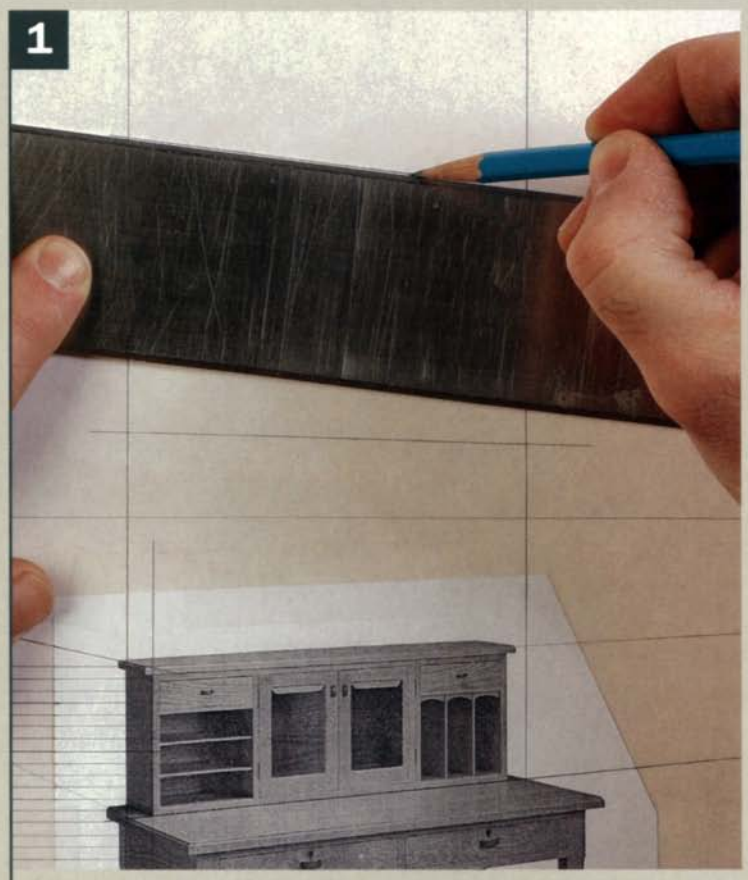
Draw perpendicular lines off to one side both from the top and bottom of the measuring line that establishes the height of the piece. These two lines will be parallel to each other. Now divide the measuring line into 1-in. increments. In this example, the

Drawings: Kelly J. Dunton

CREATE WIDTH AND DEPTH SCALES

Width and depth are trickier to visualize because they are created in perspective. Still, there is an accurate graphic solution for plotting both views.





Rectangle represents the width scale. *Draw a measuring line to the vanishing point, along the width of the desk where it meets the upper case. Then draw vertical lines at each end. Draw lines from one vanishing point (above) to mark off a grid space in perspective.*

height is 42 in. Use the architect's rule to find a scale in which the distance from 0 in. to 42 in. is somewhat longer than the distance between the two parallel lines. Lay the scale at an angle so that the 0 point is on one line and the 42 in. is on the other. In this case, a scale of ⅛ in. = 1 ft. worked well. Mark the 1-in. increments along the scale on your drawing. Then extend each mark back to the measuring line on the corner of the piece of furniture. You now have a ruler than can be used to measure 1-in. increments on any vertical dimension on the piece.

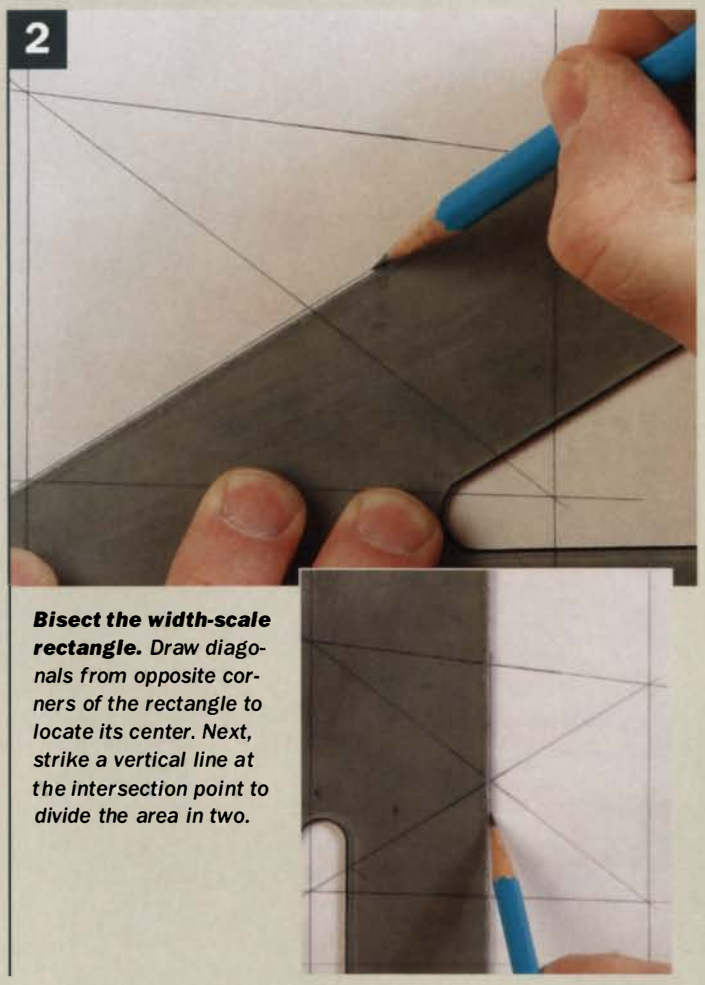
Determine horizontal dimensions

Horizontal measurements are a bit harder to determine. The process is similar to laying out the vertical dimensions in that you take a known dimension—usually the width at the top—draw parallel lines up from the two ends, then divide this distance into smaller, more useful increments. However, the width dimension that is provided with the photograph applies to a line that is receding into the background, so the increments on this line recede as well, getting smaller from foreground to background.

Dividing a receding line into accurate dimensions is done using the diagonals of a rectangle to divide the distance in half, and doing that as many times as necessary to reach a useful set of increments. The rectangle is formed by the two vertical lines extended from points that describe the width of the image, and another pair of lines that meet at a vanishing point. The four lines form a rectangle that recedes into the background.

Bisect rectangles to find useful increments for measuring—When you connect the opposite corners of this receding rectangle with diagonals, you have found its center. Drawing a vertical line from the center point onto the photocopy divides the distance between the two sides in half, according to the rules of perspective. Because the distance you are bisecting is receding, the two halves are not equal lengths, but they are accurate to the image in the photocopy.

This process of bisecting the width using diagonals is done as many times as neces-



Bisect the width-scale rectangle. *Draw diagonals from opposite corners of the rectangle to locate its center. Next, strike a vertical line at the intersection point to divide the area in two.*

Continue to divide into smaller increments. *Bisect each grid area. Divisions appear to get smaller as they approach the vanishing point because they are in perspective.*

sary until you arrive at a set of useful increments. In the example, the known width is 38 in. Bisecting this dimension gives you two increments of 19 in. Do this four more times, and you have increments of 1 3/16 in.; fine enough for most measuring and similar to the 1-in. increments of the vertical scale.

Finally, create a depth scale, using the same procedure you used in developing the width scale. When you connect the sets of points, and extend those lines across the face, sides, and top of the piece of furniture, you will establish a complete and detailed grid. The grid will enable you to read any element on each of these defined planes. With this information, you will be able to draw your piece full scale and create an accurate working drawing from which to build. □

Miguel Gomez-Ibañez is an architect and furniture maker in Boston.

Draw a scaled plan. *From the three scales you now can determine any dimension you need to draw an accurate measured plan.*

18-inch Bandsaws

These big machines excel at cutting thick stock and slicing veneers quickly

BY ROLAND JOHNSON

Many woodworkers have 14-in. bandsaws. For a wide variety of cuts, these machines are more than adequate. But if you cut a lot of thick stock, or if you resaw stock in the 9-in.-wide to 12-in.-wide range, an 18-in. saw is worth considering. Not only is it a size that offers extra capacity, but most 18-in. bandsaws also have more horsepower to cut faster.

I looked at 11 models of 18-in. bandsaws, ranging in price from $900 to almost $3,000. They include the Agazzani B-18, Bridgewood PBS 440, Craftsman 22450, Delta 28-682, General 90-270, Grizzly G0506, Jet JWBS-18, Laguna LT18SE, Lobo BS-0181, Rikon 10-340, and Woodtek 118-199. (At the time of the review, the 18-in. bandsaw made by Mini-Max was unavailable and will be reviewed in a subsequent issue.)

A good guide system is a good start

Among the important characteristics of a bandsaw, the quality of the upper and lower blade-guide systems ranks high. Although they can differ, all guide systems have a common function: to support the blade during a cut.

With that in mind, I looked closely at each guide system. As I soon found out, they can be grouped in three different categories: solid-block guides (steel or ceramic), wheel (European) guides, and bearing guides.

Despite their differences, all of these guide systems are designed to support the blade at three points—the sides of the blade and the back of the blade. Side support helps keep the blade from twisting or drifting side to side during a cut. The

A VARIETY OF BLADE GUIDES

BEARING GUIDES

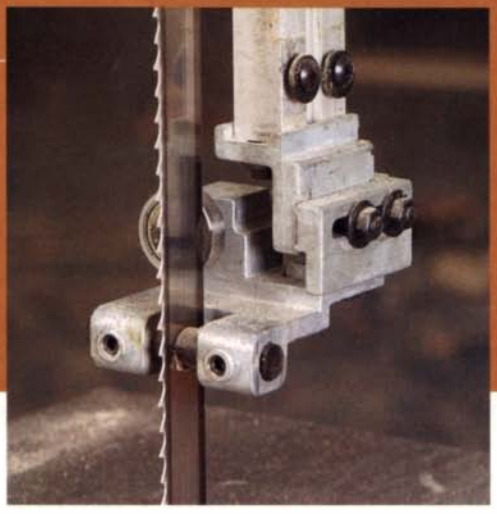
Because the edges of the guides bear against the sides of the blade, bearing guides offer good support. Also, friction is reduced because the ball bearings spin at the same speed as the blade.

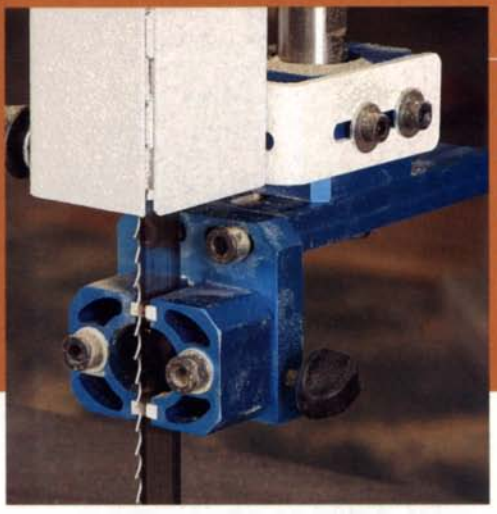
WHEEL GUIDES

Guides designed in the European style support the sides of the blade using the face surface of the ball bearings. Compared with solid guides made from steel, the wheel guides produce less heat from friction.

STEEL SOLID-BLOCK GUIDES

Solid-block guides made from steel have one drawback—friction from the blade can wear down the blocks, especially when making curved cuts.





CERAMIC SOLID-BLOCK GUIDES

The solid-block guides on the Laguna bandsaw are made from ceramic, a material that's harder than steel, so they'll last longer.

back support helps prevent the blade from flexing on edge, which can cause blade drift (that annoying propensity of a bandsaw blade to wander off a straight line during cutting), an uneven cut, or both. It also prevents the blade from getting pushed off the wheels.

Solid-block guides—On the Craftsman, Laguna, and Lobo bandsaws, solid blocks support the sides of the blade. The blocks on the Craftsman and Lobo are steel; the Laguna has ceramic blocks.

Both the Craftsman and the Lobo have an angled outside lower guide block, which shortens the distance between the upper and lower guides. That's a plus, because the blade is less likely to bow or twist. However, it was a chore to set the guides on the Craftsman and Lobo saws. I needed four different tools—a screwdriver, an open-end wrench, and two different-size Allen wrenches. Also, a hard-to-reach bolt made it difficult to adjust the guides front to back. I resorted to tilting the table to reach the bolt on the lower guide. Then, after carefully setting the upper guides, I learned that tightening the setscrews made the guides move slightly, so they no longer were positioned properly. It took several tries to figure out how to compensate for the problem.

The Laguna bandsaw features a unique guide system that incorporates blocks made of ceramic, a material that won't wear as quickly as steel. Two blocks, instead of the usual one, support each side of the Laguna's blade. The back blocks are ceramic, too, and allow the back edge of the blade to slide against them during a cut.

The Laguna guides worked well, providing especially good support to the blade, and setup was relatively easy. This model was my favorite among the saws with solid-block guides.

Wheel guides—The Agazzani, Bridgewood, General, Grizzly, and Woodtek use wheel guides (a wheel mounted in a bushing) to provide side-to-side blade support. The wheel guides, sometimes called European guides, are adjusted so that the side of each one ends up lightly touching the blade. To ensure that the wheels won't contact and dull the blade teeth, the edge of each wheel is positioned just behind the gullets of the blade.

For back-of-the-blade support, Bridgewood uses a third wheel guide. However, I'd prefer to see a ball-bearing setup, such as that on the General, Grizzly, and Woodtek. On those three saws, the bearing's edge faces the blade. As a result, the blade and the edge of the bearing move at the same speed, minimizing friction.

All of the wheel guides were somewhat fussy to set and adjust. For starters, there was a lot of play in the side wheel guides and the back guides, so seating the guides required a bit of pressure be-

Photos, except where noted: Tom Begnal

AGAZZANI B-18

323-999-2909
www.eagle-tools.com

Acceptable results in the resaw test; did well in curve-cutting test; ranked fourth in frame-deflection test; very good rip fence; cast-iron trunnion support and trunnions a plus; fussy-to-adjust guides made blade changing a chore; fit and finish were top notch.

Street price
$1,995

Motor
2½ hp, 11.8 amps at 230v

Resaw capacity
12¾ in.

Rip capacity
17⅛ in.

BRIDGEWOOD PBS 440

800-235-2100
www.wilkemach.com

AUTHOR'S BEST OVERALL CHOICE

Fastest resaw cutting-speed; did well in curve-cutting test; ranked first (best) in frame-deflection test; cast-iron trunnion support and trunnions a plus; very good rip fence but lowest rip capacity; fussy-to-adjust guides made blade changing a chore.

Street price
$1,800

Motor
3 hp, 16.5 amps at 230v

Resaw capacity
11⅝ in.

Rip capacity
16¾₁₆ in.

DETAILS MAKE A DIFFERENCE

When adjusting the guides on the Jet saw, Johnson found the small thumbscrews difficult to tighten fully without pliers. The front-to-back bearing adjustments on the Delta (below) incorporate handles that were convenient and relatively comfortable.

tween the guide and blade. Also, it was impossible to get an even amount of guide pressure on each side of the blade because none of the side wheel guides was on the same plane.

Bearing guides—The Delta, Jet, and Rikon saws use ball-bearing guides to support the sides and back of the blade. But unlike wheel guides, the bearing-guide system supports the sides of the blade using the edge of the ball bearing. Each bearing can be positioned to almost touch the blade (about 0.003 in.), so the guide provides excellent support. Plus, when the bearing and blade touch, they both move at the same speed, which helps reduce friction.

On the Delta saw, the back of the blade bears against the face of the ball bearing. This arrangement works okay, but it sometimes can produce grooves in the face of the bearing. Eventually, that can cause the bearing to chatter or to stop rotating altogether. I prefer the design used on the Rikon and Jet saws, where the edge of the bearing runs against the blade.

Setting the guides on the Delta was a mix of ease and exasperation. Crank handles proved handy for loosening the setscrews that allow for front-to-back adjustment. But to make the side-to-side adjustment, I had to search for an Allen wrench and a screwdriver. Adjusting the lower guides on the Delta meant tilting the table and using a ball-end-type Allen wrench and screwdriver. The adjustments had to be done without a good line of sight to the blade.

The Jet saw also came up short here. Smallish thumbscrews lock the back bearing, and when hand-tightened, they quickly loosened. So I ended up using pliers to turn them. In addition, the lower side bearing on the Jet was a chore to adjust, especially when changing from narrow to wide blades. The Allen-head screws securing the

Photo, this page (top left): Roland Johnson

guide holder were positioned poorly. Indeed, the inside screw could be reached only with the table tilted and the guide moved to its rearmost position. The lock knob for the side bearing adjustment was in the way, and the knob had to be removed.

I prefer guides that simply slide back and forth, as on the Rikon. That way, the axles on the ball bearings remain parallel. The Rikon was easy to set up, needing only two Allen wrenches to adjust all of the guides. The toughest part was setting the upper rear bearing, because the blade guard created an obstacle. Even so, the Rikon saw was my favorite among the machines with bearing-guide systems.

A solid frame is important

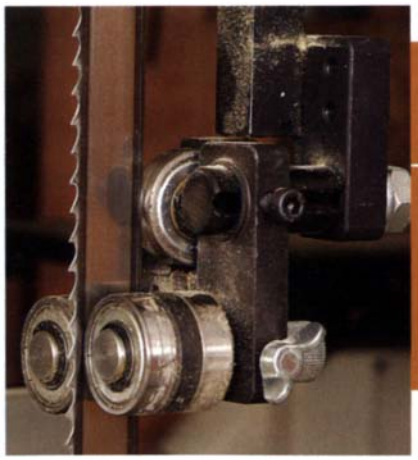
When cutting on a bandsaw, especially when resawing wide boards or thick stock, the blade gets pushed into the rear guide. That force, in turn, is applied to the upper portion of the saw. A frame that lacks adequate stiffness is going to deflect slightly. When that happens, the blade twists, and the quality of the cut suffers.

I ran a simple test to see how these saws compared when it came to frame stiffness. I used a push-pull gauge to apply 16 lb. to the upper frame of each saw while measuring the deflection of the frame using a dial indicator. Most of the saws performed well on this test, with the Bridgewood, General, and Grizzly getting the highest marks (see the chart on pp. 70-71). On the other end of the scale, the Craftsman, Jet, and Woodtek had more deflection than I'd like to see.

Blade changing should not cause headaches

I change from one blade size to another pretty regularly, so a saw that allows for quick blade changes gets extra points from me. Honors for the easiest blade-change went to the Laguna and the Rikon saws. Both saws required only two wrenches (included with the saws) to make all of the adjustments to the guides, which were easy to set. I didn't have to remove the blade guards, and the throat plates were large and easy to use.

I did have to remove the rip-fence guide on the Rikon, but it was held in place only with large turn knobs and could be removed quickly. The lower guide on the Rikon has a fine adjustment knob that was a breeze to set. I did find that I had to track the ⅜-in. blade slightly forward of center because the lower guides could not move back far enough to clear the blade teeth. A screw head holding the rack on the trunnion was the culprit.

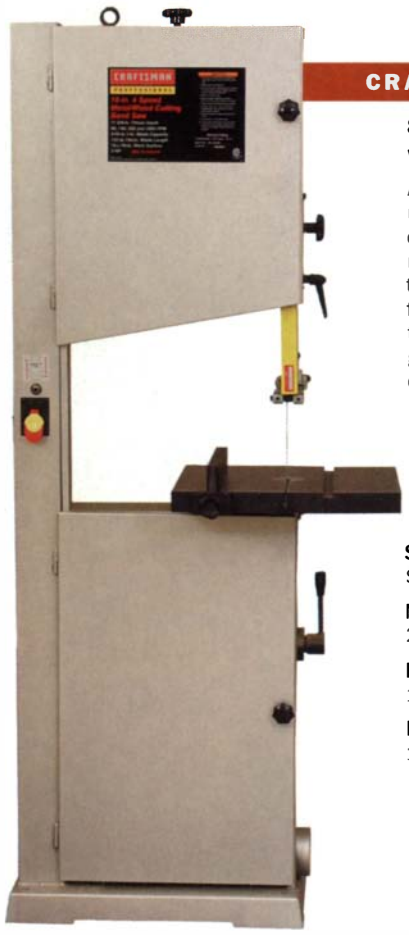


LOW-FRICTION REAR GUIDE

The Rikon and Jet saws each positions the rear bearing so that its edge faces the back of the blade, allowing it to move freely with the blade.

Wheel alignment helps the blade to track properly

Ideally, the upper and lower wheels of a bandsaw should be on the same plane prior to blade installation. If they aren't, blade



CRAFTSMAN 22450

800-697-3277
www.craftsman.com

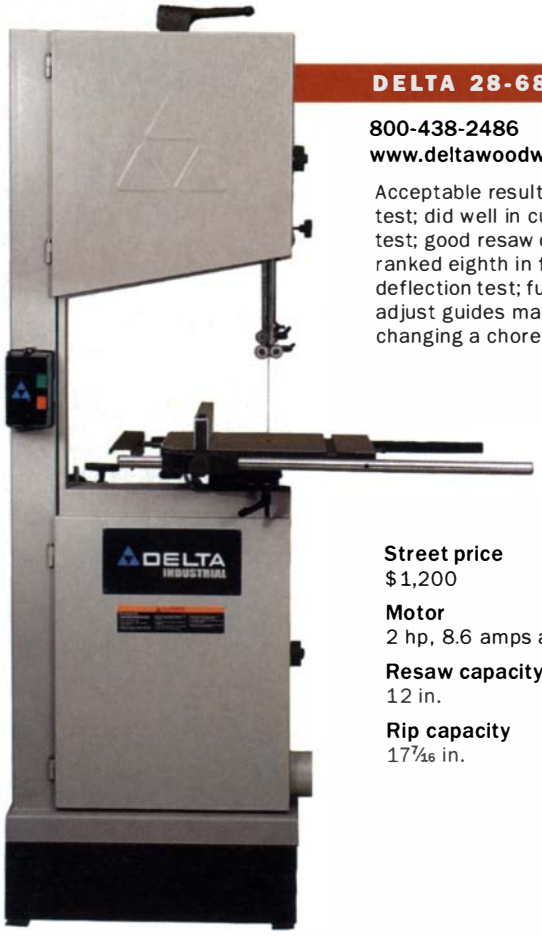
Acceptable results in resaw test; did well in curve-cutting test; ranked ninth in frame-deflection test; fence not adjustable for drift or squareness to table; fussy-to-adjust guides made blade changing a chore.

Street price
$1,300

Motor
2 hp, 14 amps at 115v

Resaw capacity
10⅞ in.

Rip capacity
17¾ in.



DELTA 28-682

800-438-2486
www.deltawoodworking.com

Acceptable results in resaw test; did well in curve-cutting test; good resaw capacity; ranked eighth in frame-deflection test; fussy-to-adjust guides made blade changing a chore.

Street price
$1,200

Motor
2 hp, 8.6 amps at 230v

Resaw capacity
12 in.

Rip capacity
17⅞₁₆ in.

GENERAL 90-270

819-472-1161
www.general.ca

Acceptable results in resaw test; did well in curve-cutting test; ranked third in frame-deflection test; cast-iron trunnion support and trunnions a plus; fence not adjustable for drift or squareness to table; fussy-to-adjust guides made blade changing a chore.

Street price
$1,500

Motor
3 hp, 19 amps at 220v

Resaw capacity
11½ in.

Rip capacity
17⅜ in.

GRIZZLY G0506

800-523-4777
www.grizzly.com

Acceptable results in resaw test; did well in curve-cutting test; ranked second in frame-deflection test; cast-iron trunnion support and trunnions a plus; fence not adjustable for drift or squareness to table; fussy-to-adjust guides made blade changing a chore.

Street price
$1,200

Motor
2 hp, 13 amps at 220v

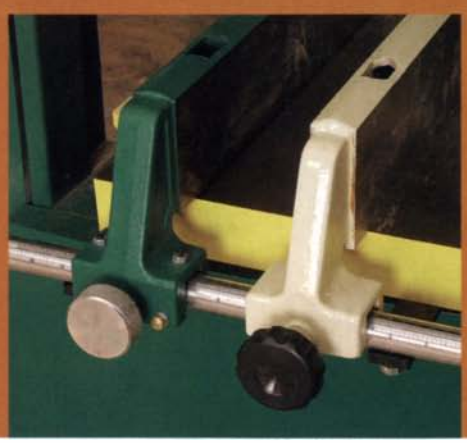
Resaw capacity
10 in.

Rip capacity
17⁵⁄₁₆ in.

A LOOK AT FENCES

High fence adds support. *With its extra height and sturdy construction, the Laguna (shown) and Agazzani rip fences offer added support to a tall workpiece, an advantage when resawing wide stock.*

Small parts make a big improvement in rip fences. *The rip fences on the General, Grizzly, and Woodtek appear identical (Woodtek and Grizzly shown). But the Woodtek (left) has four screws at the clamp head, making the fence easily adjustable for blade drift and squareness to the table.*



Dealing with drift. *To adjust the Jet and Rikon rip fences for blade drift, you simply loosen four bolts.*

JET JWBS-18

877-274-6848
www.jettools.com

Acceptable results in resaw test; did well in curve-cutting test; good fence; ranked eleventh in frame-deflection test; lowest resaw capacity; fussy-to-adjust guides made blade changing a chore.

Street price
$1,200

Motor
1½ hp, 16 amps at 115v

Resaw capacity
9⅞ in.

Rip capacity
18⁵⁄₁₆ in.

LAGUNA LT18SE

800-234-1976
www.lagunatools.com

AUTHOR'S BEST OVERALL CHOICE

Did well in curve-cutting test; second-best resaw speed; highest resaw capacity by far; best guides; relatively easy blade changing; cast-iron trunnion support and steel trunnions a plus; very good rip fence; second-lowest rip capacity; ranked sixth in frame-deflection test.

Street price
$2,900

Motor
5 hp, 21 amps at 220v

Resaw capacity
17¾ in.

Rip capacity
16¾ in.

tracking can be difficult, or even impossible if the misalignment is bad enough. Measurements showed that all of the wheels were close to perfectly aligned, so I had no problem tracking the blade on any of these machines. Keep in mind, though, that wheel alignment out of the box is not necessarily evidence of poor design, as all of the saws I looked at offered a means to adjust the lower wheel.

A stiff table can support heavy stock

A bandsaw table shouldn't tilt while supporting a heavy board. To get a sense of table sturdiness, I applied 30 lb. of force (a number I deemed reasonable) to the outside end of each table, and checked for movement.

The Agazzani, Bridgewood, General, Grizzly, Laguna, Rikon, and Woodtek bandsaws scored high marks in this test. All of them have trunnion supports made from cast iron, and trunnions made from either heavy-gauge steel (Laguna, Rikon) or cast iron (Agazzani, Bridgewood, General, Grizzly, and Woodtek). Also, the tables on all seven of these saws could be locked securely. Large handles on the Laguna and Rikon made them easiest to lock, but I had to use a wrench to lock the tables on the Agazzani, Bridgewood, General, Grizzly, and Woodtek.

The Craftsman, Delta, Jet, and Lobo saws have trunnions and trunnion supports made from a lightweight alloy. The tables on all of them tilted when the 30-lb. test force was applied.

For resawing, a quality rip fence is a must

Each of the saws I tested came with a rip fence. Depending on the kind of work you do, the value of the fence can range from can't-possibly-get-along-without-it to never-use-it. Any woodworker doing a lot of resawing, however, will want a good-quality rip fence—one that is sturdy and locks solidly in place. It also should sit square to the top of the table. The rip fence should be adjustable for blade drift, too.

The fences on the Craftsman, General, Grizzly, and Lobo saws can't be adjusted for blade drift. They also can't be adjusted square to the tabletops on any of these saws.

At first glance, the Woodtek fence looks to be a clone of the General and Grizzly fences. But, to Woodtek's credit, a closer look reveals the manufacturer took an extra step, adding a few adjustment screws that allow the rip fence to be adjusted both for blade drift and for squareness to the table.

The Jet and the Rikon each has a rip fence with a Biesemeyer-style clamp head mounted to it. Loosening the bolts that attach the fence to the clamp head enables the fence to be pivoted slightly and allow for blade drift. When checked, the fences on both saws were dead-on square to the tabletop.

The Agazzani and Laguna saws both have fences that can be mounted in a high or a low position. In the high position, the Laguna rip fence is the tallest; a bonus when resawing wide lumber. When set in the low position on each saw, the fence doesn't interfere with the upper blade guide and guard, allowing the guide to be lowered closer to the workpiece for better support and a safer cut.

The Agazzani, Bridgewood, and Laguna fences are adjustable for blade drift. Although there is no adjustment for squaring the fence to the top of the saw table, these three fences all can be shimmed

square. The Agazzani and Bridgewood were perfect when checked; the Laguna needed only minor shimming to get it square.

Cutting curves and resawing wide stock were not a problem

Once all of the preliminary tests were completed, it was time to put wood to steel and find out just how well these saws could cut. The test had two parts. First, I checked to see how well the saws would cut curves. Then I gave them a resawing workout.

For the curve-cutting test, each saw was equipped with a ⅜-in.-wide, 0.025-in.-thick, hook-tooth, 6-tpi, carbon-steel blade made by Lenox. To make the saws work extrahard, I used pine that was a full 6 in. thick. All of the curve cuts were made in an "S" pattern, and each machine made several cuts. I was pleasantly surprised to find that all of the saws handled the curve-cutting test with little difficulty. Therefore, I gave all of them a grade of excellent.

To do the resawing test, I first installed in each saw a 1-in.-wide, 0.035-in.-thick, 3-tpi, carbon-steel blade from Lenox. Also, for those saws with fences that didn't adjust for blade drift, I built a 6-in.-high wooden fence that could be clamped to the saw table at any angle. The test consisted of making several ⅛-in.-thick veneer cuts through 8-in.-wide red oak and 10-in.-wide hard maple.

At the end of the day, the Bridgewood proved to be the fastest when it came to resawing. At a normal feed rate, the cut quality was quite good, and I practically could ram the wood into the blade without bogging the motor. Even with an extreme feed rate, the cut quality suffered somewhat but was still pretty good.

All of the other saws performed adequately, but I did note that the feed rate was directly proportional to the motor's horsepower: Higher horsepower generally translated into faster feed rates.

Choosing favorites

The three most important features of a bandsaw are adequate horsepower (more so if you mostly resaw wide stock; less so if you crosscut thin material), minimal frame deflection, and upper and lower guide systems that give the blade plenty of support.

With that in mind, the Bridgewood and the Laguna both get my vote for Best Overall. With its 3-hp motor, the Bridgewood had plenty of get-up-and-go, as made clear by its top rating in the resaw test. It also received the best mark when it came to frame deflection. And while its wheel guides weren't my favorite, they did offer pretty good support. In addition, the Bridgewood had a very good rip fence and a sturdy tabletop.

The 5-hp motor on the Laguna was by far the biggest in this group, and it resawed at a brisk pace, although not as fast as the Bridgewood. Blade-changing speed was the quickest, though, and the saw's ceramic guides were my favorite. The Laguna also got high marks on the tabletop-sturdiness test and had an excellent rip fence.

Both the General and Grizzly saws also stood out. Their frames showed little deflection, and their tabletops were plenty sturdy.

Considering its bargain-basement price, I was pleasantly surprised by the overall quality of the Rikon bandsaw. It offered acceptable power, easy guide setup, and lots of thoughtful little features, such as the view port to check blade tracking with the upper wheel cover closed. The Rikon easily got my vote as Best Value. □

Roland Johnson is a woodworker living in Sauk Rapids, Minn. Several of the tests in this review were done with the assistance of John Kirchoff, a woodworker in Foley, Minn.

LOBO BS-0181

562-949-3747
www.lobomachine.com

Acceptable results in resaw test; did well in curve-cutting test; ranked fifth in frame-deflection test; fence not adjustable for drift or squareness to table; fussy-to-adjust guides made blade changing a chore.

Street price
$900

Motor
1½ hp, 12 amps at 220v

Resaw capacity
10¾ in.

Rip capacity
17⅝ in.

TEST RESULTS

You usually can get a good idea of quality by looking at how effectively the bandsaw performs a few basic tasks. In particular, cutting ability, machine sturdiness, and blade-changing ease have a big impact on overall performance. So Johnson put the machines through some tests to see how well they handled those basic tasks. The chart shows the results.

Measuring frame deflection. *To find out how much each frame deflected during a heavy cut, Johnson used a push-pull gauge and a dial indicator. Too much deflection can cause the blade to twist, resulting in blade drift, a rough cut, or both.*

MODEL
Agazzani B-18
BEST OVERALL Bridgewood PBS 440
Craftsman 22450
Delta 28-682
General 90-270
Grizzly G0506
Jet JWBS-18
BEST OVERALL Laguna LT18SE
Lobo BS-0181
BEST VALUE Rikon 10-340
Woodtek 118-199

RIKON 10-340

877-884-5167
www.rikontools.com

AUTHOR'S BEST VALUE CHOICE

Acceptable results in resaw test; did well in curve-cutting test; relatively easy blade changing; cast-iron trunnion support and steel trunnions a plus; good fence; ranked seventh in frame-deflection test.

Street price
$900

Motor
2 hp, 12.5 amps at 220v

Resaw capacity
11⅛ in.

Rip capacity
18½ in.

WOODTEK 118-199

800-645-9292
www.woodworker.com

Acceptable results in resaw test; did well in curve-cutting test; cast-iron trunnion support and trunnions a plus; good fence; ranked tenth in frame-deflection test; fussy-to-adjust guides made blade changing a chore.

Street price
$1,000

Motor
2 hp, 9.6 amps at 230v

Resaw capacity
10 in.

Rip capacity
17¼ in.

RESAW TEST	CURVE-CUTTING TEST	TABLE-LOCK EFFECTIVENESS	FRAME DEFLECTION	EASE OF BLADE CHANGING	GUIDE TYPE
Very good	Excellent	Excellent	0.0213 in.	Fair	Wheel
Excellent	Excellent	Very good	0.0145 in.	Fair	Wheel
Good	Excellent	Fair	0.0470 in.	Fair	Steel block
Good	Excellent	Fair	0.0408 in.	Fair	Bearing
Very good	Excellent	Very good	0.0175 in.	Fair	Wheel
Good	Excellent	Very good	0.0153 in.	Fair	Wheel
Fair	Excellent	Fair	0.0698 in.	Fair	Bearing
Very good	Excellent	Excellent	0.0335 in.	Excellent	Ceramic block
Fair	Excellent	Fair	0.0283 in.	Fair	Steel block
Good	Excellent	Excellent	0.0338 in.	Very good	Bearing
Good	Excellent	Very good	0.0595 in.	Fair	Wheel

Templates Guide the Way

Create elegant curves and furniture parts with router templates

BY DOUG PETERMAN

When the talk turned to tools at a recent woodworkers' meeting, I surprised myself by naming router templates as my favorite. Don't get me wrong: I love hand tools and use them constantly, but my work would be less efficient and less profitable without these simple but versatile templates.

Router templates can be used to create and fine-tune furniture forms before cutting into expensive stock. They allow me to see a design full-size and in relation to the other parts of a piece. Not to mention, templates make it easy to reproduce identical parts.

Almost all template-routing operations require only a handful of tools, including a router, two common bearing-guided bits, a bandsaw, a sander, and a shopmade template. With those items and a few drawing tools, such as a compass or even french curves, you are fully equipped to tackle any template-routing job.

Making a template

Templates can be made from any stiff sheet material with enough strength and thickness to guide the bearing on a router bit. In a pinch I've even used scrap wall paneling and old crate lumber, but there are better choices. Mainly, I use two materials: ⅛-in.-thick Masonite for one-offs and ¼-in.-thick Baltic-birch plywood for production. Both have the basic characteristics of dimensional stability and consistency (no hard or soft spots), and are readily available.

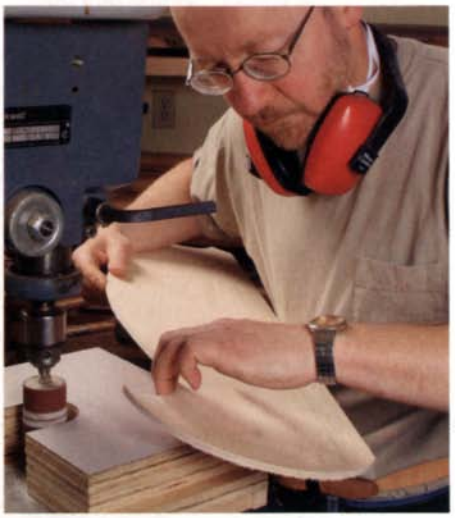
Drawing the pattern—Trusting your eye is the quickest route to getting the shape you want in a template, but drawing tools will help you get there.

I usually begin by sketching the template pattern directly on the surface of the workpiece, especially when I'm working to preserve the grain in a particular board. Once I'm satisfied with the shape, I transfer it to the template stock.

When drawing the pattern on the template, it's a good idea to add at least 1 in. of material lead-in and exit beyond the workpiece edge wherever possible. Without it, the bit can catch as you try to make the first corner of the template meet the bearing. Believe me, I've done it.

Whether you draw a pattern freehand or with drawing tools, you often will be left with bumpy lines and rough transitions

Photos: Matt Berger



Cut and sand the template. *After roughing out the template on the bandsaw—cutting 1/16 in. outside the line—smooth the template to its final shape using a belt sander (left) for flat or convex areas and a drum sander (right) for inside curves. Subtle irregularities are difficult to see, so inspect your template for dips and bumps by running your hand across its edge.*

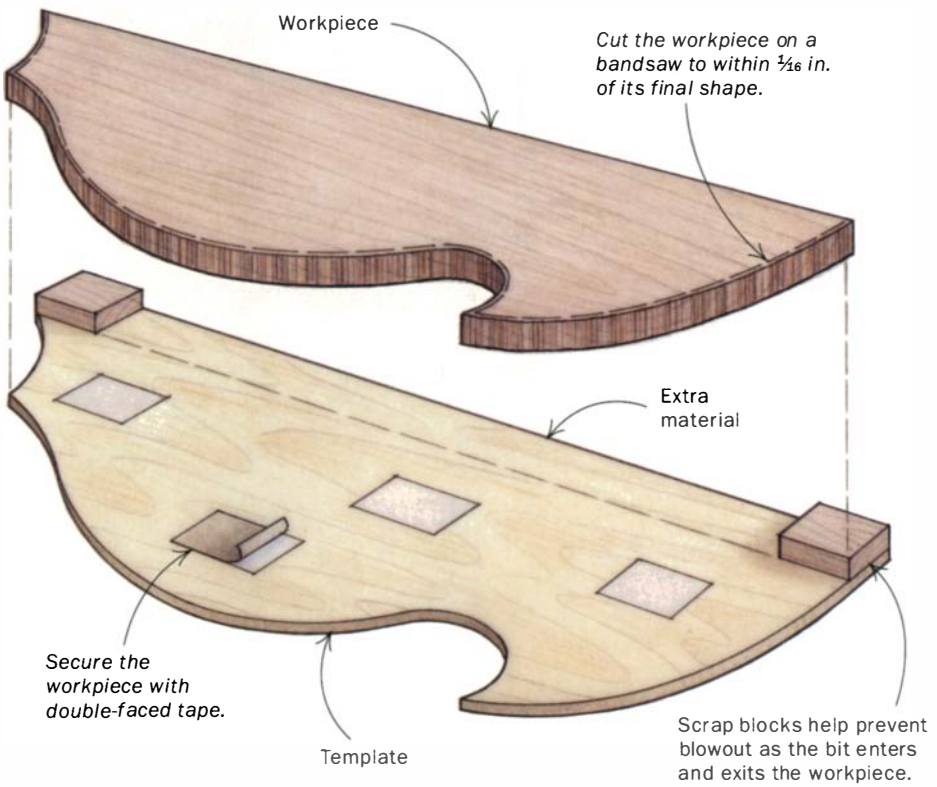
Glue scrap blocks to the template. *The blocks prevent the bit from catching the corner of the workpiece and damaging it upon exit and entry.*

that need to be smoothed out. The trick to achieving a smooth, or fair, curve is to get your eyes right down near the drawing surface and look along the line. Bumps and dips are easy to see, but also look for transitions that are too abrupt. Work your way along the line, refining it until the curves are fair.

Rough-cut on the bandsaw, then sand—When rough-cutting the template, keep the blade about 1/16 in. from the pencil line to leave enough stock for sanding and final smoothing.

To get to the final shape, use a stationary belt sander. I use two—a 6-in. belt and a 1-in. belt—and both run with the table perpendicular to the vertical belt. For tight inside curves, a sanding drum mounted in the drill press is ideal.

Power sanding to a line involves a few simple rules. First, keep the material moving smoothly with even speed and light pressure. Never let it stop. Second, for optimal control, try to have the waste come off so that you hit the line just as the template passes the trailing edge of the belt or the center of the drum. This gives you one spot to watch and the comfort that the rest of the abrasive belt is safely cutting waste. Finally, work on bumps and dips by sanding the areas around them. Start before the fault, sand smoothly through it, and carry on a bit beyond.



If you don't have power-sanding equipment, templates can be smoothed by hand, using either files or sandpaper. I prefer files because it's easier to keep a square edge with them. Use a flat file along the edge on convex curves, and a half-round or round file pointed diagonally across the template but still moving along the edge for concave areas. Sand as the last step if you must, but use a very firm or hard block to avoid rounding the edge.

To check your work, slide your hand over the finished piece to find any bumps or dips. Smooth them out as needed.

Using the router templates

When routing a workpiece with a template, I use bearing-guided straight bits

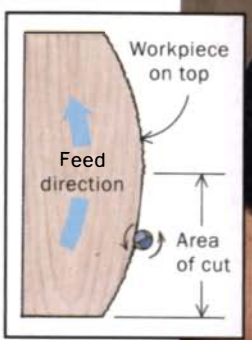
Drawings: Vince Babak

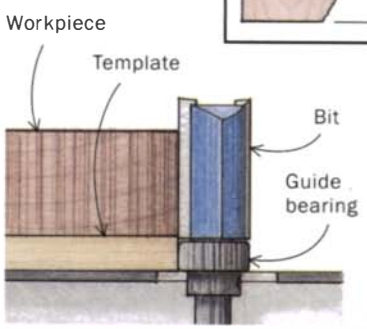
TEMPLATE-ROUTING

To avoid tearout when the grain changes direction on a workpiece, flip the piece onto its opposite side to reverse the direction of the cut. At the same time, switch from a pattern bit to a flush-trimming bit instead of removing the template and remounting it on the other side.

BEGIN WITH THE TEMPLATE ON THE BOTTOM

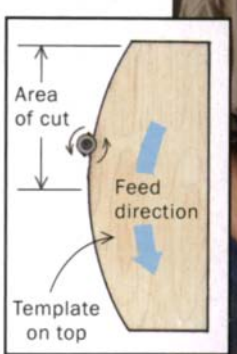
With the template on the underside of the workpiece, use the pattern bit to rout all of the areas where the bit is cutting in the same direction as the grain. Leave the remaining areas uncut.

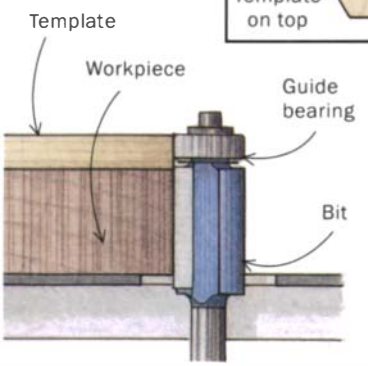




FLIP THE WORKPIECE AND CHANGE THE BIT

With the template on top of the workpiece, use the flush-trimming bit to rout the remaining areas in the opposite direction.





that are known as flush-trimming bits when the bearing is on the tip, and pattern or template bits when the bearing is on the shank. You need one of each type; mine are ½-in. bits with a cutter length of 1 in. When using these straight bits with templates that are exactly the size of the finished piece, there's no need to add offset for a bushing, and no worries that a bushing may be off center.

The bearings should be exactly the same diameter as the cutter path to produce a flush cut. A good way to test is to make one pass with only the bit riding on the template edge; then make a second pass with the bearing riding on the surface that was just cut.

There should be no step between the first cut and the second cut. If the bearing has left an impression where it rolled along the cut surface, it means your router has excessive runout, you have a bad bearing, or the bit does not run true. In all of these cases, the bearing is acting like a

Troubleshooting common problems

BUMPS

Bumps occur when the template loses contact with the bearing. This often is caused by chips impairing the edge of the template. Also, make sure the bearing is running against the template and not the workpiece, and then take another pass.

DIPS

If the router bit slips, the bearing will lose contact with the template, and the cutter will dig into the workpiece. To avoid this tough-to-repair mistake, make sure the router-bit height is locked securely, and keep steady pressure on the workpiece while cutting.

TEAROUT

Tearout results from cutting against the grain, when the bit lifts fibers and breaks off small chips. Routing with the grain is the simplest solution. When routing highly figured wood, you can avoid tearout by changing the cutting direction more frequently.

BURNING

Burn marks are left when the workpiece moves too slowly past the bit; they show up worst on end grain. To avoid burning the finished edge, move the workpiece more quickly past the bit for the final pass.

hammer as it swings around just off the center of rotation.

Secure the template to the workpiece—For quick one-off routing, attach a template with double-faced tape or a few globs of hot-melt glue.

If I have to make several parts with the same template, I try to use clamps (shop-made cam, wing nuts or knobs, toggle clamp, etc.) to hold the work. Vacuum clamping works well for production pieces where you need 360° access to the piece. Special needs call for creativity: Templates can be made into two-sided jigs or jigs that box in a piece—anything to get the template securely in place.

Trim the waste on the bandsaw—With the template attached to the workpiece, use a bandsaw to cut away the bulk of the waste. Cut to about ⅛6 in. from the line all around to reduce routing time. I used to leave more wood and hog it off with the router, but those heavy cuts sometimes raised chips that ran into the grain below the template edge. For quick trimming—especially handy when producing multiple copies of a template—I attach a finger guide to the bandsaw tabletop to keep the template ⅛6 in. from the bandsaw blade. This also ensures that the cut stays on the waste side of the workpiece.

Use a router table and two straight bits—I do as much template routing as possible on the router table. Only when the workpiece is too large to be coaxed across the table will I take the router to the piece. Setup is very simple: Just mount the bit and raise or lower it until the bearing is lined up with the template.

As much as possible, rout with the grain. If you think of the grain as a stack of paper, the cutter should be making the edge of each sheet lie down, not lift up. This is why you need both types of bearing-guided router bits. To rout with the grain on all edges of the workpiece, you must flip over the workpiece and alternate between the two bearing-guided router bits.

One thing to avoid is climb cutting, which is when the bit is spinning in the same direction as the workpiece is being fed. This is dangerous and should be attempted only where almost all of the waste has been trimmed off. Even so, always anticipate the workpiece being pulled forward into the cut, and keep your hands out of the bit's path.

Starting with the pattern bit in a router table, rout all of the areas that you can without lifting the grain. Change to the flush-trimming bit, flip the workpiece so that the template is on top, and rout the remaining uncut areas, going with the grain. If you have trouble keeping track of grain direction, draw arrows on the worksurface that point in the direction of the grain. □

Doug Peterman makes custom furniture in his home workshop in Stratford, Ont., Canada.

Working With MDF

Medium-density fiberboard is the perfect choice for painted cabinetry and veneered surfaces

BY WILLIAM DUCKWORTH

At the risk of inviting the scorn of some purists, I'm here to make a bold declaration: For the cores of veneered panels and tabletops and any painted cabinetry, there is no better and more appropriate product to use than medium-density fiberboard (MDF). And virtually any species available as the face veneer of hardwood plywood is also available with an MDF core.

No material is perfect, of course, but in the case of MDF, the pros far outweigh the cons. MDF is inexpensive and extremely stable, and it's manufactured in consistent thicknesses (unlike most plywood). In some ways, using MDF is more environmentally friendly than using solid lumber

because there is an inexhaustible, renewable supply of the raw material MDF is made from—a supply that will be available for generations to come. On the downside, though, sheets of MDF are heavy, and the dust kicked up when you cut and rout the material can be, at best, an irritating nuisance; at worst, it can be a health hazard if your exposure is extreme.

What is MDF?

Until conducting research to prepare for this article, I knew little about MDF besides that it is a wood composite. I got my hands on industry documents that describe the contents and manufacture of MDF in terms of cellulosic fibers, tracheids, pendistors, and defribrators—some of the words sound almost like language you'd expect to hear in medical school. Put in layman's terms, most MDF can be defined as panel products made from wood that has been pulverized into tiny fibers, heated, mixed with glue, pressed to a consistent thickness, dried, and cut to size.

Industry standards differentiate between three density grades of MDF: low (weighs less than 40 lb. per cu. ft.), standard (40 lb. to 50 lb. per cu. ft.), and high (more than 50 lb. per cu. ft.). And like any competitively manufactured product, there is a huge variety in kind and quality, even within the standard-density grade that makes up the majority of MDF made and sold.

All MDF is not equal—Some manufacturers are strict about what goes into the cauldron, discarding all of the bark and using only logs of a single softwood species for the fibers. Makers in Chile and Australia use radiata pine, which yields a panel light in color and light in weight. Manufacturers in the southern United States often use yellow pine, and in western states, they use Douglas fir and spruce. But not all MDF is made from softwoods. Manufacturers in the northeastern United States and in Canada also make panels using aspen, birch, cherry, maple, and oak in the form of freshly cut logs and what they call sawmill residuals—the cutoffs and scraps from other wood-processing facilities. Also, reclaimed wood, such as the waste generated at construction sites, can be added to the mix, and agrifibers from straw, wheat, barley, rice, and sugar-cane crops also increasingly are being used to make MDF.

As any good cook can tell you, the ingre-

What goes into medium-density fiberboard

Pulverized wood fibers (right) are mixed into a soup of glue resins and waxes, formed into sheets under immense pressures, dried, sanded to exact thicknesses, and cut to size. When MDF is machined in a woodshop without a good dust-collection setup, those tiny fibers become an airborne cloud that will settle on every horizontal surface. A good dust mask is essential when you cut or rout MDF.

MDF IS AVAILABLE IN MANY SHEET SIZES AND THICKNESSES

Some manufacturers make MDF panels as thin as 3/16 in. and as thick as 2¼ in., but the more commonly available thicknesses are ¼ in., ⅜ in., ½ in., ⅝ in., ¾ in., 1 in., 1⅛ in., and 1¼ in. Because the manufacturers' press sizes are quite big (I found one listed at 5 ft. by 24 ft.!), you can get MDF in sheet sizes so large that lifting them becomes an issue. I once built a conference table from four sheets of 1¼-in.-thick MDF, 5 ft. wide by 9 ft. long. At a density of about 50 lb. per cu. ft., each of those panels weighed more than 225 lb., and handling them was not fun. But one big advantage to extralarge sizes is that you can minimize the waste generated by some jobs. A standard 4-ft. by 8-ft. sheet of ¾-in.-thick MDF weighs about 96 lb. The lightweight varieties weigh about 64 lb.—just enough to keep you in shape.

THE DENSITY AND WEIGHT OF MDF

Low- and standard-density panels make up the majority of MDF used for furniture and cabinetwork. The heavier high-density panels are used primarily for flooring. The average weight of a ¾-in.-thick, 4-ft. by 8-ft. sheet of each density is listed below. Standard-density MDF is heavier than most plywood; low density is lighter.

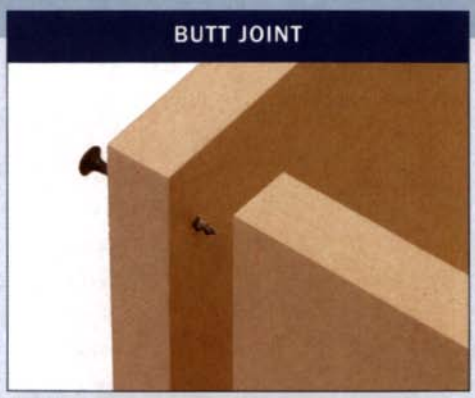
Photos, except where noted: Kelly J. Dunton; facing page (right): Scott Faber

Building with MDF

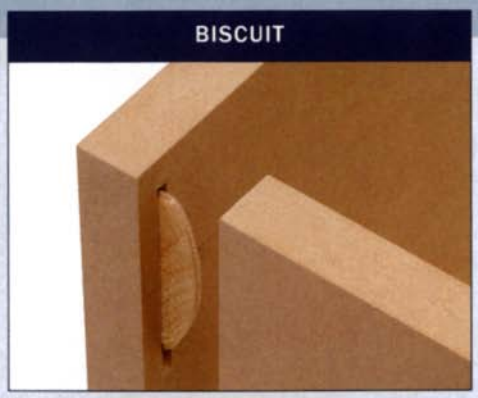
MDF cores are not as strong as most lumber and plywood, but when joining together pieces of MDF, you can use just about any joint that you would use with plywood: butt joints with screws, biscuits, splines, fully rabbeted edges, and rabbeted tongues in dadoed grooves (see the photos at right). You also can miter the edges if you want an invisible joint in a preveneered panel, but be sure to use plenty of glue on the mitered edges because they're so porous.

You must drill properly sized pilot holes whenever you fasten a screw into an MDF edge; otherwise, it will split readily. For casework, I like to use a rabbeted tongue in a dadoed groove. This joint is not as important for the added glue surface and strength it may provide as it is for the assistance it renders when you're assembling large cabinets. It makes the job a lot easier, especially when you're working alone.

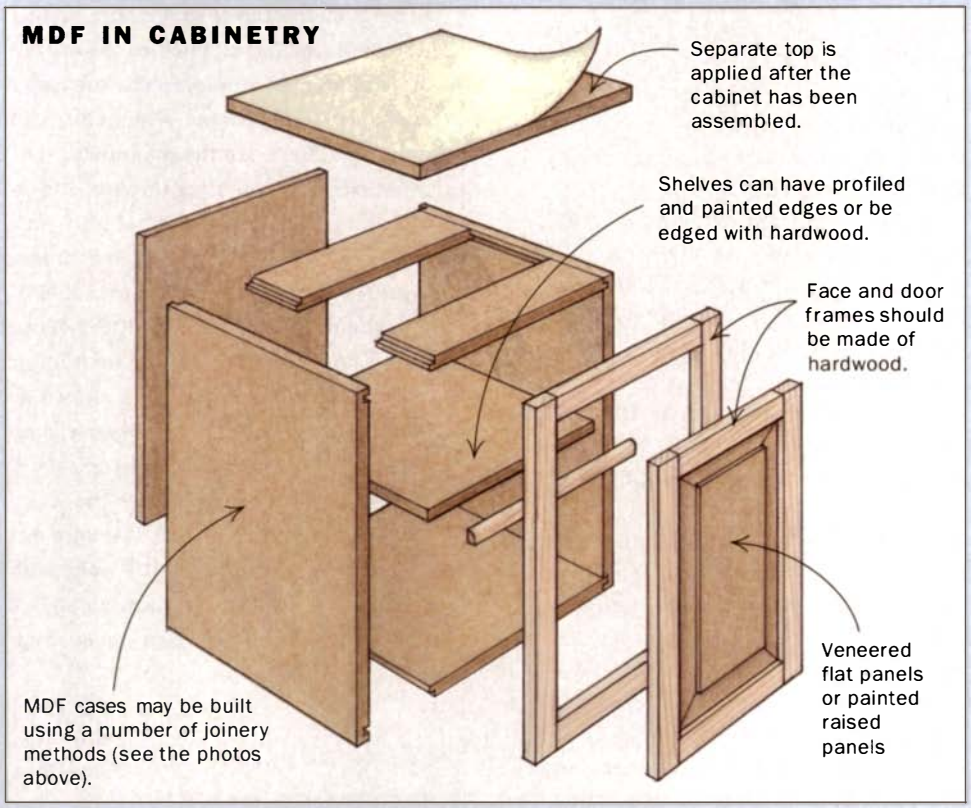
Deciding whether to use simple or complex joinery in cabinets is always a judgment call. Most casework is fairly simple, and it rarely has to be engineered to carry heavy loads, so butt joints with screws are sufficient. But when cabinets will be subjected to stress (a heavy television, a stone countertop) or abuse (young children who like to slam doors), don't skimp on the glue and screws.



Screwed butt joints are the simplest way to connect two case components. *Glue at these joints is not very effective because the edges of MDF are extremely porous.*



Biscuits add moderate structural muscle. *Biscuit joints can be cut quickly, and make pieces easy to align without the use of mechanical fasteners.*

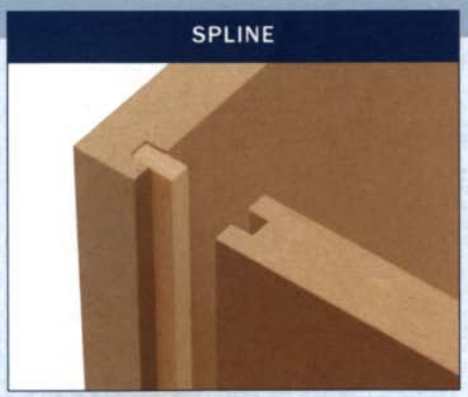


dients that go into the recipe greatly affect the outcome. Different characteristics of weight and strength result from the manufacturing process. Color also is affected, though that's not a variable I care much about because most of the MDF I use gets covered with veneer, strips of lumber, or paint. One exception is MDF used around the shop for jigs, fences, and the like, but who cares what color that is?

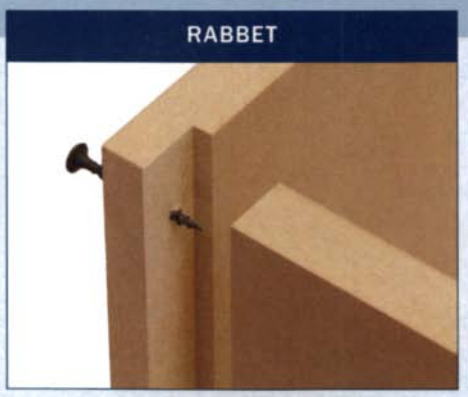
Another big variable that affects the end product is the type of glue used. Urea formaldehyde (UF) resins have been the primary adhesive for the composite-panel industry since its inception in the years shortly after World War II. UF resins lend strength and stability to the finished panels, at a reasonable cost, but they offer only limited moisture resistance. They also emit small amounts of formaldehyde, which can irritate eyes and respiratory systems and possibly cause more severe health problems in people with extreme sensitivities to it. If you or a family member fits that category, you can buy a formaldehyde-free panel. The Medite Corporation (www.sierrapine.com) makes Medex and Medite II—moisture-resistant and interior-grade MDF panels that emit only extremely low levels of formaldehyde.

Melamine-fortified UF resins and phenol-formaldehyde (PF) resins are glues sometimes used to enhance the water resistance

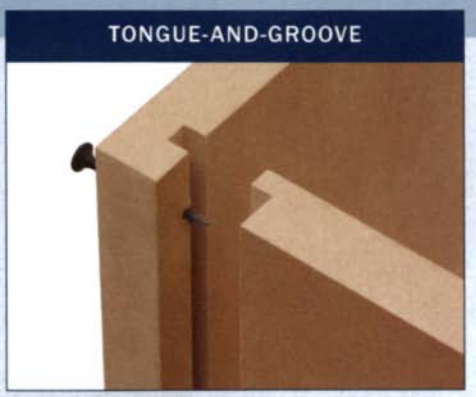
Drawings: Vince Babak



Splines are a little stronger. *They align corner joints perfectly, and when clamped with enough glue, they don't require screws or nails.*



A step up from butt joints. *Rabbets can be cut with a dado set on the tablesaw or with a router. Parts can be screwed or nailed together.*



Tongues and dadoed grooves require two setups. *You have to mill matching shapes in mating pieces, but case assembly is a breeze.*

A QUICK TONGUE-AND-GROOVE JOINT ON THE TABLESAW

Cut the dadoed groove first (top). *Use scraps to tweak the location and depth of the cut. To mill the matching tongue, add a 1/16-in. blade to the dado set and a scrap of wood or plywood clamped to the saw fence (bottom).*

Dry-fit and drill pilot holes before final assembly. *After cutting the joints but before adding glue, assemble the cabinet to make sure all of the components fit together easily. At this stage you can drill pilot holes for screws, as necessary. Pilot holes are a must; otherwise, screws will split the MDF.*

of the final product. Methyl diisocyanate glues are used in panels made from agrifibers for the same reason. There is no such thing as waterproof MDF, but Medex—which was developed for nonstructural, high-moisture applications, such as countertops, bathroom cabinets, baseboards, and painted window sills—is rated as highly water resistant. An industry sourcebook, *Buyers and Specifiers Guide,* published by the Composite Panel Association (www.pbmdf.com), lists a couple of plants in Canada that make an exterior-grade MDF using spruce and pine as the raw material.

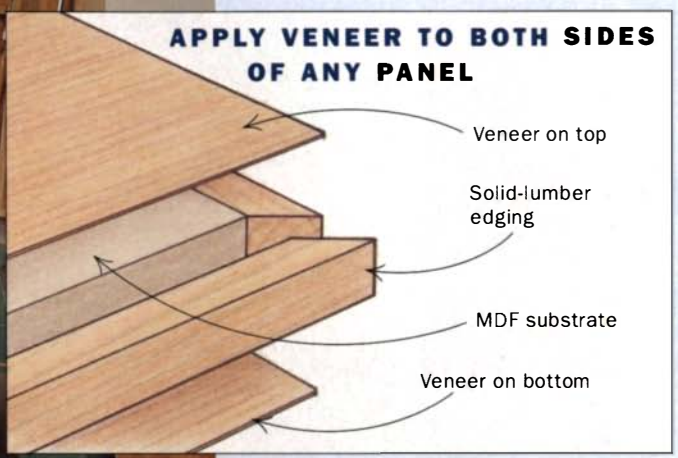
As a substrate for veneer or paint, MDF has no equal

Years ago, when I first tried my hand at veneering, I rummaged through volumes of used books and found an old how-to text on the subject. I learned that the core of veneered panels should be made from either mahogany or poplar. I also learned that crossbanding—a layer of veneer glued to the core under the face veneer—was essential to minimize core movement and to provide a smooth surface that would not telegraph imperfections (knots, plane gouges, etc.) in the core surface through the face veneer. I dutifully followed that advice for my first few veneered projects, laboriously milling the lumber, gluing up

MDF is a stable core for furniture. *Duckworth used MDF for the veneered tabletop (above). He added the lumber edging to the MDF core before laying up the veneer.*

No better core for veneer

Unlike lumber used for the same purpose, MDF does not require any crossbanding because the surface is perfectly smooth and the material is more stable than lumber. MDF will swell and shrink slightly with seasonal moisture changes but not nearly as much as lumber will. Whenever possible, glue up panels larger than the final size you need, and then trim them to size after the glue has set. If your design calls for solid-lumber edgings, shaped or square, it's better to glue them on before veneering the surface of the MDF. Use a paint roller to apply the glue: You'll get more even coverage, and it will save time. Always lay up veneer on both sides of any panel, even if only one side will be visible. A balanced panel is a lot less likely to warp.



You can use a paint roller to apply glue. *Some people pour glue onto a panel surface and comb it out with a notched trowel. Disposable paint rollers do the job faster, and they provide more even coverage.*

Watch it on the Web — **For tips on veneering MDF, go to www.finewoodworking.com.**

the cores, and crossbanding them before applying the final show faces. When an older, wiser woodworker suggested that I use MDF instead of going to all that trouble, it was an epiphany of sorts.

I never looked back, and I have used MDF exclusively for veneered tabletops and door panels ever since. More often than not, I no longer lay up any crossbanding; I just glue the face veneer directly over the smooth face of the MDF core. The only exception is when a specific finished thickness requires adding some crossbanding to build up the thickness. MDF readily accepts any glue that I decide to use for veneering.

Some glues are more creep resistant and moisture resistant than others, and your choice of glue should depend on how those properties relate to the end use of your project. I usually prefer the convenience and quick setting time of regular yellow polyvinyl acetate glue, and I apply it with a paint roller to get even coverage quickly. If creep resistance is a critical concern, I use urea resin glue; for maximum moisture resistance, I use resorcinol. Having used contact cement once, I never will make that mistake again. Veneers laid up with contact cement probably won't delaminate, but they will buckle when exposed to severe seasonal changes in humidity. When laying up veneers on a

core, treat both sides the same: What you glue to one side, glue to the other to make a balanced panel that will not warp. It's an old rule, and a good one—ignoring it will invite trouble down the road.

MDF takes a paint finish beautifully— For any painted cabinets, furniture, wall paneling, and some moldings, MDF is a great choice of material. Surface faces come from the factory sanded to 150 grit or better, essentially paint-ready. I usually scuff-sand the surface quickly with 120-grit or 150-grit sandpaper to remove any dirt and grime and to provide for better adhesion of the primer coat.

Solvent-based primers (oil-, alcohol-, or lacquer-based) are a must. Never use a water-based product for the initial finish coat. The wood fibers will swell too much when they absorb the water, and you'll get what is, in effect, raised grain on the surface that will not sand out. After the surface has been sealed with something else, though, a water-based paint will not affect the MDF adversely. I use latex paint over properly sealed wall paneling and trim molding, but for painted furniture or cabinets, I prefer the finish quality of oil- or lacquer-based paint that is applied with a spray gun.

The only real difficulty that arises when painting MDF is what to do about the edges, which are more porous than the surface—similar to the end grain of lumber—and drink in most of the finish. I've known woodworkers who go to the trouble of edge-banding the MDF. That approach takes more time than the method I prefer, and, no matter how well the edge-banding has been applied and trimmed, a seam still may show at the very edge.

I use drywall compound to fill the edges, whether they are cut squarely or shaped with a router bit, and I apply the compound liberally with a finger or with the palm of my hand. Unlike spackle or conventional wood putties, drywall compound has a soupy texture, so it's a little sloppy going on. But after it dries, it sands off easily.

For edges shaped with a router, you can use the same router bit as a scraper to remove the excess globs of compound before touching up the edges with 220-grit, silicon-carbide sandpaper. □

William Duckworth is associate editor.

A perfect surface for paint

The edges of MDF are more porous, so they need to be filled before painting. Drywall compound works well because it's easy to apply and easy to sand smooth after it has dried. One application of compound usually is enough, but lower-density panels may require two. Never use a water-based paint product as a first finish coat on MDF. The moisture will cause the wood fibers to swell too much, resulting in a lousy finish. Shellac or oil-based primers are a must for the first coat; what you apply after that doesn't matter. Cabinetmaker Justus Koshiol sprayed the faces of the MDF built-ins (right) with oil-based paint.

You don't need a putty knife. *A finger is the only tool you need to fill the edges of MDF with the soupy drywall compound. Sand the surface and the sharp corners of edges before filling them.*

Router-bit scraper. *Excess compound is easy to scrape away using the same router bit that cut the shaped edge.*

Oil-based primer for the first coat. *Oil-based (or shellac or lacquer) primers are a must for the sealer coat on MDF that will be painted. After the surface has been sealed and sanded smooth, you can use a water-based paint.*

Photo, this page (top right): Scott Faber

Current Work

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David Conigliari Flanders, N.J.

Conigliari and his wife needed more wardrobe space, so he built this Honduras mahogany and pau ferro armoire (26 in. deep by 53 in. wide by 82 in. tall) for their bedroom. "After studying examples of many large case pieces," he said, "I decided I wanted mine to have an Asian look." Toward that end, Conigliari incorporated a curved top, shaped legs, and tansu hardware into the piece. The armoire is finished with hand-rubbed oil-based varnish and wax.

Glen O. Bohusch
Medina, Ohio

This bowl (4⅜ in. dia. by 4⅝ in. tall) is made of sycamore with holly and walnut and took 50 hours to complete. Bohusch, a turner for 10 years, was inspired to make this piece after seeing a porcelain vase with a similar pattern. The bowl has a polyurethane finish.

Matt Williams Hawkins, Texas

Williams made this poker table (62 in. dia. by 30 in. tall) for a client. Made of mahogany with ⅛-in. brass-strip inlays, the table took approximately 200 hours to complete. It can become a modest dining table when the drink trays are pushed in and the chip trays flipped over. The table is finished with hand-rubbed lacquer and wax.

Mike Girelli Bend, Ore.

This entertainment console (20 in. deep by 72 in. wide by 36 in. tall) is made of wenge and bubinga. "My design objective was to create something practical, stylish, and based on a classic idea," said Girelli, "but with subtle lines and features that make it interesting." The console has a hand-rubbed oil finish.

Pete Rodrigues
Kill Devil Hills, N.C.

Rodrigues made this wishbone shelf after attending a one-week design course at the Anderson Ranch Arts Center in Snowmass Village, Colo. "The course helped me think differently about designing furniture," said Rodrigues, "which then led me to sketch, make a model, and finally construct the wishbone." To make the shelf (16 in. deep by 48 in. wide by 77 in. tall), Rodrigues used bending plywood veneered with mahogany and birch plywood veneered with quilted maple. The project took 220 hours to complete and is finished with wipe-on polyurethane.

Michael Zwack Cambridge, Mass.

"I'm a self-taught woodworker who never has had occasion to build a chair before," Zwack said. After seeing a Chippendale chair at The Metropolitan Museum of Art, he decided to make this reproduction (20½ in. deep by 31½ in. wide by 44½ in. tall) "for the sport." Both the chair and the stool are made of walnut and finished with shellac.

Barry Walker South Dartmouth, Mass.

Inspired by the work of John Townsend, these bedside chests (16 in. deep by 24 in. wide by 28 in. tall) are made of tiger maple and walnut. The two pieces are almost identical, save for the different-style drawer fronts and the walnut bead under the base molding on the one at the right. Both chests are finished with shellac and varnish. Photo by Tim Sylvia

Michael Karafa Pittsburgh, Pa.

Karafa built this desk for a client who had seen a church altar that he liked and wanted a desk that reflected its Asian/Mission style. The desk (42 in. deep by 78 in. wide by 30 in. tall) is made of cherry and took approximately 320 hours to complete. It is finished with oil stain, shellac, and lacquer.

Michael Ragsdale Orlando, Fla.

This indoor version of an Adirondack chair (36 in. deep by 31½ in. wide by 33½ in. tall) is a story of many personal firsts for Ragsdale. Among them is the experience he gained beveling the slats to make the curved back and seat. The chair, made of sapele, is finished with an oil-and-polyurethane mix and polyurethane.

Mark W. Gordon Columbus, Ohio

This carving stands 24 in. tall with a diameter of 12 in. Gordon made the six-sided vase from a single white pine board, soaking the wood in warm water and clamping it to a real vase until dry; then he relief-carved each of the pieces before assembling them. Each petal of the 25 flowers was hand-cut, shaved, and then bent in warm water. The rims of the glasses were carved out of one solid piece of wood. The carving took about 400 hours to complete. Photo by J. Tomasi

Rudi Libenschek Ocean, N.J.

Having built two Queen Anne highboys, Libenschek decided to try his hand at a third, but this time in a different style. This Chippendale version (22 in. deep by 40 in. wide by 82 in. tall), made of mahogany with secondary wood of poplar, is based on measured drawings in Franklin H. Gottshall's *Making Furniture Masterpieces* (Dover Publications, 1996). The piece took approximately 280 hours to complete and has a rubbed-out varnish finish.

Alan Powell Arroyo Hondo, N.M.

Made of vertical-grain Douglas fir, this sideboard (16 in. deep by 58 in. wide by 35 in. tall) is inspired by Southwestern architecture, blending the lines and textures of adobe construction in its design. "The quiet, steady grain pattern plays against the lift given by the buttressed legs and arch," Powell said. The finish is Danish oil.

BY BOYD A. HUTCHISON

Why wood moves

We constantly are reminded that wood is dimensionally unstable: Floorboards that butt tightly together in the summer have gaps between them in the winter; those drawers that fit perfectly last winter now bind and stick in the summer. This expansion and contraction of wood exposed to changing atmospheric humidity occurs because wood is hygroscopic: It has a chemical affinity for water in both liquid and vapor forms. This affinity is due to the chemical nature of the cellulose and hemicellulose compounds that largely make up wood.

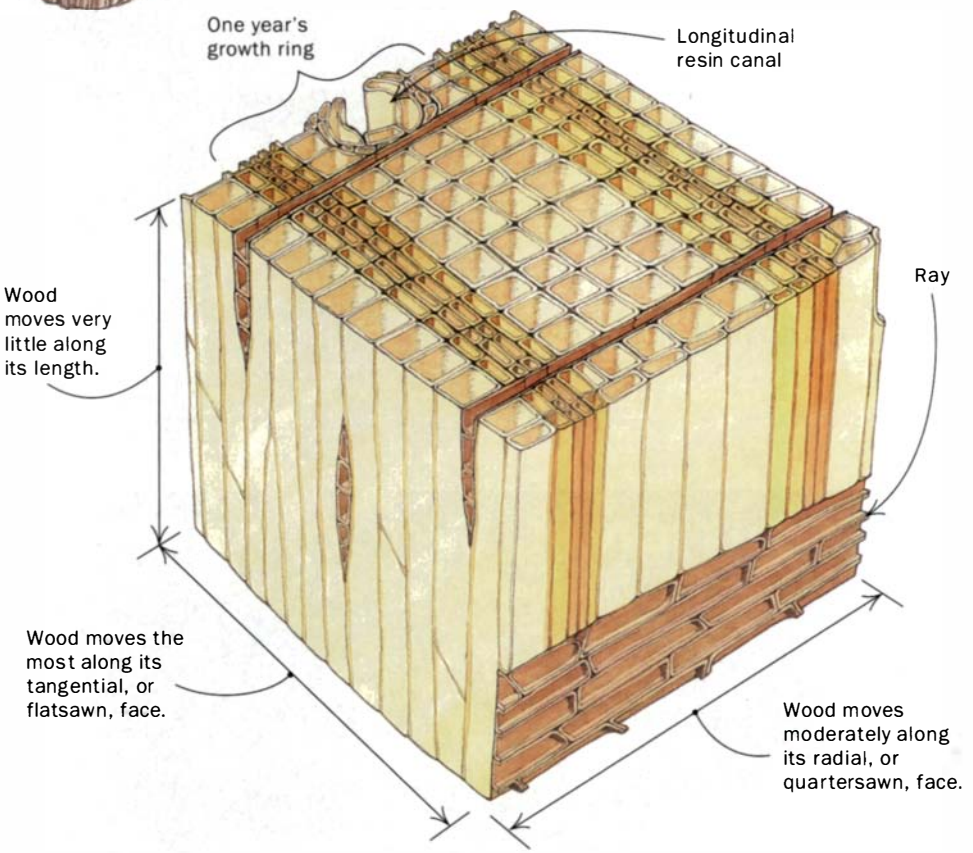
Water is fundamental to a tree, living or dead

The hygroscopic nature of wood plays a role in the transport of water and dissolved nutrients from the roots, up through the trunk, to the canopy of leaves or needles, where photosynthesis produces the carbohydrates needed for growth and survival. In a living tree, water is found in two main areas: The cell walls are saturated with water bound chemically to the cellulose/hemicellulose fibrils that make up these walls, and the cell cavities are filled with free, or unbound, water.

After the tree has been cut down, evaporation removes the free water from the cell cavities. Now the wood is said to be at its fiber saturation point (FSP): Although the

CELL STRUCTURE DETERMINES MOVEMENT

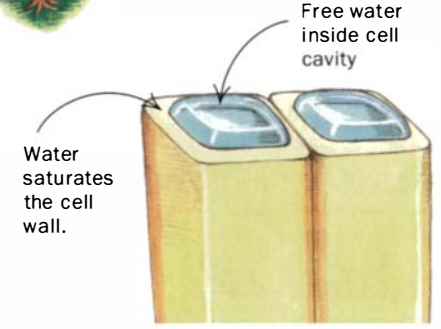
This simplified drawing shows how the majority of cells in a tree are oriented vertically. Because the cells are stable along their length, there is very little movement in this direction. The diameters of the cells vary with changes in moisture, so wood expands and contracts perpendicular to the grain. A small number of cells (called rays) radiate out from the center of the log and help stabilize movement along the radial, or quartersawn, face of a board.



HOW WOOD SHRINKS AS IT DRIES

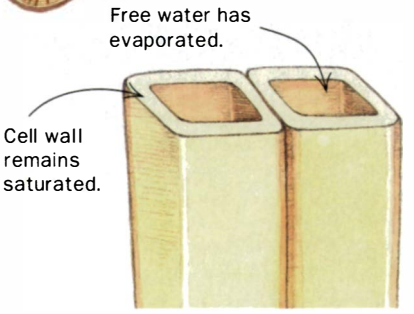
GREEN WOOD

In a living tree, water is present not only inside the cell cavities (called free water), but it also saturates the cell walls.



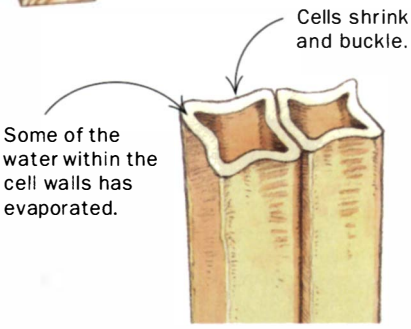
WOOD AT FIBER SATURATION POINT (FSP)

After a tree has been cut down, the free water evaporates. But as long as the cell walls remain saturated, cell size doesn't change.



MOISTURE CONTENT LESS THAN FSP

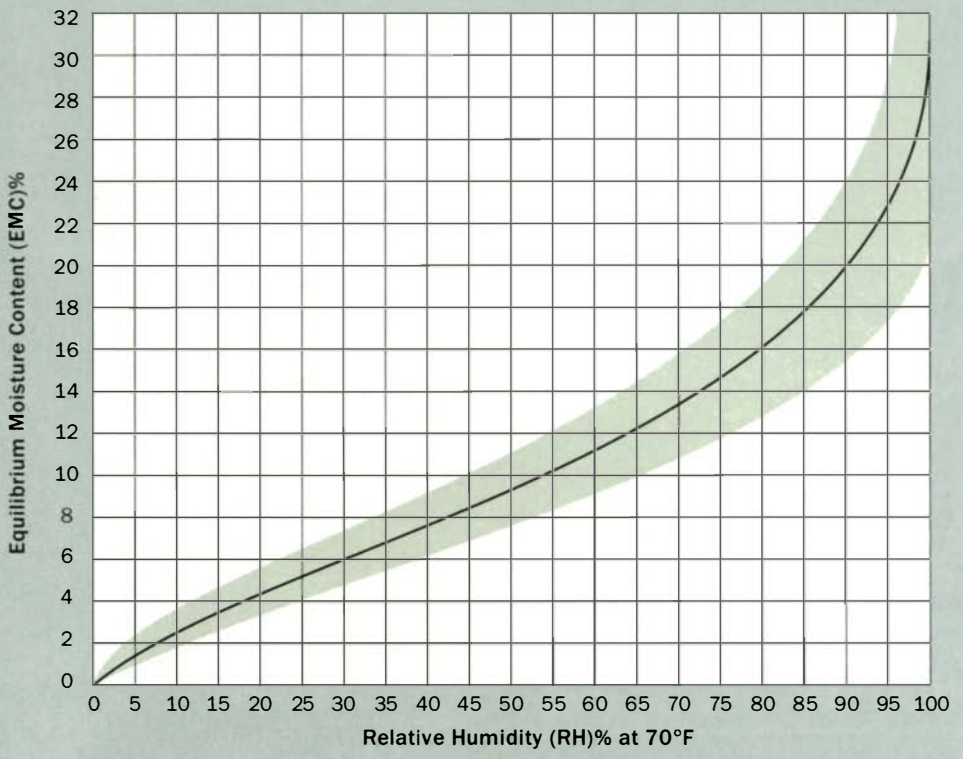
When the water in the cell walls evaporates, the cells become smaller and harder.



Drawings: Fred Carlsson

Any newly acquired lumber, whether kiln- or air-dried, should be stickered and allowed to adjust to the humidity in your shop. Before using it, check that the moisture content is similar to that of other boards in the shop. The graph at right shows how the moisture content in lumber is affected by humidity in the air. The solid line represents white spruce, but most wood species fall within the shaded area.

MOISTURE CONTENT CHANGES WITH HUMIDITY



Although this curve is based on wood at 70°F, the EMC drops by only about 1% for a 25° to 30° temperature rise (a similar temperature drop raises the EMC 1%). Under normal workshop temperatures, the values shown here will vary little.

cell cavities are empty of free water, the cell walls still are saturated with bound water. This has no effect upon the size of the tree trunk or upon the dimensions of boards sawn from such a log.

However, any further drying has profound effects on the dimensions of boards. When wood dries to a moisture content below its FSP, the cell walls shrink and buckle (see the bottom drawings on p. 88). Although the cross-sectional dimensions of the cells are reduced, very little change occurs in their lengths. The cause of this unequal shrinkage lies in the makeup of the cell walls and the orientation of the cells in the wood.

Why boards change in width, not length

The bulk of the fibrils in the cell walls spiral around the cell cavity so that the long axes of the fibrils roughly parallel the long axes of the cells. Because the changing amounts of water in a fibril affect its diameter but not its length, this behavior translates to changes in cell thickness but not in cell length.

In the drawing at the top of p. 88, a cube of pine enlarged several hundred times shows the long axes of most cells oriented vertically, parallel to the long axis of the trunk. But a significant minority of the cells are oriented perpendicular to the long axis of the trunk. These two cell orientations determine a board's stability as its moisture content changes. A greater number of vertically aligned cells means the board is most stable over its length. A smaller number of horizontal cells in the rays makes the radial dimension more stable than the tangential dimension. This means that a quartersawn board is more stable in width and less likely to distort than a flatsawn one. A good rule of thumb is that tangential (flatsawn) movement will be approximately twice the radial (quartersawn) movement.

Why woods differ in stability

Some woods are dimensionally very stable (catalpa, eastern red cedar, sugar pine, mahogany, teak), yet others are notoriously unstable (paper birch, black oak, sweetgum). The differences in stability result from differing contents of lignin and other extractives, as well as the anatomical structure of different species.

Lignin serves as the glue holding wood cells together, greatly adding to the rigidity of wood. Lignin is not hygroscopic, so the greater the amount of lignin in cell walls, the greater the dimensional stability of the wood.

Similarly, extractives that convert sapwood to heartwood also are mostly nonhygroscopic. Thus, woods with high extractive contents tend to have greater dimensional stability.

The relationship between humidity and moisture content—As a result of the hygroscopic nature of wood, for any relative humidity (RH) in the air, there is a corresponding equilibrium moisture content (EMC) in the wood. If wood is immersed in air at some unchanging RH, the amount of

Photo: Mark Schofield

bound water in the cell walls eventually will stabilize at a fixed value. The graph on p. 90 presents the relationship between EMC and RH. While the solid line represents white spruce, most other species have relationships between humidity and moisture content that fall within the shaded area. Species with high lignin and extractive content occupy the lower portion of the shaded area, and woods with fewer lignins and extractives occupy the upper portion. At 100% RH, the EMC of wood is equivalent to its fiber saturation point, meaning the cell walls are saturated with water.

Let the lumber adjust to your workshop

Lumber stored in my shop with a moisture content of 11% to 12% in late summer will drop to 5% or lower in late winter, when the central heat is on. Consequently, the wood in my shop has an EMC at least 6% lower in winter than in summer, when the RH inside and outside is more comparable, as my windows and doors are nearly always open.

This annual variation in EMC translates to tangential dimension changes of about 3/16 in. across a 12-in.-wide flatsawn cherry board. (For a simple algebraic method of approximating dimensional changes in wood, you should read *Understanding Wood: A Craftsman's Guide to Wood Technology* by R. Bruce Hoadley [The Taunton Press, 2000]). Armed with this knowledge, use it to let lumber acclimatize to your workshop.

How long should you wait?—Most of the wood I buy has been kiln-dried. Unfortunately, my suppliers do not say, or do not know, how long the wood has been out of the kiln or how it was stored during that period. So how do I know when the moisture content of the wood is in equilibrium with the humidity conditions in my shop?

Using a moisture meter, I quickly can establish the moisture content of a new batch of lumber and compare this value with other lumber that has been in my shop for some time. If the moisture values between the new and old lumber differ, which they nearly always do, I stack and sticker the new batch of lumber and wait a week or more for it to acclimate. Before I bought a moisture meter, I always stacked and stickered new lumber for two to four weeks to be sure that it wasn't going to move during construction.

You may think this is overkill, but some years ago I was commissioned to build an entertainment center of tulip poplar finished with milk paint. I purchased 300 bd. ft. of kiln-dried poplar, assuming that it really was kiln-dried. Big mistake!

There were 14 frame-and-panel doors with double-pinned through mortise-and-tenons. I built the piece, installed it, and was called back a month later to find at least a 1/64-in gap between each rail and stile. The poplar could not have been anywhere near the 7% to 8% moisture content that kiln-dried cabinet lumber should be upon coming out of a kiln. I made 14 new doors (I did salvage the original panels), bought a moisture meter, and have not repeated that mistake. □

Q&A

Distracted by wood dust

Q *I am distracted and annoyed by constantly having to blow off wood dust as I drill holes or use my bandsaw. There must be a better way. Any ideas?*

—Mort Curtiss, Dearborn, Mich.

A **Will Neptune replies:** If you have a compressor, I strongly recommend using a jet of air. I have my compressor hooked up to an adjustable nozzle with a magnetic base. The one I use is made by Woodtek and sold by Woodworker's Supply Inc. (Part No. 826-182; 800-645-9292). The adjustable stream of air blows away the dust so that you can see the layout lines.

[Will Neptune is a frequent contributor to *Fine Woodworking*.]

Air hose keeps dust away from cutting line. *The flexible hose sits on a magnetic base. An adjustable valve controls the stream of air that keeps work free of dust.*

Ripping wood safely

Q *I have a number of accessories and jigs designed to hold work flat against the tablesaw surface and tight against the fence, and I believe they virtually eliminate any chance of kickback. I find that I can stop feeding a board in the middle of a ripcut, and go around to the back of the table to complete the cut without the board moving even slightly. Is this a good practice?*

—Scott Beahn, Las Vegas

A **Gary Rogowski replies:** No. Placing total trust in an accessory is an invitation to a missile launch. No accessory or jig by itself "virtually eliminates" kickback in all cases. It's a bad idea to stand on the outfeed side of a tablesaw (with no helper at the infeed side) because of the risk of getting pulled along with a kickback into the blade.

I always prefer to be at the infeed side of a cut so that I can continue to push the workpiece tight to the fence. Use a splitter and a firm grip or a push stick when necessary.

[Gary Rogowski is a contributing editor.]

Yeung Chan's mallet

Q *Inspired by the brass-faced mallet in Yeung Chan's article "A Clever Tool Case" (FWW #167, pp. 75-77), I am building my own version of the tool. However, I have no clue how to attach brass to the faces. How does Mr. Chan do it?*

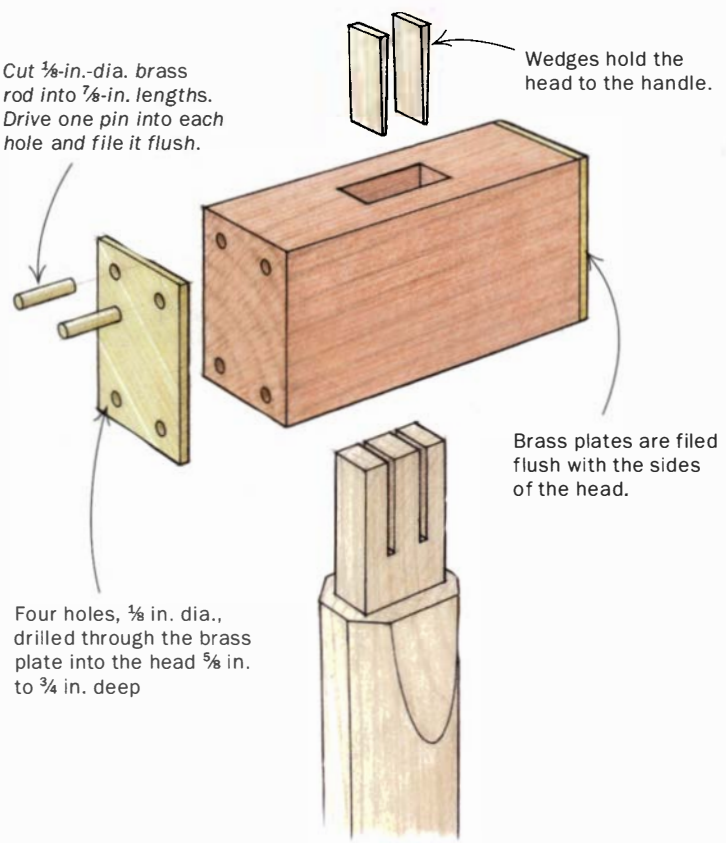
—Dave Owsley, Aurora, Colo.

A **Yeung Chan replies:** This handy tool is pretty simple to make, including the application of the brass plates to both faces of the mallet.

Once the head of the mallet has been dimensioned and mortised, mark and drill four holes in each end. Use a ⅛-in.-dia. bit, and drill about ⅝ in. to ¾ in. deep.

The plates are made from ⅛-in.-thick or 3⁄16-in.-thick brass sheet plate. Cut two pieces of the brass, leaving them a little oversize for now. Next, drill four holes into each plate, making sure that the location of the holes on the plates lines up with the holes in the head. Cut eight pieces of ⅛-in.-dia. brass rod into lengths of about ⅞ in. Then connect the brass plates to the head by driving brass rods into the holes. Adhesive is unnecessary; friction will hold the rods in the wood, and the hammering action will spread the ends of the rods slightly, locking them in place. Finally, file the brass-plate edges and the ends of the brass rods until they feel smooth, and assemble the mallet.

[Yeung Chan is a woodworker and teacher in Millbrae, Calif.]



Photos, except where noted: Karen Wales; drawing: Vince Babak

Extending the life of sandpaper

Q *Can you tell me how to fold sandpaper to get the most use out of it?*

—John Kreiger, Detroit

A John White replies: Fold a sheet of sandpaper in half in both directions until you've folded it into quarters. Then simply tear any one of those folds to the center of the sheet and fold up the sheet as shown.

Folding the sandpaper this way will keep any two of the sanding faces from rubbing against each other and wearing out. When you use up one face, it is easy to fold it in and bring out another new face to use. This method lets you extend the usefulness of a sheet of sandpaper, and it also makes the face you're using less likely to tear.

[John White is the shop manager for *Fine Woodworking*.]

First, fold and tear. *Fold the sheet of sandpaper in quarters, then tear to the center.*

Then fold and tuck into the adjacent crease. *Continue to fold and tuck in either a clockwise or counterclockwise direction.*

Choosing backsaws

Q *I want to buy a backsaw to cut tenons for a table I'm making. The tenons will be 3 in. wide. Should I get an 8-in., 12-in., or 14-in. blade? What are the criteria for making the selection?*

—Edward M. Hughes, Shrewsbury, Mass.

A Christian Becksvoort replies: You'll do yourself a favor by getting two types of backsaws. Cutting the cheeks (the face, or glue surface, of the tenon) is an operation that requires a ripsaw because you are cutting with the grain. Cutting the shoulders (the part that butts against the table leg) requires a crosscut saw. Get the best saws you can afford. Look for well-shaped, comfortable handles, stiff brass backs, and well-tempered blades. As for length, 12 in. is a good compromise for both saws.

[Christian Becksvoort is a contributing editor.]

A ripsaw cuts tenon cheeks. *Cutting the cheeks (or faces) of a tenon is done most efficiently with a ripsaw because they are cut with the grain.*

A crosscut saw is best for shoulders. *A 14-tpi crosscut saw produces a clean, accurate cut across the grain.*

How can I keep walnut from fading?

Q *What should I use to finish a walnut project to enhance the rich, dark colors of the wood and to protect it from fading over time from exposure to natural light? I don't want to obscure the subtle, natural color variations in the walnut. The finish also must have the characteristics of a hand-rubbed oil finish. Can you help?*

—E.M. Shannon, San Jose, Calif.

A Chris A. Minick replies: Two things are needed for walnut to fade: ultraviolet light and oxygen. Block them by adding a barrier, and you reduce fading. My unstained walnut drop-leaf table, finished with a light coat of oil-based varnish, has sat under the living-room window for more than 20 years. Most finishes won't totally seal out ultraviolet light and oxygen, but they can keep walnut from fading in your lifetime.

Danish oil is a good finish option for your project; three or four coats will impart the hand-rubbed look you desire and provide some protection from fading, too. Plus, Danish oil will not mask those nice purple highlights in air-dried walnut. Best of all, a Danish-oil finish is easily renewable. If your project starts to look dull after a few years of use, simply wipe on another coat of Danish oil, and it will look like new again.

[Chris A. Minick is consulting editor.]

Prevent walnut's rich color from fading. *Use three or four coats of Danish oil to preserve the dark, rich color of walnut while giving the piece a hand-rubbed look.*

Photo, this page (right): Kelly J. Dunton

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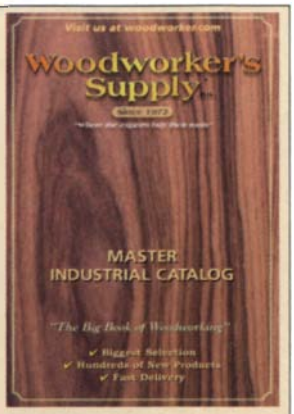

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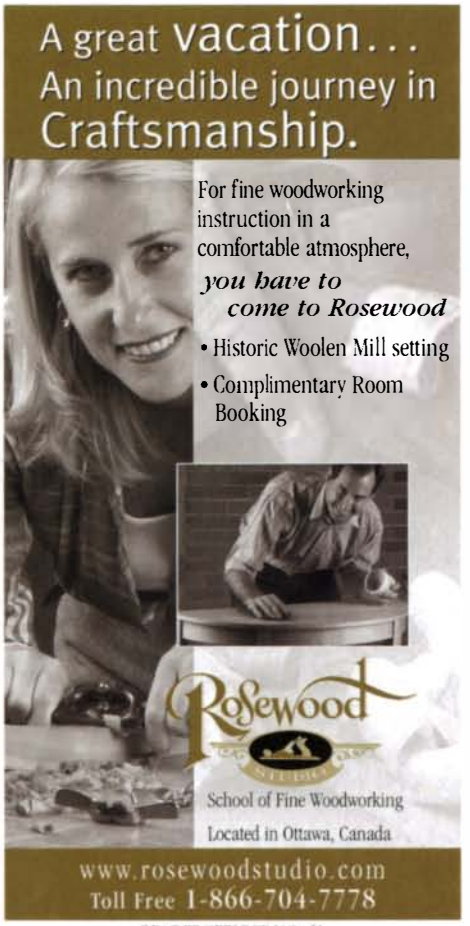

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Sharpening to a point

Q *How do you grind and hone awls, scribes, and round-leg dividers?*
—Dell Farnham, Cleveland, Ohio

A **Mario Rodriguez replies:** I hold the awl, scribe, or compass leg tangent to the grinding wheel, tip pointed up, and hold it against the tool rest as I rotate it, removing enough material for an even and balanced tip. The tip may be honed further with a coarse slip stone, sandpaper, or other abrasive surface.
[Mario Rodriguez is a contributing editor.]

Keep the tool moving. *For a balanced grind, roll the tool under your thumb as you hold it against the wheel.*

Refine the point. *Use a benchstone, sandpaper, or other abrasive surface to smooth and sharpen the point.*

A workshop fire extinguisher

Q *Can you tell me what type of fire extinguisher is best for a woodworker's shop?*
—Anna Green, Seattle, Wash.

Read the instructions. *The best extinguishers for a woodworking shop are marked with the letters B (for flammable liquid) and C (for electrical fires).*

A **Mike Dunbar replies:** If I had a fire in my shop, I'd want the very best and most effective fire extinguisher for the job. I asked New York City firefighter Steve Katz what type of fire extinguisher he recommends.

The number-one cause of fires in workshops is an overloaded circuit. Other electrical problems, such as loose wires and screws at outlets, come in second. Wood dust is highly flammable and is the third leading cause of woodshop fires. Shops typically contain flammable solvents, too.

The best extinguisher to cover all of these situations is a carbon-dioxide model, rated ABC (wood/paper, flammable liquids, and electrical).

[Mike Dunbar is a contributing editor.]

Childproofing the shop

Q *My 3-year-old son is eager to "help" when I work. Obviously, I want to keep him safe, but I don't want to isolate him from the shop when I am in it. How can I childproof the shop?*
—Tom McKenna, Wallingford, Conn.

A **Garrett Hack replies:** I have many memories of children in my shop, right back to when they were sitting in baby chairs clamped to my bench, watching me work. As they got older, I always encouraged them to come to the shop and make things, and I still do.

Machines, sharp tools, and finishing supplies are obvious hazards. In most cases, it's not the machine that's a problem (from a child's perspective, my cabinet saw is just a metal box with some interesting wheels on the sides); but pushing the ON switch certainly is. Unplug any machines with switches that are within reach of a small child, flip the breaker, or install a safety cover over the switch. Low receptacles, V-belts, and other exposed parts of machines should have covers to keep out curious little fingers. I avoided running machines while children were around, and they quickly learned that the machines were off limits. Sharp tools and finishing supplies all should be well above the reach of children, on high shelves, in cabinets, or inside drawers.

The best way to make your shop an inviting and safe place for your child is to give him a good place to play and some of your attention. For years, parked next to my tablesaw was a fleet of trucks and bulldozers for moving and piling sawdust. Kids love to hammer nails and glue scraps together into boats or towers. They also love to sweep, or to sort bolts and nails. When they were old enough to be curious about the work that I was doing, I gave them small planes, stubby carving chisels, and nice, clear pine to work on. Give them an early appreciation and respect for your shop, and it will pay dividends for many years to come.
[Garrett Hack is a contributing editor.]

Photos, this page (bottom left): Kelly J. Dunton

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BY DAVID MARKS

An extraordinary patina finish

The patina finish, a hybrid wood-coloring technique that I have developed over the past decade, is a trademark of my work. The technique combines the use of paints, gilding (metal leafing), mild acids, and lacquering methods that result in a finish that may look faux, ancient, metallic, or even stonelike.

I've used the patina finish primarily on turned work, such as vases or wall hangings, but I also have applied it to tabletops. The procedure is time-consuming, so keep that in mind if you choose to use it on larger projects.

Walnut and ebony vase. *No two patina finishes are exactly alike. The process gives wood a unique look that can be adjusted infinitely, depending on the paints, metals, and chemicals used.*

The process involves five basic steps: sealing the wood, adding color, gilding, chemically treating the gilding to create patinas, and finally, topcoating the surface for protection.

Sand, seal, and paint the substrate

Any type of wood can be used, but open-pore woods need to be filled and thus require more work. When the finished object will be a combination of patinated and natural wood, I choose highly figured stock. But when I plan to color the entire piece, I use paint-grade woods or man-made materials such as medium-density fiberboard (MDF) or plywood.

The areas to be colored and gilded must be primed, or sealed, first. I apply white pigmented shellac, which dries quickly. Then I add numerous layers of paint. Either oil- or water-based paints can be used, but I prefer Japan colors, which are oil based. Available in a variety of rich hues, Japan colors dry fast, sand smooth, and may be brushed or sprayed on.

Maple meets metal. *Marks finished the lower section of this vase with a patina finish of paint and metal leaf treated with acids.*

After the paint has dried, sand the surface with 320-grit paper, and then selectively sand through various layers of color. The process of layering on colors, and subsequently sanding through the layers to expose underlying colors, is similar to

BEGIN WITH A LAYER OF COLOR

Prime and paint the workpiece. For primer, use a white pigmented shellac. Then apply one or more layers of Japan colors. Last, selectively sand through the paint, exposing some of the underlying colors.

Photos, except where noted: Anatole Burkin: this page; Jerry Anthony (top right). Hap Sakwa (bottom left)

GILD THE SURFACE

Metal leaf goes over the painted surfaces. To add texture and abstract patterns, do not apply the leaf uniformly.

Brush on the size. *The size, a type of varnish, acts as an adhesive for the metal leaf. To test the size for readiness, drag a knuckle across the board (below). The surface should feel tacky.*

Apply metal leaf. *Because Marks is after a random textural pattern, he uses a mesh bag (the kind fruit or vegetables are sold in) to mask off parts of the workpiece. Then he applies pieces of metal leaf with a brush (called a gilder's mop), pressing through the gaps in the mesh.*

Remove the mesh. *The result is a random fish-scale pattern.*

Remove excess metal. *After the size has dried and the leaf has adhered fully, brush away loose pieces of leaf.*

the Japanese lacquering technique known as *urushi*.

Gilding comes next

Gilding involves laying very thin layers of metal foil on a surface. (For more on this topic, see *FWW* #141, pp. 110-114. And for more on the techniques described here, my video *Gilding and Chemical Patinations*, with Grace Baggot, is available at www.djmarks.com.) Most people are familiar with gold leaf, but other metals are available in leaf form. Because patination involves tarnishing or oxidizing the metal, gold is not used because it resists tarnish. Metals appropriate for patination include copper, silver, and Dutch metal leaf, which is gold in color.

For metal leaf to bond to a surface, an adhesive is necessary. I like to use traditional oil size—either Rolco quick-dry size or Le Franc three-hour oil size—which must be applied to the workpiece with a special brush (see Sources of Supply below). Apply the leaf after the size sets up but before it cures; in this state, it acts as an adhesive. To test the readiness of the size, rub a knuckle across the workpiece. You should feel a slight resistance, as if you were dragging your skin across the sticky side of blue masking tape.

Apply leaf in nongeometric shapes, tearing the sheets and laying them down with ragged edges. I deliberately leave about 5% to 30% of the background paint exposed (a Japanese technique called Notan gilding), and sometimes I mix different metals for effect. I also use a mask, or a resist, made of mesh netting to create a fish-scale effect.

To burnish the leaf and ensure that it firmly adheres to the size, place a sheet of waxed paper over the leaf and rub it down with your finger.

Tarnish the metal with chemicals

Chemical patinas are achieved by oxidizing the metal leaf with mild acids.

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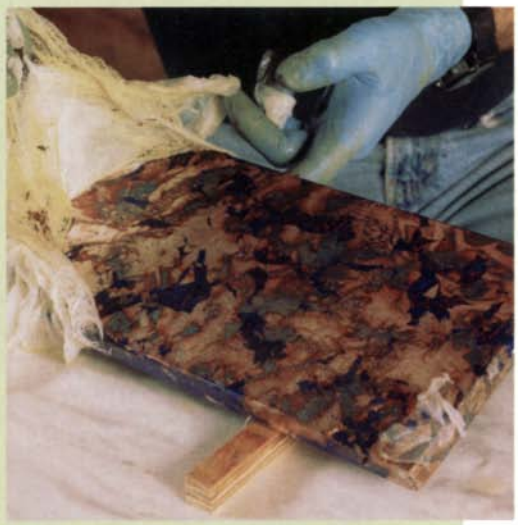
COLOR THE METAL WITH CHEMICALS

Paint with acid. *Instead of applying the acid directly to the metal leaf, which would leave a more uniform patina, Marks selectively covers the substrate with layers of tissue paper and cheesecloth moistened with water. Then he dabs on acid with a brush.*



Remove the chemical-soaked cloth. *Taking away the cloth reveals a patina with a wide range of tones. Be sure to dab away the remaining acid using a paper towel moistened with water. When dry, the piece should be sealed and topcoated.*

BASIC FORMULA

Mix ⅛ teaspoon dry chemical to ¼ cup warm water (always add the chemical to the water as opposed to adding the water to the chemical).

PAINTING WITH CHEMICALS

Patina chemicals are mild acids that will change the color of metal leaf (silver, copper, and Dutch metal). The intensity of the color may be controlled by how much and how long acid is applied. These chemicals are caustic, and it's a good idea to wear hand and eye protection when mixing them. Work outdoors or in a well-ventilated area.

CHEMICALS AND THEIR EFFECTS

Potash sulfurated (liver of sulphur) turns silver leaf a gold tone, then magenta, blue, and finally black.

Barium sulfide turns copper leaf purple.

Sodium sulfide turns copper leaf orange, then magenta, and finally blue. Also turns Dutch metal orange, then magenta, and finally blue-green or gold-green.

Equal amounts of cupric nitrate and ammonium chloride turn Dutch metal to a green, chalky-bronze patina.

Examples of patination. *Copper-leaf panel (left) was treated with sodium sulfide; silver panel (center) was treated with potash sulfurated; Dutch metal leaf (right) was treated with ammonium chloride and cupric nitrate.*

When mixing and using the caustic chemicals, wear gloves and eye protection and work in a well-ventilated space.

The chemicals may be applied with a brush, sea sponge, spray bottle, or rag. To avoid an overly uniform patina, apply different absorbent materials to the workpiece to allow different rates of chemical exposure. For example, I sometimes lay wrinkled tissue paper or cheesecloth on the surface (moistened with water so that it remains in place), then apply the chemicals with a brush, dabbing selectively. Feel free to experiment to find the right effect.

After the chemicals have done their work, remove the paper or cheesecloth and blot the workpiece dry with paper towels. The chemical reaction is gradual, which allows you to stop the patination process before full oxidation takes place. Different exposure times will produce slightly different colors on the metal only.

Seal the workpiece to protect it

Once the surface is dry, finish it with shellac, vinyl sealer or lacquer, or additional coats of the size. I prefer vinyl sealer because it is neutral in color. Finally, topcoat the piece with your choice of clear wood finish, such as nitrocellulose lacquer or polyurethane. □

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How to prevent fisheyes

BY SEAN CLARKE

What are they? *Fisheyes are craters in the finish caused by impurities on the wood's surface, which create uneven surface tension in the finish.*

We've all had a flawless film-forming finish become marred by a few dimples or craters. Known as fisheyes, these blemishes persist no matter how many coats of finish you spray or brush on. Fisheyes aren't a reflection of the way you applied the finish, but rather the result of uneven surface tension caused by impurities or open grain on the wood's surface. Fortunately, there are several ways to deal with fisheyes, either by preventing contamination of the wood or by repairing the damage without stripping and refinishing the surface completely.

Avoid fisheyes in the first place

The first line of defense against fisheyes lies in correctly prepping surfaces. When using a tack cloth, unfold it, lightly crumple it, and wipe it gently over the dusty surface. If you apply too much pressure on the cloth, wax or resin is left on the surface, contributing to fisheyes. Don't use a tack cloth before applying a water-based finish because the slightest trace of wax will repel it.

Another precaution is to wear latex gloves so as not to contaminate the workpiece with oils from your hands, which may interfere with finish adhesion. Surfaces that already have a coat of finish on them are prone to fisheyes, especially if you are applying a gloss finish. Flattening or matting agents in satin and matte finishes make them less susceptible to fisheyes.

You also can prevent fisheyes by applying a coat of super-blond shellac (2-lb. cut), which acts as a barrier between any surface impurities and the finish without adding color. After this coat thoroughly dries, apply a very thin first coat of finish or sanding sealer, which helps to even surface tension further before additional coats are applied.

In the case of open-grain woods, filling the grain prior to applying finish can even up surface tension and reduce the possibility of fisheyes. Apply a thin washcoat of shellac and then use any commercially available grain filler. It should be noted that the use of grain filler will alter the

STEPS TO A BLEMISH-FREE FINISH

Tack lightly. *Wax or resin from a tack cloth may cause adhesion problems with a finish, so when removing dust, move the cloth gently over the surface.*

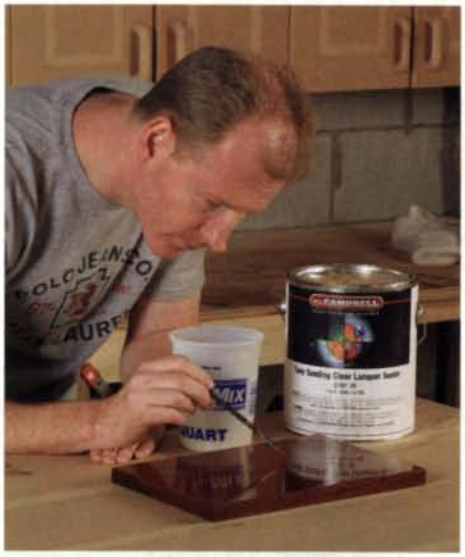
Seal with shellac. *Brush or wipe on a seal coat of super-blond shellac to create a barrier between surface contaminants, such as oil or wax, and the finish.*

Take great care in handling the workpiece. *Wear gloves to prevent oils in your skin from contaminating the workpiece. Surfaces that already have been finished are particularly prone to oil-induced fisheyes.*

Photos: Mark Schofield

THREE WAYS TO REPAIR FISHEYES

1 ***Use a fisheye reducer.*** *Adding a few drops of fisheye reducer to your finish will let the finish flow into and fill areas marred by fisheyes.*



2 ***Fill with sealer and sand flat.*** *Use an artist's brush to fill the fisheyes with a sanding sealer compatible with your finish. Sand the filled areas until they are level with the surrounding surfaces.*

3 ***Rub out the fisheyes.*** *Soak a wad of cotton cloth in thinned finish and wrap it in a cotton bedsheet, leaving the bottom wrinkle-free (inset). Glide this rubber over the surface to fill any fisheyes with finish.*

overall color of the piece slightly, as well as emphasize the grain.

Getting rid of fisheyes

If, despite all of your efforts, fisheyes still appear, there are several remedies to choose from.

Add fisheye reducer—Although not foolproof, one treatment is to use fisheye reducer, a silicone liquid that slightly relaxes the finish, allowing it to flow into problem areas and level them. Fisheye reducer is sold at auto-parts stores, but make sure the type of reducer is compatible with the finish you are using.

First sand the problem area lightly to lessen the appearance of the craters. Then add fisheye reducer to the next coat of finish. Reducer can be brushed or sprayed on, but some people are leery of adding fisheye reducer to their spray equipment for fear of permanent silicone contamination. I've never found this to be a problem.

Fill fisheyes and sand—Another method of dealing with fisheyes is to use an artist's brush to drop unthinned sanding sealer into the craters. When the sealer has cured, sand the entire surface with 320-grit paper before applying a second coat of finish. This method is time-consuming, though, and is best for small areas of fisheye.

Rub out fisheyes—By far the most reliable method for removing fisheyes is to use a rubber identical to the one used in French polishing. It consists of wadded cotton cloth wrapped in a piece of cotton bedsheet. Thin some of the finish you are using by two-thirds with a compatible solvent (i.e., paint thinner for varnish or polyurethane, alcohol for shellac, or lacquer thinner for lacquer). You will not be able to thin a water-based finish by this amount. Soak the wadding in the finish, squeeze out the excess, and then wrap it in the cotton sheet. Glide the rubber over the surface in straight strokes with the grain. After several passes, the fisheyes begin to fill, and the surface evens out.

When you're satisfied with the appearance, let the surface cure and then lightly sand it with 320-grit paper. You can apply as many additional coats of finish as necessary. I have never had fisheyes reappear on subsequent coats with this method. □

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READER SERVICE NO. 181

A Box of a Thousand Pieces

Randy Gengarelly had a fondness for cigars, which led him into woodworking. His eventual series of fancy humidors so impressed a friend that he commissioned Gengarelly to build this jewelry cabinet. Made of black walnut and walnut burl with East Indian rosewood and African ebony accents, the piece is based on a photograph of a late-16th-century cabinet in *Western Furniture–1350 to the Present Day* (Philip Wilson Publishers, 1996). The cabinet features Corinthian capitals, fluted columns, and moldings all done by hand, as well as two secret compartments. One thousand separate pieces were used in its construction.

Photos: Elliot Lincis