TAUNTON'S
Fine WoodWorking

February 2003
No. 161

Three sawhorses for the shop

Frame-and-panel bookcase

Strategies for leg-to-apron joints

Drafting basics

Hinges and lid supports for chests and boxes

Hand-rubbed lacquer finish

We test six combination machines

Concealing sapwood

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Photo: Scott Phillips

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Contributors

After **Peter Zuerner** ("Cherry and Fir Bookcase") graduated with a degree in economics from Cornell University, a temporary job as a framing carpenter soon caught him in the gravitational pull of custom furniture making. In relatively quick succession, he went from framing to finish carpentry to kitchen-cabinetmaking to architectural work to furniture. As owner of Zuerner Design LLC (www.zuernerdesign.com) in Middletown, R.I., he takes special pride in building furniture to last for generations. Zuerner, who also enjoys mountain biking, lives near Newport, R.I., with his wife Miquette and daughters Miranda and Zoe-Mae.

Tom Wisshack (Master Class) has been making and restoring furniture for 40 years. His preference is to re-create furniture from the past by using hand tools and applying a convincing, ancient-looking finish. He spent many of his teen years in Europe visiting relatives and studying architecture, art and antique furniture, becoming an artist in several media. He returned to Germany in his 20s and 30s for stints as an antiques restorer and conservator. He said Europeans always were surprised at how little he charged and often gave him more, while in the United States he was considered pricey. Today, he lives in Galesburg, Ill., and works for a large furniture importer, creating antique finishes for high-end pieces.

For **David Wright** (Rules of Thumb), the memory of his grandfather building a barn when Wright was 7 years old had an enormous impact on what he would do with his life. The smells of the wood and the wonder of seeing a structure being built of wood are still with him. In 1983 Wright moved to Berea, Ky., and discovered a growing community of woodworkers. Within a few years he was making Windsor chairs—one at a time—in a small shop next to his house. From this simple beginning he concentrated on making traditional green-wood chairs, working long hours to develop his skills but mainly to remain in business. He's still making those Windsor chairs, along with dining tables and beds.

Always interested in how things work, **George Walker** ("Fight Backlash") said he used to get yelled at as a young boy for taking apart the toys of a kid in his neighborhood. After a six-year apprenticeship, Walker became a journeyman machinist and later spent six years working as an industrial repairman, troubleshooting machinery of all makes and sizes. These days, he enjoys woodworking more and is currently building the 18th-century Pennsylvania secretary recently featured in *Fine Woodworking* (#154-#156).

Mike Dunbar ("Hinges and Lid Supports for Chests") and his wife, Sue, run The Windsor Institute in Hampton, N.H. Starting in 1971, he revived the long-forgotten craft of Windsor chair making. Through Dunbar's teaching and writing, Windsor chair making has become part of mainstream woodworking. In its 22 years, The Windsor Institute has taught some 5,500 people to make these chairs. It also publishes a quarterly magazine for chair makers. With strong marketing and public relations backgrounds, the Dunbars enjoy helping professional chair makers learn how to run a business. As well as being a contributing editor to *Fine Woodworking*, Dunbar is the author of seven woodworking books and scores of magazine articles.

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Letters

Fine Woodworking wins second Folio award

For the second time in as many years, *Fine Woodworking* was honored with an Editorial Excellence Award by Folio, a publishing industry association.

The judges cited the magazine's "excellent photography" and described it as the "*Architectural Digest* of woodworking magazines." I'm not sure what that last phrase means, but rest assured, we won't be hiring interior designers to spiff up the workshops of our flannel-clad authors.

Being recognized by one's peers in the publishing industry is an honor, but the true test of whether this magazine is doing right is how it serves our readers. For that, we rely on what you tell us via letters and the in-person conversations at the many trade shows and seminars we attend. We're not perfect, but we keep perfection in our sights, and your feedback improves our aim.

–Anatole Burkin, executive editor

Green, bug-free wood—After reading the Q&A "Keeping wood green" (*FWW* #159, pp. 108-110), I thought of a solution to the problem of keeping an outdoor tank free of bugs. Mosquitoes breed in stagnant water, and the solution discussed by Brian Boggs only exacerbated that case. I don't know how much wood is to be kept, but I suggest a vertical tank, similar to an old water heater, with a small opening at the top with water percolating up or splashing down to agitate the water enough to keep renewing the oxygen and keep away the pesky critters. The solution requires investment in the tank, a reliable pump and some pipe.

–Bill Witt, Palo Alto, Calif.

Kudos to the magazine's web site—I wanted to drop you a line and let you know how great your web site is. I have been a subscriber to one of your competitors for a number of years because I believed the magazine had the stuff I wanted. But after seeing your web site, I have decided to make some changes to my subscriptions. Your site has tools I can use, and I particularly like the instructional video clips. I'm telling all my friends. Thanks for setting the standard of how a web site should operate. Keep up the good work!

–Kenan D. Schultz, Channelview, Texas

The best of Current Work?—I enjoy seeing the pieces shown in the Current Work department. I have been fortunate to have one of my projects showcased in the department, and it is always interesting to see the many different types and styles of furniture that people work in.

Have you considered ranking the pieces that have appeared in a given calendar year and possibly giving a prize to the top few vote-getters?

–Craig Arnold, Pearland, Texas

EDITOR REPLIES: That's an excellent idea. Beginning with this issue, we'll start picking semifinalists and let the readers pick an overall winner at the end of the year. See Current Work (p. 84) for details.

Gel-stain clarification—I am writing to you in regard to Teri Masaschi's article "Gel Stain User's Guide" (*FWW* #158, pp. 60-63). As an author—*The Wood Finisher* and *The Weekend Refinisher*—and experienced wood finisher, I was particularly troubled by a comment made by Masaschi that may be misleading.

She stated that gel stains are "sold as one-step, foolproof finishes that need only a rag as an applicator... ." While that information may be accurate for a few manufacturers' products, it does not entirely represent the gel-stain category overall and may provide inexperienced wood finishers with unrealistic expectations.

Unless clearly stated, most gel stains are not a stain and a finish. A gel stain is

Writing an article

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

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simply what its name implies: a heavy-bodied colorant that's easier to control on a vertical surface.

While Masaschi's evaluation of gel stains appears to be somewhat subjective, it would be helpful to note that the Minwax Gel Stain in Cherrywood was designed to be a light red tone to complement the company's line of gel stains that includes two darker red tones. As with all gel stains, a second application of this product allows you to build a deeper color.

—Bruce Johnson, wood finishing consultant for Minwax and Formby's

Replacing bandsaw bearings—John White's "Bandsaw Tune-up" (*FWW* #157, pp. 46-52) is a well-written and illustrated article, but I take exception to one of his procedures. On p. 48 of the article, he illustrates the practice of driving a bearing out with a punch and installing it by tapping with a soft hammer.

Bearings should always be pulled or pressed out, and the correct installation procedure is to press them in with the properly sized tool. The practice of installing bearings with a soft hammer is not an approved installation method in a balanced wheel.

—Ellis Helm, Tallahassee, Fla.

JOHN WHITE REPLIES: Mr. Helm is correct: Using specialized bearing pulling and insertion tools would guarantee that neither the bearing nor the wheel hub would be damaged when replacing the wheel's bearings. Unfortunately, even the most basic set of bearing tools costs several hundred dollars, so I fell back on a tried-and-true method that has served backyard mechanics well for more than a century. Tapping a bearing out with a punch and installing its replacement with a small brass hammer, when done carefully, is a perfectly adequate substitute when working on the typical small woodworking machine.

Thanks to a great bunch of authors—As a novice, I have found that while my mistakes are discouraging, they are invariably instructive, and some of my best insights have occurred while trying to recover from "Oops!" That is why I appreciate the warnings in your articles about what can go wrong, and how one can prevent it.

So, I was paying particular attention to the layout tip in Mario Rodriguez's article "Two Ways to Make Curved Drawer Fronts" (*FWW* #158, pp. 40-44). It cautioned that the heart side of the solid drawer-front board should be oriented down when cutting through the face so that the resulting grain on the cut face would arch up pleasingly rather than droop down sadly.

Now, I'm just the kind of rookie that would overlook that and not notice the grain droop until the cut was completed, probably in a very expensive piece of rare tropical wood. I visualized myself making that mistake and suddenly my "Oops!" alarm went off. But after several seconds of panic, I realized that by flipping the sawn board end-over-end I might turn the droop into an arch. Of course, if that didn't work, there is always paint.

I euphemistically refer to such blunder-recovery techniques as "reverse layout and design," but admittedly it usually feels more like "Whew!"

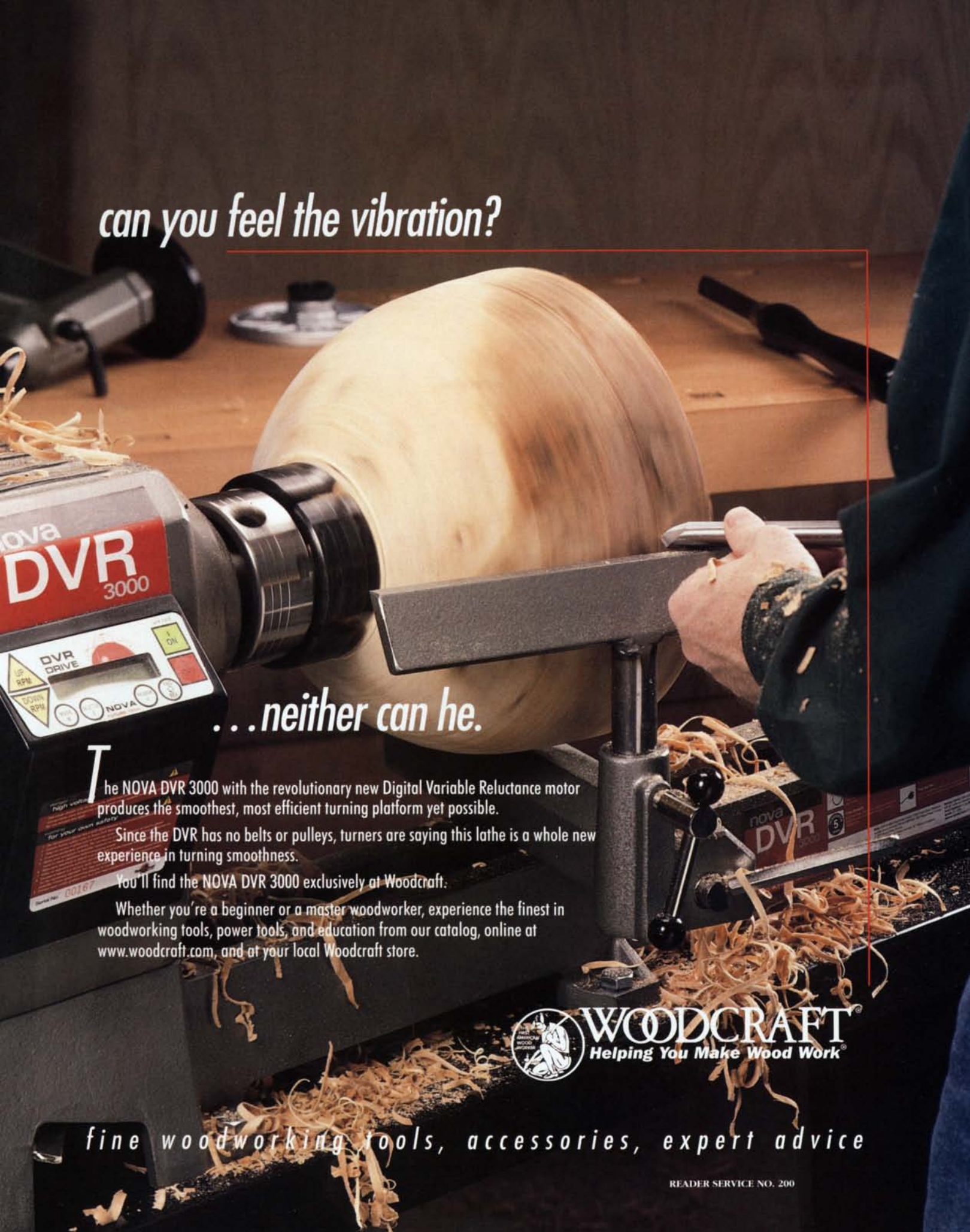
Keep up the good articles from the pros like Rodriguez. You have many such great contributors who seldom make mistakes any longer, and they make your valuable magazine a joy to read.

—Bob Edwards, San Francisco, Calif.

Update—Harbor Freight no longer carries the low-cost granite plates suggested in a Methods of Work tip on sharpening (*FWW* #159, p. 18). Another source for granite plates is MSC (800-645-7270).

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, executive editor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Methods of Work

EDITED AND DRAWN BY JIM RICHEY

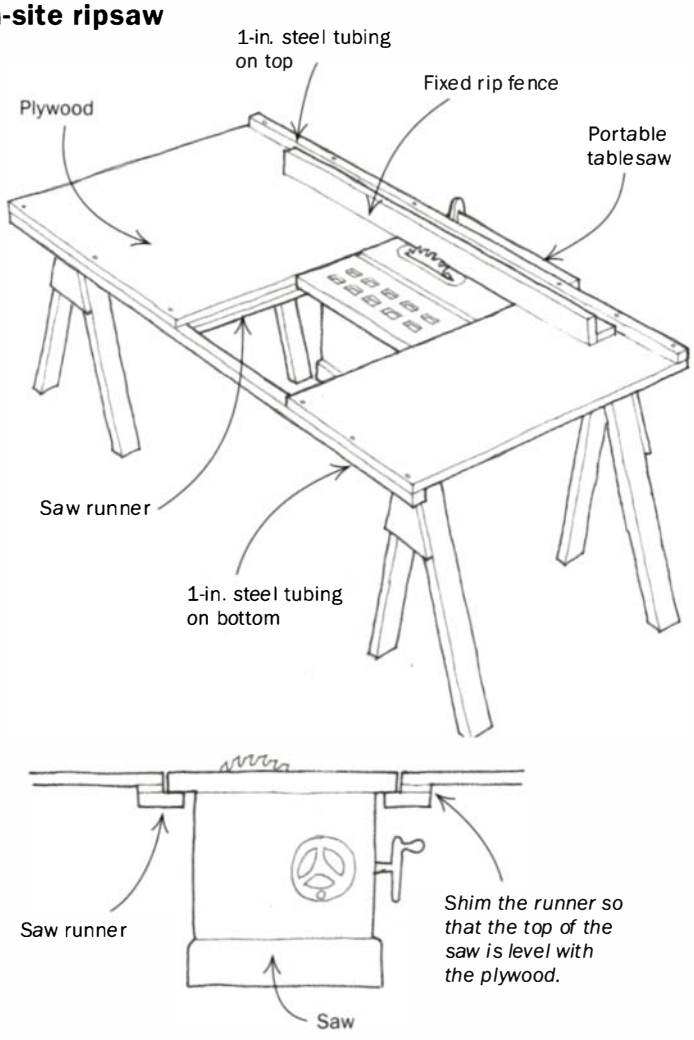
Computer-printed patterns

A computer is not a traditional woodworking tool, but I use mine for drawing and transferring templates and carving layouts. I start by drawing the desired pattern with a standard drawing software package. I can scale the drawing to any size in a snap while retaining the exact same proportions. I print out the drawing at its actual size and mount it to the wood with spray contact adhesive. If the pattern is bigger than one page, it's not a problem, because the drawing program will tile the design over several letter-size pages. All I have to do is assemble the pages with clear tape before gluing the pattern to the workpiece. This technique is simple, cheap and precise. And it saves the time needed to draw the shape directly onto the piece of wood.

Because the contrast of black lines on white paper is high, it is easy to saw curves precisely. For carving jobs, I use a sharp knife to transfer the lines onto the piece of wood by cutting through the glued pattern. Then I remove the paper before carving.

—Réal Paquette, Beaulac, Que., Canada

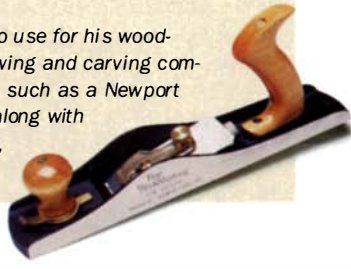
On-site ripsaw



I have a big cabinet saw in my shop that makes ripping long boards or sheets of plywood a relatively easy job. Unfortunately,

A reward for the best tip

Réal Paquette's career as a software developer led him to see the computer as just another tool to use for his woodworking. Paquette recognized the value and simplicity of making same-sized paper patterns for sawing and carving complex shapes. He is fond of 18th-century American furniture, and plans soon to tackle a big project, such as a Newport secretary, which will provide ample opportunities for using his winning tip. Send us your best tip, along with any photos or sketches (we'll redraw them) to Methods of Work, Fine Woodworking, P.O. Box 5506, Newtown, CT 06470-5506.



What's the Secret to Flawless Glue Line Rips?

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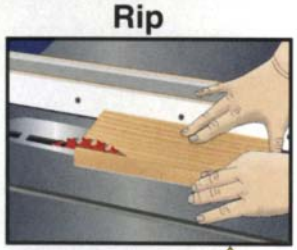
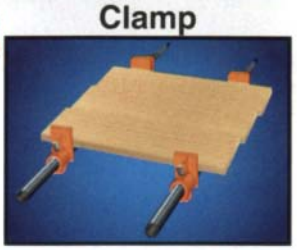
1 Rip



2 Glue

3 Clamp



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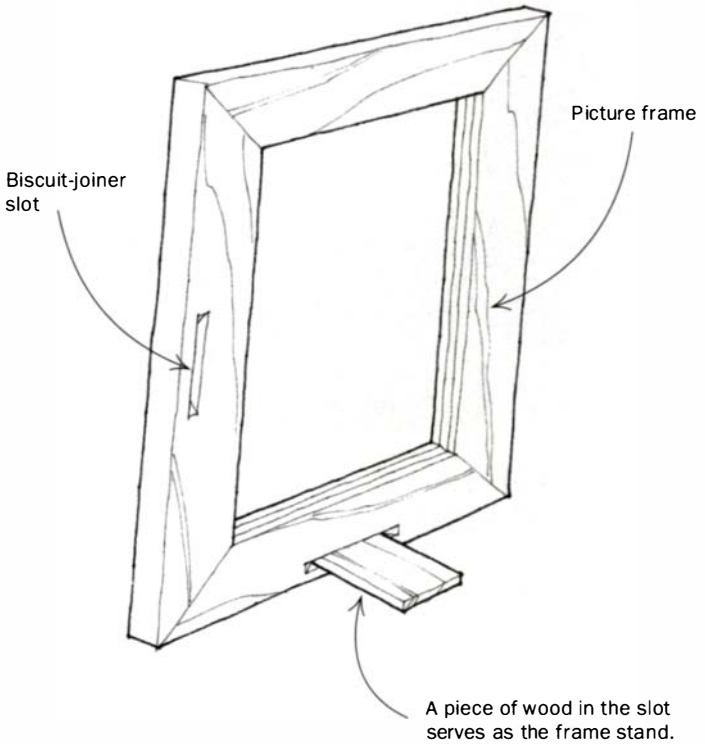
though, my small contractor's saw for site work doesn't have the same capability. So I constructed a lightweight auxiliary table that brings big-saw ripping capability to the job site.

The auxiliary top is made from ¾-in.-thick plywood and light steel tubing; no welding is required. The fence is fixed, and the lightweight tablesaw is suspended from and slides on runners to vary the rip setting. Just slide the small saw until the blade is the correct distance from the stationary rip fence and then clamp the saw in that position with a C-clamp. The steel tubing screwed to the top on the rip fence side (as you face the blade) allows the saw to slide beneath the fence for narrow rip settings. The steel tube on the left-hand side is set below the work surface to allow for maximum adjustability.

You also can crosscut with this setup by using a scrap piece of plywood riding against the fence as a miter gauge.

—Gary Pichon, Marble Hill, Ga.

Picture-frame stand



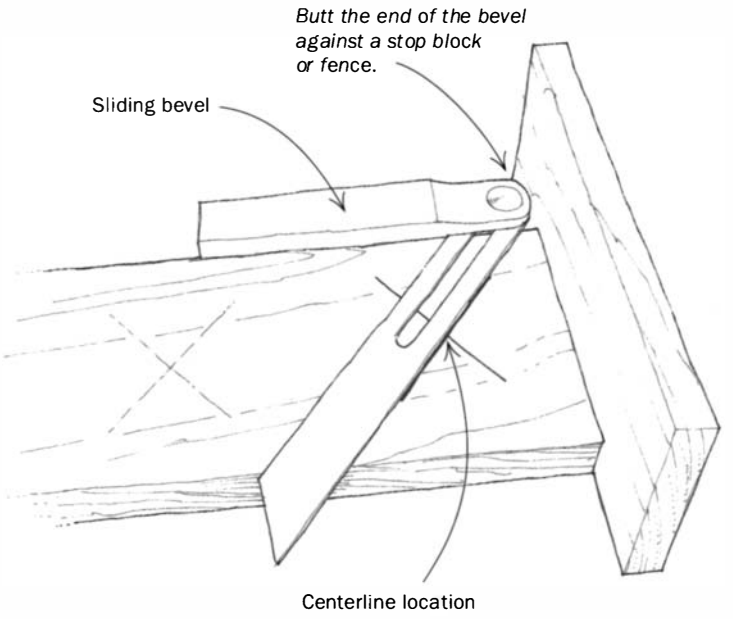
Here is a design detail that makes picture frames more versatile. Use a biscuit joiner to cut two slots in the back of the frame, in adjacent sides, as shown. By slipping a small piece of wood into the slot to make a leg, you can stand the frame on a desk or a table.

—Andy Olerud, Driggs, Idaho

Quick tip: To keep my fine lettering and varnishing brushes in good shape, I always squeeze petroleum jelly into them after cleaning. For alcohol or water-based brushes, I use water-soluble hair-styling gel. *—Thomas M. Cox, Baldwinsville, N.Y.*

Finding a centerline with a sliding bevel

To find the centerline of a workpiece, set a sliding bevel to any convenient angle. Butt the bevel against a fence on the end of the workpiece or against a stop clamped squarely across the face, hold the bevel along each edge and draw a line. The intersection of the two lines will be on the centerline.

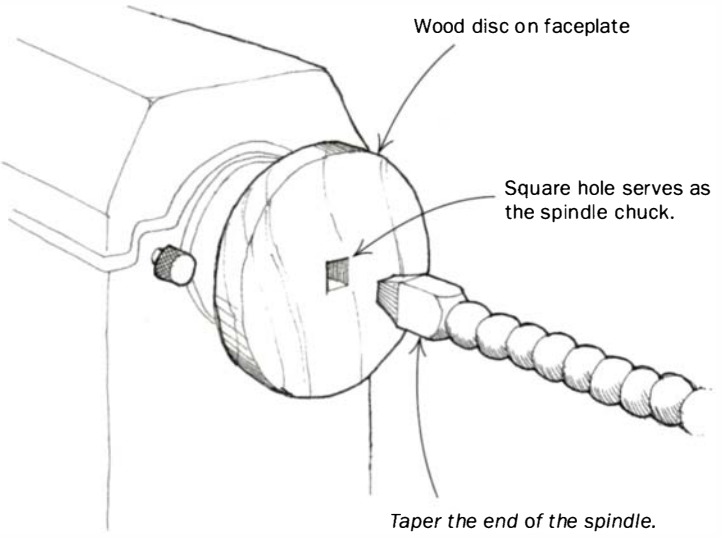


—Len Urban, Rancho Mirage, Calif.

Quick tip: If you have trouble gripping those small handles on wood clamps, just wrap the handle with non-slip drawer liner—that soft foam waffle-weave material that is sold at discount chain stores. I hot-glue one end of the material to the handle, wrap it around two or three times, and then hot-glue the other end. This provides a soft, easy-to-grip handle.

—Don Peterson, Fergus Falls, Minn.

Shopmade lathe chuck



Recently I needed to turn some small spindles for a project on my lathe. However, I do not have a chuck, so I had to find another way. I came up with this cheap and quick solution. I screwed a

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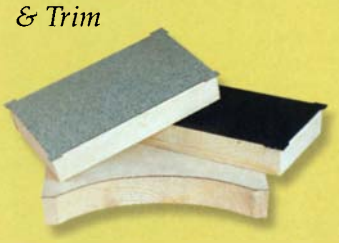

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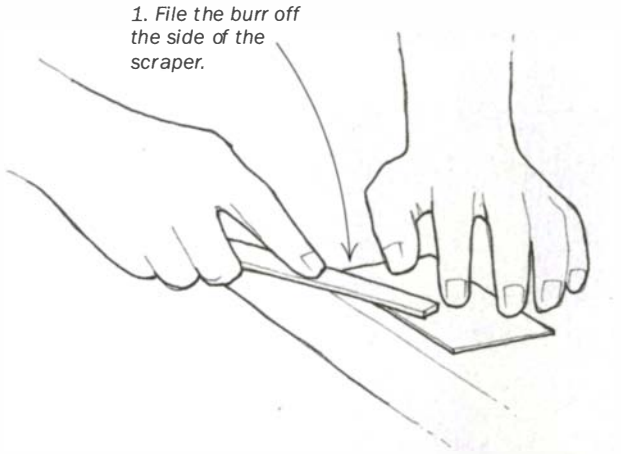
piece of wood to the faceplate and centered a hole into the wood the approximate size of the spindle to be turned. Then I squared the hole with a chisel. Next I squared and tapered the end of the spindle so that it fit snugly into the square hole when fixed between centers. *—W. Kurvits, Adelaide, South Australia*

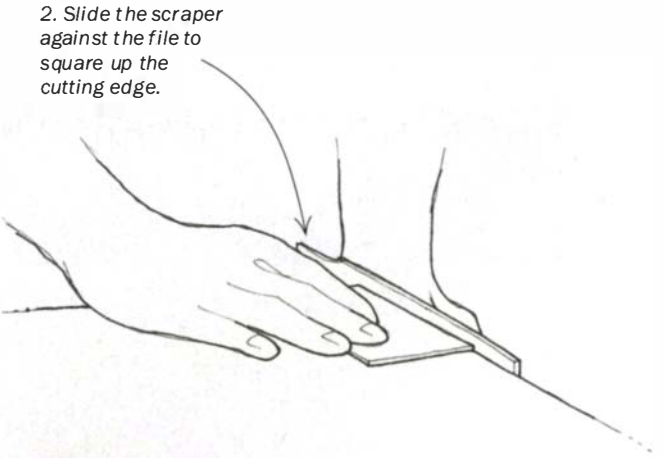
A quick, precise method for sharpening scrapers



Here is a fast and accurate method for sharpening a card scraper. It requires only a mill file, a burnisher and a worktable. The secret is controlling the angle of the burnishing tool using the thickness of your worktable.

The first step is to file off the old burrs (left). Lay the scraper flat on the worktable and run the flat side of a sharp mill file down the length of each burr. To get crisp edges, it is important to keep the filings out of the file and off the scraper, so tap or brush the file clean and wipe off the scraper after every few strokes.

The second step is to square up the cutting edge of the scraper (below). Hold the mill file against the side of the worktable and push the scraper against it. A few strokes are all that is needed.



The third step is to burnish the edge to the desired angle (see p. 20). To do this, I use the thickness of the worktable top as an

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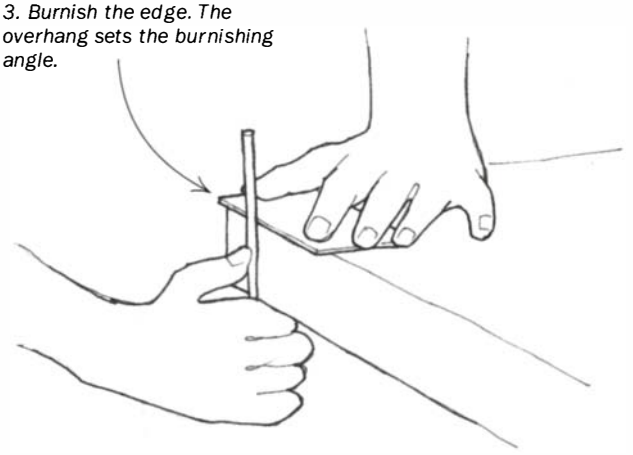
angle gauge. Place the scraper on the worktable, overhanging the edge to be burnished by just a fraction of an inch. Put the burnishing tool against the bottom edge of the worktable and against the scraper edge to be burnished; this is the final angle. But start the burnishing process with the burnisher held at an angle less than that final angle, and make a few swipes across the edge to start the burr. Continue increasing the angle of the burnisher until it is swiping at the final angle against the worktable's bottom edge.

3. Burnish the edge. The overhang sets the burnishing angle.



The larger the overhang, the larger the burr angle on the scraper. For fine work, I like a burnishing angle of about 4°. For rough work, a burnishing angle of 7° or so is best. My worktable top is 2¼ in. thick, and an overhang of 5/32 in. leaves a 4° burr angle. An overhang of 7/16 in. leaves a 7° burr angle. The thickness of your worktable and your preference for the burnishing angle will determine how much you should overhang the scraper. With this method I can tune up a scraper in a couple of minutes.

—Peter Loring, Robbinsdale, Minn.

Bending wood with a microwave oven

If you have a workpiece that is small enough to fit into a microwave oven, here's a way to steam it for bending. Soak the piece briefly in water, wrap it in a wet cloth, place it in a covered glass baking dish and heat it for a minute or two. After heating, let the wood stand for 15 minutes, after which it should be ready for bending. Some complicated bends may require another heating cycle. Also, a partially bent piece can be held on a wooden form for subsequent heating cycles. Be sure to hold the wood to the form with string or nylon ties. Avoid using any metal forms, fasteners or wire in the microwave oven so that you don't damage it.

—Don Anderson, Sequim, Wash.

Quick tip: To keep your fingers from slipping while honing a plane blade or a chisel, make a stack of three rare-earth magnets on the blade to provide a handle. The magnets are available from Lee Valley and other mail-order suppliers.

—Peter Duncan, Walnut Creek, Calif.

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Notes & Comment

One by the master. *Esherick built this cherry music stand in 1951 for a local cellist.*

Beautiful music at the Wharton Esherick Museum

Following in Esherick's footsteps. *The Wharton Esherick Museum celebrated its 30th anniversary with a competition and exhibition of music stands. From left, Terri L. Cadman's organic piece, "Nature Sets the Tone," won first prize; Brian Kolakowski's jazzy, Picasso-esque "O'Norman" took second; and Ken Christy's "A Stand to Lift the Spirit" received the third-place award.*

The Wharton Esherick Museum celebrated its 30th anniversary in September 2002 and used the occasion to award prizes in its ninth annual design contest.

Esherick's sculptural yet functional forms ushered in a new genre of free-form furniture, inspiring the work of Sam Maloof and Wendell Castle, among many other contemporary woodworkers.

In keeping with Esherick's work, the annual competition seeks new, imaginative forms for functional items. This year's theme was music stands, a form Esherick himself experimented with.

From a field of 54 entries, 16 stands were chosen for exhibition, and Terri L. Cadman's "Nature Sets the Tone" won first prize. The organic, mahogany music stand, with its branchlike base and leaf-shaped desk, looked right at home alongside Esherick's work.

The museum, in Valley Forge, Pa., consists mainly of Esherick's home and studio, which he built and furnished over four decades until his death in 1970. He crafted the building and almost everything in it, from coat hooks and door latches to a built-in serpentine sofa with hidden drawers and a massive, red-oak spiral stairway in the center of the structure. For more information on the museum, which is a National Historic Landmark for Architecture, call (610) 644-5822.

—Tony O'Malley

Wood web

www.toolseeker.com

This web site is a powerful and easy-to-use tool for online shoppers. It's basically an Internet search engine that finds the lowest prices on power tools and then presents those results and a comparison of features and specs in a straightforward format.

Click on a category—drill, sander, tablesaw, dust collector—and the site responds with a list of products in various sizes and styles, grouped by manufacturer. Select as many as you want from that list, and Toolseeker puts them in a head-to-head chart comparing features and the best available price on the Internet. Another click lists various prices for a single tool, including shipping costs and tax. Toolseeker searches for project plans available online, too.

Toolseeker also locates customer reviews for many tools and offers links to product reviews by various woodworking magazines. *—Asa Christiana, senior editor*

Photos, this page (from left): Courtesy of the Wharton Esherick Museum; courtesy of Terri L. Cadman; courtesy of Brian Kolakowski; David L. Sanford

READER SERVICE NO. 136

A marriage of wood and plastic

Polished cherry meets polymer clay. *"Java Credenza" combines the woodwork of J.M. Syron with polymer veneers hand-crafted by his wife, Bonnie Bishoff.*

Fine furniture with plastic panels? Actually, it's polymer clay. Bonnie Bishoff layers, rolls, slices and flattens it into complex patterns before passing on the sheets to her husband, J.M. Syron, who uses them as thick veneers in his furniture.

Polymer clay comes in many artist's colors and can be baked to a hard-rubber consistency in a conventional oven. It can be applied to common veneering substrates and wet-sanded.

Bishoff is responsible for the artistry of the designs. She models the patterns after the fractal geometry that occurs naturally in seashells, plants and cells. The first step is to mix custom colors, using artist's colors and translucent tones. She then uses a pasta-making machine to crank out layers of various colors and then rolls the sheets into canes, or "jelly rolls." She takes cross-sectional slices off the end of a roll and assembles them side by side like puzzle pieces, a process called *millefiore*, borrowed from Italian glassworking.

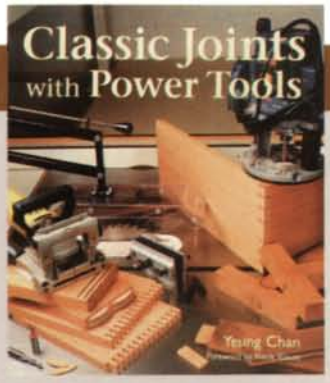
A step-by-step process. *Single colors are rolled into canes, which resemble jelly rolls. The canes are combined and rolled into more complex canes, from which thin slices are taken. Last, the slices are lined up and flattened into continuous patterns.*

Bishoff uses Premo brand polymer clay, available for $16 per pound from Clay Factory Inc. (760-741-3242; www.clayfactory.com).

While the exquisite polymer patterns blend seamlessly with Syron's furniture and picture-frame designs, selling the work means educating gallery owners and prospective clients about the new material. However, Bishoff said, the job is getting easier as the material becomes more widely recognized and accepted and as the work is seen in major shows and galleries.

—A.C.

Book review



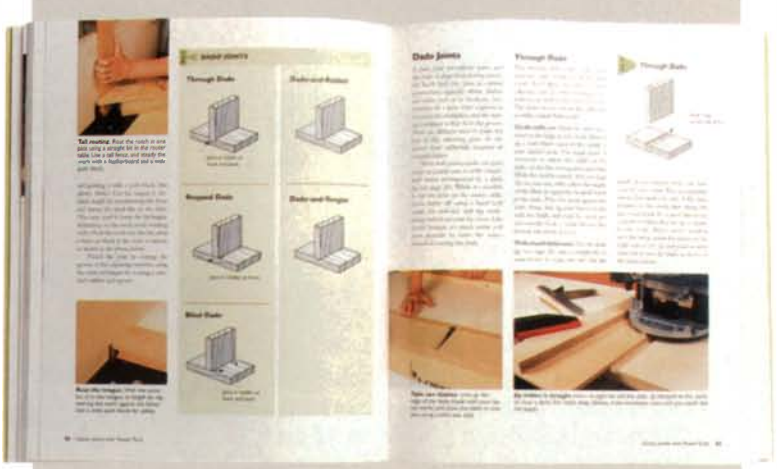
Classic Joints with Power Tools *by Yeung Chan. Sterling Publishing, New York; 2002. $19.95 paperback; 176 pp.*

"With today's highly efficient and affordable power tools," Yeung Chan writes, "you can make the same joints our ancestors made—in much less time, and with greater accuracy." His dual goal in this excellent book is not only to make high-quality joinery more accessible for beginners and intermediates but also to show seasoned veterans faster and more efficient ways to work.

Chan starts by describing how to construct a number of shopmade jigs, which are used throughout the book. These are elegantly simple jigs, but they are invaluable for accurate crosscutting, mitering and doweling, among other fundamental techniques.

Chan then works his way through the various categories of joints—from basic butt and splined joints through dovetails and mortises and tenons—offering variations of each: stopped cuts, various workpiece orientations and so on. While the emphasis is on power tools, a few of the more complex joints require light handwork after the machine cuts.

To suit the average woodworker, who is a few tools short of a dream shop, Chan also offers multiple techniques for cutting many of the joints, using several different machines. Many techniques are unconventional, but all are effective, such as cutting dovetails on the bandsaw or tablesaw and cutting long slots with a biscuit joiner. He is not interested in the "right" way to cut each joint; instead, he presents the pros and cons of a number of techniques. This adaptable approach, combined with the sheer number of joints covered, makes this one of the best books on joinery that I've seen. *—A.C.*



Options. *Chan presents many variations on each joint and a number of ways to cut each one.*

Photos, this page: Dean Powell (top left); Asa Christiana (bottom left); Rodney Diaz (top and bottom right)

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Two new benchtop planers

CRAFTSMAN 21743 (800) 697-3277

On the upside, the machine had minimal snipe. The built-in dust collector worked great, as did the motorized carriage. On the downside, the Craftsman was noisy and out of parallel by 0.0100 in. (the owner's manual shows how to correct it). Changing knives was time-consuming. It's heavy and expensive.

RYOBI AP1300 (800) 525-2579

On the upside, the machine had minimal snipe. Carriage parallelism and dust collection were good. Knife-changing was relatively fast. And it's inexpensive. On the downside, the Ryobi was noisier than most other planers recently tested.

*Editor's note: Last issue (*FWW *#160, pp. 74-81) included a review of benchtop planers by contributing editor Lon Schleining. Since then, a couple of new benchtop planers—the Craftsman 21743 and the Ryobi AP1300—have been introduced. So we asked Lon to repeat the close-up look he gave the others.*

Craftsman 21743

The Craftsman 21743 has a couple of practical features you won't find on any other portable thickness planer: a built-in dust collector and a carriage that raises up or down with the flip of a lever.

The planer includes a canvas hood designed to accept either a 30-gal. trash can or bag. The built-in high-volume vacuum removed chips effectively and neatly deposited them in the can.

Raising or lowering the carriage on the Craftsman 21743 is a one-finger operation. Push the control lever up, and the carriage moves up; push the lever down, and the carriage lowers.

As you might expect, those features make the 21743 among the largest and heaviest of the portable planers on the market, a drawback if you move the planer a lot. Also, the Craftsman was noisier than most, especially when it was idling.

My measurements showed the planer to be out of parallel by 0.0100 in., the most of any planers that were tested previously. On the plus side, though, the owner's manual clearly explains how to adjust the carriage for parallelism, so you should be

Planer Specs and Performance

	CRAFTSMAN 21743	RYOBI AP1300
AVERAGE STREET PRICE	$440	$270
MAXIMUM PLANING THICKNESS, WIDTH	6 in., 13 in.	6 in., 13 in.
WEIGHT (NET)	95 lbs.	77 lbs.
SPEED (NO LOAD)	8,000 rpm	9,900 rpm
KNIVES REVERSIBLE	Yes	Yes
EXTRA SET OF KNIVES INCLUDED	No	No
KNIVES CAN BE SHARPENED	No	No
PRICE FOR NEW SET OF KNIVES	$50	$30
DUST-COLLECTION HOOD	Included	Included
AVERAGE SNIPE PER SIDE	0.0010 in.	0.0015 in.
OUT OF PARALLEL	0.0100 in.	0.0010 in.
NOISE (LOAD)	100 dB	101 dB
TIME NEEDED TO CHANGE KNIVES	23 minutes	14 minutes

Photos, except where noted: Rodney Diaz; facing page (middle and bottom right): Tom Begnal

able to adjust it to zero. Test cuts showed a planed surface that was very good, although it wasn't quite as smooth as the surface produced by the other portable planers. Still, the result was better than what I've seen from many of the big stationary planers on the market.

Ryobi AP1300

Ryobi, manufacturer of the first portable thickness planer, has returned to the market with the AP1300, available only at The Home Depot.

The Ryobi AP1300 produced virtually no snipe. The board was almost parallel when measured from edge to edge, and the surface quality was excellent. Plus, it sells at an appealing price.

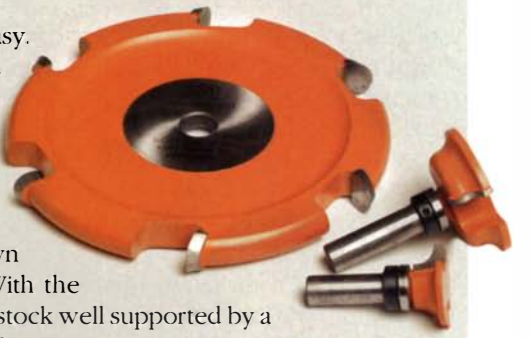
But this planer was noisy. And it had another drawback: When I attempted to measure the time required to change the blades, I discovered the machine screws that fasten the knives to the cutterhead were overtightened. Most of them came out after considerable effort. But three refused to budge, so the heads had to be ground off. Once removed, the screws were replaced and the blade-changing time was measured. At 14 minutes flat, it required less time than most others.

All things considered, the AP1300 looks like it is a good planer at a good price.

—Lon Schleining is a contributing editor.

Can it. *The Craftsman 21743 benchtop planer has a built-in dust collector that feeds chips into either a 30-gal. trash can or a 30-gal. plastic trash bag (cans and bags are not included).*

A set of cutters for tablesawn crown molding



Finding the perfect crown molding isn't easy. Commercial stock tends to be available in a limited number of sizes and profiles. If you are lucky enough to find the right size and shape, the stock is likely to be made from maple—when you want mahogany.

That's why many woodworkers end up using the tablesaw to make their own crown molding. The process is basic enough. With the stock well supported by a fence or two, it's run at an angle across the body of the blade, while no more than 1/16 in. of material is removed with each pass. Simply by varying the angle at which the stock meets the blade, you can produce a wide assortment of cove profiles.

Crown-molding cutter. *CMT's crown-molding set has two components: a heavy-duty dedicated cutter for creating the main cove, and a half-dozen router bits for decorating the edges.*

But the tablesaw blade isn't designed to cut stock at such an unusual feed angle. The result is a surface that's pretty rough. And smoothing it requires nothing less than a good deal of scraping and sanding.

With all that in mind, woodworker Lonnie Bird and the router-bit outfit CMT got together and designed a cutter specifically for making crown molding. It features a 3/8-in.-thick, 7-in.-dia. steel body with six curved cutting tips.

Using the cutter, I produced a generously sized cove in several lengths of pine and oak, removing no more than the recommended 1/16 in. of stock per pass. I also made the same cove using my carbide-tipped tablesaw blade. When compared, the surfaces produced by the CMT cutter were noticeably smoother than those made on the tablesaw. As a result, I faced considerably less time with my scraper.

In addition to the cove cutter, the CMT set comes with six router bits for use in a router table. Compared with conventional router bits, however, these have profiles that are upside-down. Not only that, the bearing is positioned between the shank of the bit and the cutter, which makes these bits perfectly suited for adding a decorative profile along the edges of the molding.

The set sells for about $340. For more information, contact CMT (888-268-2487; www.cmtusa.com).

—Mark Ziobro builds and restores furniture in Sheffield, Mass.

These bits were designed for use in a router table. *The bearing is located between the shank of the bit and the cutter. The design makes it easy to apply a shaped edge to the molding.*

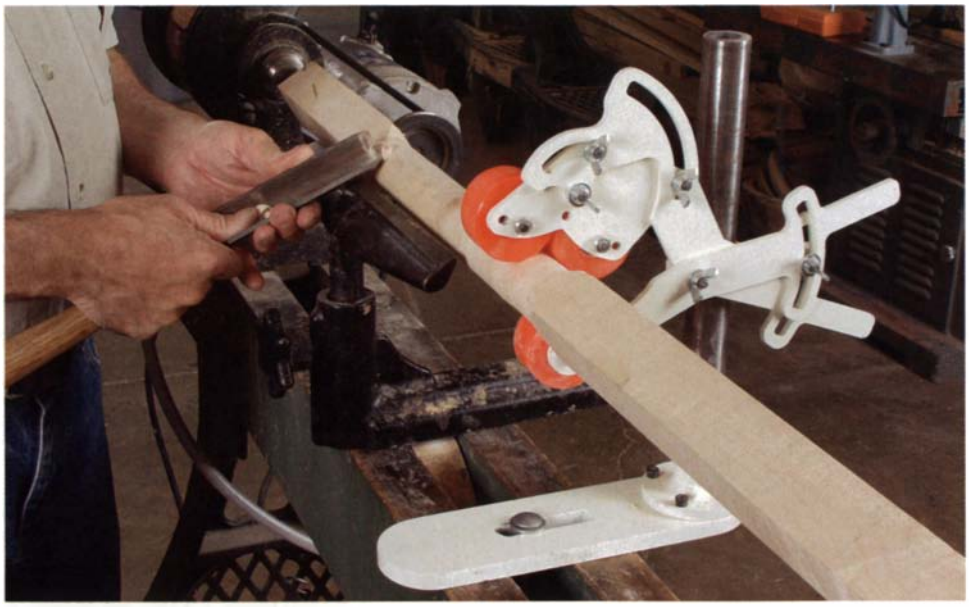
New and improved steady rest for the lathe

A long, thin spindle can vibrate while it's being turned. And when a part is vibrating, it's impossible to get a smooth surface.

Over the years, wood turners have devised various forms of a shopmade gadget called a steady rest to keep thin spindles from shaking. But the steady rest can be difficult to make and use.

Commercially made steady rests are another option, but they too aren't exactly user-friendly. Usually, they require individual adjustments of wheels or ball bearings. And with wheels or bearings in the picture, it becomes difficult to add or remove a spindle from the lathe.

So, while at a turning symposium last spring, I was intrigued when I spotted a new steady rest by Oneway Manufacturing, one that addresses all of the typical problems I mentioned earlier. I immediately arranged to try it out in my shop.



Steady as she goes. *Oneway's new lathe steady rest sets up quickly, adds plenty of support and makes it easy to add or remove a workpiece.*

Once the steady rest arrived, I put it to the test by having each of my students in a Shaker-furniture class use it to turn 1⅝-in.-dia. by 43-in.-long back posts for their rocking chairs. This allowed me to see just how well the Oneway steady rest performed at a variety of skill levels.

Oneway's design differs significantly from others I have seen. The base bolts to the bed of the lathe via a T-block that's supplied. It even can be mounted on a tubular bed.

It's easy to adjust the height of the Oneway. Simply loosen a setscrew, then raise or lower the height of the support assembly and retighten the screw.

Once the height is set, the use of the Oneway steady rest is simplicity itself. First, mount the workpiece in the lathe and start it up. Then, working only in the short section that the rollers are going to contact, turn the workpiece fully around. Now loosen a series of wing nuts and squeeze the handles at the back of the steady rest. This brings the three wheels into firm contact with the work, perfectly centered. After that, simply tighten the wing nuts while maintaining pressure on the handles. At this point, with the wheels supporting the spindle, the turning can be completed with little fear of vibration.

My students found the Oneway easy to use, and it produced good posts. Their only criticism was related to the small wing nuts: They were difficult to tighten adequately by hand. We all resorted to pliers.

Overall, though, the Oneway steady rest is a well-made tool and, except for the wing-nut issue, it lived up to all of its advertised virtues. It sells for $100. For more information, contact Oneway (800-565-7288; www.oneway.on.ca).

—Ernie Conover teaches wood turning in Parkman, Ohio.

Wood glue comes in a clever container

Loctite Products (800-321-1733; www.henkelca.com) has added Wood Worx, a yellow woodworkers' glue (aliphatic resin), to its line of adhesives. What makes this product special is the plastic bottle.

Typically, wood glues are easy to squeeze out when the bottle is full or nearly so. But squeezing glue out of a nearly empty bottle is another story. To speed up the process, the Wood Worx bottle is designed to lie on its side during a glue-up, resting on a flat, tapered section of its otherwise cylindrical shape. When on its side, the bottle tips toward the nozzle, so the glue is always at the ready. Also, the nozzle is positioned off center, placing it adjacent to the flat section and near the lowest point on the bottle when it's sideways. A cap threads on the nozzle, making everything airtight and spillproof. And, to help eliminate lost caps (my shop has dozens somewhere), the top includes a cap holder.

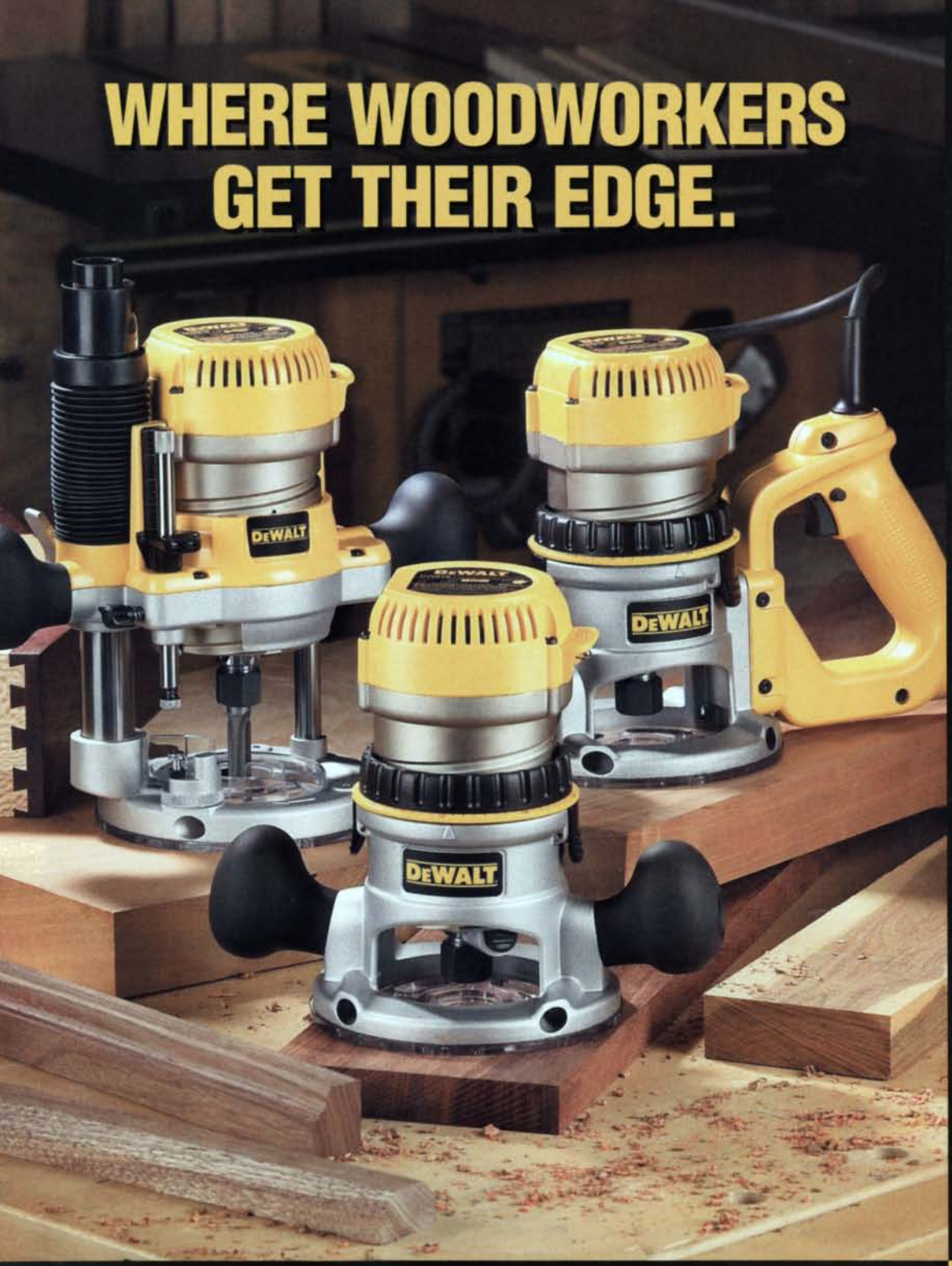
Keeping glue at the ready. *Wood Worx's unique plastic glue bottle allows it to lie on its side, so the glue is always in the nozzle and ready to apply.*

Wood Worx glue is available at Wal-Mart. A 13½-oz. bottle sells for about $4.

—Tom Begnal is an associate editor.

Photo, this page (top): Ernie Conover

WHERE WOODWORKERS GET THEIR EDGE.



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Sawhorses for the Shop

Three horses that cover all of your shop needs

BY CHRISTIAN BECKSVOORT

Sawhorses are an indispensable part of my shop equipment. No matter what the process or project, I reach for a horse to saw boards, to stand on, to lay out panels and joints, to hold parts and to elevate cabinets for sanding or planing. I also use sawhorses for drill-press work supports, assembly, finishing, outdoor power carving and routing, changing lightbulbs and even photography. I've constructed a pair each of three different heights: 1 ft., 2 ft. and 3 ft. The 3-ft. set includes height extenders for even more versatility.

Sawhorses are not fine furniture. I built these horses quick and dirty, to be useful but sturdy. The material is whatever I happened to have on hand at the time: pine, ash, oak, fir and even the ever-plentiful cherry scraps. For joinery I relied on butt joints held together with glue and screws. I spent a lot of time and effort on my toolbox (see *FWW* #153, pp. 84-89) and will do the same when I have to replace my aging workbench. But sawhorses are a different story. I give them the roughest treatment without a second thought. While studying and restoring Shaker pieces, I noticed that although most of their work reflects meticulous craftsmanship and graceful design, many of their tables, stands and cases intended for shop use are merely glued and nailed together. They had the same idea. □

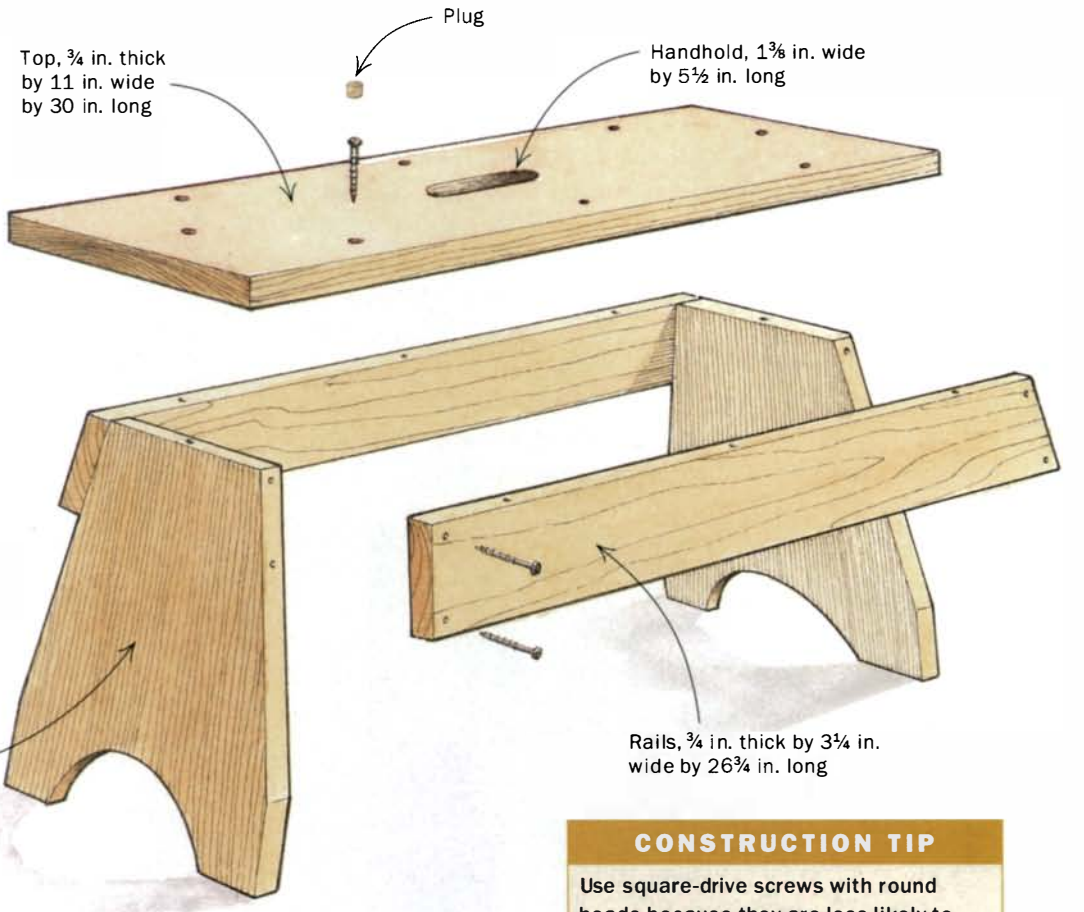
Christian Becksvoort is a furniture maker and contributing editor.

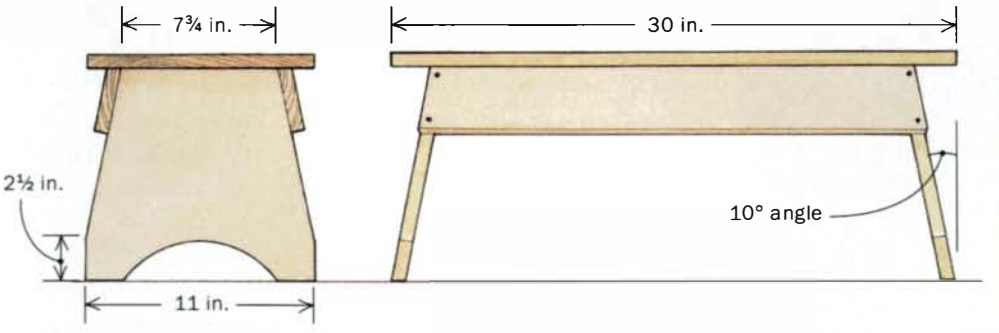
Photos, except where noted: Michael Pekovich; this page: Tim Sams

WIDE-TOPPED SHORT HORSE SERVES TWO PURPOSES

Essentially, this horse is a stool, but it can be used as a short bench for sawing, holding tall work in a vise and holding case work off the floor for finishing.

Stepping up for crosscuts. *The 1-ft.-tall horse raises the workpiece so that you can use a crosscut saw comfortably.*





CONSTRUCTION TIP

Use square-drive screws with round heads because they are less likely to strip out and, unlike flat-head screws, won't act as a wedge.

My shortest sawhorse is really a larger version of a footstool or a small bench. It's about a foot tall and is assembled with screws. Because the top of this horse is relatively large, it has a handhold in the middle to make it easy to pick up the horse and move it with one hand.

Generally, I use the short horse for sawing long planks to rough length. If I'm cutting off just a couple of inches from the end of a long plank, a pair of these horses goes under the long section. If I'm cutting the plank near the middle, the sawcut is made between the horses to support the cutoff.

Most often I'll use the short horses to bring a case piece up to a comfortable working height. For example, I'm over 6 ft. tall, so a 30-in.-tall cabinet that needs to be planed or sanded is in a much better working position for me with this horse placed underneath it. When edging wide panels or case backs, I set one end into my bench vise and support the other end on the short horse. My ancient Skil belt sander weighs close to 15 lbs., and I prefer to use it in the horizontal position. Consequently, when finish-sanding the top of a 5-ft.-tall cabinet, I stand on the short horse to make sanding easier. When working on a nearly completed piece, I pad the top of the horse with carpet scraps to protect the piece from unwanted dings, dents

Drawings: Heather Lambert

and scratches. I'm not the only one who finds my short sawhorses useful. The short horse gives every *Fine Woodworking* photographer who comes into my shop a great view of work in progress on my tall workbench.

The footprint of the base is the same size as the top so that the horse is safe to stand on, and a pair can be stacked. The legs are cut at 10° along both sides and are tilted at the same angle when attaching the side rails. A "V" or half-round cutout on both ends results in four feet. The rails are screwed in place, and the top is attached to the base with screws. I plugged the screw holes to keep chips and oil from accumulating in them, and I beveled all edges with a block plane before putting this horse into service.

When I build a pair of these horses again, I'll make one improvement: The rails will be 4 in. to 6 in. wide for added strength and racking resistance. My set, after 20 years of use, is starting to wobble a bit. Otherwise, I'm pretty happy with them.

Use horses in conjunction with your bench. *While a workpiece is secure in the vise, the short horse provides solid support from below.*

A pair of medium-size horses makes an impromptu workbench. *At 2 ft. tall, these horses are the right height for doing finish work on a large case piece. The carpeting protects the workpiece.*

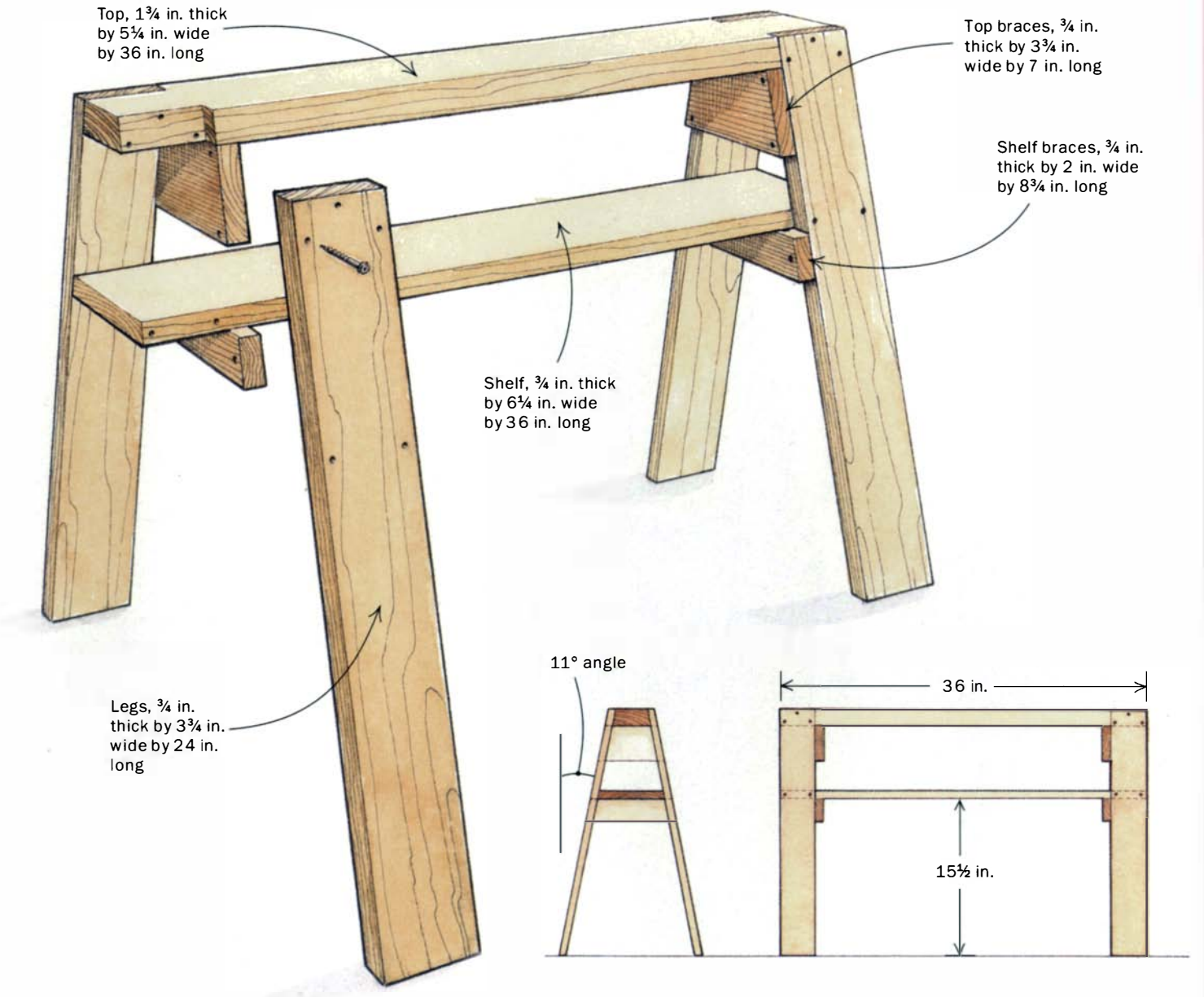
The 2-ft. sawhorse is the workhorse in my shop. This style is easy to make and move around. I make them in pairs, and the design allows the horses to be stacked when not in use. I also stapled carpeting to the top to prevent pieces from being damaged while they are on the horses.

Their primary use is for holding case pieces at working height. When fitting face frames, backs or doors, or when sanding or installing hinges, I find these midheight horses indispensable. Standing on these puppies brings me right up to the ceiling in my shop: I can change lightbulbs or sand the tops of tall cabinets. And because the braces are inboard of the legs, I can clamp onto the ends as well as the middle of the top. I sometimes use these horses to clamp case sides upright when laying out and transferring dovetails from the top to the sides. This is a real handy feature when working alone.

There are many ways to construct a 2-ft. sawhorse. On mine, the legs are let into notches in the top piece. Braces provide racking resistance in two locations, and a shelf is handy for storage or as a step. The legs are splayed out 11° to

2-FT. SAWHORSE IS THE MOST USEFUL

This is a standard-size horse for general carpentry, but it also can be handy for holding case pieces. The shelf is optional, though it provides additional stability to the horse.

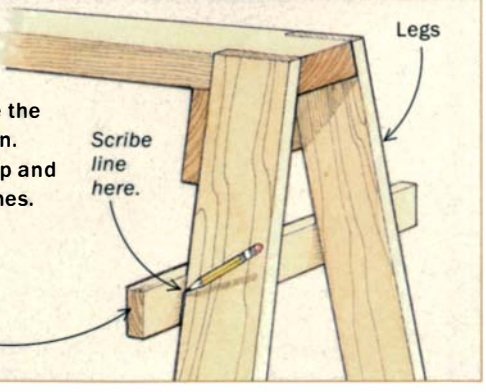


the sides. For the top, you can rip the sides of a 2x4 to 11° and simply attach the legs. Or you can use a 2x6 and let in the legs. The 2x6 gives you a wider top, which provides extra stability should you wish to stand on it. In addition to the two pairs of braces shown in the drawing, one of my 2-ft. horses has additional bracing just above the floor (see the photo above left).

A shelf on the lower braces not only adds strength to the horse, but it also is strong enough to act as a lower step. The braces under the shelf provide enough support that I can stand on the shelf without it flexing. For a while I had side strips along the shelf that kept tools from rolling off. They worked, but they collected all sorts of debris and were difficult to keep clean, so I took them off.

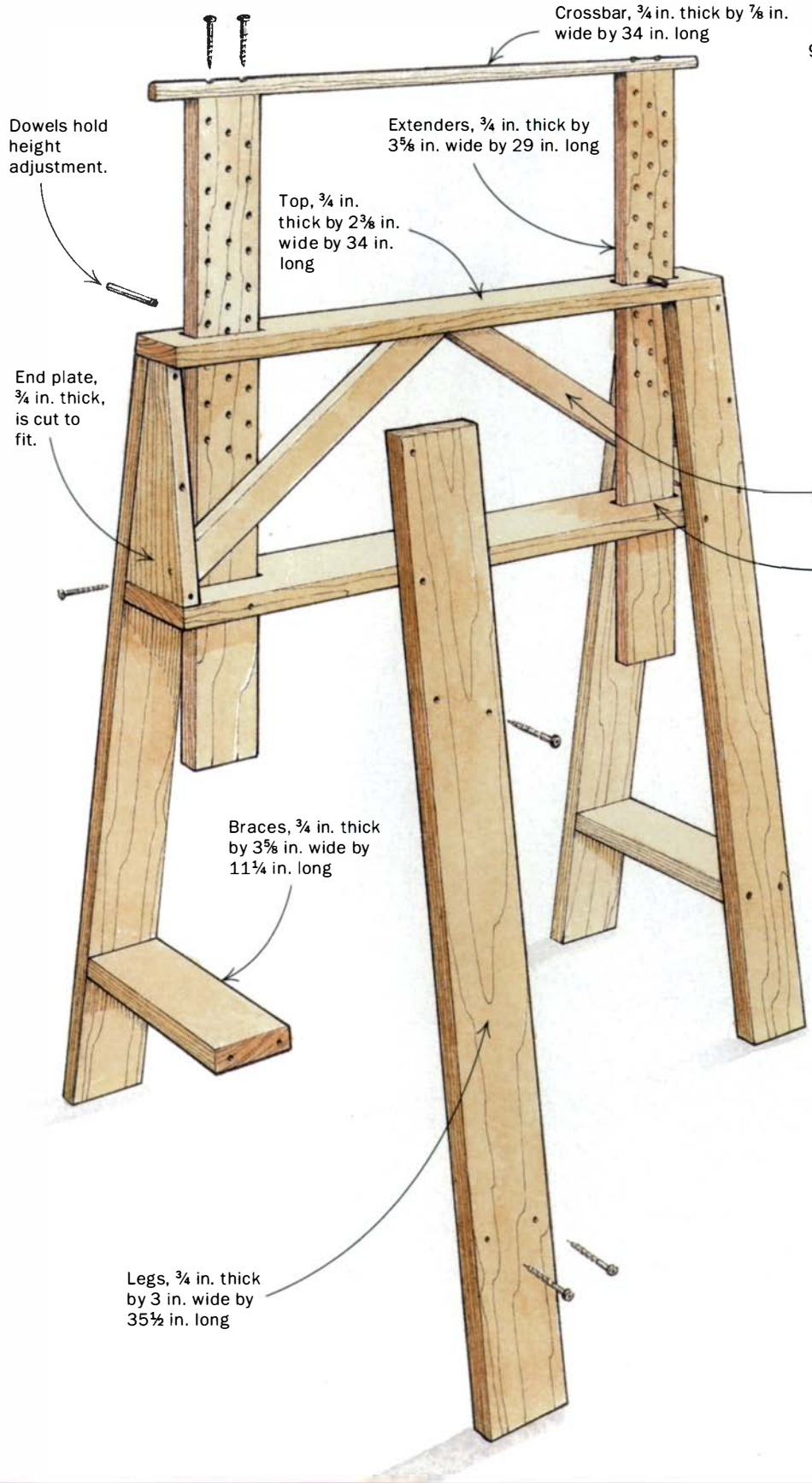
CONSTRUCTION TIP

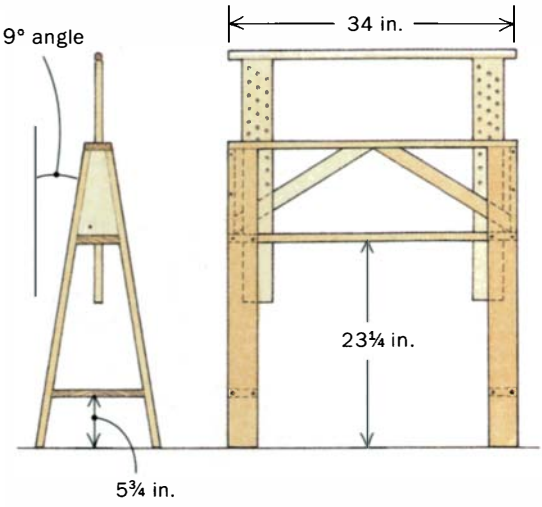
Make the shelf braces after the legs have been completed. Place the shelf braces 8½ in. down from the top and scribe your cut lines.



TALL HORSE IS ADJUSTABLE IN HEIGHT

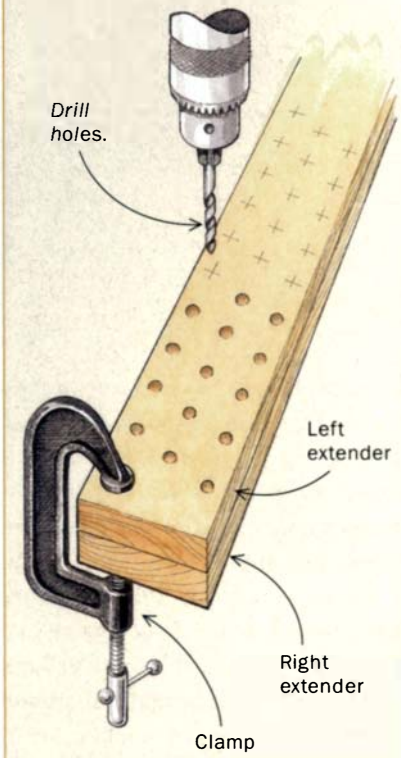
The extenders on this horse raise your work to a comfortable height. The ends of the horse are made flush so that you can clamp tall pieces to them.





CONSTRUCTION TIP

Stack your extenders together and drill the dowel holes in one step to ensure proper alignment.



Adjustable-height sawhorses are versatile. *Avoid back fatigue by raising the work up to a comfortable height.*

I recently added a third pair of sawhorses that can be adjusted in height between 36 in. and 55 in.

I use these horses mainly for sanding and finishing. Even though they're 36 in. tall, I still have to bend over slightly, hence the extenders. For my height, 42 in. to 44 in. is ideal for sanding and finishing, especially tabletops. For fine, close-up work like carving or inlaying, I prefer 48 in. to 54 in. That's about mid-chest height for me, just right for the real fussy stuff. When I have messy work to do, I haul these horses outside, remove the extenders and use them like a bench for seat carving, grinding, sanding and routing. At the drill press, the extenders are useful for holding long work at the correct height.

The tall horses are built almost like the two-footers. The major difference is that I have enclosed the ends and added diagonal braces for strength. The extenders consist of two 3⅝-in.-wide boards connected to a ¾-in.-thick crossbar. The boards are drilled at ½-in. intervals and fit into slots in the top and the lower shelf, much like a centerboard of a sailboat. Two ⅜-in.-dia. dowels through the 25/64-in. holes hold the extenders at the desired height. The crossbar is padded with ¾-in.-dia. foam pipe insulation to protect the workpiece. It also provides grip to prevent panels from sliding around when they're being sanded.

Feel free to customize these horses as needed for specific applications. For example, the crossbar is fine for supporting wide panels, but it won't take the weight of a 4-in.-thick plank. A wider board or even a T-shaped crosspiece would make a good substitute. On occasion, when I use the horses as a single unit, I have scrap V boards fitted between them. Two bar clamps hold the whole unit together so that I can use it as a bench.

Height adjustment is made with a dowel. *The holes are numbered on both sides for quick alignment.*

Pad the crossbars to protect your work. *Foam pipe insulation works well and easily slips on and off the top.*

How to Conceal Sapwood

Use gel stains, dyes and pigments to refine cherry and walnut

BY TERI MASASCHI

A few years ago, cherry boards containing sapwood were the exception at reputable lumberyards. Now they seem almost the rule. Increasingly, furniture makers are faced with a dilemma: Do they waste growing amounts of an ever more expensive product by cutting off the sapwood, use only narrow boards or resign themselves to unsightly streaks of sapwood in their work?

The solution is to color the sapwood so that it blends in with the heartwood. There are a number of different ways to stain, dye, glaze and seal sapwood. While I will use cherry for most of my examples, I also

METHOD 1

COLOR THE SAPWOOD WITH GEL STAIN

A coat of clear gel varnish (below) followed by gel stain is an easy way to conceal sapwood.

Stain the sapwood. *After the coat of varnish has dried, wipe on a coat of gel stain over the lighter area to blend it in (right). If the tone of the gel stain isn't quite right, adjust it by adding some Japan color. Unlike the heartwood, cherry sapwood does not darken with age, so stain the sapwood a little darker than the surrounding wood.*

will show a method for concealing walnut sapwood, because sapwood is appearing more regularly in both cherry and walnut stock available today.

For a natural look, color only the sapwood

The popularity of the natural look on finished cherry has made hiding sapwood more difficult. There are three methods to blend in the sapwood without darkening the whole board.

Combine gel varnish and gel stain—For a light, natural cherry look, wipe a clear gel varnish over the entire surface and then match the sapwood to the heartwood using a gel stain. It is quite likely that the commercial gel stain won't be an exact match with the heartwood. Blend Japan colors or artist's oil colors with the oil-based gel varnish to get a perfect match. Don't worry if the stain is too light; repeated applications will make the sapwood darker.

Brush away the sapwood—Dye stains applied with an artist's brush are a great way to blend in small streaks of sapwood, especially if the aim is to have a natural final appearance for your workpiece. Water-based dyes can be used, but they have the side effect of raising the grain. Instead, you may opt for alcohol-based non-grain-raising (NGR) dyes, which are fast drying and come premixed.

On a piece of scrapwood that closely matches the workpiece, wet the area surrounding the sapwood with a solvent such as mineral spirits or naphtha to get a better idea of what the wood will look like with a clear finish. This will dictate the color that the sapwood needs to match. Using this sample board, choose a dye that most closely matches the wet heartwood, combining two or more colors, if necessary (I used amber fruitwood and golden oak in this example). Carefully brush the dye on the sapwood and check the color. If it is too dark, wipe the sapwood with a rag dampened with denatured alcohol to lighten the dye. Rewet the surrounding area to compare the match. If the colors are close, go forward with a clear sealer coat.

After the sealer coat has dried, a final color tuning can be done with a light application of glazing stain or pigment stain. Bear in mind that cherry heartwood character-

METHOD 2

COLOR THE SAPWOOD WITH DYE STAIN

Dye stains offer a greater choice of colors than gel stains and more flexibility in choosing a clear finish.

1. Simulate the finish. *Wipe the piece with naphtha or mineral spirits to see how it will look with a finish applied. This allows you to color the sapwood to match the heartwood's final appearance.*

2. Always test first. *On a matching piece of scrap already wiped with solvent, test the color for a good match with the heartwood.*

3. An artist's touch. *Brush the dye onto the sapwood. If it is too light, add another coat; if it is too dark, wipe off the dye at once with a cloth dampened with alcohol.*

Photos: Mark Schofield

METHOD 3

APPLY MULTIPLE LAYERS OF GEL STAIN

For an antique cherry look, color the whole piece using a gel stain.

One coat may not be enough. *If one general application does not hide the sapwood (above), wipe another coat of stain specifically on the sapwood (right). Normally, two coats are enough to blend heartwood and sapwood.*

istically darkens as it oxidizes and ages, so you may want to leave the sapwood looking a little dark initially.

If you don't want to go to the trouble of painting the small streaks of sapwood, but you still want a light finished look, simply seal the entire surface of the wood with a washcoat of shellac. Then lightly apply either a pigment stain or a glazing and shading stain in either Vandyke brown or burnt umber. Quickly wipe off the bulk of the stain with a clean cloth. Treating the surface like this won't make the sapwood streaks disappear, but the stain or glaze will mute the streaks.

Hide sapwood by staining the entire board

For the darker, aged appearance of antique cherry, color the whole piece. There are two different ways to do this.

Apply incremental coats of gel stain—Gel stains are probably the simplest way of blending the lights and darks in a piece of wood. If the color of the gel stain is an acceptable tone, apply a single coat of stain over the entire piece, wipe off the surplus and buff the surface. When it's dry, apply a second coat of gel stain to only the sapwood streaks, again wiping off the surplus and letting it dry. Two applications should be adequate, but for high-contrast areas, a third coat may be necessary. The reason gel stains are so easy to use is that they add more color with each incremental coat. While several coats on the entire surface may give a muddy appearance, this is not a problem on small areas of sapwood.

Combine both dyes and glazes for flexibility—Because cherry is prone to blotching, I strongly suggest spraying the dye in this next process. If you do apply the color by hand, pretreat the wood with a stain controller (see Finish Line, *FWW* #156, pp. 113-114). Adjust the gun to spray a fine mist and stain the entire piece with a golden-oak NGR dye. Now set the gun for a narrow pattern and give the sapwood streaks a few extralight applications. This method is successful because the dye dries as soon as it hits the surface and builds the color layer by layer. Because the dye does not penetrate the wood, this method gives you plenty of control. Next, apply a washcoat of a 1- or 1½-lb. cut of dewaxed shellac. When it's dry, scuff-sand with 320- or

METHOD 4

COMBINE DYES AND GLAZES

For ultimate control, treat the wood with a dye and then adjust the tone with a glaze.

First spray the piece with a light coat of dye stain. *The stain dries quickly, without blotching. Then dial the gun to produce a narrow pattern over the sapwood only.*

Then brush on a glazing and shading stain. *Aim for overall but not uniform coverage. Do the edges last.*

400-grit paper. Finally, glaze with a burnt-umber glazing and shading stain, and topcoat when dry.

Avoid bleach and chemical stains

Bleaching the entire board to an even whiteness and then staining it to match the rest of the piece could be one solution. However, the bleach is harsh, and because it's water based, the bleach creates more problems than it solves. Applying bleach raises the grain and opens the pores, so boards treated in this way tend to accept stain differently than untreated wood.

Chemical staining is a solution that's a long way from the problem. Because chemical staining is designed to work by reacting with the existing tannic acid in the wood, and sapwood has little or no tannic acid, you first have to add tannic acid to these areas. Even so, it is not a totally reliable process and sometimes requires a color touch-up afterward. □

Teri Masaschi is a finisher and furniture restorer who lives near Albuquerque, N.M.

A recipe for walnut

Walnut has its fair share of sapwood, and this four-step staining method is my personal favorite for dealing with it. With this method, you can enhance the appearance of a whole piece and hide the sapwood. Stain the entire piece by hand or spray it with a light color, in this case, a lemon-yellow non-grain-raising (NGR) dye, and let it dry thoroughly. Then apply a darker dye or pigment stain over the whole piece (here I used Vandyke-brown NGR dye) and let this dry, too. The third step is to brush or spray on a washcoat of shellac; after it dries, scuff-sand with 320- or 400-grit paper. Finally, glaze the board with a complementary glazing and shading stain such as burnt umber, wiping off the surplus with a clean rag. Application of a topcoat reveals a beautiful, consistent brown tone.

Tone it down. *Apply a yellow dye to neutralize the sapwood. After it has dried, brush on a coat of Vandyke-brown NGR dye to establish a base color.*

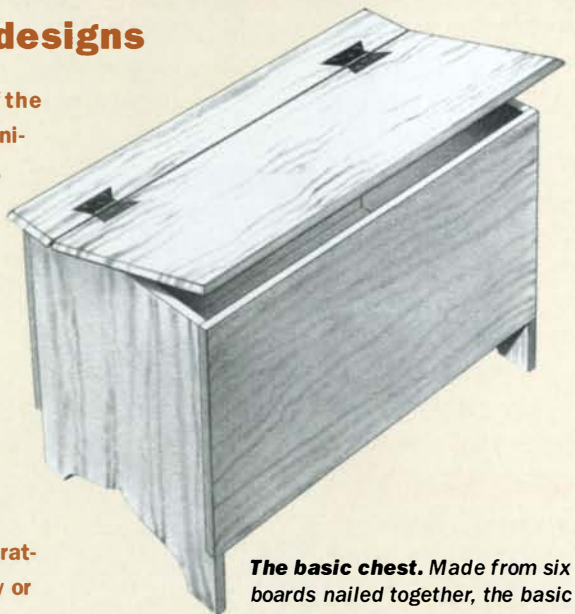
Hinges and

Traditional, decorative or practical, there's hardware to match any style

BY MIKE DUNBAR

Blanket-chest designs

Blanket chests were one of the most common pieces of furniture made by the Colonists, so they have a strong association with American woodworking. Many a simple six-board chest stood at the foot of the bed to store blankets, but others were elaborate and intended as a living room's centerpiece. Cabinetmakers lavished a lot of detail on such pieces, decorating them with carving, inlay or faux painting.



The basic chest. *Made from six boards nailed together, the basic chest had a lid that opened via a pair of easy-to-install butterfly hinges.*

A traditional chest. *From Colonial times until the Arts and Crafts Movement, chests have relied on strap hinges, which may be mounted on the inside or outside of the lid.*

Lid Supports for Chests

Almost every furniture style—from Shaker to Arts and Crafts—has adopted and adapted the basic chest, in the process creating a range of styles and uses. But no matter which design you choose, a chest needs hardware.

I am always surprised when someone invests a great deal of effort in making a piece of furniture and then buys whatever hinges the local hardware store carries.

If you source from the quality suppliers that I'll mention, the choice of hardware is enormous: You can choose hinges that not only match the quality but also the style of your workpiece. I'll show you how to install the brilliantly simple snipe hinges in that six-board chest you're making; I'll show you where to find and how to install hand-crafted strap hinges worthy of the finest blanket chest; and if it's a toy box for a child that you're making, I'll cover hinges that will resist the most destructive toddler as well as lid supports to prevent crushed little fingers. □

Mike Dunbar runs The Windsor Institute in Hampton, N.H.

A new age. *The introduction of mass-produced and easy-to-install butt hinges coincided with the rise of Shaker furniture making.*

STRAP HINGES COMBINE BEAUTY AND STRENGTH

Inside or outside. *This particular hinge mounts under the lid. Other styles may be mounted on the top of the lid.*

The typical strap hinge has a long, narrow leg that extends more than halfway across the underside of the lid of a chest and a shorter but wider leg that attaches to the inside of the back board. The strap hinge is a strong choice for a chest because the long leg is secured at several locations, and the other leg is attached to the wide surface of the back board, not to its thin upper edge.

Strap hinges for chests are different from those used on doors in that the short leg is offset by a right-angle bend. This offset enables the leg to lie flat against the inside surface of the back board. The thickness of both the long leaf and the offset prevent the lid from sitting flush against the top of the chest. You can reduce this gap by inletting the offset, which is a simple process, or eliminate the gap by inletting the long strap, too, which is more time-consuming.

Watch it on the web

For tips on installing a strap hinge, go to www.finewoodworking.com.

A knife marks the spot. *Mark the back board of the chest where the offset arm of the strap hinge is to be inset. When ordering strap hinges, be aware that the offset should match the thickness of the boards you are using.*

BUTTERFLY HINGES ARE EXPOSED ON TOP OF THE LID

Although butterfly and H hinges were intended for doors, they can be used on a chest. These hinges are easy to install but require the lid to be designed with a plank at the back that's attached to the chest. Because these hinges are mounted on the outside of the chest, it pays to look for an attractive pair made from either wrought iron or brass. Butterfly and H hinges are not suitable for a chest that is intended to be locked.

A visible hinge. *Butterfly hinges and their close cousin, H hinges, are mounted on top of the lid, which is divided into two parts.*

SNIPE HINGES ARE ROOTED IN COLONIAL AMERICA

Drill holes for the legs. *The angled holes in both the lid and the rear of the chest receive the two legs of each snipe hinge.*

Make fish hooks. *Pry apart each pair of soft iron legs with a screwdriver. Then use pliers to bend over the point 180°.*

Completed snipe hinge. *Pound the bent legs flat with a hammer, then file them flush with the surface. They will be barely visible under a coat of paint.*

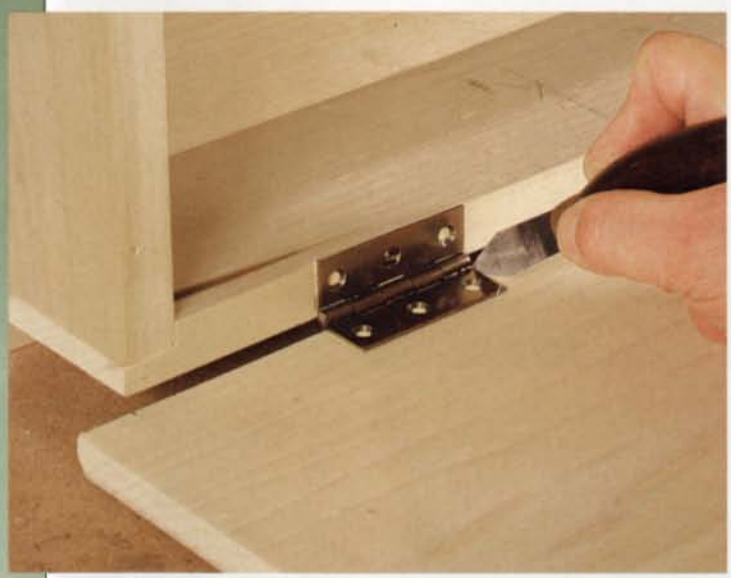
Early American six-board chests were too humble for expensive hardware, and their lids typically were attached with snipe hinges. This simple hinge looks like a pair of cotter pins linked by their eyes, and the ends of the snipe hinge's legs resemble the point of a nail.

A snipe hinge is installed by drilling holes at an angle through the lid's rear edge and near the top of the back board. The hinge's legs pass through these holes, and then the ends are bent over and hammered into the surface. The shanks also are pounded flush with the wood so that very little of the hinge is visible.

Photos: Mark Schofield

BUTT HINGES ARE SIMPLE AND TIME-TESTED

Nineteenth-century cast-iron butt hinges were so easy to use that they quickly became the hinge of choice for blanket chests. However, cast iron cracks like glass when stressed, and a lot of these 19th-century cast-iron butt hinges broke. Thankfully, breaking is not a problem with today's brass or steel butt hinges. But one drawback to all types of butt hinges is the way they are mounted. Because the lower leaf is secured to the back board's upper edge, overextending the lid pulls on the screws and can split the wood.



Mark both sides. *Use a marking knife to locate the position of the hinges on both the lid and the back board of the chest.*

Cut the mortise. *Mortising the butt hinge into the lid and the back board enables the lid to sit flush.*

PIANO HINGES ARE A MODERN SOLUTION

The piano hinge looks like a long butt hinge but does not have to be mortised. A piano hinge is screwed into the back board's upper edge. Because so many screws are used, it is much stronger than a butt hinge. A piano hinge would be suitable for a chest likely to receive rough treatment, such as a children's toy box.

Cut to length. *Mark the length of the hinge and cut it to size with a hacksaw. The hinge should be sawn 2 in. shorter than the width of the chest.*

Long and strong. *The sheer size of a piano hinge gives it a lot of strength. Because it's thinner than a butt hinge, there is no need to mortise a piano hinge into a chest. The top, however, will not close flush against the case unless the hinge is mortised.*

Drawings: Michael Gellatly

A lid support is a worthwhile addition to a chest

Blanket chests usually are placed against the wall or at the end of the bed so that the lid is supported when open. However, as the broken hinges on many antique blanket chests testify, accidents do happen. If the lid is allowed to fall, its weight can damage or break either the hinge or the chest. Unless you are making an exact reproduction, it is a good idea to include a support that prevents a chest's lid from falling backward. Chests for children's rooms can be fitted with lid supports that prevent the lid from slamming.

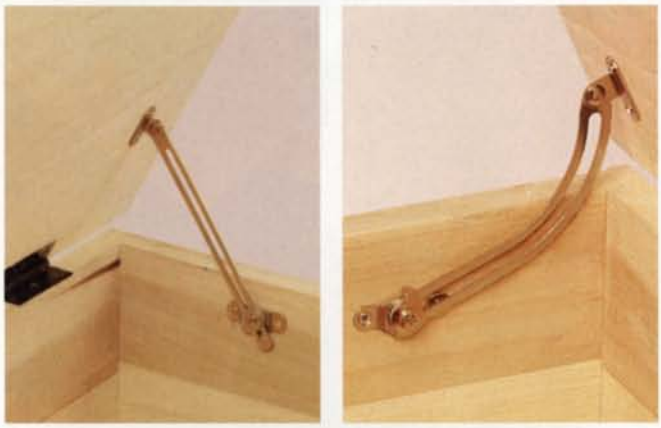
A SIMPLE CHAIN

The simplest form of lid support is a chain. For small lids, brass-plated versions made for this purpose are available. For heavy lids, hardware stores carry a variety of different chains sold by the foot.

Brass-plated chain makes the link. *Screw one block into the lid about 4 in. from the rear edge. Open the lid to the desired angle, then attach the other block to the side of the chest. For extra support, a matching chain can be attached to the other side of the chest.*

BRASS-PLATED FRICTION SUPPORT

An attractive alternative to a chain is a brass-plated friction support. This type of support is either straight or curved (for situations in which depth is limited). The tension adjusts by tightening a screw.

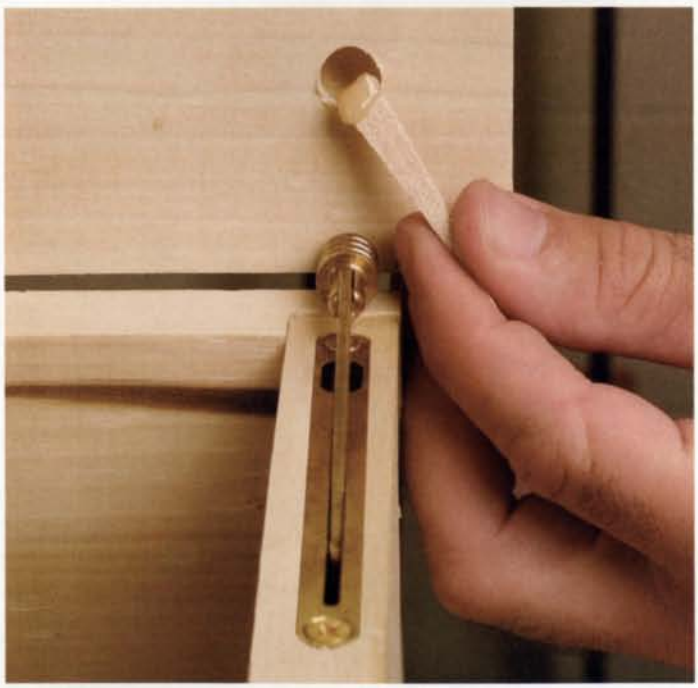


Straight or curved. *The straight support can be used on the left or right side of the chest. The curved form designed for shallow chests is nonreversible. Mount these supports exactly in the location specified in the instructions to ensure that the lid closes fully.*

A DECORATIVE SUPPORT

This solid-brass Brusso support is for small and medium chests. It consists of a hanger glued into the lid, an arm and a housing mortised into the chest's side. As the lid is opened or closed, the arm slides out of or into the housing.

Rout a mortise. *With a ⅜-in. spiral-cut router bit set to the depth of the support and a fence installed to guide the router, cut the mortise into the chest side.*



Secure the lid support. *Use epoxy to fasten the hanger to the lid.*

COMBINATION HINGE AND LID SUPPORT

This may not be the prettiest piece of hardware you'll ever install, but when it comes to ease of installation and use, combination supports win hands down. Made of brass-coated steel, they mount to the back and each side of the chest and to the underside of the lid. Friction joints support the lid at any angle until fully open at 90°.

A one-piece hinge and lid support. *These hinges allow a slab-style lid to clear the rear edge of a chest and remain open at 90°.*

SOURCES OF SUPPLY

The following catalogs specialize in period hardware, providing items that are not only historically accurate but also accurately made. This often requires handwork, so the hardware can be expensive; however, I am always willing to pay the long dollar for quality.

HORTON BRASSES (800-754-9127; www.horton-brasses.com)

VAN DYKE'S RESTORERS (800-558-1234; www.vandykes.com)

Other catalogs offer a broader range of hinges and supports. The hardware carried by these sources is usually well made but less historically accurate, so it is usually less expensive.

LEE VALLEY (800-871-8158; www.leevalley.com)

ROCKLER (800-279-4441; www.rockler.com)

WOODWORKER'S SUPPLY (800-645-9292; www.woodworker.com)

WOODCRAFT (800-225-1153; www.woodcraft.com)

Safety lid supports

For chests that will be used by children, such as a toy chest, consider lid supports that give continuous opening and closing tension to prevent small fingers from getting squashed. Such supports include versions for attaching to the left, right or center of the rear of the chest. They must be mounted in the correct location to make the lid close exactly. Some models require you to match the support to the weight of the lid so that the spring in the support closes the lid slowly.

A mounted support for each side. *This type of safety lid support is designed for a specific side of the chest. Properly installed, it won't let the lid fall.*

A single center-mounted support. *The weight of the lid needs to be matched to the strength of the support's internal spring.*

Combination Machines

Five-function machines are heavy duty and save space, but are they worth the price?

BY ASA CHRISTIANA

1. TABLESAW
A large-capacity sliding table running next to the blade sets this saw apart from American-style cabinet saws.

2. JOINTER
A 12- or 16-in. jointer will mill a flat face on most of the lumber a furniture maker encounters.

3. PLANER
Combination machines also include a heavy-duty 12- or 16-in. planer.

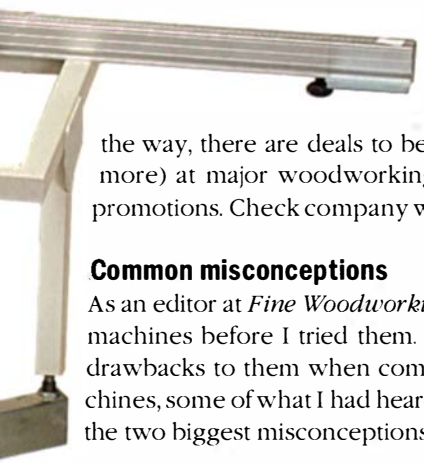
Less space, better machines

Space savings aren't the only benefit of European combination machines. Each of the five individual tools will represent an upgrade for most small shops.

Most American woodworkers know very little about European-style combination machines—except for their high price tags relative to other small-shop equipment. It has been 22 years since the last review of these machines in *Fine Woodworking*, so this article also provides a general introduction to them. I have defined combination machines as five-function, three-motor, heavy-duty units. The smaller multipurpose machines such as the Shopsmith are a breed unto themselves. All of the machines covered include a sliding tablesaw, a shaper, a planer-jointer and an add-on horizontal mortiser with a sliding table.

Six brands—Felder, Hammer, Knapp, MiniMax, Robland and Rojek—are currently imported into North America, with a multitude of models and configurations.

To keep the price tags as low as possible and to be sure I was comparing similar machines, I ordered the 12-in. planer-jointer units, as opposed to the 16-in. size that most brands also offer, and a sliding table stroke that could handle a 48-in.-wide panel. I opted for the bolt-on mortising unit but passed on the scoring blade for the saw and variable speed for the shaper, among many other options. As outfitted, these machines range in price from $6,000 to $15,000, with four of them priced under $9,000. By the way, there are deals to be had on all of these (10% off or more) at major woodworking shows and through in-house promotions. Check company web sites.



Common misconceptions

As an editor at *Fine Woodworking*, I had heard a lot about these machines before I tried them. While there certainly are a few drawbacks to them when compared with single-function machines, some of what I had heard turned out to be false. Here are the two biggest misconceptions, in my opinion:

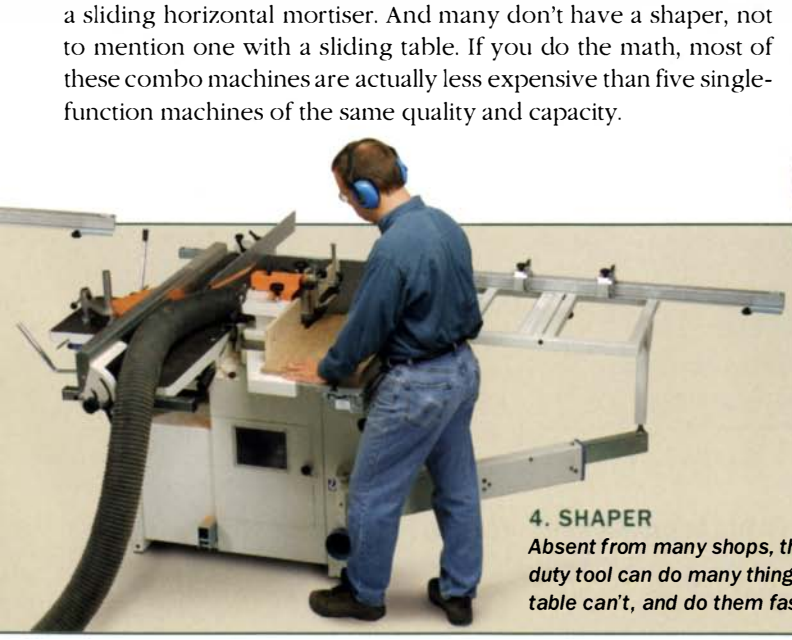
Myth 1. The combination machines are expensive when compared with the five single-function machines bought individually—The machines in a combination machine don't compare directly to the machines in most shops. Most small shops I know don't have a sliding tablesaw, a 12- or 16-in.-wide jointer or a sliding horizontal mortiser. And many don't have a shaper, not to mention one with a sliding table. If you do the math, most of these combo machines are actually less expensive than five single-function machines of the same quality and capacity.

A real-world shop test. *To try out each function as well as the changeovers from one to the other, Christiana made a frame-and-panel door on each machine.*

The fact is that this combination of machines would represent an upgrade to most small shops. The sliding tables—which run right next to the sawblade and offer long strokes and accurate crosscut fence systems—are more comparable to an industrial sliding table such as a Martin than they are to the add-on sliders available for American-style saws. A sliding tablesaw can make precise joinery cuts and crosscuts on solid or panel stock without the need for auxiliary sleds, jigs or work supports. Also, it can make a long, straight-line rip on rough lumber. These sliding tables also work with the nearby shaper spindles for operations like tenoning.

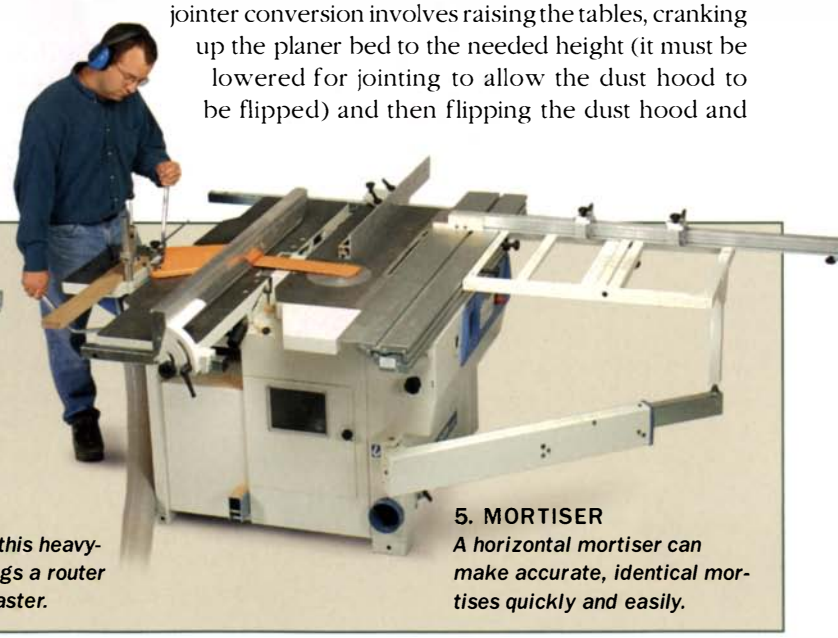
You also get a shaper with 3 hp (or more). Yes, shaper cutters are more expensive, but they accommodate custom knives and can take a much bigger bite than router bits can. The panel-raising cutter I used to test these shapers was able to take at least half of the cut in a single pass, while leaving a smooth finish and little-to-no breakout at the end of the panel. Shapers also feature precise height adjustment. Once woodworkers go to a shaper, they usually find it difficult to go back to a router table.

Myth 2. Slow conversions are a deal-breaker—The only necessary conversions are from saw to shaper and from jointer to planer. The saw-to-shaper conversion involves fastening the shaper fence to the table, so it takes a bit longer, but it's not an operation you will have to do often, because shapers typically get less use than tablesaws, planers and jointers. The planer-to-jointer conversion involves raising the tables, cranking up the planer bed to the needed height (it must be lowered for jointing to allow the dust hood to be flipped) and then flipping the dust hood and



4. SHAPER

Absent from many shops, this heavy-duty tool can do many things a router table can't, and do them faster.



5. MORTISER

A horizontal mortiser can make accurate, identical mortises quickly and easily.

Photos: Kelly J. Dunton

MACHINES UNDER $9,000

The Hammer, while overall a nicely made machine in its price range, arrived with two major problems. For starters, there was severe vibration in the saw unit, resulting in very rough cuts. A company spokesman said this was due to a defective motor, so I tried another machine. I got much better rip and crosscut results, but the quality still was rough. The other problem was damage to the steel tracks in the sliding mortising table, which resulted in a bumpy ride. Hammer sent a new table that moved smoothly. There were smaller assembly problems that needed attention, too: a loose height-adjustment support block on the saw unit and an internal dust hose fastened in the wrong position.

The Hammer also has a few design problems. The rip fence, which pivots to become the jointer fence, flexes under pressure and has three closely spaced clamp levers, which were annoying to deal with. The splitter also has too much flex, due to its placement on a long, weak arm. The mortising table doesn't travel quite high enough to center a bit in ¾-in.-thick stock, but this can be remedied by inserting a scrap spacer between the workpiece and the table. Unlike the Rojek and MiniMax, the Hammer does not offer reverse rotation on its shaper spindle, which would allow cutters to be flipped for safer orientation of certain workpieces. Also, using the five jack bolts underneath, I was unable to get the sliding table level throughout its stroke with the central saw table.

HAMMER C3-31 COMFORT

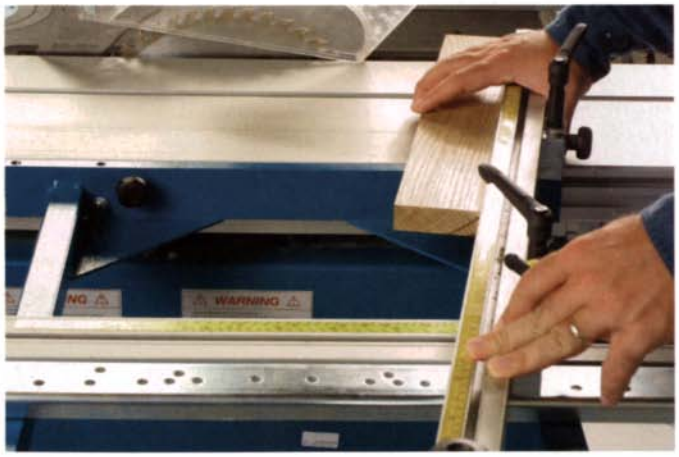
Source: Made in Austria, distributed by Hammer USA (800) 700-0071 www.hammerusa.com

Price of model tested: $8,790, with mortiser option

Weight: 1,200 lbs.

Minimum width: 43 in.

The pivoting rip/jointer fence is a problem. *The closely spaced clamp handles are hard to tell apart, and they get in each other's way. Also, the fence has significant flex.*



The crosscut fence excels at miters. *There are many positive stops (holes) for common angles.*

hose. But once I got the hang of it, this process took only about 30 seconds on most of these models. And, as many users have pointed out to me, you can organize your workflow—a benefit in itself—to reduce the overall amount of changeovers. I found the planer-to-jointer conversion to be a bit annoying at times, but I would make the tradeoff if space were a big consideration in my shop.

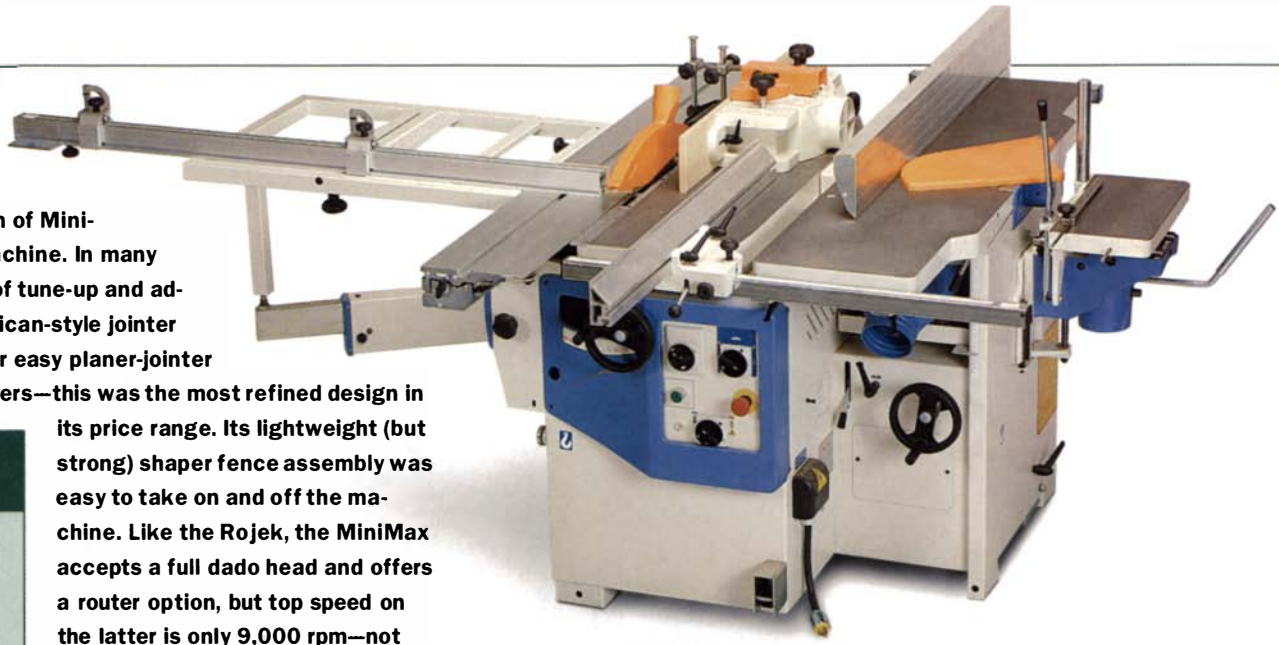
If you want these five core woodworking functions in one space-saving unit, one of these combination machines may be for you. However, size and weight may be deal-breakers for your shop. You need a floor that can support a 1-ton machine and a doorway wide enough to get the machine through. Check the minimum width for each. All machines are available with a single- or three-phase motor.

Watch it on the web

For more on combination machines, go to www.finewoodworking.com.

What to expect when ordering a machine

Unless a manufacturer has the exact model and setup you want sitting in a stateside warehouse, you will have to wait at least a



This is the latest version of MiniMax's combination machine. In many ways—fit and finish, ease of tune-up and adjustment, quietness, American-style jointer guard, Tersa cutterhead for easy planer-jointer blade changes, among others—this was the most refined design in its price range. Its lightweight (but strong) shaper fence assembly was easy to take on and off the machine. Like the Rojek, the MiniMax accepts a full dado head and offers a router option, but top speed on the latter is only 9,000 rpm—not enough for most bits. Other than routing, the MiniMax handled each of its tasks well.

However, like the others in its group, the MiniMax has a few manufacturing wrinkles to iron out. The jointer tables sagged 0.010 in. away from each other over the entire length—tolerable maybe, but too much for my liking. However, it would not be difficult to insert shims in the table supports to bring them level. In fact, I noticed that the factory already had inserted a few. Also, the extruded-aluminum jointer fence had a 0.008-in. bulge in it from top to bottom, enough to leave jointed edges just slightly off square.

This machine had almost as quick a planer-jointer conversion as the Knapp, due to a similar dust-collection design, but a few details slowed it down. Still, it was a quick changeover.

The MiniMax has the shortest outrigger travel, a drawback because it does not allow very wide cuts when the crosscut fence is in its normal, forward position.

MINIMAX CU300 SMART

Source: Made by SCMI in Italy, distributed by MiniMax USA
(866) 975-9663
www.minimax-usa.com

Price of model tested: $7,495, with scoring blade and mortiser standard

Weight: 1,260 lbs.

Minimum width: 42 in.

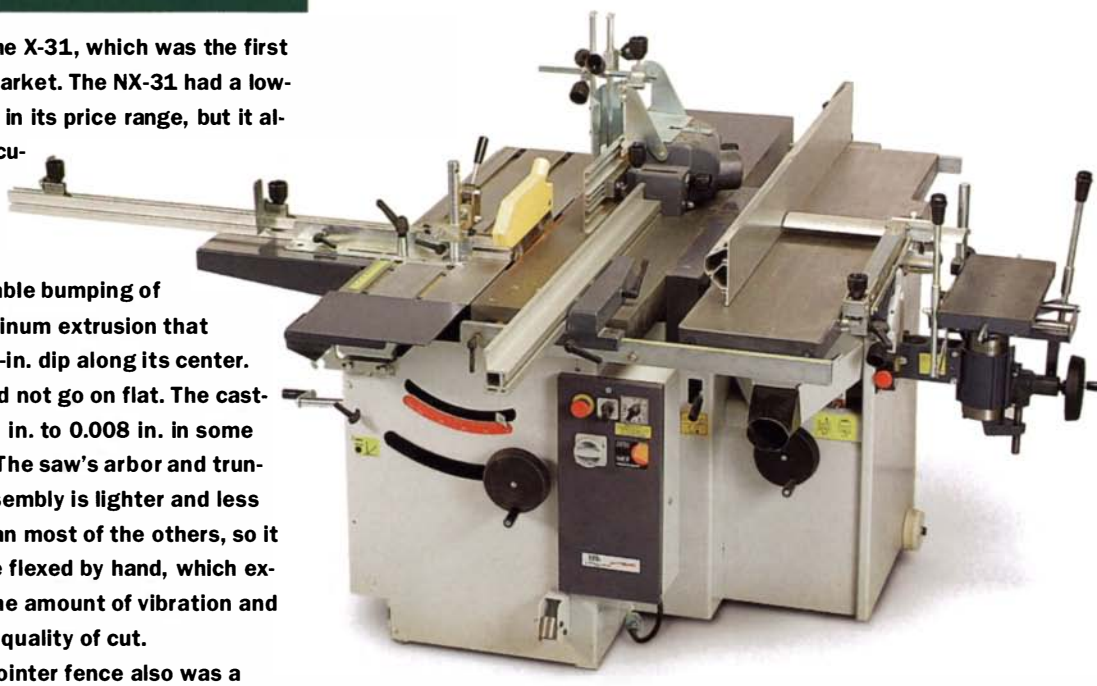
Quickest planer-jointer conversion in its group. *As on the Knapp (p. 59), the planer dust hood is smaller, meaning the planer bed does not have to move as far during the changeover. However, the rip and jointer fences have to be moved or removed.*

month—maybe two—to get your machine. Then plan on two days to unpack the machine, clean off the oil-and-wax protectant, put on the various attachments and tune up the machine for use. I found the manuals to be weak, so expect to do some head-scratching and trial-and-error to figure out assembly and tune-up. However, there is U.S.-based technical support for each of these machines; call the companies' toll-free numbers.

Felder and Hammer offer a company installation for $400 extra. A factory technician will spend the better part of a day at your shop assembling, tuning up and demonstrating your new machine. This is a worthwhile investment, especially considering the overall price tag, and more than 90% of Felder buyers choose this option, according to the company. Laguna also offers this service for its Knapp machine. You cover the cost of a technician's airfare and pay an hourly rate.

The testing procedure

With the help of John White, *Fine Woodworking*'s shop manager, I first uncrated and cleaned each machine and its many parts. Then I assembled and tuned up each one. The sliding table must



The NX-31 is an updated version of the X-31, which was the first combination machine on the U.S. market. The NX-31 had a lower cost than the other combo machines in its price range, but it also was significantly lower in quality, accuracy and efficiency than the others.

The sliding table dipped as much as 1/16 in. at the front of its stroke, rising near the blade, and there was a noticeable bumping of the bearings as the table slid. The aluminum extrusion that makes up the sliding table had a 0.007.-in. dip along its center. Also, the crosscut extension table would not go on flat. The cast-iron center saw table also dipped 0.007 in. to 0.008 in. in some places. The saw's arbor and trunnion assembly is lighter and less solid than most of the others, so it could be flexed by hand, which explains the amount of vibration and rougher quality of cut.

The jointer fence also was a problem: Its extrusion was cupped 1/32 in. at the ends but bulged 1/64 in. near the center, more than enough to affect squareness of cut.

There were a number of significant design problems on this machine. One example: On the crosscut fence, there is no stop at 90° (although one could be fabricated by the user). Also, the machine required much more assembly than any other machine I looked at, and wiring access was difficult. The machine is rated for a 12-in. blade, but the 12-in. diameter caused the splitter to sit so high that it couldn't drop below the surface of the table (a clear saw-table surface is necessary when using the shaper). The machine accepts a dado head but doesn't provide a throat plate to fit one, as the others do. Laguna doesn't recommend the Robland's router spindle, which mounts directly on the shaper spindle, limiting it to 6,000 rpm and keeping the collet ½ in. above the tabletop at its lowest point. Last, the height adjustment on the tablesaw was very stiff and difficult to move, especially at the bottom of its range.

ROBLAND NX-31

Source: Made in Belgium, imported by Laguna Tools
(800) 234-1976
www.lagunatools.com

Price of model tested: $5,995

Weight: 1,500 lbs.

Minimum width: 47 in.

The sliding table is sloppy in its travel. *After being adjusted level with the central saw table, the sliding table's height changes at the blade and shaper spindle by as much as 1/16 in. as it is pushed forward and backward, which reduces the accuracy of saw and shaper cuts.*

be level with the main saw table and parallel with the blade. The crosscut table that rides on the slider and the outrigger support also needs to be adjusted level, as do the detachable auxiliary infeed/outfeed tables that come with most machines. Last, I bolted on the mortising unit and adjusted it level with its chuck, which is attached to the end of the planer-jointer cutterhead.

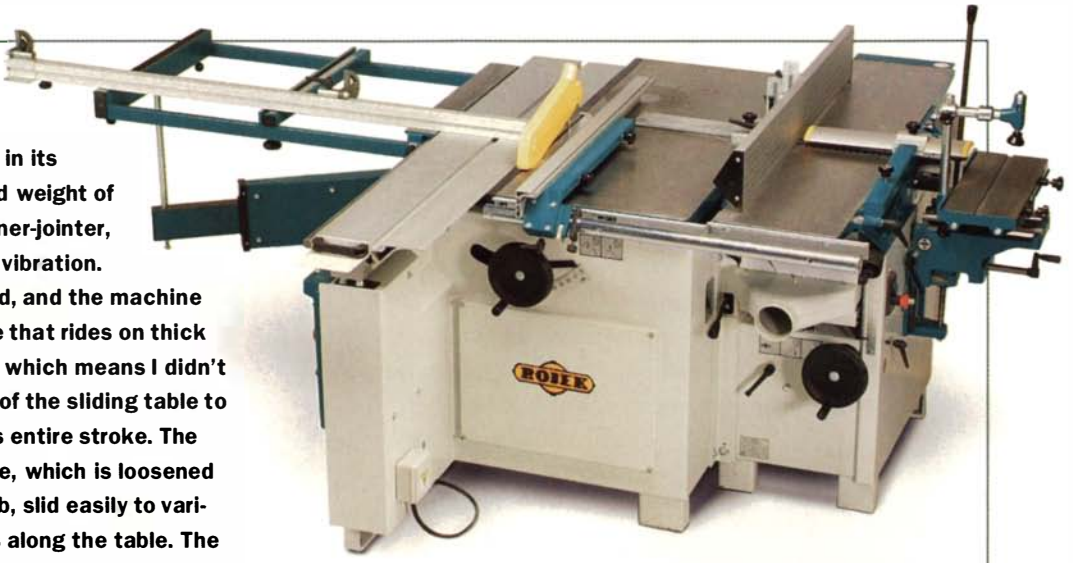
Next, I ran through the general functions of each machine, but to try them in a real-world situation, I also made a frame-and-raised-panel door using each one, switching between functions as I milled stock, cut joinery and shaped a wide ogee profile on the panel.

Many features in common

The quality and accuracy among the machines I looked at varied. But these European machines have a lot in common. All use a selector switch to divert power to various functions, ensuring that only one can be running at a time. Each comes with a motor that's at least 3 hp, with more horsepower as an option. Dust collection is integral, with fittings around the machine and hoses inside.

The sliding tables lock for ripping cuts and have crosscut extension tables to support large stock. Four or five jackscrews make the sliding-table assemblies easily adjustable for level and square.

Each of the saws has a curved European-style riving knife (a type



The Rojek has more mass than the others in its group, which is always good. The size and weight of the machine more than likely helped the planer-jointer, saw and shaper make smooth cuts with less vibration. The Rojek comes with a four-knife cutterhead, and the machine has a thick, strong base and a solid rip fence that rides on thick rails. It also has the longest outrigger travel, which means I didn't have to move the crosscut table to the back of the sliding table to use the saw's entire stroke. The crosscut table, which is loosened with one knob, slid easily to various positions along the table. The saw accepts a dado head.

While in the past the Rojek line had not included a tilting shaper spindle, as most of the other machines do (a popular option because it creates many potential profiles for a single cutter), Tech Mark said a tilt option will be available early this year. Like the MiniMax, the Rojek offers a quick-change router spindle, but the speed tops out at 10,000 rpm.

While the Rojek is the most heavy-duty machine in its group, there are a few crude areas in its design. For one, there is no easy way to adjust the level of the crosscut extension table where it attaches to the sliding table short of grinding or filing its bearing surfaces. On the machine I tested, this table sat 0.011 in. high at one end of the slider, and level at the other—not a deal-breaker, but troublesome. You'd want to pick a spot along the sliding table to locate the crosscut table for your most accurate cuts. The planer-jointer design has a few drawbacks. The jointer fence must come off to allow the tables to be lifted for planing, and the planer bed must be cranked down to the 8-in. mark (100 cranks) to allow the dust hood to be reversed for jointing, giving this machine the slowest changeover time. Also, the bar that supports the rip fence sticks out in front of the planer, not in the way of boards being fed but awkward for the user.

ROJEK KPS 300A

Source: Made in the Czech Republic, imported by Tech Mark (501) 945-9393 www.tech-mark.com

Price of model tested: $8,274, including optional mortising unit, with scoring blade standard

Weight: 1,500 lbs.

Minimum width: 34 in.

The planer design is problematic. *The support bar for the saw's rip fence remains between the user and the planer, and the jointing tables open outward, making the user go farther to reach a board.*

The shaper is almost dust free. *The Rojek is the only machine in its price group to offer a dust port under the table as well as in the fence/hood assembly.*

of splitter). The splitter hugs the blade closely and moves up and down and tilts sideways with it, which means it can stay on the saw more often than not, preventing kickback.

The combination machines come with options for longer or shorter sliding tables and strokes, with large and small crosscut extension tables (with or without outrigger support arms). There are options for tilting and variable-speed shapers, scoring blades and 16-in. planer-jointers, among others. Also, most companies offer their saw-shapers and planer-jointers as separate machines, which are popular options. By the way, on most of these machines you should consider purchasing the smaller crosscut table with no outrigger, unless you cut large panel stock all the time. The outrigger got in the way when I was standing on the left side of the machine using the shaper or changing sawblades.

Each machine has a shaper hood outfitted for dust collection, with a tall, sturdy fence, and adjustable hold-downs and an outfeed fence. All machines accept a router spindle, but most don't offer spindle speeds that are high enough for efficient routing. Four of the six saw units accept a dado head.

With the exception of the MiniMax, all of the machines have a European-style cutterhead guard on the jointer, which I found to be an annoyance. Because the guard stays in place I was forced

MACHINES OVER $10,000

Both the Knapp and the Felder machines arrived from the factory within close tolerances in every way. Tune-up was easy, with each bolt and setscrew offering positive adjustment. Machines built as solidly as these two should stay aligned for years.

Felder offers more combinations of features and capacities than any other manufacturer: up to 10-hp motors (three-phase), digital readouts, a wide range of saw strokes and crosscut capacities, two types of scoring systems, variable speed and more. Felder also makes the Hammer line of combination machines, offered at a lower price.

FELDER CF 731 PRO

Source: Made in Austria, distributed by Felder USA (800) 572-0061 www.felder-usa.com

Price of model tested: $13,389, with optional mortiser, single-phase power and router spindle

Weight: 2,000 lbs.

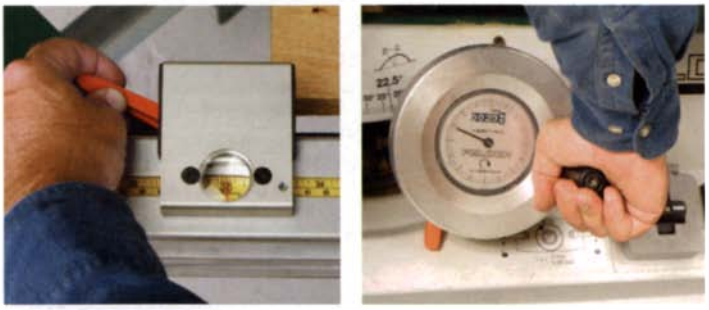
Minimum width: 31 in.

While the Knapp machine is heavier, the Felder sports a few more refinements of design. It was clear that every detail—from shipping to woodworking—had been considered carefully. Just a few highlights: All of the height dials and scales on the machine can be reset to zero at any point. The Felder sliding table locks in two positions: one for ripping, and the other for shaping. The saw's internal dust hose has a flange that can be adjusted to hug a 10-in. blade as closely as a 12-in. one. The router and shaper spindles can be changed out quickly. This is the only machine of the bunch with the shaper fence assembly pegged into holes in the table, so the assembly can be removed to use the saw and then returned to the previous setting. This machine's base (and that of the Hammer) has gaps built in to accept a pallet jack for mobility.

Performance was a delight. All of the functions delivered clean, precise, almost dustless cuts, and none of the motors even threatened to bog down. The mortising unit was the best among these machines, with ergonomic clamping handles and a screw-driven hold-down (as opposed to a cam). It also was the easiest unit to attach and detach from the main machine, and its stops were the easiest to set and use.

However, the Felder doesn't accept a dado head, so dadoing must be done using the router spindle and the sliding table, which takes longer. Also, the router spindle turns only at 15,000 rpm, which is too slow for small bits. However, if you opt for the variable-speed shaper, the router spindle will run at 19,000 rpm.

The 45-in.-long jointer/rip fence is a slight drawback. It had more flex than the Knapp rip fence, and when it was mounted on the jointer it came up too short on the outfeed side for my liking.



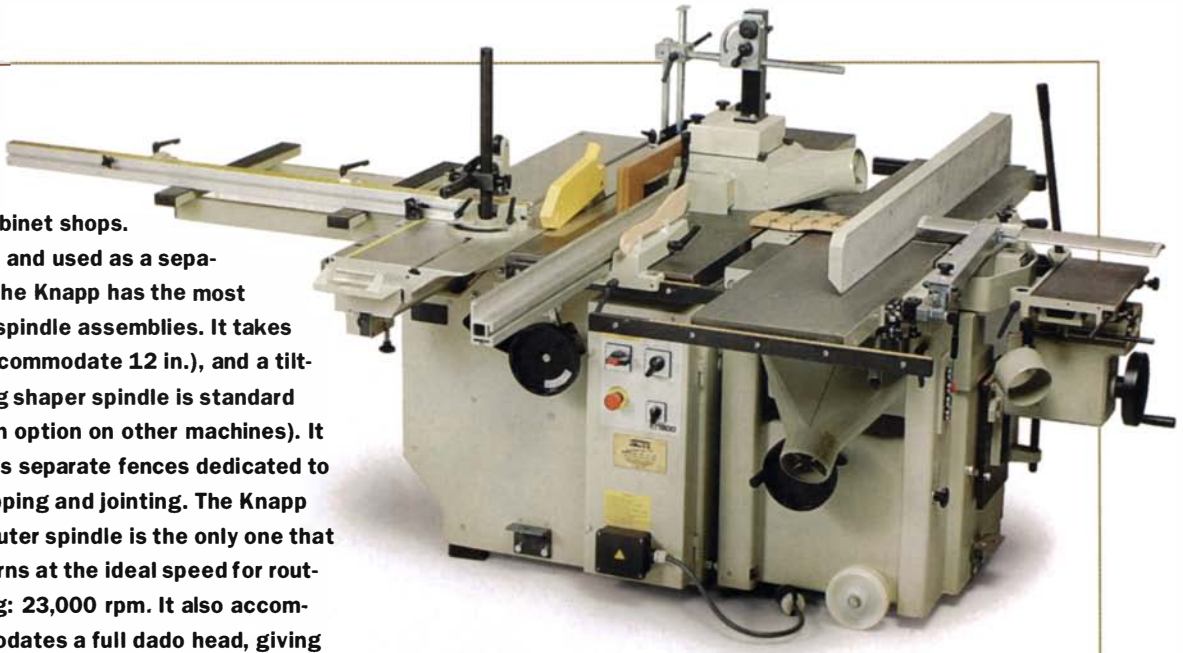
Bells and whistles. *Many thoughtful features, like magnified scales and accurate dials that read in 0.001-in. increments, make the Felder a pleasure to use.*

to reposition my hands as I pushed a board over the cutterhead. For face-jointing, I ended up sliding the guard completely out of the way—not the safest situation. The MiniMax, however, is outfitted with an American-style guard, which pivots out of the way as needed. Finally, all of the units offer some means for mobility.

Head-to-head comparison

Combination machines range widely in price, performance and overall brawniness. There basically are two high-end machines—Knapp and Felder—in the $10,000 to $20,000-plus range, depending on options. Both are from Austria, and I found them to be engineered and manufactured with very few compromises.

Then there is another tier of four combination machines at $6,000 to $9,000. While most in this group are at least as accurate and well-built as the cabinet saws and other equipment many of us have, they can't compete with the Knapp and Felder. In general, tune-up is a bit more difficult and there is less mass throughout, which results in more vibration and slightly rougher cuts; and there are cruder stops, dials and scales, which reduce efficiency somewhat. Accuracy is slightly diminished but still within acceptable limits



The Knapp is an industrial machine, built to withstand a lifetime of abuse in European cabinet shops. The planer-jointer can be unbolted and used as a separate machine, a nice touch. Also, the Knapp has the most cast iron in its massive arbor and spindle assemblies. It takes up to a 14-in. blade (the others accommodate 12 in.), and a tilting shaper spindle is standard (an option on other machines). It has separate fences dedicated to ripping and jointing. The Knapp router spindle is the only one that turns at the ideal speed for routing: 23,000 rpm. It also accommodates a full dado head, giving you two options for dadoing.

Its switches were heavy-duty and conveniently mounted, and the ripping and jointing fences were the most rigid. The height adjustments of the saw, shaper and planer bed were the smoothest and most solid of any machine tested. Although it didn't need much tuning, this machine was the most easily tuned up and adjusted for flat and square. Also, all of the dust-collection ports are on the same side of the machine—the back.

The wide sliding table was by far the most massive and smooth. It was deadly accurate throughout its stroke, with positive fence stops built in at common angles. The round bearings run against round bars for point-to-point contact designed to resist fouling by dust.

I preferred the Knapp's standard crosscut extension table over any of the others. It requires no outrigger to support it. It is lightweight aluminum but dead-flat and rigid enough to support large panels.

The only design flaw I encountered was that the cam-driven hold-down on the sliding table pushed the stock forward when it was engaged. While these hold-downs are not necessary for most operations, they increase the accuracy of miter and joinery cuts on the saw, and tenoning on the shaper.

KNAPP KOMBI 410 PROFIT

Source: Made in Austria, imported by Laguna Tools (800) 234-1976 www.lagunatools.com

Price of model tested: $15,150

Weight: 2,200 lbs.

Minimum width: 35 in.

Knapp has its own bells and whistles. *It shares many of the Felder's niceties, and its switches are the most accessible.*

Best planer-jointer changeover. *As on the Felder, the jointer tables lift in one piece, but the Knapp's cleverly designed dust-collection ports mean the planer bed has to be moved only to the 4-in. mark for jointing operations.*

on most. And each of these midrange machines has its own unique drawbacks; if you are interested in this group of machines, the question is which issues are significant for you and your work.

If I had the money and if space were an overriding consideration in my shop, I'd be ecstatic with either the Felder or the Knapp. In terms of design, the Felder has a few more refinements than the Knapp. But the Knapp has its own advantages, such as its mass and complete lack of vibration, its dado capacity, its more substantial fences and its ability to be broken apart into separate machines: saw-shaper and planer-jointer. However, it's more expensive.

On a budget, and again with space as a major consideration, I'd go with the MiniMax because of its overall performance and small footprint. It accepts a dado head and comes standard with a mortiser and a scoring blade. The Rojek ran a very close second. It has more mass and solidity, but it's a little rougher in its design and sports a higher price tag. Note: The Rojek can break down into halves temporarily and fit through a smaller doorway than the MiniMax. □

Asa Christiana is a senior editor. John White, Fine Woodworking's *shop manager, also contributed to this article.*

Cherry and Fir Bookcase

Subtle details add elegance to a simple frame-and-panel design

BY PETER ZUERNER

Several years ago, my sister Cicely was looking for a bookcase that would be attractive, functional and reasonably easy to move. The piece I designed and built for her is now one of the stock pieces in my furniture shop. I call it, appropriately, Cicely's Bookshelf.

I wanted the bookcase to have a spare and elegant look, so I kept the frame parts to a minimum and elevated the piece off the floor by extending the corner posts to create four short legs. All four edges of the top, along with the front edge of each shelf, were given a generously sized cove to create the illusion of thinner stock. As a result, even when the piece is filled with books, it appears light and graceful.

Choose the wood with care

For me, the first and most important step in any furniture project is the process of selecting the wood. Consistent color and grain are important, and I'm always on the lookout for something interesting. I especially like to incorporate special grain or a natural defect. Not only does an odd grain or a small defect make each piece a bit more unique, it also provides a strong visual connection to the tree from which it evolved. For instance, the piece shown here has a small, sound knot near the front

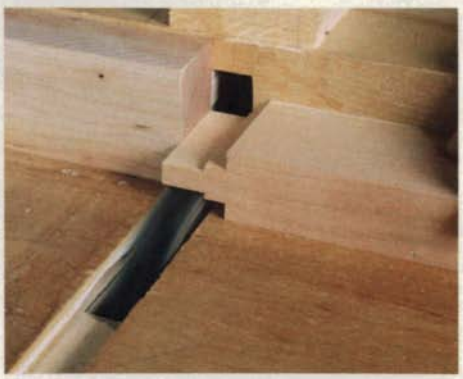
Photos, except where noted: Tom Begnal; this page: Michael Pekovich

CUT THE JOINERY FOR THE POSTS AND RAILS

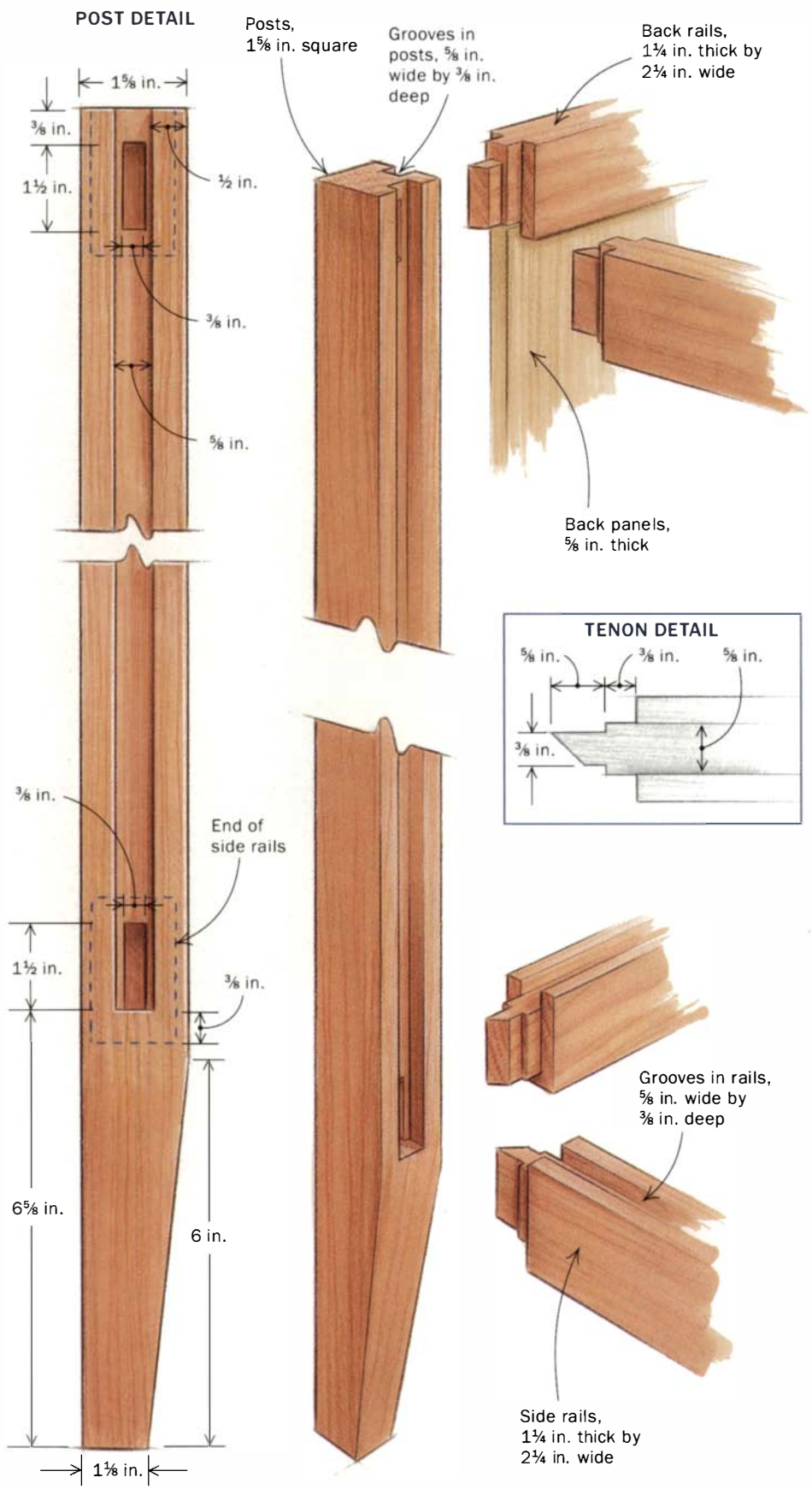
The rails have stepped tenons that fit snugly in both the panel groove and the mortise, adding strength to the joints.

Cut grooves to accept the fir panels. *To cut stopped grooves in the posts, first clamp an extralong auxiliary fence to the rip fence of the tablesaw, then clamp a stop block to the auxiliary fence. Use a dado head to cut the grooves.*

Square the corners. *The dado head leaves a rounded portion at the stopped end of the grooves. A chisel makes them square in short order.*



Two-step tenon. *Use a dado head to cut the tenons. First clamp a stop block to the fence to establish the tenon length. Then cut the portion of the tenon that fits into the groove. To create the step, reset the blade height and reposition the stop block as shown.*



Drawings: Bob La Pointe

FRAME-AND-PANEL BOOKCASE

Zuerner incorporated frame-and-panel construction in his bookcase, with the mortise and tenon accounting for most of the joinery.

of the lower shelf, about midway across the span.

In this piece, I liked the idea of blending darker cherry with the strong grain of quartersawn Douglas fir. So I used cherry for the frame parts, the top and the front edging on the shelves. The quartersawn fir is incorporated into the panels.

Sometimes, when wood is moved from one location to another, the new conditions of temperature and humidity can cause it to warp a bit, often within a few hours of the relocation. So once I have all of the oversize stock together in my shop, I like to give it a few weeks to acclimate to its new temporary home. Then, after rough-milling the stock, I allow it to sit for another day before cutting it to final size. Any last-minute twisting or cupping gets removed at this stage.

Construction is straightforward

I began by gluing up blanks for the ⅝-in.-thick side and back panels. To do that, I resawed 8/4 fir, book-matching the panels to add a balanced look.

All of the shelves were made from commercially available 5/4 by 12-in.-wide stair stock. However, the front of each shelf received an edging of 2¼-in.-wide cherry, so the bookcase ends up with an all-cherry look when viewed from the front. The cherry edging has another plus. Because fir sometimes can be splintery, the cherry almost eliminated any splitting out when the coves were cut.

Most of the frame was put together with mortise-and-tenon joints. The one exception is a sliding dovetail joint that I used to connect each end of the lower front rail to the lower side rail.

To accept the panels, I cut ⅝-in.-wide grooves into the posts, the center divider, the side rails and the upper and lower back rails. The grooves in the posts were stopped about 7 in. short of the bottom. Then, at each stopped end, I used a bench chisel to square up the rounded portion.

After all of the joints had been cut and fitted, I cut the panels to final length and width. All of the panel surfaces were sanded through 220 grit. After that, I applied four coats of tung oil to each panel.

Oil finishes sometimes "bleed" from the wood pores while drying. When that happens, the finish often ends up with tiny

ASSEMBLY BEGINS AT THE BACK

With all of the parts cut and fitted to his satisfaction, Zuerner is ready to begin assembly. First, though, he applies finish to all of the panels. Then he makes the back and adds the remaining parts.

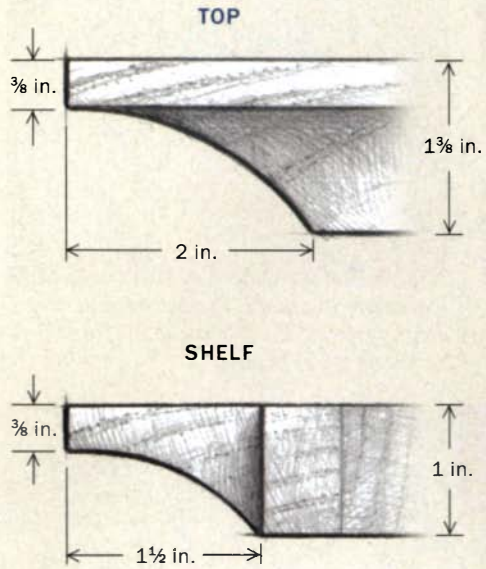
Finish the panels. *Before assembly, the panels are finished with four coats of tung oil.*

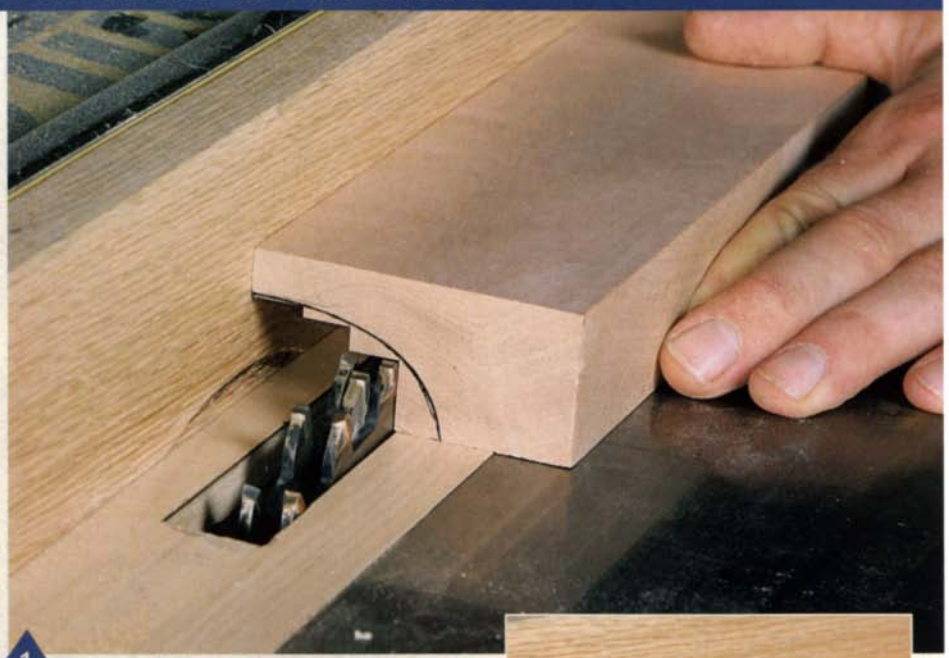
Assemble the back. *The two back panels are slipped into the grooves in the frame parts and then clamped.*

Add the remaining frame-and-panel parts. *Once the back glue-up has dried, the remaining frame-and-panel parts are added in one big glue-up. First, the lower front rail is assembled to the two lower side rails, and then all four of the side rails are added to the back posts. Following in quick succession are the side panels, front posts and the upper rail (above). An assortment of clamps keeps the joints tight until the glue sets up (left).*

CUT THE COVES IN TWO STEPS

Applying a generous cove to the exposed edges of the top and the shelves makes the parts look thinner, giving this large bookcase a lighter feel.





1 *Remove most of the waste.* *Make a series of increasingly deeper cuts with the dado head. A test block, with the cove profile marked on the end, helps establish the location of the cuts.*

2 *Make a series of cuts using the router table and a large cove bit.* *Use a curved scraper to smooth out any wavy edges left by the cove bit.*

beads of hardened oil, and that can give the finish a slight roughness. So, once a coat had dried, I sanded it lightly with 1,000-grit sandpaper wetted with mineral oil. The wet-sanding removed any beads that formed. Then, I wiped the sanded surfaces with a clean, soft cloth and allowed the mineral oil to dry. Once it was dry, I added the next coat of tung oil.

Assembly starts with the back section

I started the assembly process by putting together all of the parts that compose the back section—the two back posts, the upper and lower back rails, the center divider and the two back panels. Except for the panels, all of the mating surfaces were glued together. That way, the panels are free to expand and contract in width as their moisture content changes.

Once the back section was dry, I joined most of the remaining parts in one big glue-up. I began by adding the lower front rail to the two lower side rails. After that, the four side rails were assembled to the mortises in the two back posts. Then I simply slid the side panels into the grooves in the side rails. Once the upper front rail was mounted, I added the clamps and checked the frame for square.

While the clamped parts dried, I cut the top and the shelves to final width and length. Then I cut the coved profile. Although you can use a special shaper cutter, I cut the coves in two steps using a tablesaw and a router table. For this technique, I used a dado head in the tablesaw and made several passes to remove most of the waste stock. Then, using a ¾-in.-radius cove bit mounted in a router table, I made a series of additional passes. The cove bit easily conforms to the profile, so it's more efficient at removing waste stock than a straight-sided dado head is.

The lamb's tongue. *A small bevel at each corner of the top is cut with a chisel to help soften the hard right angle of the edges.*

After the work with the cove bit had been completed, I was left with a wavy profile that needed to be smoothed out. A curved scraper came in handy here.

Once all of the coves had been cut and smoothed, I used a chisel to cut a small bevel, sometimes called a lamb's tongue, where the coves meet at the corners. Granted, it's a small detail, but it brings the corners to a crisp point. Also, to anyone looking at the bookcase, the bevel sends a subtle message that this isn't a production piece.

At this point in the construction, all five of the shelves were just about complete. I

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

FINISH WITH THE SHELVES AND THE TOP

Attach the bottom shelf. *The bottom shelf is secured by driving screws up through the cleat and the lower front rail. To allow the shelf to expand and contract with changes in humidity, Zuerner uses a rat-tail file to slot the portion of the hole that accepts the shank of the screw.*

Add the top. *After cutting several shallow slots in the upper rails, Zuerner slips a notched wood button in each slot. Then the buttons are screwed to the underside of the top.*

Straightforward construction. *You won't need much more than a weekend or two to build this elegant bookcase.*

simply had to notch the front and back corners to fit around the inside corners of the four posts.

I used a simple jig to drill the holes for the pins that support the shelf. And I had two options here. I could have drilled a series of holes, spaced evenly apart, to provide adjustability. Or, if the client didn't want to see all of those holes, I could have simply drilled them where the shelves were going to go.

To add strength to the bookcase, the bottom shelf was fixed in place. It rests on two parts: the lower front rail and a cleat that's screwed to the inside face of the lower back rail. Six screws hold the shelf in place. The screws were driven up through counterbored holes in the lower front rail and the cleat.

Next, I sanded all exposed surfaces, except for the panels, with 220-grit paper. Then, again excepting the panels, I added four coats of tung oil, sanding between each coat with 1,000-grit paper while the oil was still wet.

To allow the top to expand and contract in width as the humidity changes, I attached it to the frame using eight small wood buttons. A final rubdown with a soft, dust-free cloth completed the project. □

Peter Zuerner, owner of Zuerner Design, builds furniture in Middletown, R.I., just a silver-spoon's throw from the historic mansions of Newport.

Photo, this page (bottom right): Scott Phillips

Box Elder

Common maple with a royal blush

BY DAVID M. FRY AND JANE F. HILL

Most people have little good to say about this scruffy relation of the maple family. But few other native North American trees can produce wood as spectacularly colored as box elder (*Acer negundo*)—mauve, rose and coral brilliantly streaked against a field of pearl.

Scientists long thought box elder's hues came from a Fusarium fungus. However, University of Minnesota researchers Robert Blanchette and Andrea Morse now suggest that the color results from the tree's reaction to injury. Each instance of damage to a trunk or branch, whether by storm, wood-boring beetle larva or another agent, can leave its mark in brilliant red.

The extent and intensity of the rosy pigment vary greatly from tree to tree. Much of box el-

LOW LIGHT PRESERVES THE HIGHLIGHTS

Because of its brilliant color streaks and easy machining characteristics, box elder is especially suitable for bowls and other turnings. The wood also creates opportunities for striking contrasts, as above where it's a surprising interior accent. But use this wood judiciously, as its figure can be overpowering, and keep it away from light, which can cause the color to fade.

der is quite pale. On occasion, color appears in the end grain of a freshly felled tree as a stunning starburst pattern, with arms radiating outward from a central, stained core. In some specimens, researchers have found stain all the way from the roots to small branches.

Unfortunately, with exposure to both natural and artificial light, box elder's color fades. Conventional finishes do not prevent red-stained box elder from fading drastically after as little as a month's exposure to direct sunlight. If, however, pigmented box elder remains in relatively low light for most of the time, the exquisite blush can last for many years.

There's more to it than just the color

Box elder's working characteristics are as appealing as its color. The wood is light and soft, weighing only 27 lbs. per cu. ft., compared with sugar maple at 44 lbs. per cu. ft. However, box elder's weak wood actually contributes to its spectacular color.

Anatomically, box elder and other soft maples resemble that of the hard varieties of maple, with diffuse-porous texture and close ray fleck on quartersawn surfaces. Similarly, box elder often produces curly and burly figure, spalts easily into black traceries and takes a relatively high polish. It also machines and turns well. Box elder normally dries quickly and check-free, with only modest warping. These traits favor nonstructural applications benefiting from light weight, paleness and pleasing figure, or in the case of stained specimens, a startling splash of red.

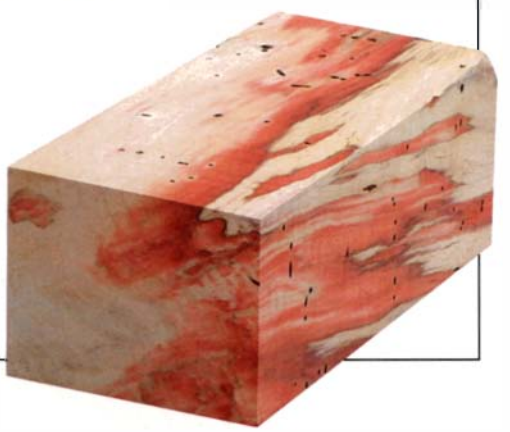
Often, pieces made of color-tinged box elder gain from a less-is-more approach. A solitary scarlet plume against the palest of backdrops may succeed where a riot of streamers would seem overblown. For this reason, even moderately pigmented wood may offer promising design opportunities.

You probably won't find this wood at your local lumberyard

Because box-elder trees often are weak limbed, poorly shaped and occasional hosts to swarming bugs, they are typically felled and discarded by loggers, so you're not likely to find this material at the local lumberyard. Box elder tends to wind up in the landfill or firewood pile rather than at the sawmill. Savvy woodworkers, however, can find a handsome windfall of this homely tree, but it may require some detective work.

A MAVERICK MAPLE

Unlike its maple kin, box elder does not have simple, lobe-shaped leaves. Instead, its leaves consist of three to five leaflets in featherlike arrangement around a single axis. Their appearance brings to mind poison ivy and the ashes. Box elder's green twigs readily distinguish it from other North American maples, and because the sexes grow separately, only female trees bear the familiar maple samaras.



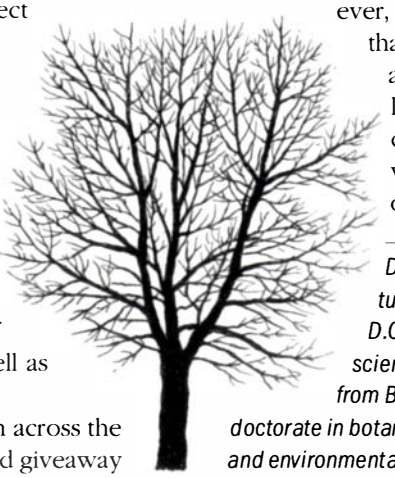
Dramatic effect from a common wood. *The red pigment in box elder courses through the tree wherever there has been distress, yielding a dramatic swath of red.*

If deadfall or cuttings are not available in your area, browse the Yellow Pages or the web to identify specialty wood dealers and sawmills. Two sources that occasionally advertise box-elder lumber are Scare Crow Wood (555-234-4873) and Irvin's Sawmill and Gallery of Wood (814-447-5656; www.innernet.net/galleryofwood). You can expect to pay $1.50 to $3 per board foot for plain or lightly colored stock and perhaps twice that for highly figured boards or blocks. Always ask how the material has been dried (kiln-dried is preferred) and whether it shows much insect damage (pinholes).

For those with a chainsaw and an adventurous streak, curbside and backyard tree cuttings offer a wealth of free material. You're likely to find this fast-growing, opportunistic tree on disturbed sites, vacant lots and roadsides over much of the East and Midwest, as well as in parts of the West.

In cut logs, bright red stain across the annual growth rings is a dead giveaway for box elder. Even if you don't see the color, there may be dramatic red further up the trunk. Older, larger box-elder trees tend to harbor the brightest hues, although a good deal of rot as well.

As usual, premium goods come at a price. With box elder, the dollar value of materials rarely surfaces as an issue. The real cost is the time needed to design a light-sensitive project, to find and dry a suitable log or board and to work with and around defects in the wood. For those willing to put in a few additional hours, however, the reward may more than justify the effort. For all of its drawbacks and lowly reputation, box elder offers the woodworker some regal opportunities. □



David M. Fry teaches wood turning near Washington, D.C., where he also writes on science and health. Jane F. Hill, from Bethesda, Md., has a doctorate in botany and writes on botanical and environmental subjects.

Photos, facing page: Rodney Diaz; this page (middle): Tim Sams; drawings: Bobbi Angell

Drafting Basics

Full-size drawings head off joinery and design problems

BY PHILIP C. LOWE

Many folks consider time spent at the drawing table to be time taken away from woodworking. They think that unless they're cutting wood, no progress is being made. Actually both time and material are being saved, not to mention a lot of head-scratching. This principle holds true for many forms of furniture—from simple to complex, from reproductions to original designs.

The first of any piece of furniture is always the most labor-intensive. To be successful, both design and construction must be ironed out beforehand, so I do a full-size drawing for every new piece I build. By laying out a design at full scale, you get a better sense of its proportions and size. Also, patterns and templates for curved parts can be made directly from an accurate drawing, which means you don't have to redraw parts that were sketched out at a smaller scale.

The full-size drawing typically includes three views and a few other important details and sections. The number of views and sections needed is determined by the complexity of the design.

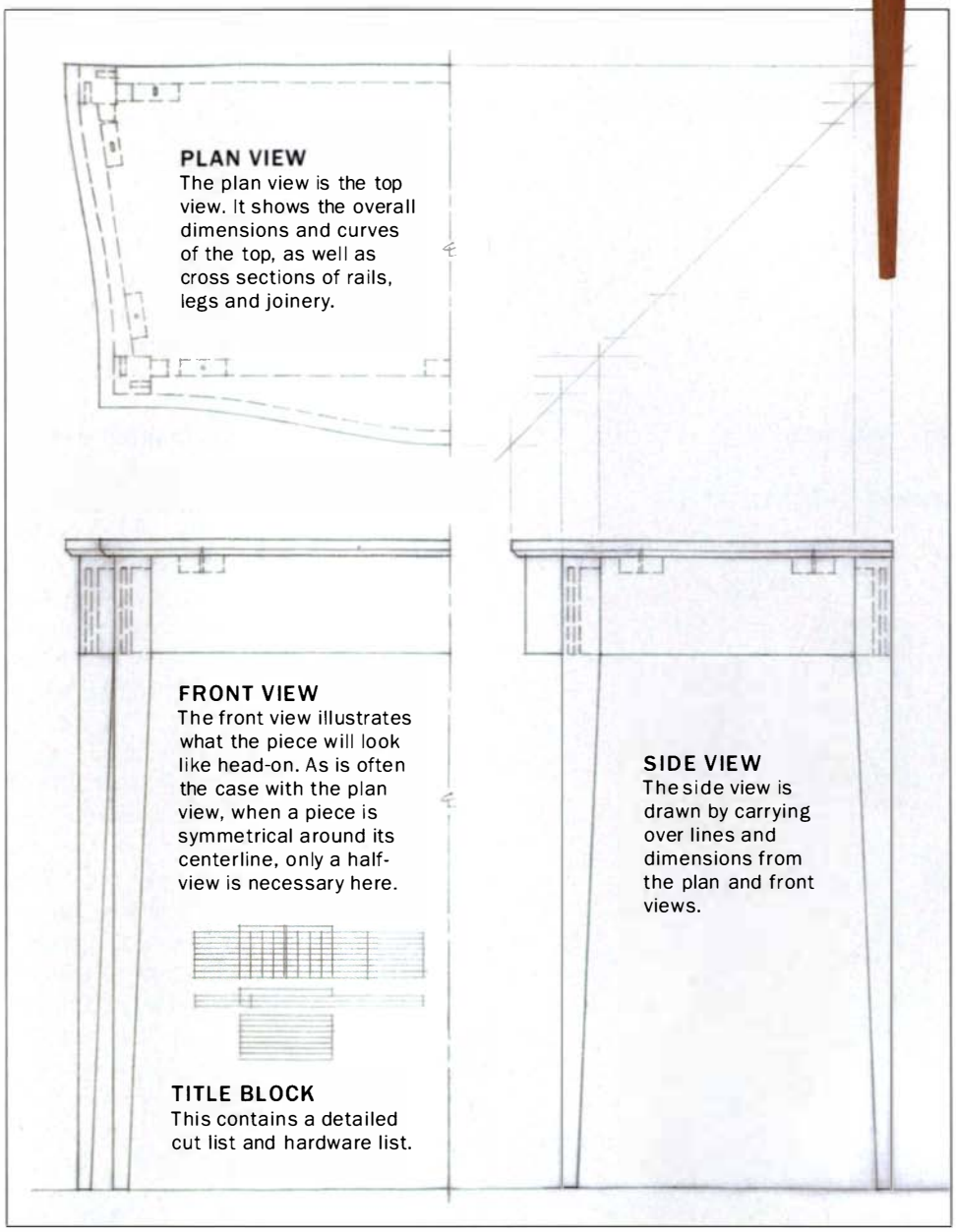
The basic tools for drawing

My drawing table is a 4-ft. by 8-ft. angled surface covered with a vinyl mat and equipped with a cable-controlled parallel rule. But all you need to make accurate drawings is a large, smooth surface (like Baltic birch plywood or medium-density fiberboard) with two parallel edges to run

Photos: Asa Christiana

EVERYTHING YOU NEED IN A SINGLE DRAWING

A full-size drawing helped Lowe determine critical design and construction aspects for this side table. Before putting tool to wood, he worked out the curves of the rails, the taper of the legs, the overhang of the top, the joinery and a precise cut list.



A GLOSSARY OF LINES

Illustrators and draftspeople use a variety of line styles in drawings to make them easier to understand.

SOLID LINES
Used to show any visible edge.

DASHED LINES
Show any hidden element.

Dotted lines touch at corners so that the eye will pick up the shape more clearly.

CENTERLINE
Indicates that the object is symmetrical around this line.

CUTTING PLANE LINE
Indicates a cross section.

BREAK LINE
Means that object continues, but drawing is cut off here.

a T-square against. Add a ruler, a set of triangles, a white plastic eraser, an erasing shield and a dusting brush, and you're off.

For best results, I recommend hard pencil lead and special drafting paper. I use a mechanical pencil and drafting vellum called Charprint 916H, which I purchase in 42-in.-wide rolls.

The two tools used most often in drafting are designed to do the two most fundamental operations. The first tool, the T-square or parallel rule, is used to draw horizontal lines. Second is the triangle: Either the 30-60-90 or the 45-45-90 is used for drawing vertical lines perpendicular to the horizontals. These triangles also are used to draw common angles measuring 30°, 45° and 60°. A straightedge is important because it can be used to draw a straight line at any angle, such as the tapers on legs. A T-square flipped onto its back (so it will lie flat) makes a workable straightedge.

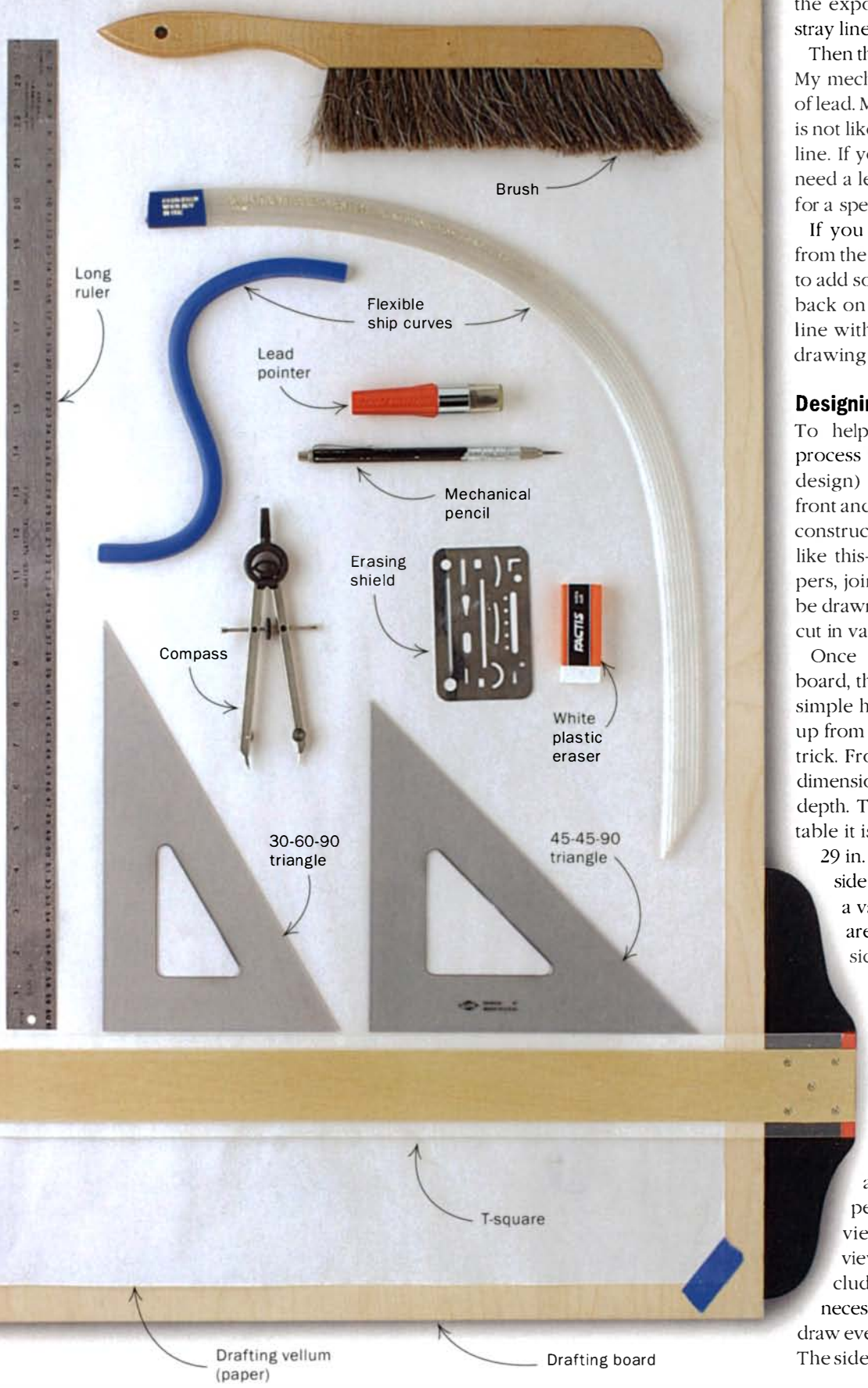
The compass is the tool of choice when a regular curve is needed. I draw irregular curves freehand, which can be more pleasing to the eye than a curve made using a compass or french curve. I smooth out these freehand lines with a long, flexible tool called an adjustable ship curve.

When drawing freehand curves, the lines tend to be a bit heavy. I clean them up using an erasing shield, a thin sheet of metal

Drawings: Vince Babak

An inexpensive kit for drafting

A large sheet of plywood and a few commonly available tools are all you need to make accurate full-size drawings.



with various shapes cut into it. By covering the portion of the line that you want to save with the erasing shield, you can erase the exposed part and clean up unsightly stray lines with a white plastic eraser.

Then there is the pencil lead that you use. My mechanical pencil can hold any grade of lead. My choice is No. 4 hard lead, which is not likely to smear but still makes a clear line. If you use a pencil like this, you will need a lead pointer, which is a fancy term for a special sharpener.

If you happen to remove the drawing from the board and discover that you need to add something, you can place the paper back on the board, match any horizontal line with the T-square edge and tape the drawing back in place.

Designing a side table in three views

To help you understand the drawing process and its advantages, I'll draw (and design) a basic side table with a curved front and sides. There are many design and construction decisions to make on a table like this—overall proportions, curves, tapers, joinery—and all of these details can be drawn on paper before making the first cut in valuable stock.

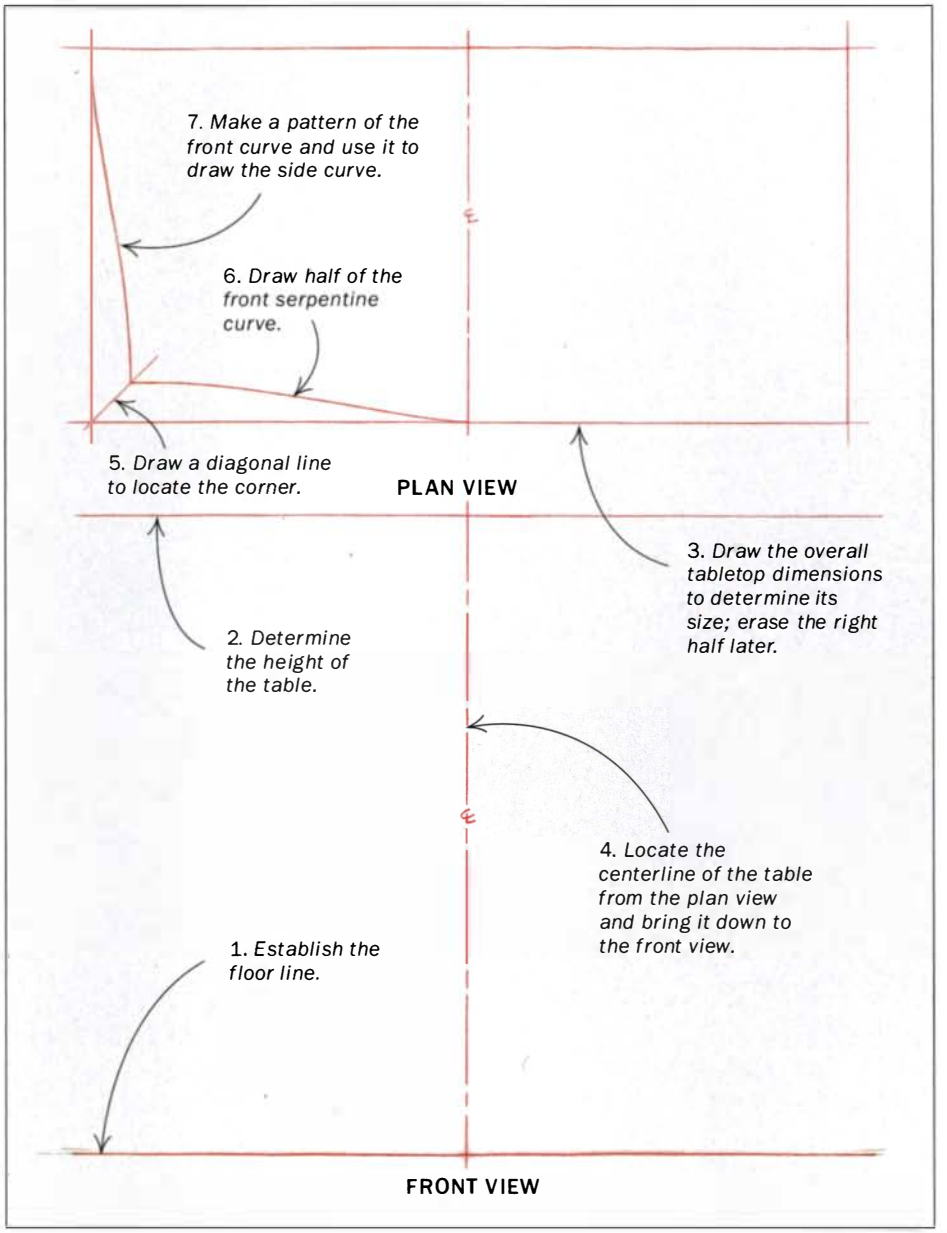
Once I have the paper taped to the board, the best place to start is the floor. A simple horizontal line, a couple of inches up from the bottom of the paper, does the trick. From here, I think about the overall dimensions of the table: height, width and depth. The height is based on the type of table it is. I draw a light, horizontal line at 29 in. to 30 in., the standard height for a side table, which most likely will have a vase or lamp on it. These two lines are the beginning of the front and side views.

Next, in the space above the front view, I draw a light rectangle that represents the size of the tabletop. This is the top, or plan, view. These few lines establish the overall size.

Half views are enough—Once I am happy with the proportions, I pencil in the centerline on the plan view and carry it down to the front view. On most pieces of furniture, including this one, only a half view is necessary for the front and plan views. I draw everything to the left of the centerline. The side view will show the entire piece.

STEP 1 DRAW OVERALL DIMENSIONS AND CURVES

Determine the height of the tabletop and get an idea of its overall size. Then draw the actual curved edges on the left of the centerline. Only half of the table needs to be drawn in the front and plan views.



These half views have a few important advantages. They not only mean a smaller drawing and less work, but they also guarantee symmetry. I make a half template for the serpentine curve across the front, and simply flip it to lay out the other side. This is much easier than trying to draw the entire curve and match both sides. Also, the same curve is used on the sides.

I draw half of the serpentine curve across the front in the plan view. I draw this line freehand, working to get a curve that is pleasing to my eye. This curve can be subtle or extreme; it's a matter of taste.

I made this tabletop twice as wide as it is deep, allowing two important things to happen. One, the same half-serpentine curve pattern for the front can be used for the side. Two, the entire table can be doubled, turning it into a card table with an identical serpentine rail on all four sides.

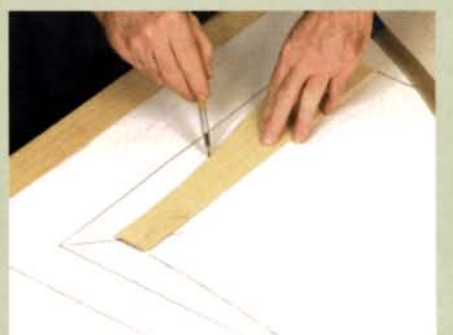
After drawing the curve for the front, I use a piece of ⅛-in.-thick plywood to make a pattern of the curve by laying the

NEGOTIATING THE CURVES

Draw half of the front curve. *Sketch it out freehand, trusting your eye.*

Smooth the curve. *Use a flexible ship curve to create a fair, even profile.*

Make a plywood pattern. *Poke a series of holes through the paper to transfer the pattern to thin plywood.*

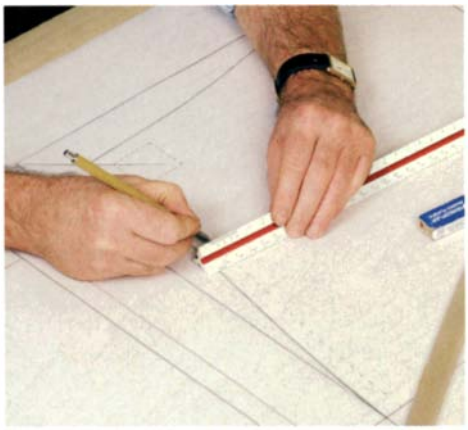


Draw symmetrical curves. *Use the pattern to draw a matching serpentine curve on the side rail and to lay out the actual workpieces.*

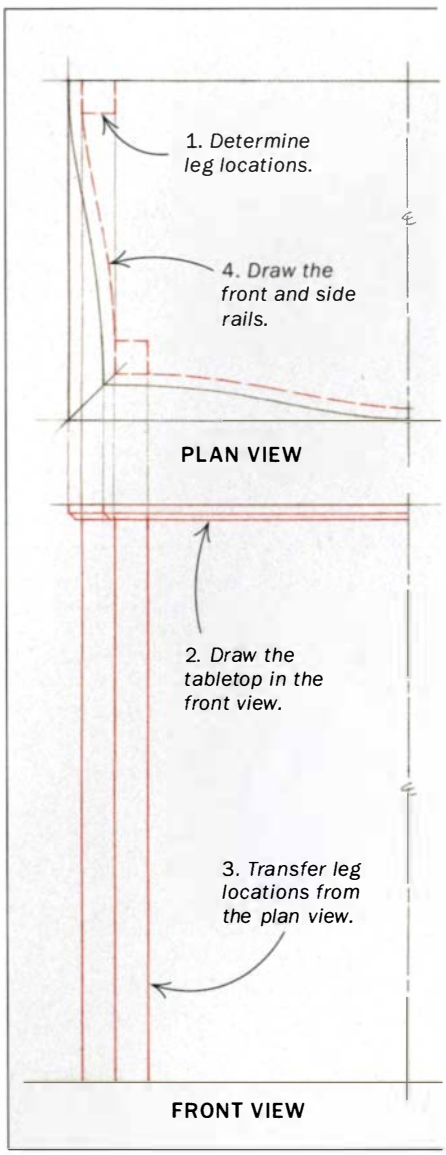
STEP 2 SIZE THE LEGS AND RAILS

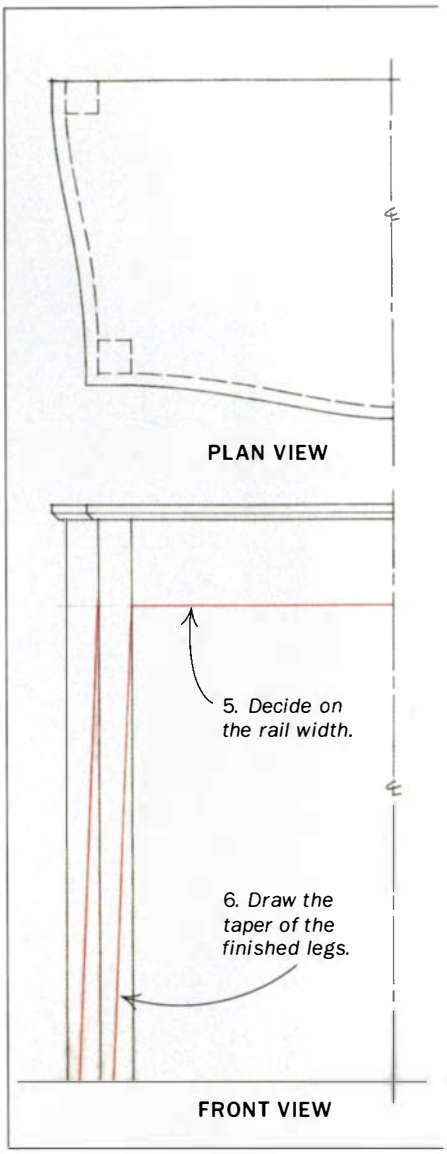
After choosing the overhang of the tabletop, draw the legs in the plan view, transfer the leg and tabletop edges to the front view, and add the tabletop chamfer and hidden lines for the rails.

Transfer lines from the plan view to the front view. *Use a long triangle to carry down the tabletop and leg edges.*



Draw the rails in the top view. *Use the overhang dimension to offset the curved rail evenly from the curved tabletop. Lowe is using a triangular scale, but any ruler will do.*





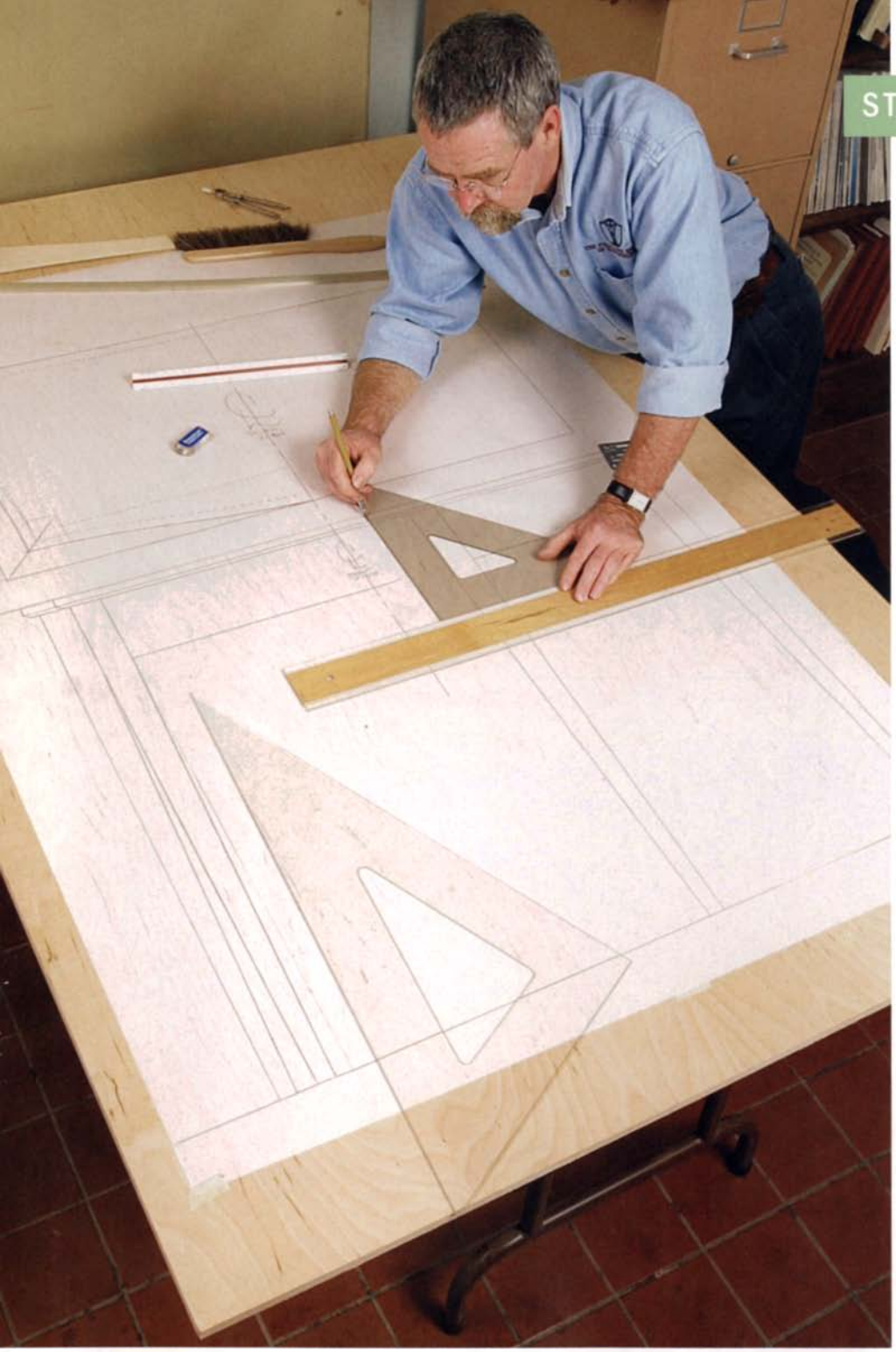
plywood underneath the drawing and pricking holes along the line, through the paper and into the plywood. I saw out the pattern and smooth it with a spokeshave and sandpaper. I can use it as a template for doing the rest of the drawing, and when building the table in the shop.

The overhang determines the table base—Looking at the front and plan views, I decide the overhang of the tabletop. For this table, a slight overhang will keep the tabletop from hiding the rail and will accentuate the matching curves in both. At this point, I also determine the thickness of the tabletop and draw it into the front and plan views. A heavy chamfer under the edge lightens the look.

The overhang dimension is used to position the legs and rails in the plan view. At this point, I consider the width and thickness of the legs and draw them. Now, using a triangle, I project the dimensions of the legs down into the front view. I also continue these light lines to the floor, which end up forming the rectangles of stock from which the legs will be sawn.

On this traditional table, I keep the rails flush with the legs. It's easier to build an inset rail, but a flush rail creates a smooth flow around the corner for a more high-style look. To draw the curved rails in the plan view, you need a hidden line that is offset evenly from the curve of the top. The overhang of the tabletop is ⅝ in. I mark this offset from the tabletop edge in seven or so places and then use a ship's curve to draw a smooth curve for the rail. Next, I pick a pleasing width for the front rail.

Jumping back to the legs, I consider how they should be tapered—on two sides or four? Having decided that a two-sided taper looks best on this table, I lay out the amount of taper at the floor line and locate one end of a long straightedge on the

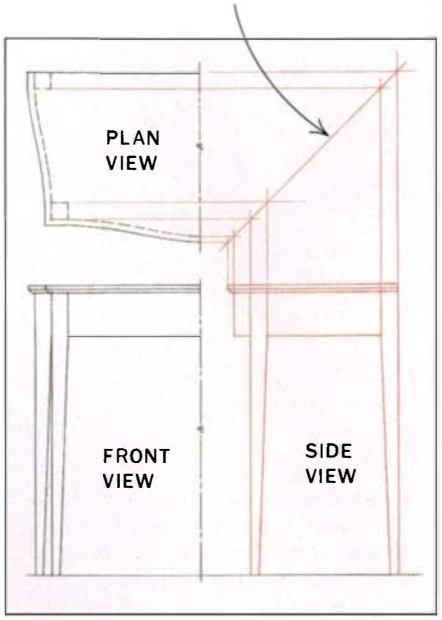


Now fill in the side view. *Carry over horizontal lines from the front view and transfer the other dimensions from the plan view using a 45° line or simply by measuring.*

STEP 3 DRAW THE SIDE VIEW

All of the information necessary to complete the side view is incorporated in the plan and front views.

To transfer dimensions from the plan view to the side view, draw a line at a 45° angle and project lines across and then down.



drawing at that point. The other end goes on a point about ⅜ in. below the rail, where I generally start my tapers.

Develop the side view—So far, I only have worked on the front and plan views. To create a side view, I project lines from the front view and take the horizontal dimensions from the plan view. Until now, only the external lines of the table have been addressed, so if any of the proportions need to be changed, this is the time to do it. The white eraser will make clean work of it. Once I'm satisfied, it's time to fill in the joinery.

Joinery determines the thickness of the rails—First, in the plan view, I fill in the locations of the mortises and tenons. Then I can draw the back edge of the rail, determining its overall thickness.

On smaller tables like this, I keep the front cheeks of the tenons ¼ in. back from the outside of the leg and use a ¼-in.-thick tenon. These locations allow long mortises to fit inside the leg without touching one another and weakening the leg.

The first step on the plan view is to draw the back rail ¾ in. thick with the standard ¼-in.-thick tenon. Then, after drawing the joinery on the front rail in the plan view, I can draw the horizontal line indicating the back of that piece, and a clear view of the stock develops. I can determine easily that it must be 2⅜ in. thick to contain the curve.

The side rails can be taken from a thinner piece of stock by drawing a construction line from the outside edge of the curve to the rail's front shoulder, and then drawing a line parallel to that one to indicate the overall thickness of the part.

Project the joinery to the front and side views—Now carry the tenon thicknesses and lengths down to the front view

STEP 4 ADD JOINERY AND TITLE BLOCK

Design the joinery in the plan view, find the rail thicknesses, fill in the front and side views and add the title block.

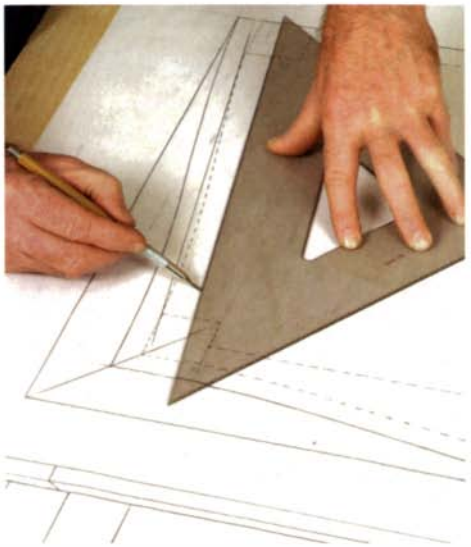
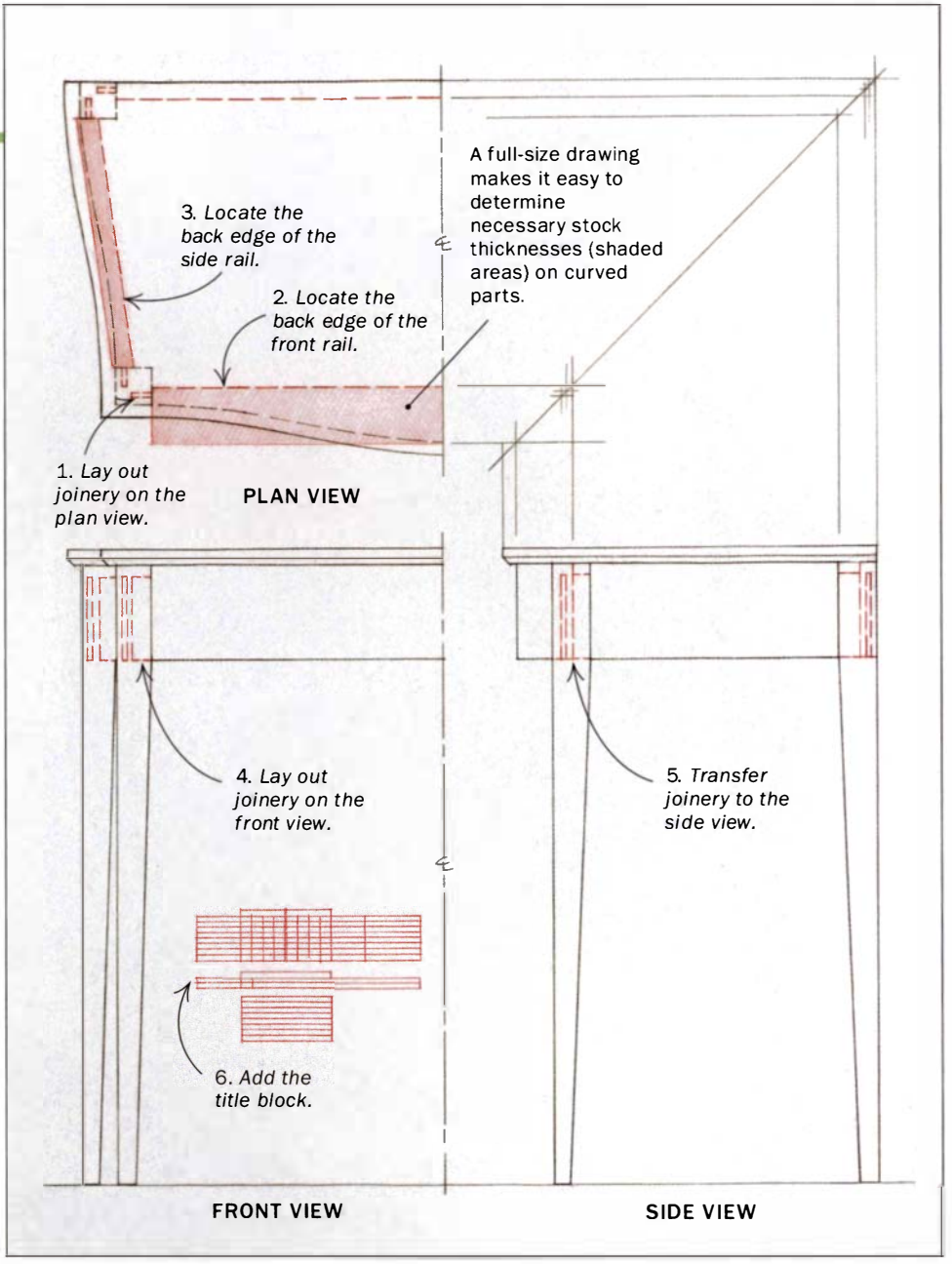


Figure out the side rail's thickness. *Start with a construction line to determine the outside edge of the rail stock, then offset a parallel line from that to find the inside edge of the rail.*



and in turn to the side view. One last decision that needs to be made regarding the tenons is their width and the size of any top or bottom shoulders to make the table resist racking. I think giving the tenons a ¼-in. shoulder at the top and no shoulder at the bottom is enough. I think it is easier to align the bottom edge of the rails to each other without a shoulder to deal with, making it easier to apply any banding that might run around the bottom edge of the rails and across the legs.

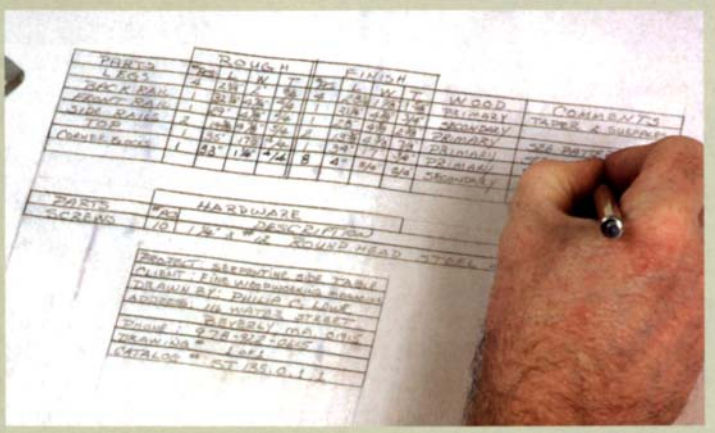
If there is no shoulder at the top, an open mortise is created and the strength of the leg is compromised. It wouldn't stand up to an accidental kick or a whack from a wayward vacuum cleaner.

The last element that I place on the drawing is the title block, which contains both a cut list and a hardware list. I refer to the drawing many times during construction, keeping myself organized and avoiding costly errors. □

Philip C. Lowe runs a woodworking school and makes period furniture at his shop in Beverly, Mass.

WHAT INFORMATION GOES INTO A TITLE BLOCK?

The title block is an important last step. It contains rough and finished stock dimensions, listing wood species and comments for each part, as well as a hardware list, the date and the maker's name and address.



Joining Legs to Aprons

The size and location of mortise-and-tenon joints affect their strength

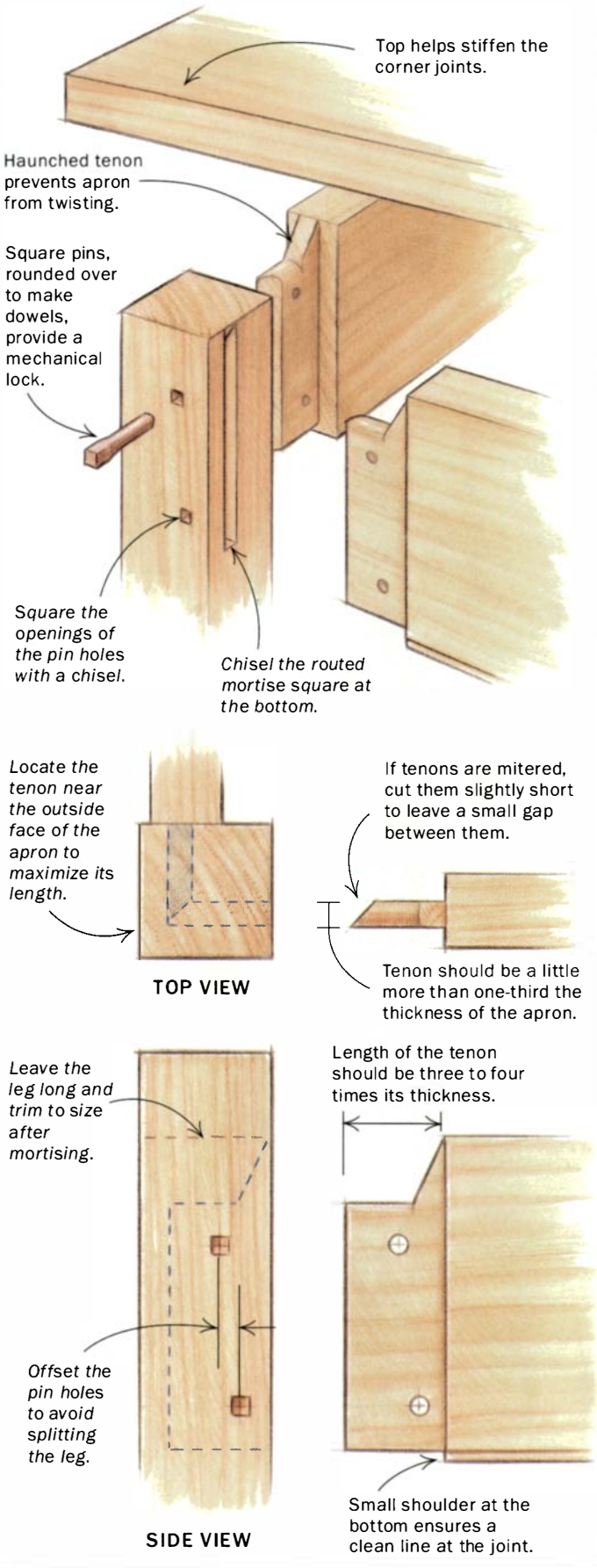
BY GARRETT HACK

The life of a table is often not easy. Legs get kicked; the table gets pushed and pulled across uneven floors, leaned against and sometimes even sat upon. To make matters worse, the very nature of wood adds to the stress. As the tabletop shrinks and swells with seasonal changes, the movement works against the integrity of the table's structure. Where is all this stress felt? It's the leg-to-apron joint that holds a table together and gives it rigidity. When that joint fails, the table falls apart.

Leg-to-apron joints must withstand three different kinds of stress. One is shear—a vertical load directly above a joint, such as when someone sits on the corner of a table. Leaning heavily on the top of a table midpoint above the apron causes the joints to undergo a bending stress trying to lever them apart. Shoving the table sideways or bumping against a leg gives the joints a mixture of twisting forces. Also, as a tabletop that is

Photo, this page: Michael Pekovich

A STURDY LEG-TO-APRON JOINT



fastened too tightly to the apron expands or shrinks, it can try to twist the joints. The best defense against these stresses is a well-designed, tight-fitting mortise-and-tenon joint that locks apron to leg. The mortise and tenon is not only a good joint for tables, but the same principles also apply to designing joints for cabinet doors and chairs.

Size the tenon

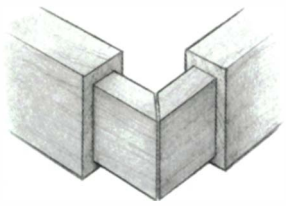
When deciding on the sizes of joinery components, the key is to attain a workable balance. Too large a mortise, and you risk weakening the leg; too skimpy a tenon, and you lose glue and mechanical strength. The ideal joint would have a large tenon with lots of glue surface, it would be the full height of the apron to best resist twisting, and the mortise would be cut from the center of the width of the leg for maximum strength. But it's not just the sizes of the mortise and tenon that you have to balance: The shoulders on both sides of the tenon must be substantial enough to do their work. They butt against the leg and resist bending and twisting forces trying to lever apart the joint. A good rule of thumb is to size the tenon thickness a little more than one-third the thickness of the apron.

While the one-third rule is a good general guide to follow, sometimes it's better to make exceptions. If I'm building a table out of butternut or a similar softwood, with aprons only ¾ in. thick, I make the tenons at least 5/16 in., maybe even ⅜ in. thick. Any smaller and a sharp bump to the leg might snap the tenon right off. Because you rarely see the thickness of an apron, one good design strategy is to make it thicker—⅞ in. or 1 in. will provide larger, stronger shoulders.

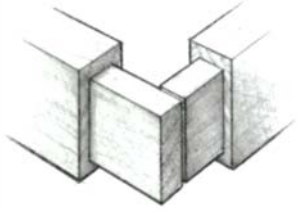
Maximize tenon length— Two other aspects of the tenon affect the joint strength. One is the amount of long-grain glue surface on the cheeks of the tenon; the other is the length of the tenon, which is affected by where the mortise is cut on the leg. Naturally, a longer tenon has more glue surface and provides more mechanical strength to the joint. As a general rule, the longer the tenon, the better, assuming the leg can accommodate it. A tenon length that's three to four times its thickness is quite adequate. When laying out the size and placement of tenons, a full-scale, top-view drawing will help you understand the orientation and relationship of all of the parts.

One engineering principle states that the stress on any part is

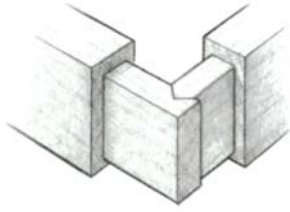
WHERE TENONS MEET



Miter them, but skip the glue on the very ends. Hack does not bother to glue the end grain of the miters, reasoning that the bond is unreliable.



Butt them together if you have tenons of unequal width.



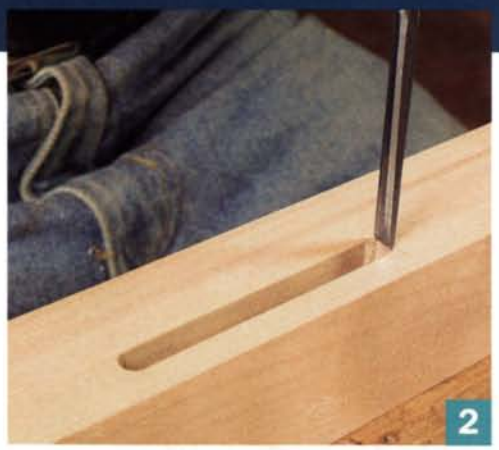
Bird's-mouth joints often are found in Asian furniture. This design offers additional strength because the tenons interlock.

Drawings: Bob La Pointe

Routers are quick and accurate. *Although his mortises often require additional handwork, Hack cuts most of them with a machine he made from scrap parts. It has a router mounted horizontally to a sliding table that can be adjusted in three dimensions.*

least along the centerline or neutral axis. A centered mortise or tenon is stronger because it has all of that wood on both sides bolstering it. For this reason, I prefer to have a shoulder on both sides of a tenon (rather than one side only) to better resist bending stresses from either direction. Even a small shoulder will cover any bruised edges on the mortise that result from cutting the joint.

A centered mortise might be ideal, but the farther to the outside of the leg you position a mortise, the longer the respective tenon will be. Too far out and the cheek of the mortise is more vulnerable to splitting under stress. Deciding on the exact placement is a judgment call that varies with each project. I have butted tenons together inside the leg, but doing so makes one tenon shorter than the other. Butting tenons together works when joining aprons of unequal width, where the wider tenon can be the shorter one because it has extra glue surface. I've also cut half of each tenon long and the other half short and locked one tenon into another with a bird's-mouth cut as Chinese furniture makers sometimes do. But I



Cut the bottom square. *Use chisels to clean out the bottom corners of each mortise as an index to seat the tenons later on.*

Scribe lines for the haunch. *A marking gauge extends the lines of the existing mortise that indicate where to cut the angled haunch.*

Chisel the haunch by hand. *There is no other practical way to cut the slope for this shape. Hack leaves the table legs long to keep them from splitting along the top edge while he chisels the haunch.*

Check the results using a small shopmade template. *The template makes it easy to check your progress as you cut the angled mortise.*

Photos, except where noted: William Duckworth

Tenons on the tablesaw. *With the workpiece firmly clamped against this tenoning jig, the tablesaw can cut tenons cleanly and accurately.*

prefer to miter the tenons within the joint without actually joining them. This is easy to do, and it can add 15% to 20% more glue surface and length to the tenons. If I must incorporate drawers into an apron, the size of the rail usually calls for a completely different tenon design (see the story on the facing page).

Shorten the tenon height with a haunch

A tenon the full height of the apron affords lots of glue surface and strength against bending and twisting forces. But there's a trade-off: A full-height mortise weakens the leg, especially if there are two mortises at the corner of the leg. With the top of the mortise open, any serious stress on the apron can more easily split the top of the leg. So the strength of such a joint relies almost entirely on the glue bond because the mechanical strength is compromised.

A simple solution, and one I prefer, is to shorten the tenon considerably for the top ¾ in. to 1 in. or so and cut an angled haunch. With this design detail, what little glue surface you lose is balanced against having a much stronger mortise.

I cut the haunch on the tenon by hand with a dovetail saw and then clean it up with a chisel. For speed and accuracy, I lay a wooden template on the tenon to mark out the haunch and use another one made as the mirror image of that pattern to size the mortise at the haunch end. To cut the mortise for the haunch, I first mark out the sides aligned with the mortise with a mortise gauge, chop the waste, and refine it using the template and a chisel. Because I cut many of my mortises with a router bit, I keep the top of the mortise below the haunch round for a small measure of added

Trim tenons to size and shape. *A matching template made to the negative shape of the one used to check mortises shows where to cut the angled haunch on the tenons. The first cut is made with a stop block on the miter gauge.*

strength. Also, a small ⅛-in. shoulder at the bottom of the apron tenon will hide any small inaccuracies in cutting the mortise, and it allows for vertical alignment when the table is assembled.

Adjust the fit and use glue sparingly

The best design and the strongest glue won't overcome a joint with carelessly fit shoulders or a sloppy fit between tenon and mortise. Even when I cut these joints with accurate machine setups, I still often find it necessary to improve the fit with a few passes of a shoulder plane or a chisel. I want the shoulders to fit tightly over their entire surface and the tenon to slide into place with a minimum of force for a good glue bond.

Part of the long-term strength of the joint is the snugness of the fit, or what I call its mechanical strength. Glue adds strength, but how long does a glue bond last? By its very nature a mortise-and-

GLUE AND PIN THE JOINT

You don't need a lot of glue. *With snugly fitting mortise-and-tenon joints, a thin layer of yellow glue spread evenly is all you need for a good bond.*

This handwork is fast and accurate enough. *A dovetail saw makes quick work of trimming the angled haunch and mitering the ends of the tenons.*

tenon joint has wood fibers running cross-grain to one another, which weakens the bond. Flexible modern glues can accommodate some of this movement.

Before gluing, I always dry-fit and clamp the parts together to discover any problems that may arise while there's still time to solve them. To ease assembly, I chamfer the ends of each tenon. Glue-ups can be stressful, but it is worth taking care to place the glue so as to avoid drips and oozing joints that would be a headache to clean up later. With a thin stick about half the width of an ice-cream stick, I apply a light amount of glue into the mortise and on both tenon cheeks. The flat edge of the stick is perfect to squeeze out the glue in a thin, even layer. Another trick that works well is to cut a light chamfer around the mortise to contain any squeeze-out. Ideally, the joint should slip together under light clamping pressure.

For large tables and for peace of mind, I often pin the leg-to-apron joints. I use a hard, straight-grained wood such as rosewood, ebony or maple for the pins. A contrasting wood can add a pleasing visual detail, and two small pins are stronger than one large one. Most often, I drill holes for the pins after gluing and drive them in either from the outside or inside of the leg, depending on whether or not I want them to show. □

Garrett Hack is a contributing editor.

Pins are an insurance policy. *Small hardwood pins will hold the joint tightly, even if the glue fails. Hack leaves the outside end of the pin square and holds it with a wrench as he hammers it home.*

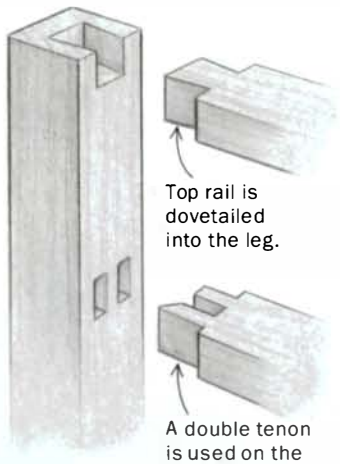
Unique solutions for different design problems

Not all aprons call for a single haunched tenon mortised into the leg. The problems presented by some leg-to-apron joints require uncommon solutions. One example is an apron that incorporates drawers into the design, such as those you'd find on a desk or some kitchen tables.

Aprons with drawers often have a narrow rail under the drawers that joins into the leg, and such rails have tenons that can't be any higher than the height of the rail, nor probably any longer than the other tenons joining into the leg. Still, these tenons are doing quite a bit of structural work. The solution is to make double tenons parallel to one another, which doubles the glue surface and provides good resistance to twisting and bending forces (see the drawing above).

TWO TENONS ARE BETTER THAN ONE

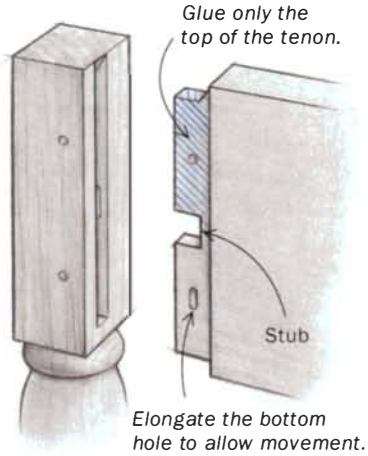
Narrow rails under drawers need beefier tenons. Doubling them up maximizes the strength you can get from such a small piece of wood.



Extrawide aprons offer another example of design problems that require different solutions (see the drawing below). Wood movement over such a wide apron is, of course, a consideration. But more than that, another real concern is that a long mortise can weaken the leg. The long sides of the mortise can flex easily, and the apron-to-leg joint loses vital mechanical strength. The solution is simply two mortises with a groove for a stub tenon between them and an angled haunch at the top. The two mortises still have plenty of glue surface and lock the apron along its full height. If wood movement is a concern, glue only the top part of the tenon, then pin the lower part with elongated holes, as you would on a breadboard end, so that the apron can move slightly. Also, cut the bottom mortise a little long to accommodate the anticipated movement.

WIDE APRONS NEED A BREAK

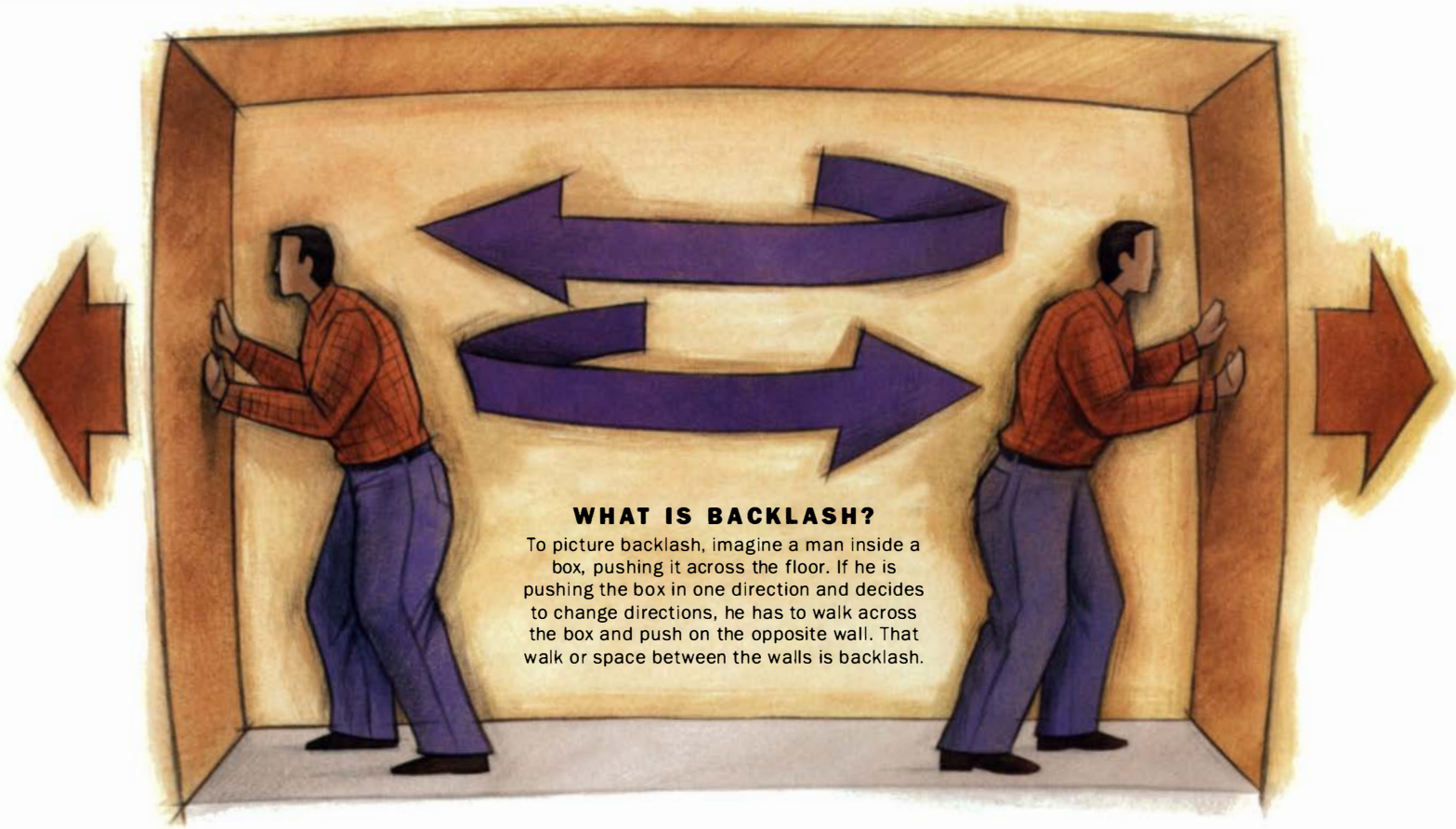
A mortise longer than 4 in. or so can threaten the structural integrity of a leg. A break in the middle for a haunched tenon alleviates that problem but still keeps the apron from twisting.



Fight Backlash

Taking the slop out of machine adjusters makes for more accurate work

BY GEORGE WALKER



WHAT IS BACKLASH?

To picture backlash, imagine a man inside a box, pushing it across the floor. If he is pushing the box in one direction and decides to change directions, he has to walk across the box and push on the opposite wall. That walk or space between the walls is backlash.

Tracking down loose adjusters

WORN GEAR TEETH

Rotation of the worn gear pushes against the gear segment, causing the two parts to wear over time, creating more dead space and backlash.

LOOSE COLLARS

The vibration caused by normal wear and tear on machines can cause setscrews to rattle loose.

WORN PINS

The pin that holds the adjusting arm on any machine can wear away, causing the adjusting arm to slide around. The easy fix is a new pin.

When I served in a traditional machinist apprenticeship nearly 30 years ago, apprentices were expected to pay their dues, which meant running old, worn-out machines and completing jobs the more experienced journeymen didn't want to fiddle with. I manned an ancient, dilapidated lathe that had spent its better years in Brazil. One journeyman, the cigar-puffing Dom, took me under his wing. He could run rings around me on a lathe, simultaneously whipping up sardine and cheese concoctions for both of us. Dom enjoyed watching me struggle with that old machine, occasionally offering strings of Portuguese curse words that he thought the lathe might remember. I never developed a fondness for sardines, but I did learn solid fundamentals. One of them was how to overcome backlash, a common problem that occurs in machine and woodworking shops alike. You may have a jointer, a tablesaw, a planer or a handplane that has a temperamental streak, that occasionally requires a little voodoo or that is just plain evil. Backlash may be the root of the problem.

Backlash is a necessary evil

Backlash is defined simply as the play between moving parts, such as gears or threads, and is most noticeable when changing directions. Although backlash is usually associated with old or worn machines, it's actually a necessary part of any machine design. Without the play, or clearance, between moving parts, mechanisms would seize up, shafts wouldn't turn, tables would not tilt or adjust. Backlash becomes a problem when that play is excessive—typically resulting from loose-fitting threads, gears or other mechanical connections—and often shows up as slop in adjustment mechanisms like the crank handles on a tablesaw.

Although backlash is usually associated with old or worn machines, it's actually a necessary part of any machine design.

To illustrate backlash, imagine a man inside a large, overturned box. If the man wants to move the box to the right, he must walk to his right and push on that side. If he wants to push left, he must step back over to the opposite wall before he can make the box move left. The gap he must traverse is backlash. It is a dead spot: Although the man is moving, the box is not. This is why a threaded shaft that is worn may feel like it has a mushy or dead spot when you change directions.

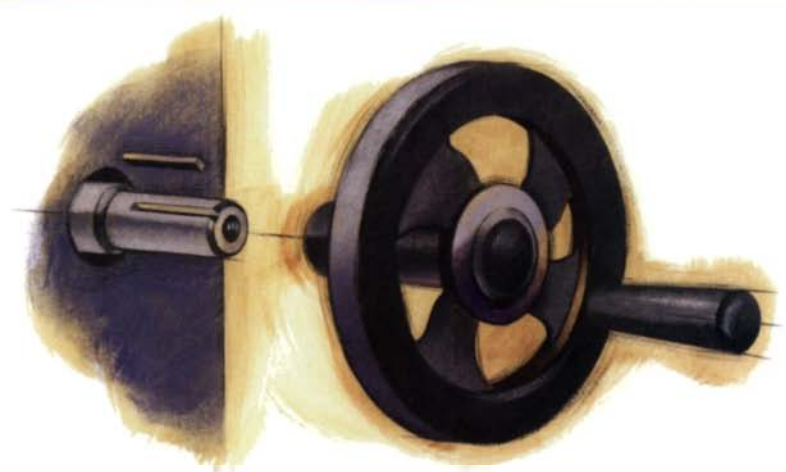
Backlash also can cause false readings on an adjustment scale, such as planer blade height. The scale may indicate that you moved the blade 1/32 in., yet the blade cuts nothing, or, worse yet, it suddenly bites off 1/8 in. It can plague the tilting table on a bandsaw or drill press, causing the table to shift or drop unexpectedly. The pattern here is loss of accuracy or pesky shifting of cutting tools, tables or fences. If a machine has adjustments driven with a screw or a linkage with moving parts, backlash may occur. Almost any machine in the woodshop can be affected. You might not see symptoms as drastic as these, but backlash can make it increasingly difficult to make fine adjustments on a machine or require you to make more trial cuts.

But there are ways to overcome the effects of backlash once you understand what causes it.

What causes backlash?

The most common cause of backlash is normal wear and tear. In a woodworking shop, sawdust is inevitable, and it works its way into the threads or moving parts of a machine. Most wear is caused by contamination and a lack of lubrication. Sawdust is pesky on both counts because it is a contaminant that soaks up lubricants. As the shaft and nut wear, the amount of dead space that must be traversed increases. You find that you have to turn the shaft further before you feel the threads reengage.

To transfer motion from a crank handle to a cutting tool, there may be a series of shafts, bearings, connecting links, gears and slides. Any of these can vibrate loose or wear out and add play. Loose connections create excessive backlash in a slightly different manner. Think of an adjustment mechanism as a metal chain. For



WORN KEYS
Over time, keys may become round or misshapen, creating a rattle and looseness in the adjustments.

PLAY IN ADJUSTER
The adjuster on this handplane has slop in the adjustment because the link fits loosely in the adjustment knob's groove.

Drawings: Brian Jensen

TROUBLESHOOT A TABLESAW

REPLACE WORN KEYS

On this tablesaw, the handle itself has slop. Begin inspection by loosening the setscrew on the adjusting wheel and remounting it.

Pull things apart. *With the handle removed, you see that the key that locks the handle to the adjusting rod has worn out.*

Out with the old. *Clean and lubricate all of the parts, then slide a new key into place, which should eliminate any slop in the adjustment.*

TIGHTEN A LOOSE COLLAR

Inside this tablesaw, a setscrew has worked itself loose and allowed the collar to loosen (above), which creates slop in the height adjustment.

that chain to transfer motion, the links must be in tension. Motion applied to a crank transfers power when all mechanical links are pulled tight; until then you are just taking up slack.

Backlash also can be inherent to the design of a tool. Loose tolerances and sloppily fitting machine parts are typical indicators of poor quality control in manufacturing. Woodworking machines are not all born equal; some, unfortunately, start life with excessive backlash. A good, solid machine with minimal play will more than make up for differences in price over the life of a tool. The old phrase, "You get what you pay for," often is true where backlash is concerned.

It also is important to understand that adjustment mechanisms are designed with a twin role. The primary purpose is to make fine adjustments. But they also act as support when all of the parts are engaged and in tension. Adjustment cranks often are equipped with a lock or brake. If you use a lock but ignore whether the mechanism is in tension, it is like stopping a car with a hand brake only. You compromise much of the stability built into the machine.

Preventing and handling backlash

What can be done to remedy the situation? Short of going out and buying a new machine, you should be able make some minor corrections to reduce backlash. You also can develop work habits that minimize the effects of backlash.

Small adjustments can have a major effect—Excessive backlash usually is caused by several loose or worn parts, so correcting even one or two can give you good results. Give the machine a thorough once-over, which will help you find problems and give you a clear understanding of how motion is transferred.

Always begin by disconnecting the power source and removing cutting tools. Remove inspection plates and guards, then vacuum out debris. Put the adjuster through the entire range of motion; reverse directions back and forth at intervals all along the range. Feel each part of the mechanism separately with your hands—push up, push down and push side to side—and look for any play or looseness. Carefully check all mounting bolts, setscrews, keys or pins, making sure they are solid and tight. Before tightening loose bolts, disassemble and remove any sawdust and make sure contact surfaces are free of burrs. When possible, I like to replace standard screws with Allen screws because they are easier to adjust. Be sure to check for missing bolts, broken springs or worn connecting pins.

This is also a good opportunity to test the locking mechanism to see how solidly it locks in the zone where you make the most frequent cuts. Once minor repairs are complete, put the mechanism back through the entire range of motion, and be sure to lubricate parts before replacing covers.

There are a number of potential sources of backlash that are beyond the scope of this article. However, I would suggest only moving forward on these repairs—the replacement of feed screws, bearings and gib adjustments on slides, for example—based on your confidence level and the availability of manuals and parts.

Working around backlash—Several techniques can negate the effects of backlash. First, avoid taking a cut while adjusters are in the dead zone. Make sure there is tension in the mechanism before locking down an adjustment or cutting anything. In practice, this means simply being aware of the feel of the mechanism when it is solidly in tension. If you want to reverse just a small amount, crank

Photos: Tom Begnal

CORRECT BACKLASH IN A BLOCK PLANE

Feel the dead space. *The depth adjustment on this handplane experiences severe backlash because the knurled knob is narrower than the adjuster it keys into.*

Reduce the gap. *Close up the slot on the adjuster with a pair of pliers or vise grips.*

the handle back anywhere from half to a full turn or until the threads fully reengage. Then creep back up to the setting you want, making sure it feels solid.

Make a habit of using the machine's normal forces to keep adjusters in tension. Think back to when you inspected the mechanism. You should have a clear idea of how it works and how forces act upon it. Usually you have the force of the wood resisting the blade, plus gravity itself. On a tablesaw these forces tend to push down; on a planer, whose cutterhead is above the work, the forces push up. This affects how you should make adjustments. Even if the mechanism is in tension, it is in tension in only one direction. If those normal forces push from the opposite direction, they can push the mechanism into the dead zone. Think of towing a car with a chain: If you tow down a hill, gravity may take over, and the car you are towing can drift forward. On a tablesaw, adjustments always should be made uphill. If you take the blade too high, back off a turn or two and approach back up. This keeps the mechanism in tension and avoids the dead zone. The blade responds to the smallest adjustment of the crank handle, and the forces from cutting and gravity cannot cause the blade to shift.

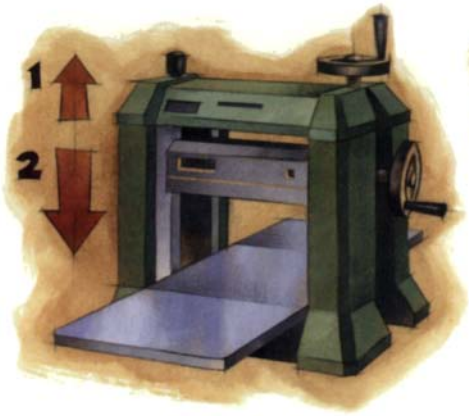
It's good practice to take a look at sloppy machines, because more often than not, excessive backlash can be corrected. But also remember that some backlash is inherent in adjustable machines, so you need to develop habits that use backlash to your advantage. The methods become second nature with only a little practice. Once the techniques have been mastered, backlash should cease to be a frustration, and you don't have to learn to curse in Portuguese. □

George Walker builds furniture in Canton, Ohio.

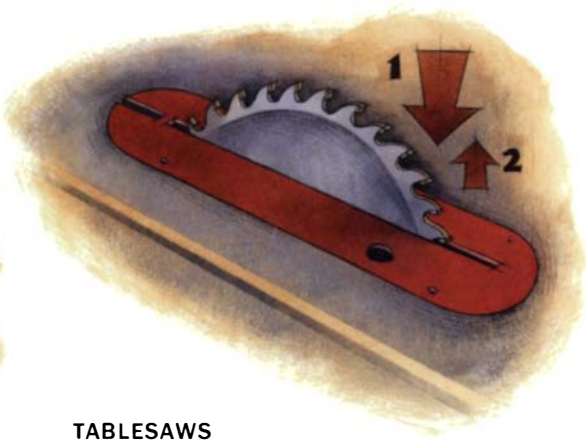
Living with backlash

No matter what you do, some backlash is inevitable. Understanding how backlash works and adjusting your habits to work around it will keep you cutting square and smooth.

HANDPLANES
To deal with backlash in a handplane, back off the blade more than necessary, then turn it forward a bit to get your final setting.



BENCHTOP PLANERS
The carriage should be lowered into the cut so that the pressure is against the thread on the adjuster.



TABLESAWS
When working at a tablesaw, adjust the blade by raising the arbor assembly to the desired height instead of lowering it. If you need to lower the blade, lower it more than necessary, then raise it to final height.

Current Work's best to be honored

Beginning with this issue, the editors of *Fine Woodworking* will select two semifinalists from each installment of Current Work (not including *Tools & Shops*) to be included in an annual Reader's Choice Award contest. In December, we'll post all 12 semifinalists on our web site, www.finewoodworking.com, and let you vote for a grand-prize winner, who will receive a $50 gift certificate toward the purchase of Taunton Press products on our web site.

Gerald C. Lauchle State College, Pa.

Lauchle, a professor of acoustics, built this Peruvian mahogany Chippendale chair (18 in. deep by 17 in. wide by 42 in. tall) to accompany a Georgian slant-top desk he built earlier. The design was based on plans in Ron Clarkson's *Making Classic Chairs: A Craftsman's Chippendale Reference* (Fox Chapel Publishing Co., 1997), and traditional hand-carving techniques were used in the chair's construction. The upholstery is velvet, and the finish is an oil stain and sprayed acrylic lacquer.

Richard Van Horn Bethany, Conn.

Van Horn made two of these cherry toy chests (15 in. deep by 32 in. wide by 19 in. high) for his grandkids. Much smaller than typical blanket chests, two fit inconspicuously into a living room. The finish on both is a hand-rubbed oil.

Keith S. Cornell and Paul N. Smith II
Whitman, Mass.

Cornell and Smith built this dining table (41 in. deep by 84 in. wide by 30 in. tall) as part of a two-piece set. The design was inspired by the desires of the client, as well as by a similar table built by an old shopmate of Cornell's and an Art Deco table built by Henri Jules Ferdinand Bellery-Desfontaines, featured in *French Decorative Art: The Societe Des Artistes Decorateurs 1900-1942* (Flammarion, 1990). Made of Honduras mahogany, the table features three crotch mahogany veneer starbursts and ebony inlay borders in the top. The finish is catalyzed lacquer.

Bill Cox Oceanside, Calif.

Cox built this Newport-style block-front secretary (22¼ in. deep by 45 in. wide by 103½ in. tall) for a class while he was a student at Palomar College in San Marcos, Calif. Cox's inspiration for this monumental six-month undertaking came from seeing John McAlister Jr.'s secretary on the back cover of *FWW* #129. Cox said McAlister's assistance proved crucial in the completion of this piece. The secretary is made of Honduras mahogany and features book-matched side panels, solid drawer fronts, a sliding-panel writing surface and nine hidden compartments. The exterior is finished with oil, and the interior is coated with shellac. Photo by Archie Breeden

Seth A. Barrett Milan, N.Y.

This hall table (18 in. deep by 67 in. wide by 37 in. tall), made of ash and jatoba, resulted from Barrett's interest in modern industrial and architectural elements. "The structure of this piece supports the functional areas in a way that is similar to how road surfaces are supported by a bridge structure," said Barrett. The table has a lacquer finish.

David F. Moyer Quakertown, Pa.

With a love of period furniture and a need for a special wedding gift, Moyer researched and then built this figured walnut Pennsylvania spice box (12¼ in. deep by 16 in. wide by 23⅜ in. tall). "The width and height of the box were determined by my desire to maximize the size of the raised-panel door," said Moyer. The walnut door is highlighted on the outside with line-and-berry inlay, while on the inside it is inlaid with a heart and date. The spice box is finished with six coats of linseed oil.

Krenov's last class

James Krenov founded the Fine Woodworking Program at the College of the Redwoods in Fort Bragg, Calif., in 1981. After 21 years at the helm, Krenov retired in June of last year. The editors of *Fine Woodworking* thought it proper to pay tribute by devoting these two pages to showcase some of the students' work from his final class.

Martin E. Goebel
St. Louis, Mo.

Goebel first saw a rendition of this elliptical Biedermier-style grandfather clock (18 in. deep by 24 in. wide by 79½ in. tall) in a magazine when he was 15. Five years later, Goebel finally built his version. The 600-hour project is made of curly western maple, cypress, jarrah, Macassar ebony and Gabon ebony. The clock dial features a hand-painted seascape. The clock has a shellac, oil and wax finish.

Nancy Fister
Glendale, Calif.

This floor cabinet (16 in. deep by 22 in. wide by 48 in. tall) took 575 hours to complete. It is made of teak, Alaskan yellow cedar and walnut burl, and features solid silver hardware. The marquetry is an assortment of woods, including ebony, mahogany, bloodwood, satinwood, spalted maple and kwila. Each of the woods used in the piece's construction has a different finish.

Rebecca Yaffe
San Francisco, Calif.

Yaffe made this writing desk (22 in. deep by 37¼ in. wide by 33½ in. tall) for her mother. In designing the piece, Yaffe was "led by the demands of the room as well as the desire to impart something quiet and calm into the room." The tabletop and gallery top have a plywood core veneered with kwila. The rest of the piece is solid kwila and maple. It is finished with shellac and wax.

Timothy Wood Fort Bragg, Calif.

This contemporary version of Thomas Jefferson's writing desk (*FWW* #144, pp. 64-71) took Wood 250 hours to build. The lap desk (17 in. deep by 23 in. wide by 4 in. tall) is made of European sycamore and guatambu. The piece features a leather writing surface, and the finish is shellac.

Ed Welch
Seattle, Wash.

"The design and workmanship on this concave china hutch are vintage James Krenov," said Welch. The hutch (16 in. deep by 27 in. wide by 67 in. tall) is made of kwila, western spalted maple and sycamore. Taking about 600 hours to complete, the china hutch features handcrafted bronze hardware. The piece is finished with shellac and wax.

Todd Sorenson
Seattle, Wash.

This chest of drawers (18 in. deep by 32 in. wide by 42 in. tall) is made of pear, jarrah, western maple and Spanish cedar. The piece is steeped in the Arts and Crafts tradition, but Sorenson softened the looks with the pillowed drawer front. The drawers are built in the NK style with additional center runners. The chest took about 500 hours to build and has a shellac and wax finish.

Chris Jungbluth Madison, Wis.

Working from a photograph of a chair made by a former Krenov student (whose piece was inspired by Wharton Esherick's work), Jungbluth made this jarrah rocker (48 in. deep by 26 in. wide by 47 in. tall) for his wife, taking 400 hours to build it. He first developed drawings from the photograph and then built a full-scale mock-up. The chair is finished with shellac under Libron varnish, and the seat is upholstered in leather.

Fine WoodWorking®

Index to issues 154 through 160

This alphabetical index covers all the issues of *Fine Woodworking* published during 2002 (*FWW* #154 through #160). For a more comprehensive cumulative index, go to finewoodworking.com. The format of each index reference is issue number:page numbers. A hyphen between page numbers means the discussion is continuous; commas between page numbers indicate an intermittent discussion. This index, like all previous indexes to *Fine Woodworking*, was prepared by Harriet Hodges, chair maker.

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Rules of Thumb

BY DAVID WRIGHT

Why and where to use straight-grained wood

Many years ago in college I took a class in wood technology that included testing the structural integrity of various woods. Invariably, the straight-grained samples endured far greater stresses before failing than cross-grained woods.

Along with the structural advantages of straight grain, I learned about the aesthetic advantages of where and when to use this wood in my furniture. Armed with this knowledge, I started out on a career as a Windsor chair maker. My search for straight-grained, defect-free wood is never-ending. Thankfully, the Appalachian Mountains that surround my shop in Berea, Ky., contain some of the best wood logged in this country, but it pays to pick through the boards in any lumberyard for straight-grained examples.

Structural integrity. *Straight-grained wood is valued for its strength as well as for its attractiveness. Straight grain is especially suitable for joinery and bending applications.*

Straight grain gives strength

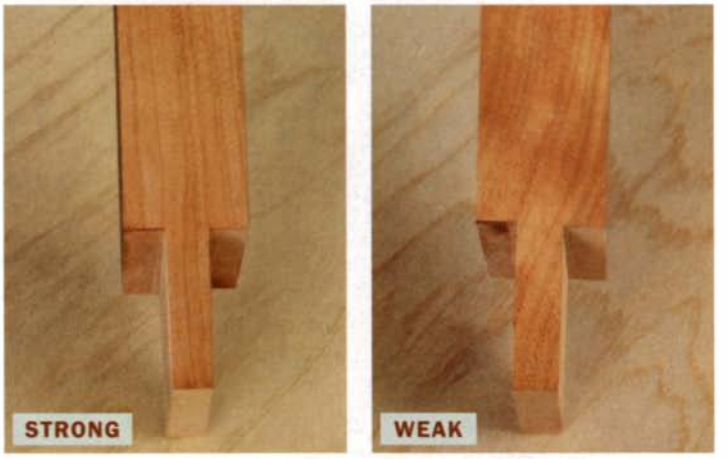
Any deviation from straight, parallel grain is considered cross-grain. If the slope of the grain is severe enough, it can critically weaken the wood—as much as 50% with some species. When the rung of a chair breaks, most often the break is not in the joint but just beyond the joint along the length of the rung. More than likely the break is at an angle following the cross-grain.

Straight-grained wood should be considered for other projects where strength is important. Table legs with straight grain not only are stronger but also look better. If a rolling library ladder is in your plans, find the straightest-grained wood for the steps and rails to be assured that no user suffers a sudden letdown.

In a typical mortise-and-tenon joint, it is vital that the tenon be straight grained. Any cross-grain along the tenon's length weakens it structurally, and it also hinders the joint's construction. Most joinery needs some paring with a bench chisel to gain that snug fit. Smooth par-

NO WEAK POINTS IN STRAIGHT GRAIN

Fault line. *A chair stretcher made with cross-grained wood is much weaker than one made with straight-grained wood. It is liable to crack along the line of the grain.*



Tenon strength. *The straight-grained tenon on the left is stronger than the cross-grain tenon on the right. When paring the latter to size, the chisel will try to follow the sloping grain.*

Not meant to bend. *Because the grain on this strip of wood runs out, when Wright steamed it and tried to bend it, the wood split along the grain in several places.*

Photos, except where noted: Mark Schofield; this page (left): Kelly J. Dunton

ing of a cross-grained tenon is far more difficult because the chisel wants to go the way of the grain.

Using a wedge in a cross-grained tenon sharply increases the risk of the tenon splitting as the wedge is driven home.

Loss of tensile strength due to cross-grain can have adverse effects on the bending capabilities of a piece of wood, whether it is steamed or cut into thin strips for laminating. Even if a bending strap allows the wood to be bent, grain running out on the outside of a curve constitutes a permanent weak point in the piece of furniture.

Straight grain affects the look of a piece

One area where woodworkers often overlook the importance of grain patterns is when making frame and panels. Aesthetically, straight grain looks better in rails and stiles, whether in a door or a case piece. Because it distracts from the overall design, you should avoid mixing straight-grained and cross-grained wood.

For the panel, it is best to avoid straight-grained wood and instead look for a piece with cathedral grain (which curves toward the center and top of the workpiece) or even a highly figured board. Think of the panel as the picture that the eye should focus on, with the frame a complement rather than a competitor. If you use straight-grained stock for the panel as well as for the frame, the appearance of the entire piece may become monotonous.

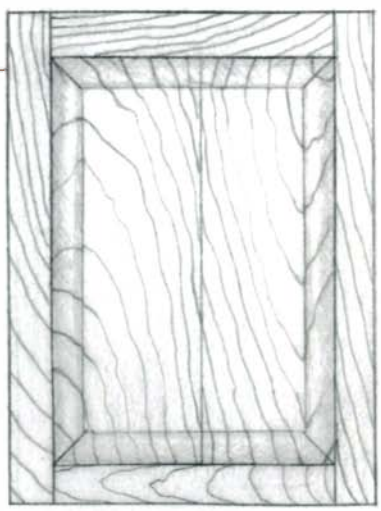
There are exceptions to all rules, including where to use straight-grained wood: Sometimes using a straight-grained board for certain parts can leave the overall design of the piece dull and unpleasing. A board with curved grain can dramatically change the look and feel of a piece of furniture. For example, curved grain can enhance an arch in a door rail, or uplift a table apron or a trestle table stretcher. Occasional use of curved grain can make for exciting woodworking, but nothing matches straight grain for structural integrity and sound joinery. □

STRAIGHT GRAIN FOR AESTHETICS

Straight grain looks best in a piece of furniture when it acts as a foil for highly figured grain.

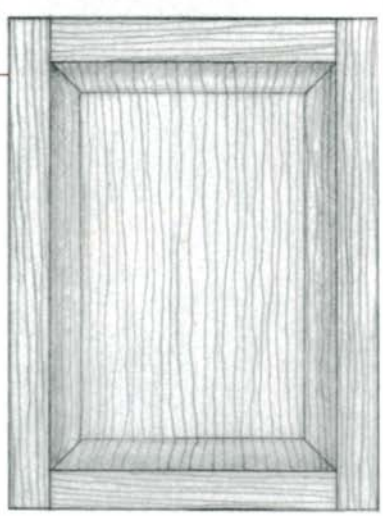
CHAOTIC

A combination of cross-grain and highly figured stiles and rails provides no contrast with the equally flamboyant panel.



BORING

Choosing straight-grained stock for the panel as well as for the frame provides no contrast.



ELEGANT

The straight-grained frames complement the uplifting cathedral grain of the two panels in this Shaker-inspired secretary by Michael Pekovich.

Drawings: Kelly J. Dunton; photo, this page: Scott Phillips

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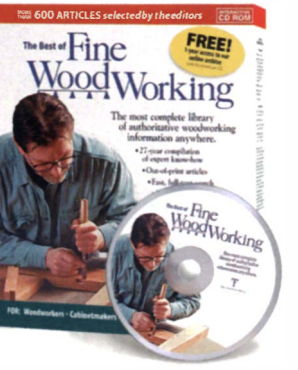

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Q&A

Bleaching the color out of wood

A client requested a bleached finish on interior trimwork in oak. Can I remove the color from the wood and make boards of varying color look the same?

—E.F. Pionkowski, St. Thomas, Barbados, West Indies

Jeff Jewitt replies: Some people use the term bleached to refer to a pickled finish. However, if what your client wants is oak with a bone-white appearance, you need to buy a two-part bleach that is sold as A/B bleach in most paint and hardware stores in the United States. The two chemicals are sodium hydroxide and hydrogen peroxide. Follow the manufacturer's instructions that come in the package. Two applications may be necessary to get rid of all of the red and yellow undertones in oak.

After you've removed the color, and the last application has dried, you'll need to neutralize the bleach with a wash of white vinegar. After that, rinse the wood thoroughly with clean water. The rinse will raise the grain, so when the wood is dry, scuff-sand the surface lightly before applying a clear finish. Topcoat with a nonyellowing finish, such as a CAB acrylic lacquer if you have a spray booth. If not, you'll have to use a water-based brushable nonyellowing finish.

Remember, you should always experiment with a new technique on some samples first. After preparing the samples, show them to your client and ask him or her to sign the back to indicate approval, which will help avoid any disagreements after the job is done. [Jeff Jewitt is a frequent contributor to *Fine Woodworking* on finish topics. He wrote an article on wood bleaches in *FWW* #124, pp. 62-65.]

RID THE WOOD OF ALL COLOR

The difference is dramatic. Bleached and unbleached samples cut from the same board show how successfully the bleaching process removes the color from the wood.

Start with two-part bleach. *Some manufacturers say to mix the chemicals together; others say to use them separately.*

BLEACH THE WOOD

One application is usually enough. *To remove all of the color from a piece of lumber, a second application may be necessary.*

NEUTRALIZE AND RINSE THE SURFACE

Bleaches leave a salty alkaline residue on the wood. Acid in white vinegar neutralizes the bleach. Follow that with a clean-water rinse to remove all remaining chemical deposits.

Why sawdust irritates

I have heard that sawdust from eastern red cedar is more toxic or irritating to the lungs than either oak or pine sawdust. Is this true? If so, what is the culprit?

—Jerry Decker, Rolla, Mo.

John Arno replies: To answer your questions, it's important first to differentiate between the ways that sawdust can affect you adversely. Fine particles of even inert substances irritate the respiratory system because they dry out the mucous membranes that line airway passages. This is true of all sawdust regardless of the species of wood. Some studies have provided evidence suggesting that prolonged, heavy exposure to this kind of irritation can cause serious, chronic health problems, such as asthma or possibly nasal cancer. So wearing a respirator is a sensible precaution.

A wood's chemical toxicity is another issue, and its effects can vary from person to person. Some chemical compounds that are unique to certain wood species can cause an allergic reaction in some people, even though they don't seem to

Photos: Kelly J. Dunton

affect all people in the same way. It is true that many of these chemical compounds are also toxins—in the sense that they are universally poisonous—but they would have to be ingested in high doses to be lethal to a healthy person who isn't overly sensitive to that particular compound.

Unfortunately, any given chemical, even in minute amounts, can trigger the immune system and cause people to develop an allergy to that chemical. For this reason, when you're considering the use of an unfamiliar wood, you should experiment with it a few times under conditions in which the exposure is limited. If working with the wood becomes progressively difficult to tolerate, diving into a major project with it, or even with a closely related species, could be dangerous.

While none of the three woods you mention are notoriously toxic, they do contain some chemicals that could be troublesome to some people. Eastern red cedar (also called aromatic cedar) belongs to the cypress family, and clinical tests indicate that a quinone (thymoquinone) found in members of this family is a potent sensitizer. The oaks are rich in tannic acid, which is potentially irritating and can cause rashes on woodworkers with sensitive skin. (I know all about that from personal experience.) Members of the pine family produce terpenes that have been identified as allergens. Also, terpenes are generally irritating for just about everyone, given the right circumstances. For example, Douglas fir (in the pine family) normally isn't noxious to work with, but when a sliver of it gets imbedded under the skin, terpenes in the wood seem to make the wound unusually painful and slow-healing.

Most woods harbor some chemical with the potential to do harm. Just how much harm depends as much on the individual as it does on the chemistry of the toxin. [Jon Arno retired from running a lumberyard and now spends his days tinkering in the shop and writing about wood.]

Replacement switch for a bandsaw

I purchased and restored a 1950s-vintage Rockwell (now Delta) 14-in. bandsaw that needed little more than a thorough cleaning, tire replacement and some adjustments. Then I ran across an article on the subject by Robert Vaughan (FWW #98, pp. 74-79), and decided that an upgrade from the old ⅓-hp motor to a new 1-hp (14-amp, 115-volt) motor would bring this machine back into top form. Vaughan suggested a push-button manual starter. However, the electrical-supply houses don't seem to have that in stock. I have experienced blank looks and recommendations to buy switches that range in price from $1.80 to $180. Why would a push-button switch on a bandsaw be any different from the one on my tablesaw? I would like to purchase a safe, efficient switch, but I am confused as to what I need. Can you help me?

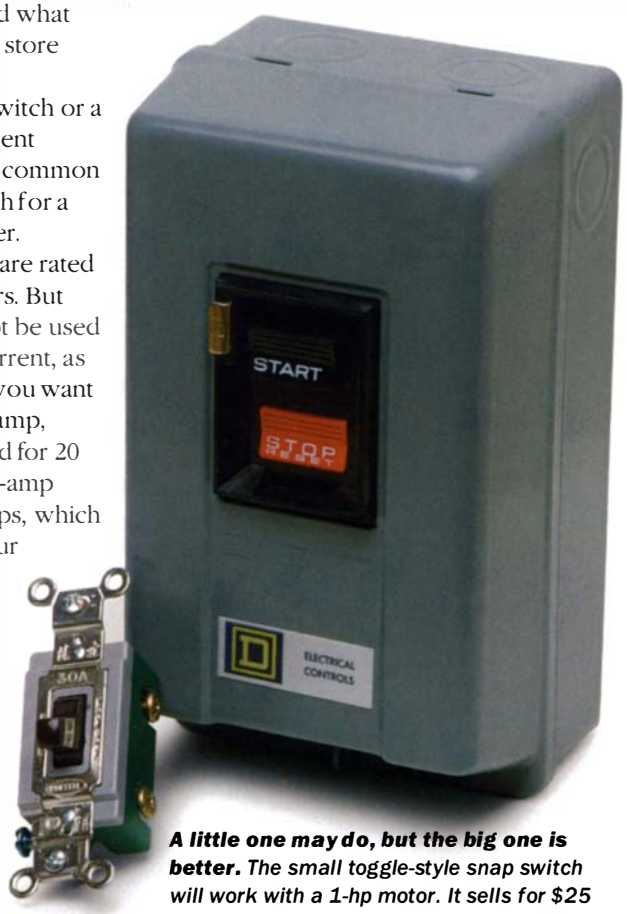
—Jim Butcher, Richmond, Va.

Rex Cauldwell replies: To answer your first question, the bandsaw switch is not really any different from the one on your tablesaw, except that the ratings probably vary, depending on the amount of electrical current that each motor draws. Many electrical-supply stores don't stock a full range of switches because of insufficient demand. You can find what you need at a W.W. Grainger Inc. store (www.grainger.com).

Do you want a simple on/off switch or a starter, which is an entirely different animal? First of all, you can use a common snap switch—a single-pole switch for a motor that is rated by horsepower. Residential-grade snap switches are rated for 15-amp, 120-volt, ½-hp motors. But with a motor, a switch should not be used for more than 80% of its rated current, as measured in amps. Therefore, if you want to use a snap switch for your 14-amp, 1-hp motor, you'll need one rated for 20 or 30 amps. I recommend the 30-amp switch (80% of 30 amps is 24 amps, which is a heavier current load than your 14-amp motor will draw). Hubbell makes one (model No. HBL3031, Grainger stock No. 5Z806) that sells for about $25.

Your other choice is a starter, a heavy-duty switch commonly used for woodworking machines that run on 1-hp or larger motors. The starter you need is called a NEMA (National Electrical Manufacturers Association) manual motor starter, type 1 surface mount. Grainger sells one (Square D model No. 2510MBG1, Grainger stock No. 1H411) for about $115. But when you buy a starter, you also will need a heater, or thermal unit, which provides additional overload protection. For a current draw of 14 amps, you need a Square D No. B22 (Grainger stock No. 1H617), which costs about $12. When wiring the starter, use only 12- or 10-gauge cable. Also, run the bandsaw on a 12-gauge (or higher) dedicated circuit.

I don't recommend running a 1-hp motor on a 120-volt circuit. The current draw exceeds 60 amps during startup, which will make the lights dim and the motor work too hard. If you have a universal motor, you can change it over to run on 240 volts, which will lower the current draw to 7 amps on each leg. With such a setup, you will need a different switch and heater; the salesperson at Grainger should be able to assist you. [Rex Cauldwell, a professional electrician, is the author of *Wiring a House* (The Taunton Press, 2002).]



A little one may do, but the big one is better. *The small toggle-style snap switch will work with a 1-hp motor. It sells for $25 at Grainger. The large switch and the thermal unit that goes with it sell for about $125.*

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READER SERVICE NO. 133

Master Class

BY THOMAS WISSHACK

Make classic profiles with molding planes

While visiting a friend recently, I saw a freshly varnished molding plane just sitting on the coffee table. I cringed and tried to avoid looking at the tool, hoping to steer the conversation in another direction. Later, I thought about the concept of yet another great molding plane going out of circulation. So many tools that have years of usefulness left in them end up this way, treasured merely for their nostalgic value.

I would like to tell you that molding planes still are available in huge numbers and that a visit to any antiques shop will yield several bargains. However, this is no longer true. Between those who varnish them for display in the home, the true collector who would never harm the surface of one and fellows like me who actually use them, the supply is dwindling.

There are still some molding planes out there, and they are definitely worth searching for. However, antiques dealers generally have planes priced by the book, and the rare or unusual profiles often get snapped up quickly by collectors. Molding planes also are handled in quantity by tool dealers and auction houses both in the United States and abroad, although I have never purchased planes from one of those concerns.

Why use molding planes?

The profiles of molding planes differ dramatically from the shapes offered by router-bit manufacturers. Although some router bits reflect classical proportions and styles, none that I'm aware of can duplicate precisely the profiles available in antique molding planes.

Of course, it is possible to have shaper cutters ground into any profile. But this process is expensive, and many woodworkers don't own a shaper.

Even if the profile made by a molding plane can be duplicated by a router bit or shaper cutter, there are physical differences between the two end products. A molding made with a router or shaper has a series of milling marks at right angles to the length of the board, caused by the spinning cutter. These appear as ripples or undulations when examined under a strong light, and they must be sanded or scraped out carefully, or the work is spoiled. Very little or no sanding is required on a hand-cut molding.

Finally, I must mention my chief objection to using a machine for making moldings: the tremendous amount of dust and noise that is generated. With a molding plane you never get dust, just long ribbons of wood that curl out as you work. You are forced to slow down and enjoy the process of making a molding.

I have collected quite a group of mold-

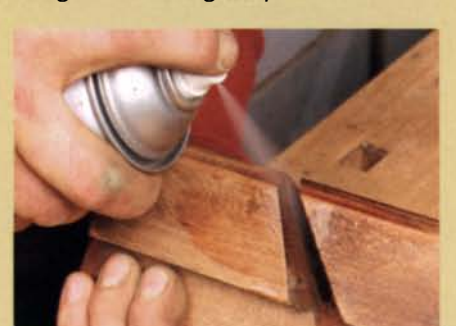
Hand-cut moldings can be combined in many ways. *This painted Jacobean-style chest combines a number of profiles not available as router bits.*

TUNING UP A PLANE

Lap the back of the blade. *Use a series of grits up to 8,000, shooting for a mirror surface. This step will have the greatest effect on cutting and chip ejection.*

Hone the bevel. *If the blade is in decent condition, it will require only light honing, which preserves the profile and its match with the sole of the plane.*

Strop the edge for true sharpness. *As a final step, Wisshack uses a leather strop wrapped around various wood blocks and charged with buffing compound.*

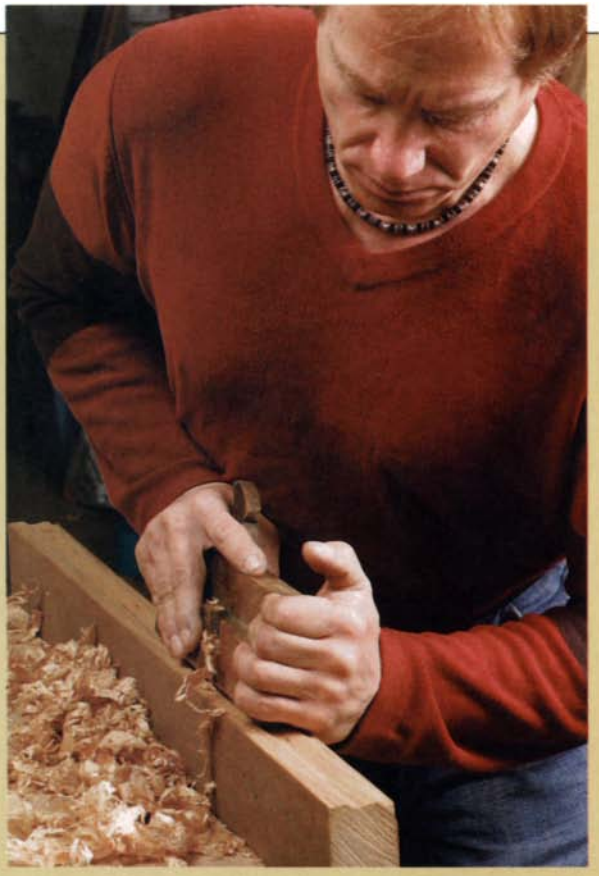


Last, clean and lubricate the throat. *Clear out any debris and give it a blast of silicone spray.*

Photos: Asa Christiana

USING A MOLDING PLANE

Advance the blade until it sticks out slightly. *To extend the blade, tap the front of the plane body. Before planing, give the wedge one last tap to tighten it.*



A good cut depends on a combination of forces. *Simultaneously, you must press down, forward and against the plane's fence, all while maintaining the proper angle. Practice makes perfect.*

Maintain the proper angle. *Keep the "spring line" on the front of the plane vertical. It helps to run a knuckle along the workpiece as you cut.*

The final cut is a lighter pass. *Tap the back of the plane to back off the blade slightly, and rub paraffin on the molded profile and the sole of the plane. The result is a glassy, handplaned surface, with no machine marks. Very little, if any, sanding is required.*

ing planes. I purchased most of them in the Midwest over a period of 25 years, and found a few during my travels to Europe. The condition of the found planes was surprisingly good; all were made usable with a little honing and fine-tuning.

Tuning up a molding plane

A newly purchased plane should be taken apart and tuned up prior to use. Striking the plane on its heel with a wood mallet will loosen the wedge and the blade.

Remove any dirt or rust from the plane iron. In a circular motion, rub the back of the iron on a fine oil- or waterstone until the metal is uniformly shiny. Then carefully hone the bevel side with convex, straight and diamond-shaped stones, preserving the profile and always maintaining the honing angle perfectly. A very fine stone, used with oil or water, is usually all that is required.

Never attempt to sharpen a plane iron on a grinding wheel. Of all the plane irons I have purchased, not one required more than this light honing. A plane with a badly pitted iron should be avoided.

Afterward, the iron can be buffed on a firm felt wheel or leather strop with jeweler's rouge. The resulting edge will perform beautifully for many hours of work.

Clean out the channel that holds the wedge and plane iron and give it a single blast of silicone lubricant spray. This will help the plane release the shavings, which prevents clogging. It will not affect the permanence or tightness of the wedge once in place.

Reassemble the plane with the blade protruding slightly. Tap in the wedge so that it's moderately tight, then strike the front of the plane, a single tap at a time, until the blade extends enough to begin the cut. Try it on a board to see how it cuts. Make any necessary adjustments, then give the wedge a final tap home.

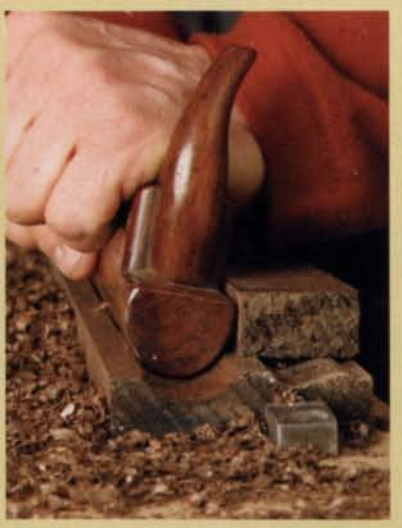
Nothing needs to be done to the wood body. Molding planes usually have a nice surface that shows they have been used and cared for over the years. On some, the patina is as fine as that on an old violin. The dirt and marks of age make a plane that much easier to hold onto during use.

Hand-cutting molding takes practice

A great deal of downward pressure is required to operate one of these planes. As it is pushed forward, it also must be forced

MANY COVES FROM A SINGLE PLANE

This type of plane needs a fence to guide it. *Clamp a strip of wood onto the workpiece. Note the other profile already cut into this piece, which will be part of a picture frame.*



Angle the plane from side to side. *This both allows the plane to cut to full depth and begins to widen the cove as needed. You can cut a 2-in.-wide cove with a 1-in.-wide cove plane (right).*

sideways, against its fence. These three forms of pressure—downward, forward and to the right—are complicated by a fourth and no less important aspect: The plane must be held at the correct angle. It takes practice to combine all four elements successfully, but in time the technique can be mastered.

Start the cut with the blade extended only slightly—most profiles will cut nicely at first, but often the plane will stop cutting before the shape is complete. Simply deepen the blade slightly and proceed until the complete profile emerges. Make numerous passes along the edge of a board until the profile appears. The first few cuts are critical because they establish the path that the plane will follow.

The angle, or skew, of the individual molding plane determines how it should be held. Often the plane will have a slight shoulder that hugs the edge of the board as you plane (see the photos on p. 110). This bearing surface, which is sometimes quite narrow, must be held parallel to the board as the work is being done.

Not all molding planes are held at an angle. Some of them are intended to be held flat on the face of a board. This requires care, too, because any divergence will cause the moldings to be slightly off.

Another type of antique molding plane, cove planes originally were offered in many widths so that practically any size molding could be made. I have only a few sizes of cove planes; however, a 1⅛-in.-wide cove plane, for example, can be used to make a variety of wider coves (see the photos above).

Whenever possible, cut a series of moldings from the same strip of wood. Later, when you chop up the strip and miter the pieces, the joint areas will match closely. Slight discrepancies are acceptable and can be filed or carved slightly where the pieces join, especially in softwood, which is forgiving.

Yes, you can hand-cut moldings in tiger maple. *The key is to have a super-sharp blade, to drench the wood with water and to rub paraffin on the sole of the plane at almost every pass.*

Grain direction is important for any handplaning operation. Normally, the tool will cut better in one direction than the other. Experiment to find the correct direction, then mark the board with an arrow pointing in that direction. This way, after you have sliced away a molding strip on the tablesaw, you can create another molding without unpleasant surprises.

If a board tears out badly in either direction it is planed, it may not be suitable for making moldings by hand. However, sometimes a cantankerous wood type is unavoidable because it suits or matches a particular piece. In those cases, plane in the direction that causes less tearout. A technique that works for me is to wet the wood and rub paraffin on the plane's sole frequently (see the photo at left). Afterward, a bit more sanding will be required to smooth those small areas of tearout. □

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A hand-rubbed lacquer finish

BY SEAN AND ANGELA CLARKE

There's a belief among finishers in the United States that it's not possible to brush on lacquer and achieve a superior finish. But it is: Pullover, a product widely used in Europe, enables you to create a flawless, high-build lacquer finish without the use of spray equipment. In fact, the only necessary tools are a brush, enough denim and cotton wadding to make a rubber, some water and a container of pullover. A solvent similar to lacquer thinner, pullover is used to polish out any brush marks or other imperfections after the lacquer has dried. The process, similar to French polishing, leaves a highly reflective surface with a hand-rubbed look and the added durability of lacquer.

Stain, seal and brush on the lacquer

Begin by sanding the bare wood to 220 grit to remove any surface imperfections. After staining all of the surfaces with an aniline dye—in this case walnut—let the piece dry for about four hours. Remember, all drying times should be adjusted to the temperature and humidity levels in your shop—the higher the humidity, the longer the drying time.

Next, seal the surfaces by brushing on sanding sealer. Apply several coats, letting each coat dry for an hour or so and leaving the final coat to dry for about four hours. Then sand all surfaces with 320-grit paper until they are completely flat without imperfections. A smooth seal coat is crucial in this lacquer finish.

Once sealed, the piece is ready for lacquer. A high-quality squirrel-

A SMOOTH START TO A GOOD FINISH

Sand before the final coat of lacquer. *After the previous coat has dried, lightly sand the surface with 320-grit paper.*

Mop on the lacquer. *Because lacquer is fast drying, apply it with a large-capacity squirrel- or badger-hair mop. With these brushes, you'll waste less time recharging, and the soft hairs will leave fewer brush marks.*

Watch it on the web

To see the author rub out a lacquer finish, go to www.finewoodworking.com.

Photos: Mark Schofield

No expensive tools. *This technique uses a rubber similar to that used in French polishing. The cotton wadding is soaked in the liquid pullover, then it's wrapped in the soft denim.*

or badger-hair mop generally holds three or four times more lacquer than a regular, flat natural-bristle brush, and because squirrel and badger hairs are softer, they leave fewer brush marks. Using a bristle brush with this technique is fine, but it will entail a bit more polishing in the pullover phase.

Brush on a few coats of a nitrocellulose lacquer, which is the only type of lacquer that the pullover (Davis International Group; 888-3-MYLAND) is formulated to work with. Let each coat dry for about two hours, then scuff-sand it with 320-grit paper, if necessary. After the final coat dries, use the edge of a razor knife to remove any debris that has settled into the lacquer. Then scuff-sand with 320-grit paper.

Make the denim rubber, and start polishing

The rubber is the actual polishing tool, flattening out any brush marks or imperfections. Use a rubber with soft denim as the outer wrap and cotton wadding at the center. The denim, unlike the cotton bed sheet used in a French-polishing rubber, is more rigid, which helps flatten the lacquer coats. First fold the wadding and then soak it in a large open container of pullover. Wring out the wadding, then fold the outer denim piece around it so the rubber is wet but not dripping.

With moderate pressure, use the rubber to make circles and figure eights on the piece, occasionally straightening out the pattern to work with the grain. If your project has legs, like the desk featured here, use straight strokes with the grain on the legs. The rubber should be kept in constant motion to avoid burning through the finish. Almost instantaneously, brush marks will disappear and a higher gloss will appear. While finishing pros in England traditionally spat on their work to lubricate it, you can use a squeeze bottle to squirt a bit of water onto the surface.

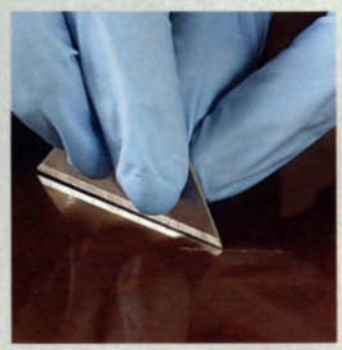
As the rubber starts to dry out and the drag increases, the rubber should be recharged. Monitor the amount of pullover on the rubber because too much can burn through the lacquer coats. If you find a stray brush hair, you can slice it off with a knife blade and then blend away the blemish with the rubber. After every area of the workpiece has been smoothed, let it dry overnight.

To fully enjoy that hard-earned gloss, you can leave the piece as is. But if you prefer a lower luster, lightly dull all of the surfaces using 0000 steel wool and finish with a paste wax. □

USE THE PULLOVER WITH A DENIM RUBBER

Rub the surface lightly. *The pullover solvent slightly dissolves the lacquer, allowing the denim to smooth away brush marks. Keep the rubber moving to avoid burning through the finish.*

Lubricate the surface. *If the rubber begins to drag, squirt on a small amount of water.*



A stray hair. *Blemishes may become apparent while smoothing the surface. Small dust particles or brush hairs can be shaved off with a knife blade. Continue polishing with the rubber until the repair is invisible.*

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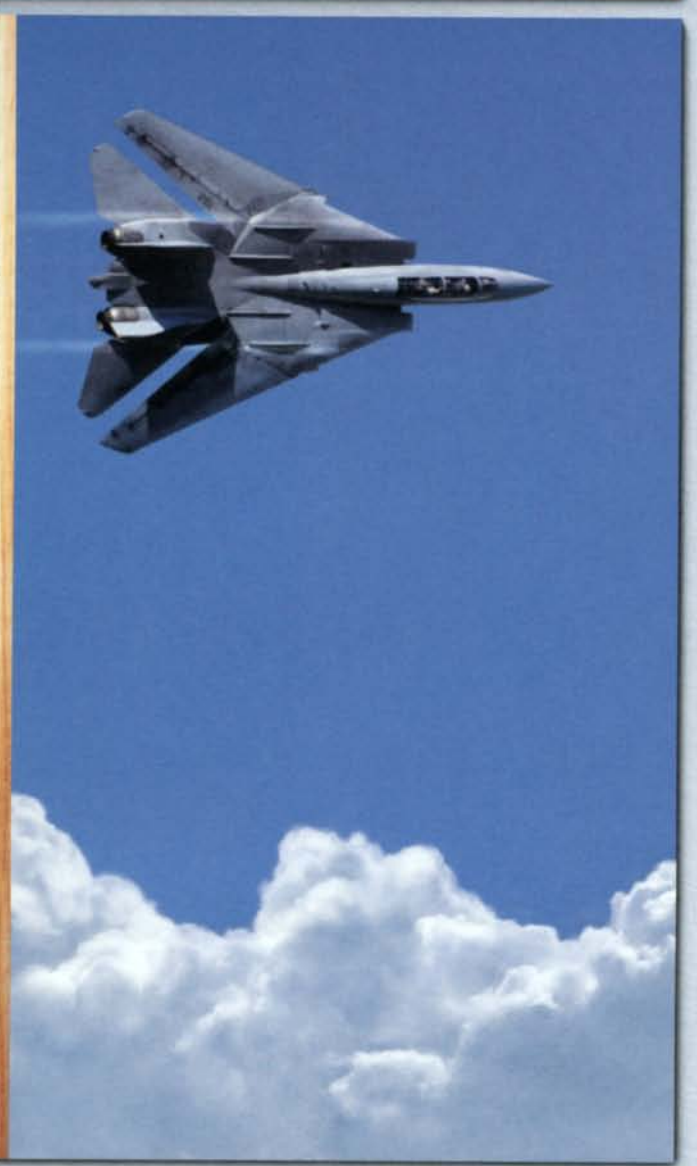

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BUILT FOR SHOW

Yeung Chan made this display cabinet as his final class project while studying under James Krenov at the College of the Redwoods. Inspired by the types of pieces Krenov is famous for, Chan wanted his case to fulfill its primary function without compromising a light, delicate design concept.

Instead of building a pair of doors into the front of the cabinet as is typically done, Chan opted for a single door on the side, which is nearly invisible because the stiles are aligned with the case's legs. As a result, the front of the cabinet, with its thin mullions, allows a nearly unobstructed view of the contents.

Although the front of the cabinet is bowed slightly, Chan used three flat glass panels, which are easier and less costly to replace in the event of breakage. The cabinet is made of kwila with spalted tiger-maple panels and drawer fronts.

Photos: Asa Christiana