TAUNTON'S

Fine WoodWorking

August 1999
No. 137

17 router bits compared

How to finish nonflat surfaces

Oak sideboard

HVLP sprayers for under $500

Sam Maloof on shaping chair parts

Spindle sanders

Simple jigs for an elegant garden gate

Joinery techniques for curved parts

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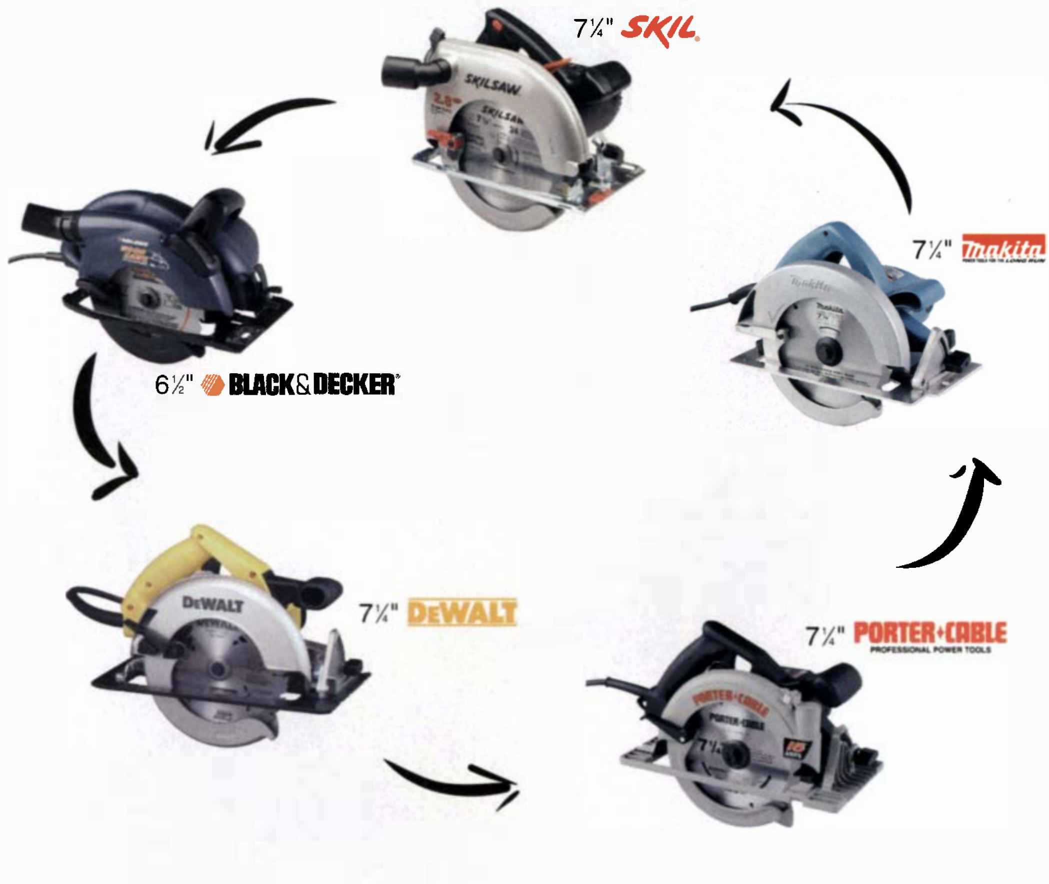

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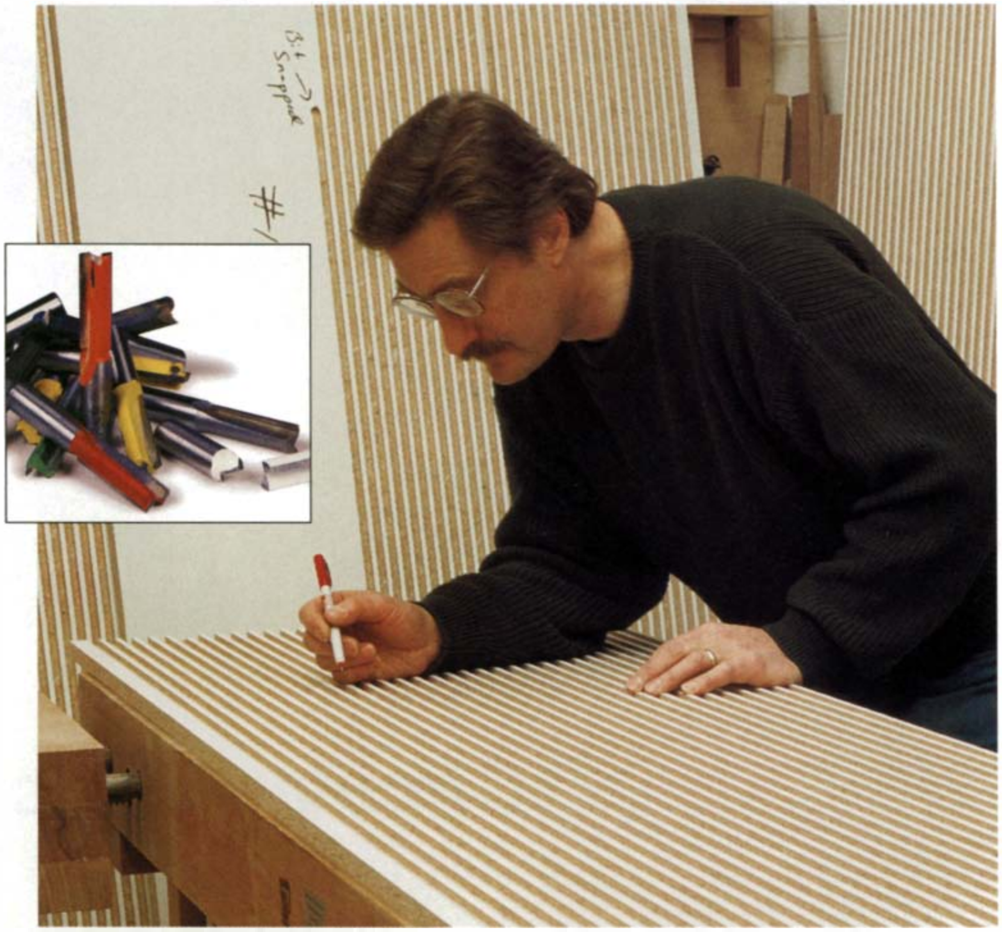
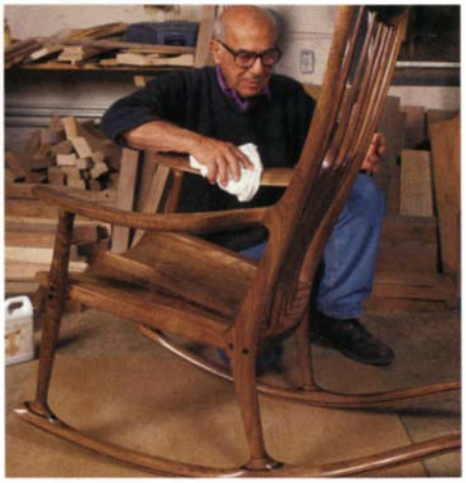


Router bits put to the test, p. 84

White oak sideboard, p. 44

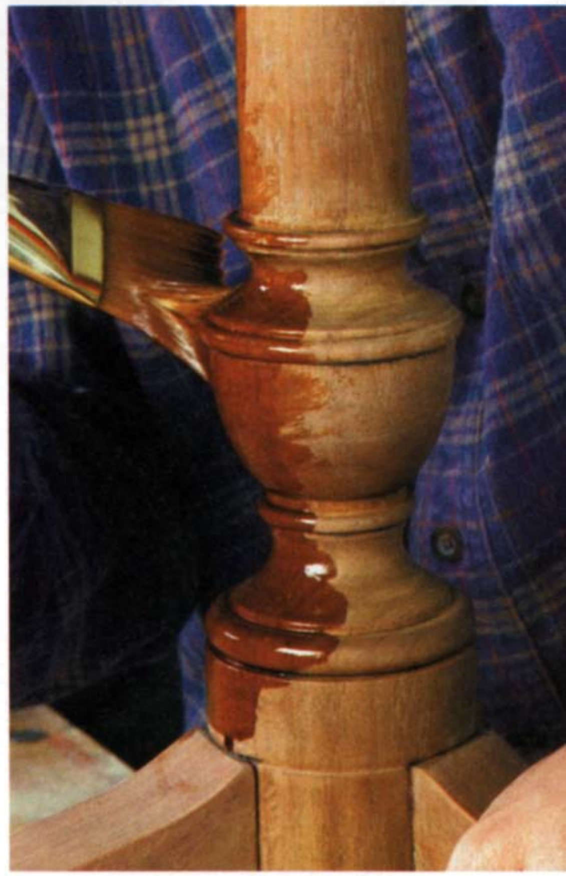


Maloof on shaping a chair arm, p. 102

On the Cover:
Curves not only add elegance to a piece, but they also present challenging joinery techniques. Garrett Hack illustrates his strategy for cutting accurate joints in curved work on p. 54.
Photo: Anatole Burkin

Articles

An elegant but sturdy garden gate, p. 68



Finishing surfaces that aren't flat, p. 40

Contributors

Sam Maloof (Master Class) has been making furniture for more than 50 years. Over the years, he has built and constantly tinkered with his house near Pasadena, Calif. Now that a highway is slated to run through his property, the house, recognized by the National Register for Historic Places, will be moved and will become a museum. Maloof will live in a new house on the museum site. He designed the house largely without drawings, working instead with a scale model (above) built by one of his craftsmen, Larry White.

Timothy Coleman ("Putting Your Stamp on Furniture") puts his creative-writing degree to use in the woodshop. After college, he worked wood in Seattle and then studied furniture making under James Krenov in Fort Bragg, Calif. For the last 10 years Coleman has run his own shop, designing and making custom furniture. He lives with his wife, Mary Beth, and their two children in Greenfield, Mass. An avid bicyclist, he resorts to virtual cycling in the winter on a stationary bike with a group of other devotees.

Eric Kell ("Hefty Sofa Table with a Delicate Touch"), once the bass player in a flurry of New York City bands, spent 10 years building high-end cabinetry for Manhattan clients. He returned to Pennsylvania in 1990, where he and his wife, Kimberly, raise two children from the old family homestead, a 25-acre mountaintop farm. His shop is a converted dairy barn that overlooks a lake. From that shop, much work still makes its way to clients in nearby Philadelphia and New York.

Bernie Maas ("Oscillating Spindle Sanders") is a regular contributor to *Fine Woodworking*. He has taught woodworking at Edinboro University in Pennsylvania since 1968, and more recently, added computer-aided design to his curriculum. Maas has two grown daughters. When he's not teaching at the university, he enjoys photography and woodworking in his home shop.

Thomas P. LeRoy ("Pain-Free Woodworking") is a physical therapist. With his wife and two children, he lives in an antique house in Chester, N.H. LeRoy toyed with the idea of going to medical school or getting a doctorate in philosophy. He decided to become a physical therapist because it would give him more direct contact with people who needed help. There has never been a question in his mind that he would work wood. From an early age he worked on projects, be they wooden swords or bathtub boats. In three more years he should have finished restoring his house and filling it with handmade furniture.

Seth Janofsky ("Component-Built Sideboard") isn't afraid of academia. He studied German literature at Berkeley and at a university in Germany; photography at Cooper Union in New York; and furniture making under James Krenov at the College of the Redwoods. In between and along the way, he has studied art history and tried his hand at painting, etching, lithography and ceramics. He also worked as a photographer for the City of New York. During that time, he began doing woodwork at night. These days, he works full-time as a furniture maker in Fort Bragg and teaches a college course in photography.

Jeff Jewitt ("Real-World Finishing") recently moved his furniture-restoration and finishing-supply businesses to a new location in Cleveland, Ohio. He contributes finishing articles regularly to *Fine Woodworking* and other magazines, and he just finished the manuscript for his latest Taunton Press book, scheduled for publication next year.

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A different method of drawing curves—I found Don Kondra's article, "Curved-Leg Table" (*FWW* #135, pp. 66-71), both interesting and informative. However, his method for drawing large-radius curves can be simplified. His center nail is not necessary. Instead, just make a mark where he puts the center nail and then staple the two sticks together so that the sticks are touching the end nails and meeting at that center mark (see the drawing below). Then use a pencil placed at the intersection of the sticks to draw the curve.

One advantage of this method is that instead of trying to set one stick parallel to the baseline, you can simply rest both sticks against the nails, line them up at the center and staple them together—thus saving some time. In addition, Kondra's method appears to introduce more potential for error, because if the center nail is not exactly centered, the two halves of the curve might not match. By contrast, with the method I have outlined, an error in the location of the center mark will affect only the height of the curve. Unless the center mark is severely off, the effect will be infinitesimal. Kondra's method might have some interesting applications in drawing curves that are not true circles. For example, by setting the center nail off center, one could create a curve that is tighter at one end than at the other.

—Bruce G. Hooke, Providence, R.I.

Desires more information on sandpaper sharpening—I have used waterstones to sharpen my tools and have achieved the highly polished surface Mike Dunbar described in Rules of Thumb (*FWW* #134, p. 94). But waterstones wear too quickly and require constant lapping to keep them flat. I am always looking for a more efficient way of sharpening my tools. The use of sandpaper glued to a sheet of glass looks very interesting, and I would like to try it. However, Dunbar did not mention the grit and type of sandpaper he uses. What levels of coarseness does he go through?

—Bill Brennan, Pickering, Ont., Canada

MIKE DUNBAR REPLIES: The sharpening system I use has numerous advantages and is very easy to use. It is less messy and very inexpensive. It produces as good an edge as any other system with a lot less work. It uses a piece of ⅜-in.-thick (minimum) glass. I adhere adhesive-backed silicon-carbide papers available in rolls from many catalogs. I use 80 grit for shaping and flattening (you won't need your grinder much anymore). I hone through grits 120 to 330. Some coarse tools are fine at this stage. For a keen edge, move on to 400-, 600-, 1,000- and 2,000-grit wet-or-dry paper (available at most hardware or automotive stores.) The system is also useful for gouges and other curved edges. It works equally well on chisel and knife edges. The only tools I still hone on stones are turning tools. For special situations I use paper around various diameter dowels and applied to palm-sized blocks of wood.

Criticism of smoothing-plane review—In his review of smoothing planes (*FWW* #136, pp. 38-45), Garrett Hack is entitled to his own opinion. However, we at the St. James Bay Tool Co. would like to clarify some of the issues raised in the article. We test all of our tools before they leave our shop. The No. 51 in question was planing quilted maple against the grain without tearout, producing a fine shaving (0.002) and keeping its edge when we sent it to Mr. Hack.

We have designed the adjuster to only control the depth. We have found that the craftsman's thumb can supply the lateral alignment better than any adjuster, making that feature redundant. This design also allows us to produce a larger and stronger handle by leaving more wood in the channel. A safety feature of our adjuster is that the adjusting rod will free itself of the ring so that you will not permanently damage the extrafine thread of the mechanism. We do, however, suggest that you not turn the adjuster excessively so as to overextend it.

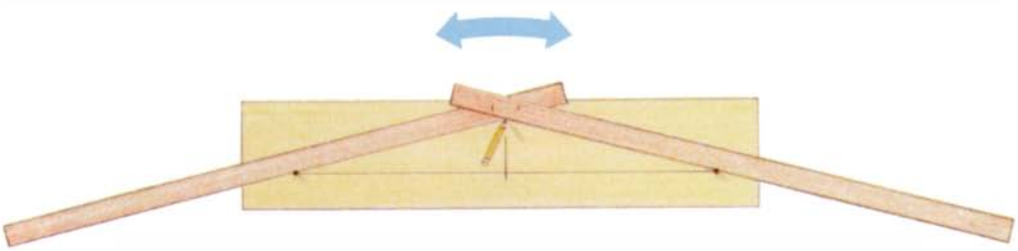
The cap screw that is referred to as a "handsome casting" is, in fact, machined from bar stock in our factory and is made of brass with a steel thread. The cap screws are made one at a time. We are proud of our attention to detail and do not skimp on parts.

The shoe for the cap screw prevents the screw from digging into your cap iron and marring it. This mark is visible on many original Norris planes. The shoe does not have to be used. If you have lost yours and cannot live without it, we will replace it free of charge.

—Jill Howard, St. James Bay Tool Co., Mesa, Ariz.

I would like to supplement Garrett Hack's article on smoothing planes and suggest two Ulmia wooden smoothers. HW3 is a standard smoother with a continental horn, applied hornbeam sole and thick double iron. The plane is substantial and well made. A most attractive feature is the triangular metal fitting, which, suspended from a metal crossbar, securely locks the wooden wedge down on the cap iron and leaves a wide throat for shaving

DRAWING LARGE-RADIUS CURVES

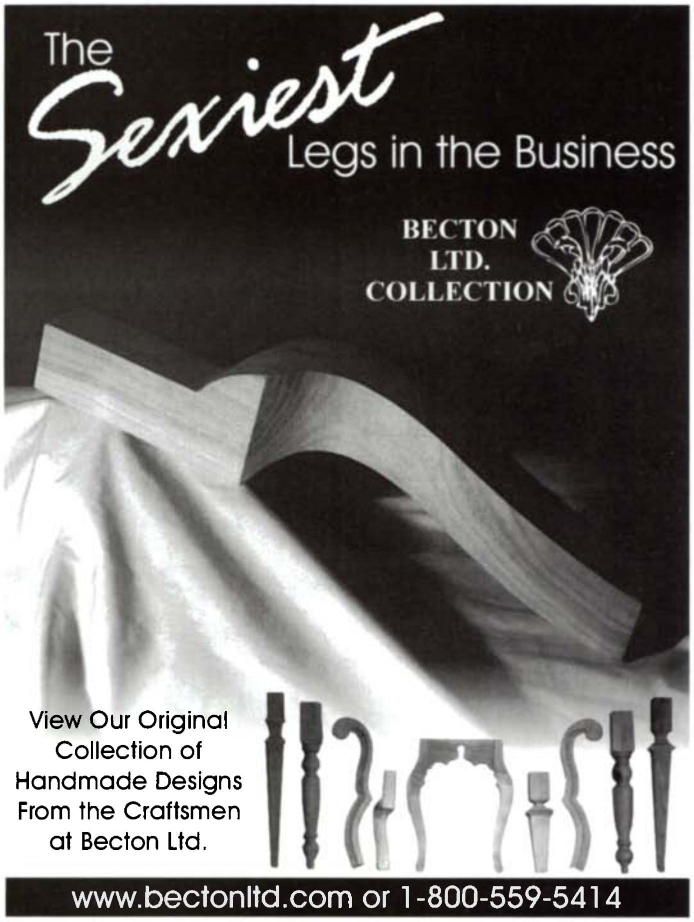


A large-radius curve connecting two end points and a midpoint can be drawn easily using two thin sticks, two nails, two staples and a pencil.

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*, PO Box 5506, Newtown, CT 06470-5506.

Drawing, this page: Michael Pekovich



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clearance. For me, another virtue is the lack of any screw adjusting mechanism. It takes a few moments to master traditional wooden plane adjustment, but when the plane is set, it stays set. The horn allows the plane to be pulled as well as pushed, a feature providing the best of both Eastern and Western traditions.

The Ulmia 25 adds an applied lignum vitae sole to a pear wood body with a well-designed adjustable throat. In this plane, a metal bolt cap locks the double iron in place, again allowing maximum throat opening. Blade adjustment is accomplished by hammer taps. I have used both these planes for 30 years, and they have served me well.

—John Alexander, Baltimore, Md.

Woodworkers don't need the perfect cabinet saw—I'd like to comment on "Cabinet Saw Test" (*FWW* #136, pp. 78-85). In my career, I've used a Delta Unisaw, the Powermatic cabinet saw, lots of contractor's saws and currently use the Grizzly cabinet saw.

The biggest advantage of a cabinet saw is how smoothly it runs compared to a contractor's saw. It's quieter. The blade cranks up and down and at angles more smoothly. Yes, they have lots of power, but if you don't saw 8/4 stock very often, you don't really need it. Cabinet saws used to be the only saws set up for dust collection, but nowadays lots of contractor's saws are also.

All the blubbering about accuracy in that article is questionable. Why do you need a perfectly flat tabletop? The wood isn't perfectly flat. Same thing goes for all the yapping about fence accuracy. Ripped boards must be jointed or planed anyway. The same thing applies to sawblades: Unless you are cutting hardwood plywood or melamine, a $30 one is fine.

A tabletop needs to be perfectly tuned to cut accurate joints. But any tablesaw, except an Ulmia, no matter how well tuned, will eventually go out of alignment. Get the tenon close on the machine, then take a few swipes with a rabbet plane to get a nice fit. My advice is to buy the Grizzly, get some good hand tools and learn to use them well.

—Anthony Guidice, St. Louis, Mo.

More on how to land a plane—I'd like to comment on Mike Dunbar's letter (*FWW* #136, p. 8) refuting the conventional wisdom that it is wrong to place a plane on its sole on the bench. If a plane is placed sole-down on the bench amid the dirt and dust, it most certainly will be damaged in a hurry. If instead it is placed on its side among other tools, nails, screws and other objects, it again stands an excellent chance of being dulled.

Has no other craftsman thought of placing a ¼-in.-thick stick on the bench so that the toe of the plane can be conveniently placed, sole-down, after each use? The keen edge never touches the benchtop, and the awkward wrist motion of turning the plane over is avoided.

—William A. Golz, Swarthmore, Pa.

More articles on turning—Thanks for a great article, "Bowl-Turning Basics," by Richard Raffan (*FWW* #136, pp. 68-73). I suggest that you follow his article with an in-depth treatise on all aspects of turning with green wood and seasoned wood. Given that the vast majority of a turned piece is waste, it is extremely uneconomical to turn lumber purchased through conventional channels. Almost all turners have some source of good-quality scrap logs available, whether conventional woods or exotics.

The article could answer questions such as: What is the best way to convert a log into a bowl blank? Which types of wood are best to turn green? What is the best way to deal with a very hard wood like maple? How do you season log sections for turning? How do you spot spalting and other attractive defects? I, and I suspect many others, would be grateful for such an article.

—Kent Simmons, Cousins Island, Maine

Clarification—To find the name of a distributor of the Starrett Digitape Plus, call (800) 541-8887. The phone number listed in *FWW* #136, p. 36, was for technical information regarding the product.

They've moved—The web address for D&S Scary Sharp listed in our last issue (*FWW* #136, p. 24) has changed. The new address is http://people.ne.mediaone.net/spokeshave/SCARY.HTM.

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

—Timothy D. Schreiner, editor

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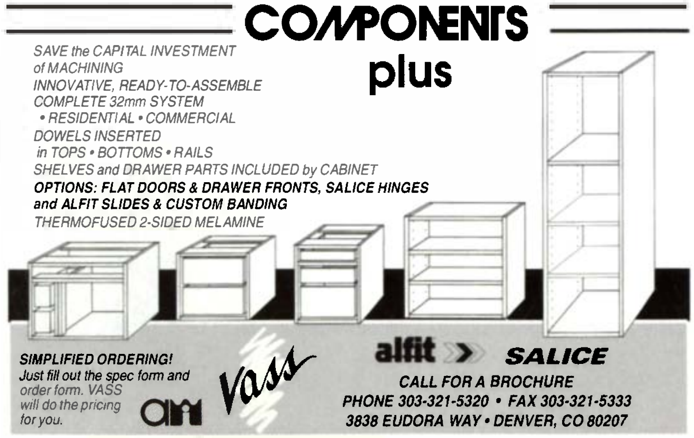

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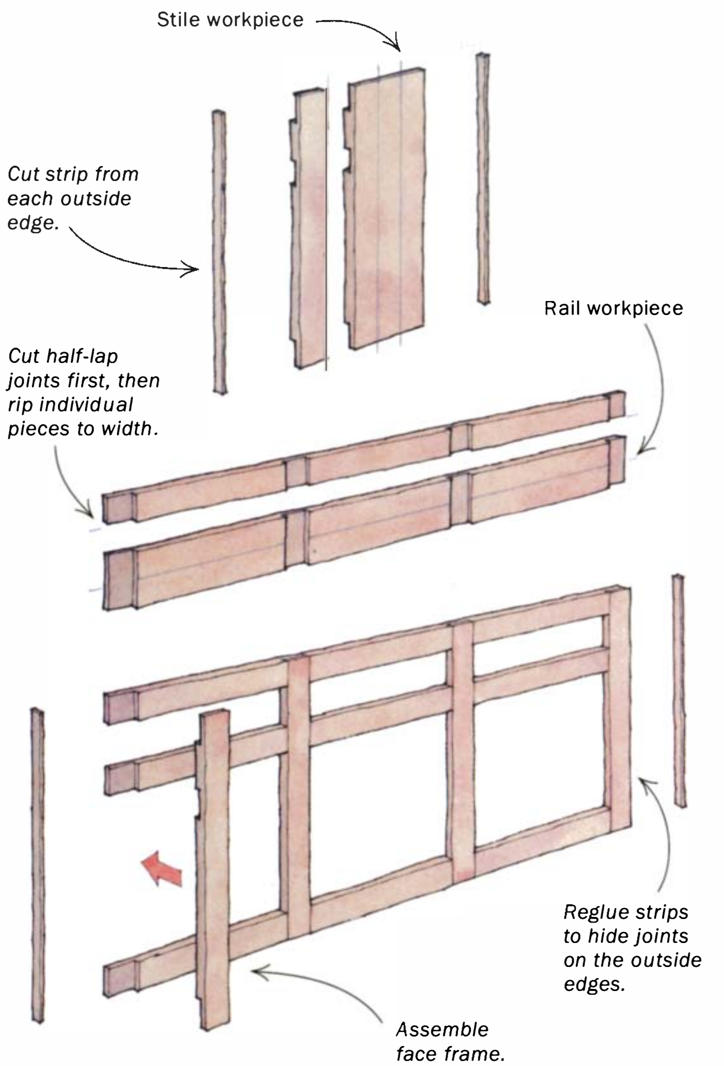
Half-lap face frames



Here's a fast and simple method to make cabinet face frames entirely on the tablesaw. Start with two wide pieces of stock, one for the stiles and one for the rails, surfaced to the finished thickness and crosscut to the finished length. It is key to have stock that is wide enough to rip all of the finished pieces, including some spare room for the rip kerfs and plane shavings. If necessary, edge-glue two or more pieces to get the width you need.

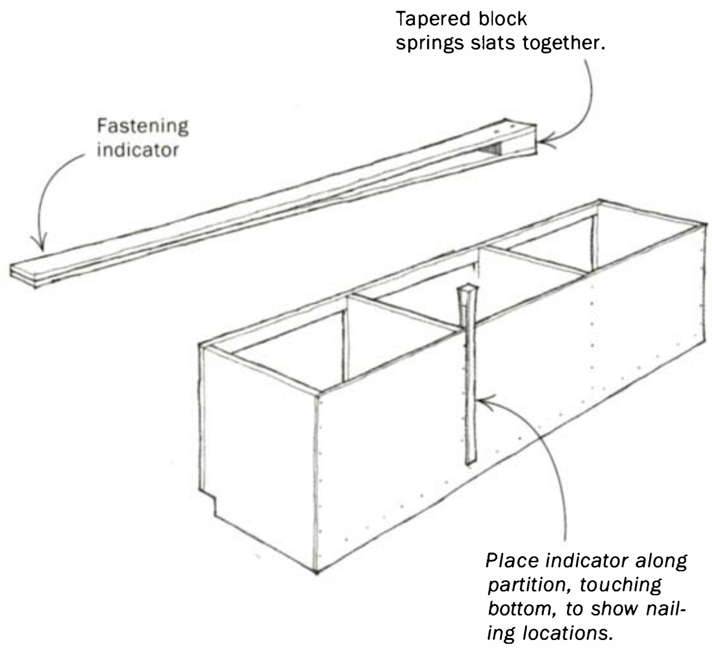
If the finished face frame is to be part of a freestanding cabinet that will be seen on all sides, rip a ¼-in.-wide strip off each edge of the stile stock. These strips will be reglued after the face frame has been assembled and will hide the half-lap joints on the outside edges. If those edges of the cabinet will be hidden, you can skip this step.

With a square and a pencil, mark the edge of each piece where all half-lap intersections occur. Note that the laps are cut into the front faces of the rails and the back faces of the stiles. Set your sawblade or dado blades to cut just slightly deeper than half of the stock thickness to allow for glue. Cut each edge of each half lap. (Scribe lines on the throat plate of your tablesaw to make this easier and more accurate.) Once you have cut the outside edges of each half-lap joint, waste the remainder with repeated passes.

When all of the laps have been cut and cleaned up, rip the finished stiles and rails from each piece of stock. I like to set the fence for a rip that's just a hair wide, then finish the edge with a couple of handplane strokes or jointer passes to remove saw marks and to make a nice press-fit at the joints.

Assembly is simple. If the half laps fit tightly, the whole thing is self-squaring, but check it anyway. Glue up the face frame on a flat surface and tap a couple of short nails or brads into each intersection. To complete the frame, glue the ¼-in.-wide strips on the outside edges of the stiles. *—Michael Vegiard, New London, Conn.*

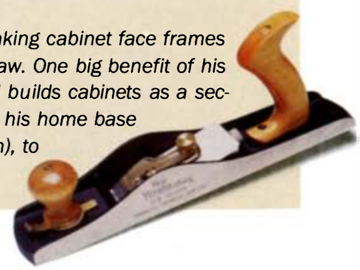
Fastening indicator for cabinet backs



When fastening the backs to kitchen cabinets, it is difficult to know exactly where to locate nails or screws that secure the back to the

A reward for the best tip

Michael Vegiard was awarded an engraved Lie-Nielsen handplane for working out a method of making cabinet face frames that saves time and adds strength to the finished product. He cuts all of the joinery on the tablesaw. One big benefit of his method is that the half-lap joints automatically square up the frame when it's assembled. Michael builds cabinets as a second, part-time career. He's also a skipper for hire, sailing boats up and down the East Coast from his home base in New London, Conn. 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.*

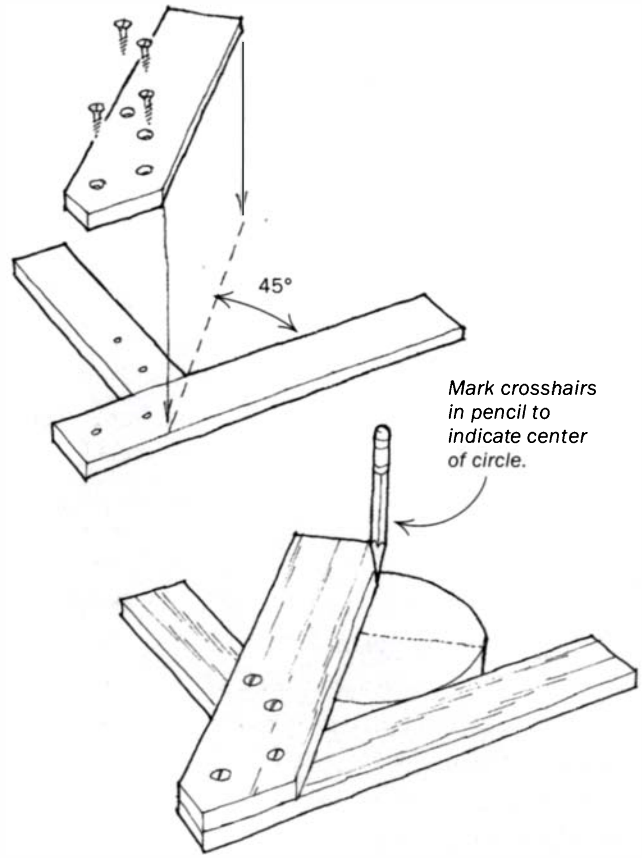


cabinet partitions. Yes, you can get out your tape and then measure and mark. But there's a faster way—using a simple tool I call a fastening indicator.

To make the indicator, glue two hardwood slats, $^3/_{16}$ in. thick by 40 in. long, to a slightly tapered block, so the slats spring together at the other end. Slip the indicator over the back of the cabinet and slide it against a partition. The indicator will show you the locations of both the partition and the cabinet bottom. Drive a line of nails beside the indicator or just below its end.

—Tim Hanson, Indianapolis, Ind.

Shopmade center finder

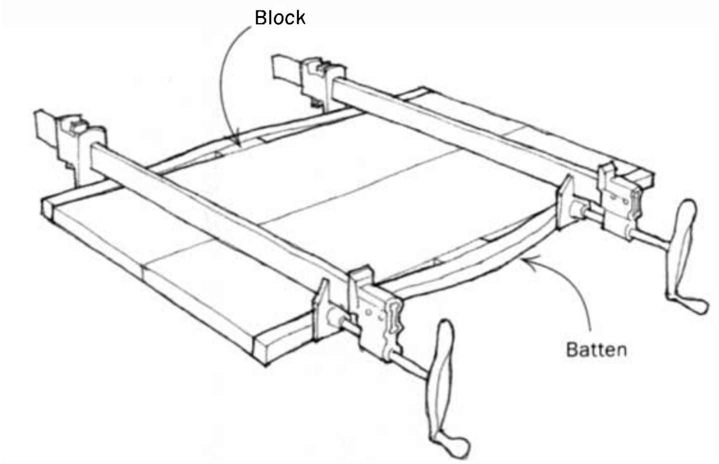


With this jig (above), you can find the center of round stock quickly and easily. Construction requires only three pieces of hardwood. Make two arms that form a 90° angle and a center member a little wider, so that all three pieces will interlock securely. Cut the length according to the largest-diameter round stock that you intend to use. To assemble the jig, locate, drill and countersink four holes in the center member. Carefully position the center member on top of the other two pieces so that one of its edges bisects the right angle. When everything is right, install the screws. Getting the angles true is the key to an accurate jig. *—Eric Orcutt, Tallahassee, Fla.*

Quick tip: To reduce the dust that accumulates in plastic face shields, spray the plastic with furniture polish and rub the surface lightly until the water beads out of the wax. Then polish with a soft cloth until the surface is clean. Dust will not adhere readily to the waxed plastic, and it wipes off easily. The wax also has the advantage of hiding some of the surface scratches on the plastic.

—Bob Hehre, Lexington, Va.

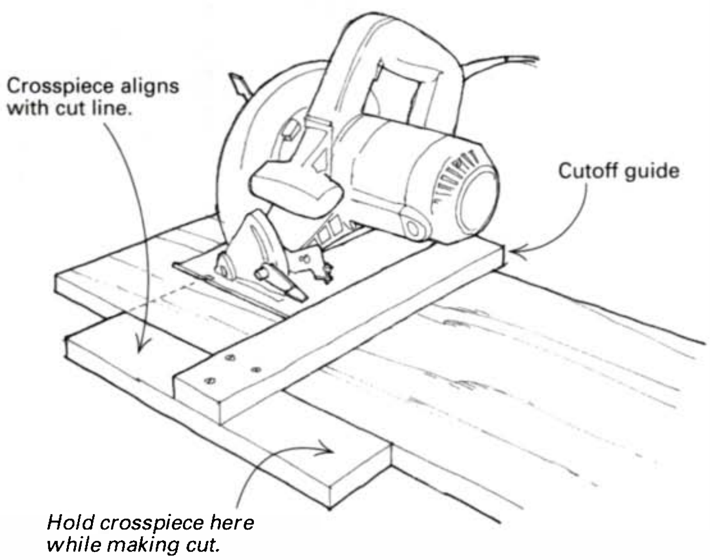
Stretching clamps



When gluing up several panels at once, I usually have a chronic shortage of clamps. Rather than waiting for the glue to set on one panel before going to the next, I make two clamps do the work of more by adding battens, one on each edge, and forcing them to bend over blocks of scrap wood in the center, as shown above. This arrangement applies clamping force not only at the clamps but also under the blocks. I can adjust the clamping pressure by changing the thickness of the battens or the blocks.

—Peter Sieling, Bath, N.Y.

Circular-saw guide for cutoffs



Here's a variation on Gary Allan May's circular-saw fixture (*FWW* #126, p. 30). This one was adapted for cutting framing and shelving lumber to length. It certainly saves a lot of time measuring, squaring and marking stock for repetitive cuts. To make the fix-

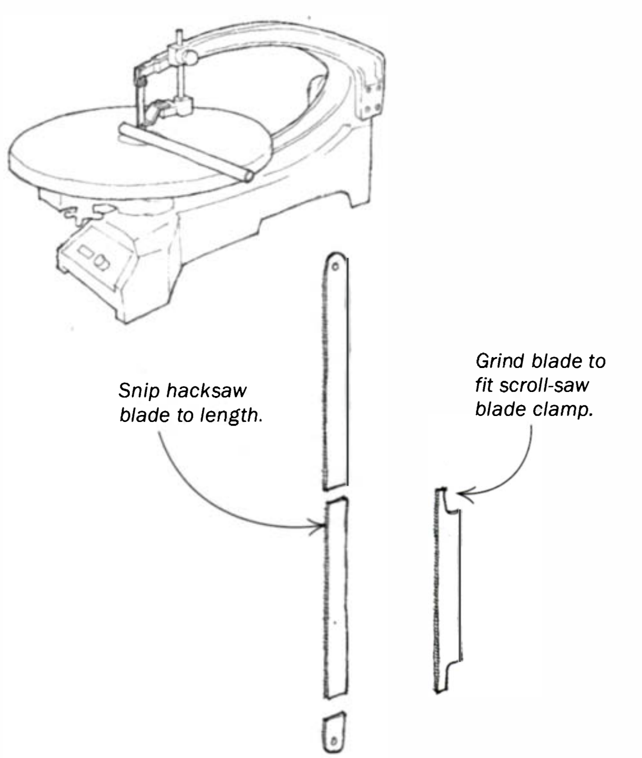
ture, screw two straight pieces of plywood together into a T-shape, carefully aligning the pieces at a right angle. Leave the crosspiece a little longer than the width of your saw's base so that on the first trial your saw will cut to the precise length.

Thereafter, by aligning the crosspiece to the cut line of your workpiece, you set the fixture in precise alignment for the intended cut. The T-shape enables you to hold both guide and workpiece with one hand safely away from the saw, leaving the other hand to steer the saw against the guide.

—Pat McGowan, Sonoma, Calif.

Quick tip—For a quick drill-bit guide, install a bronze bushing in a piece of scrap wood. Bronze bushings are inexpensive and come in a variety of common, useful sizes. Drill a hole the size of the outside diameter of the bushing through a piece of scrap using a drill press. Press the bushing into the hole, clamp the scrap to the workpiece and drill away. *—Ken Werner, Hamilton, N.Y.*

Cutting metal with a scroll saw



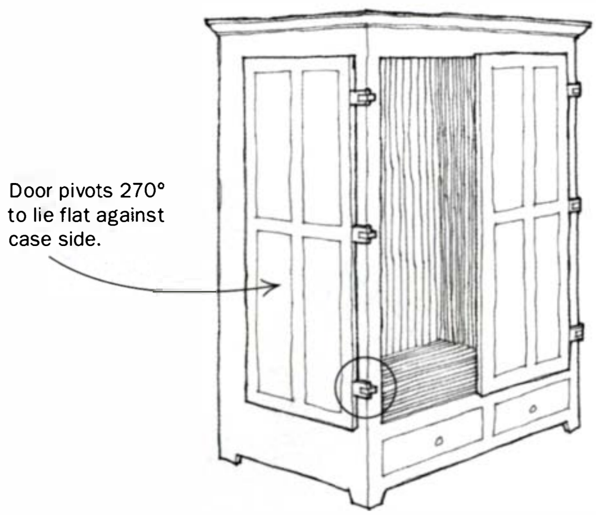
If you own a variable-speed scroll saw, you can easily turn it into a power hacksaw by modifying a standard hacksaw blade. With a good pair of tin snips, cut the hacksaw blade to the same length (probably 5 in.) as your scroll-saw blades. Grind the ends of the blade to fit your sawblade clamps. Clamp the blade in the saw, teeth pointing down, and adjust the speed to a slow 300 strokes per minute. Hold the workpiece firmly and use a very slow feed rate. Be especially careful as the blade completes the cut.

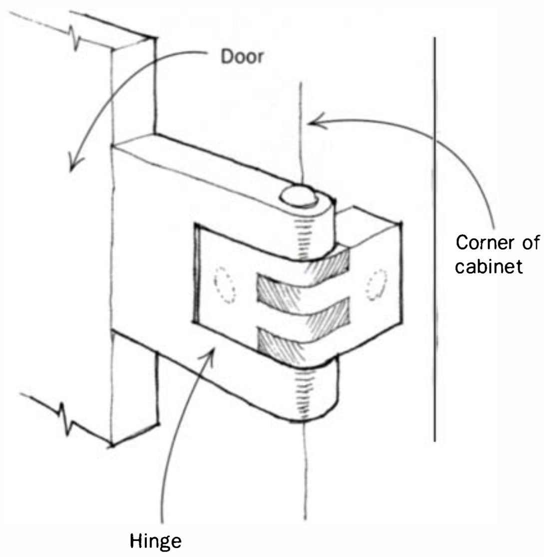
I have cut tubing, angle and flat plate in aluminum, brass and steel up to ⅛ in. thick. You can also make internal cuts by first drilling an access hole. One thing I like about this method is that I get straight cuts that require just the touch of a file to make them smooth. It sure beats a hand-operated hacksaw.

—Jim Miller, Milan, Ill.

Quick tip—Add wax to the sides of a mortise chisel when hand-chopping a mortise. The wax reduces binding as the chisel goes deeper into the mortise. *—Paul Coppinger, Plano, Texas*

Wood hinges for entertainment-center doors





When I built a large entertainment center, I wanted the 5-ft.-tall doors to be out of the way when opened. So I designed wood hinges that pivot 270° and allow the doors to lie flat against the sides of the case. Each hinge has two parts: a finger-jointed, L-shaped piece that attaches to the corner of the cabinet and a U-shaped piece that attaches to the door. Round off the end of the U-shaped piece so that it doesn't rub against the case, then round off the corner of the L-shaped piece to match. Each hinge pivots on a turned hardwood pin. *—Stan Kessler, Ft. Wayne, Ind.*

Free Catalog **Garrett Wade Tools** Free Catalog

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

High quality German-made. With a throat depth of 2½″, these small fast-acting clamps are endlessly useful. Light and strong. And the vinyl capped swivel end and perfectly flat jaw minimizes marring.

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

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

37F10.10	Combination Set	$205.85	$139.50

B / Anchor Knife

Made by one of the oldest established knife making firms in Solingen Germany – a solid tool for recreation or day-to-day use in the shop. Single, ready to use 2½″ long blade.

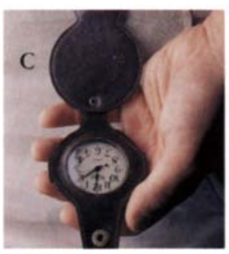
10H07.01 Anchor Knife $29.50

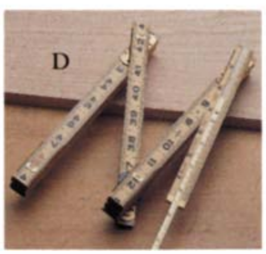
C / A Great Woodworker's Belt Watch

It's a nifty timepiece in a leather carrying case, with an integral belt loop. The snap holds it closed until you want to check the time.

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

02B03.02 Woodworker's Belt Watch $64.50





SALE D / Starrett Classic 6 Ft. Folding Hardwood Rule – At An Exceptional Price

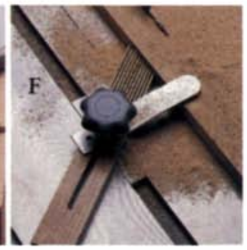
This style of rule is perhaps one of the most familiar "working tools" used in in the USA. Starrett made. Solid Brass fittings. Clear markings. Here it is – at a huge saving to you.

		Regular	Sale
20K12.01	6 ft. Starrett Rule	$29.95	$14.95

E / A Self Centering Punch

It's tricky to center pilot holes when mounting hardware. This clever and inexpensive tool does the job easily. A cone shaped nose insures that the prick-pointed plunger will hit exact center.

35K08.01 Self Center Punch $9.95



SALE F / Universal Table Saw Feather Board

Exceptionally effective in controlling a rip cut. Keeps the stock tight against the fence and saw table throughout the cut. Top-mounted hold-down arm ensures smooth feed. Unique expanding table slot bar makes positioning quick and easy in the ¾″ wide slot standard on most saws. On large saws use 2 feather boards.

		Regular	Sale
88K01.01	Feather Board (single)	$17.95	$13.95
88K01.10	Feather Board (Pair)	$35.90	$24.95

G / Deluxe Dowel Centers

A Full Set of 32 centers, 8 of each size. Outside diameters are: ¼, 5⁄16, ⅜ & ½″, inside measures 3⁄16, ¼, 5⁄16, & ⅜″.

35K09.01 Set of 32 Dowel Centers $9.95

SALE H / The Historic Stanley "#1 Odd-Job"

Originally made by Stanley from 1888 to the early 1930's, as useful to us today as it was then.

Made in the USA of solid manganese bronze casting, carefully machined to .0015″ tolerances on all sides. The screws are stainless steel.

It's an inside mitre and try square, a depth gauge, a scribing tool for arcs and circles, a T-square, a depth marking scribe, a plumb level, and a 6″ brass bound rule (also marked in mm). Rules are laser engraved.

		Regular	Sale
23N02.01	#1 Odd Job	$54.95	$49.95

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I / Get A Gross Of Utility Brushes

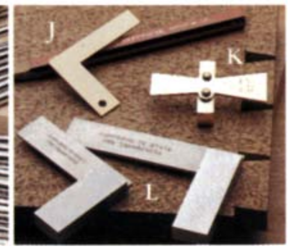
Clean, wipe, spread, rub – and then throw away. At just over $.10 each, these ½″ wide metal-clad disposable brushes are endlessly useful in a wide variety of shop tasks.

83K04.01 Gross (144) Utility Brushes $18.50

J / Small Brass Quick Check Square Slips Right Into Your Pocket

This precise, solid brass square has legs 1¾″ and 2⅜″ long. Weighs less than ½ oz. Perfect to keep with you all the time to check your work as it progresses. Made in England.

70N02.01 Quick Check Square $9.95



K / Solid Brass Dovetail Marker

Overall length 2½″, it can mark dovetails up to 1″ long. 2 ratios: 1:5 for softwood and 1:8 for hardwood. Made in England.

71J08.01 Brass Dovetail Marker $28.50

L / Engineer's Squares – Made In England

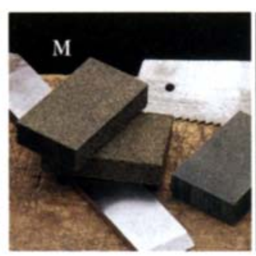
An extremely accurate square (±.0005″ per linear inch) that is of particular value in setting up power tools. Beware of competitor's squares made in India or China. They may be cheaper, but our quality is guaranteed according to British engineering standards.

39N04.05	2″ Engineer Square	$10.75
39N04.04	3″ Engineer Square	$12.35
39N04.01	6″ Engineer Square	$15.95

SALE M / "Wonderbar" Makes Your Old Tools Look Like New

These 3¼ x 2 x ¾″ blocks work on metal like an eraser works on paper. Won't clog up or load. Can be cut with a utility knife to fit any shape. Can be used dry or with any standard lubricant, including water. Clean rust, corrosion, scratches or stains from most metal surfaces.

		Regular	Sale
06K03.02	Set All 3 Blocks	$17.25	$14.95



N / Key Knife For Your Key Ring

You have to hold one of these in your hand. Barely larger than an ordinary key, this German made pocket knife will easily slip on your key chain.

02B05.01 Key Knife $19.95

To Order Call 800-221-2942 or Visit us at www.garrettwade.com

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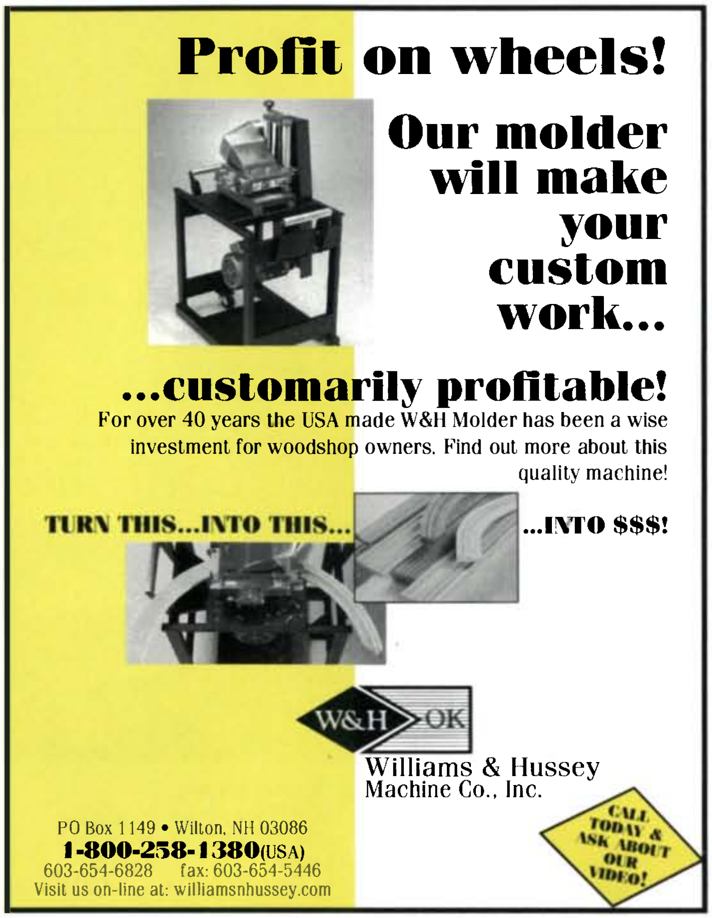

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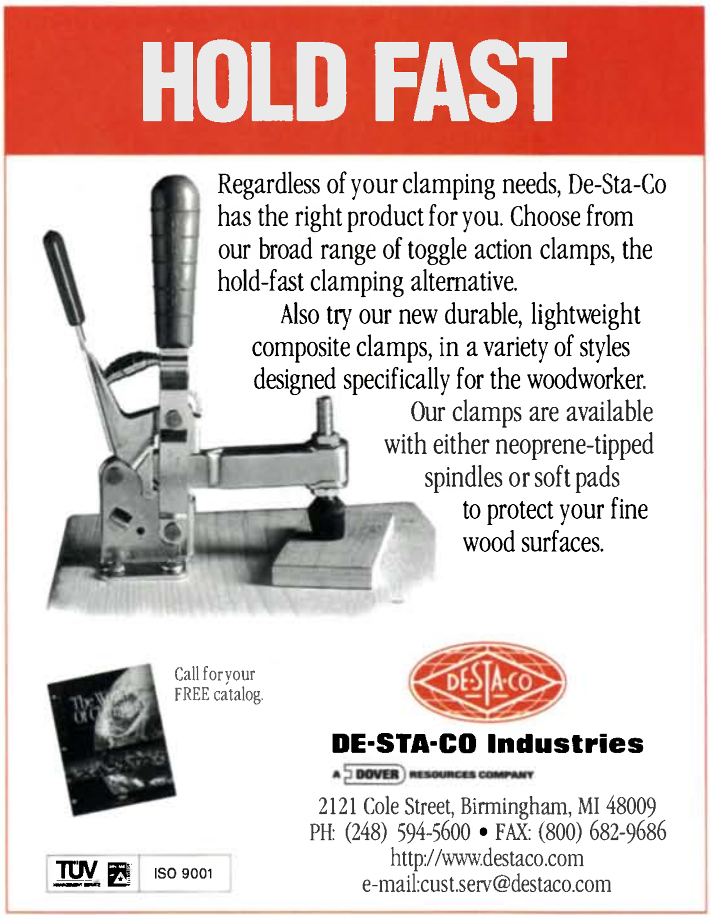

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The Furniture Society's annual conference

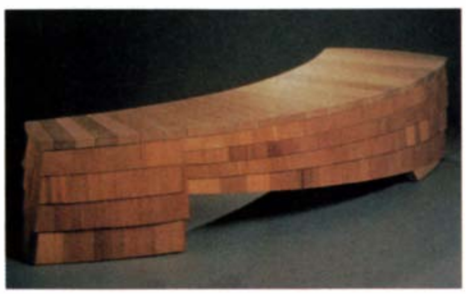
Seat for two. *David Fobes' "Sideshow" is made of plantation mahogany; the finish is milk paint.*

Furniture 99: The Circle Unbroken—Continuity and Innovation in Studio Furniture, is the third annual event held by The Furniture Society. Established in 1996, the society defines itself by broadly stating that it is dedicated to advancing the field of studio/art furniture.

This year's conference, to be held at the Appalachian Center for Crafts in Smithville, Tenn. (July 17-19), includes numerous lectures and panel discussions. On exhibit during the conference is an exhibition of 32 pieces chosen from more than 300 slides entered this year. Earlier conferences were held in Purchase, N.Y., and in San Francisco. Ever mobile, the 2000 conference is headed for Toronto.

A general membership into The Furniture Society costs $35 a year. For more information, call the society at (804) 973-1488 or visit its web site at www.avenue.org/Arts/Furniture.

—Matthew Teague, assistant editor at Fine Woodworking



New take on benches. *Rich Tannen's bench is made of white cedar and red cedar shakes.*

Wood webs

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

Router woodworking

If it concerns routing, you'll likely find it at www.patwarner.com. Author, furniture maker and frequent contributor to *Fine Woodworking,* Pat Warner has established a site devoted entirely to woodworking with the router. You'll find information on tearout, technique, router bits, router safety, routers, router books, edge guides, offset router subbases and router tables. And if you can't find the information you're looking for, Warner always welcomes questions related to routers or routing. Send e-mail to pat@patwarner.com.

Shopmade belt sander

The impetus for Robert Frink's belt sander is the same as that of most tools—he needed it. "Out of necessity one afternoon, I built a couple belt sanders using scraps and junk lying around the shop. Friends encouraged me to market them, but I decided to show people how to build their own." Frink has loaded an article's worth of text and photos on-line. If you want to build a belt sander with just the right amount of sophistication, point your browser to http://loganact.com/mwn/howto/sander1/sander.html.

FWW gives award in Philly

Economist-turned-woodworker Timothy Mowry (right), of Annapolis, Md., currently in only his second year of business, was the winner of this year's Best New Artist in Wood award at the Philadelphia Furniture and Furnishings Show. Sponsored by *Fine Woodworking*, the $1,000 award was presented by Editor Tim Schreiner at the show's opening ceremonies on April 30. For more information about the award and next year's show (May 12-14, 2000), call (215) 440-0718. *—M.T.*

Photos, except where noted: Matthew Teague; this page: Michael James (top); Geoff Tesch (bottom left)

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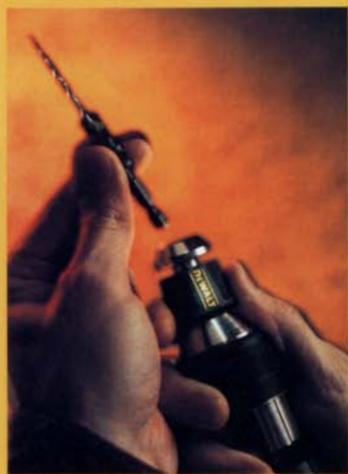

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Introducing the first quick change accessory system designed for woodworkers. It's Rapid Load™ from DEWALT, and it lets you change bits up to 50% faster than standard keyless chucks. The Rapid Load system features a heavy-duty holder and a wide selection of professional-grade, Guaranteed Tough™ accessories. The bits easily slide in and out of the holder while the universal 1/4" hex shank design prevents slipping. Even better, the Rapid Load holder fits all brands of 3/8" and 1/2" cordless and corded drills. So get your Rapid Load system today, and see how fast you finish your work tomorrow.

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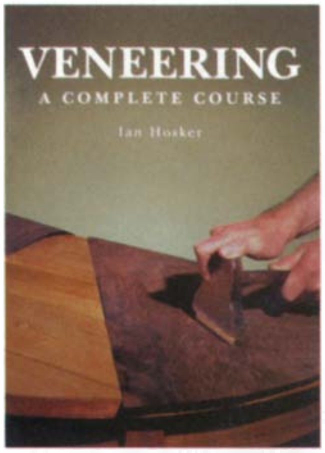
READER SERVICE NO. 109

A gentle approach to veneering



Veneering: A Complete Course *by Ian Hosker. Guild of Master Craftsman Publications, Ltd., East Sussex, United Kingdom; 1998. $19.95 softcover; 160 pp.*

In recent years the word veneer has come to mean thin, shoddy, unsubstantial and fake. But to woodworkers, the practice of traditional veneering has always meant mixing and heating glue, using cauls and presses, flattening buckled crotches and shooting seams—exotic tools and arcane practices. Some woodworkers avoid veneering like the plague.

The truth is that veneering can open a whole new world, dramatically broadening a woodworker's scope of work. By using veneer, a woodworker can employ the natural patterns of wood that might not be stable enough for solid-wood construction. To that end, what's been sorely needed has been a book on the basics of veneering.

Ian Hosker's book is the gentlest approach to veneering that I've come across. He is a woodworker and teacher after my own heart; determined to present material in uncomplicated and straightforward terms. Unlike other books on the topic, this one won't scare you away. The material is sensibly organized and progresses in a friendly manner, covering topics such as history, equipment, technique, marquetry, parquetry, finishing, polishing and restoration.

My only criticism of the book is the poor quality of the photographed work. Some projects clearly display open seams, bad miters and tearout. Even the cover shows veneer being laid on solid wood, a bad practice by any estimation. But the text and instruction are otherwise first rate.

—Mario Rodriguez, a contributing editor to Fine Woodworking

READER SERVICE NO. 206

It's not just a class: it's an adventure

Imagine being in the governor's mansion at six in the morning, practicing the finishing and restoration skills you learned in class when a hulking, shirtless Jesse "The Governor" Ventura walks past you. Instructor Mitch Kohanek and his students were stunned; "That guy is really big!"

The wood-finishing program at Dakota County Technical College in Rosemount, Minn., offers students a chance to gain real-life experience refurbishing historic furniture. Kohanek believes that "working on a 200-year-old piece of furniture is a great confidence-builder" that will give students the hands-on experience needed to be successful after graduation. Beside the governor's mansion, Kohanek's students have honed their skills at Minneapolis' Supreme Court and the Basilica, St. Paul Cathedral, and Glenshein mansion in Duluth. Class size is between 12 and 16 students that vary in age from 18 to retirees.

Deb Figge

Take the bench. *Student Joseph Amaral spends his class time repairing the woodwork at the Supreme Court in Minneapolis.*

The class begins every August and runs five days a week, five to six hours a day.

The program has been ongoing for 25 years, with Kohanek at the helm for 20 of them. Kohanek, who did his internship in furniture restoration at the Smithsonian Institution, runs a tight ship. Asked if all of his students pass, he responded, "No. I give them all the information they need, and then it's up to them." But his teaching style seems to work: For the last three years the program's job-placement rate has been 100%. Many of the alumni have started successful businesses.

The tuition for this one-year, 36-credit program is $2,700 for state residents and $5,130 for out-of-state students. For more information, call (877) 937-3282 or visit the college's web site at www.dctc.mnscu.edu.

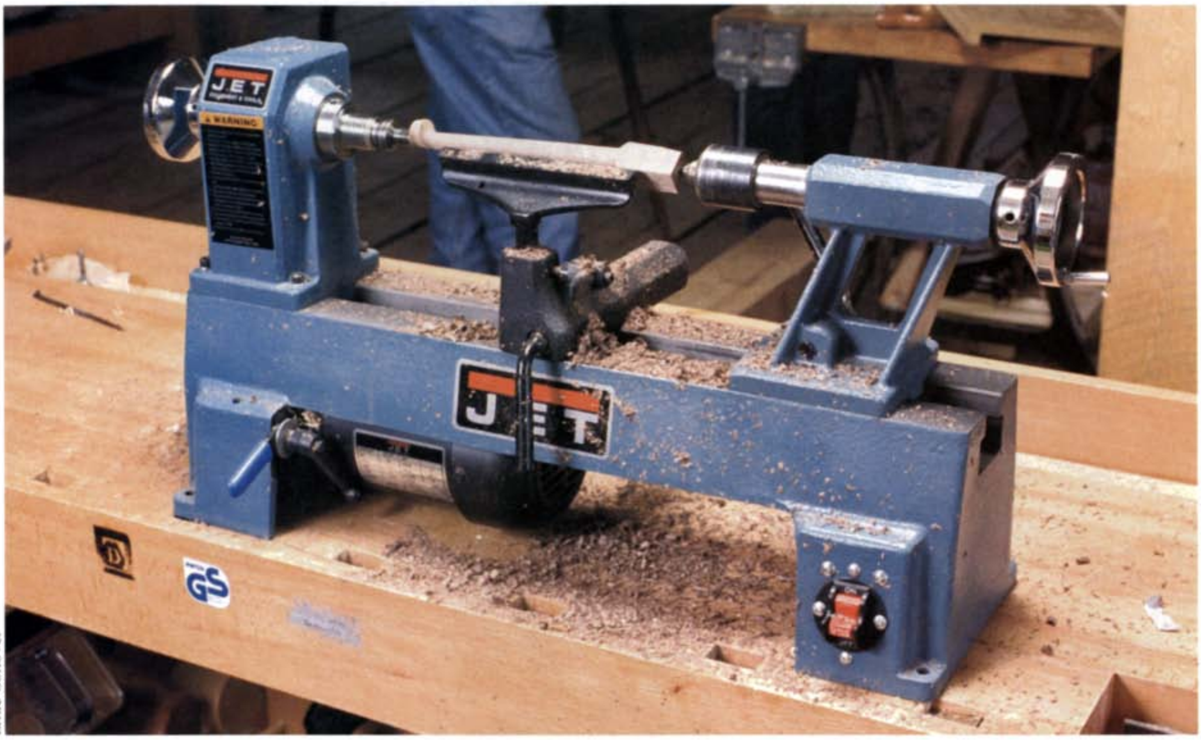
—Chris Baumann, editorial assistant at Fine Woodworking

Notes & Comment

We welcome news stories, anecdotes about the triumphs and pitfalls of woodworking, photographs of unusual work—anything that you think other woodworkers would like to know about. We pay for the material we use. Send submissions to Notes & Comment, Fine Woodworking, *P.O. Box 5506, Newtown, CT 06470-5506.*

Tools & Materials

More than a minilathe



Ernie Conover

Benchtop lathe from Jet. *The JML-1014 has a 10-in. throw and 14 in. between centers.*

Although it's called a minilathe, the Jet JML-1014 is really a bit more than that. With a 10-in. throw and 14 in. between centers, the Jet can be used for miniature work as well as for turning functional bowls or small furniture parts.

The Jet, which is made in Taiwan, shares some similarities with the Australian-made Vicmarc VL100 lathe. The struts of the tailstock on the Jet lean outward, which adds about an inch to the length of stock that can be turned, an improvement over the Vicmarc. I checked the six speed settings on the Jet, from 500 rpm to 3,975 rpm, and found them to be very accurate. Speed adjustment is achieved by changing the belt on a five-step pulley. Belt tension is released by a locking lever at the front of the lathe, and the poly V-belt is accessed through two doors.

The machine comes with its own live center, which fits fine. But when I tried using one of my preferred aftermarket live centers, I discovered that it didn't fit. The problem: The No. 2 Morse taper in the Jet's tailstock spindle was bored about 0.007 in. oversized. The fix, if you're a machinist, isn't that big a deal. I machined about 9/64 in. off the nose of the spindle.

Although you can use the lathe as is and have good results with it, as a former lathe maker I couldn't help but tweak it some and make it work the way I wanted it to. The JML-1014 sells for $320. For more information, contact Jet at (800) 274-6848.

—Ernie Conover

Craftsman Redi Drill has built-in bit storage

Drill bits are easy to find. *The 12-volt cordless Redi Drill holds five bits inside a rotating magazine.*

Cordless drills eliminated the problem of drilling without an outlet nearby. Now the engineers at Sears/Craftsman (800-377-7414) have solved the problem of keeping track of bits and drivers. The Craftsman Redi Drill (catalog No. 27491) allows you to switch between five different bits—drills or drivers—which are stored inside the 12-volt, 3/8-in. drill/driver.

To change bits, loosen the keyless chuck and pull back on a magnetized lever, which retracts the bit. Another bit can be selected by rotating an internal magazine. Bits are viewed through a small plastic window. In dim light it can be difficult to see the selection, but after using the tool for a while, you'll know the location of bits, and making a choice becomes automatic. The stock bits (two drills and three drivers) that come with the tool can easily be replaced or switched with other bits.

Redi Drill has a fast speed for drilling and a slow speed for driving, which activates the electronic clutch. The tool seems sturdy, and the 12-volt battery provides plenty of torque. The drill with charger, bits and two batteries sells for $159.99.

—Anatole Burkin

Overarm tablesaw blade cover has improved dust collection

I have been using an overarm blade cover on my tablesaw for several years now, and I wouldn't work without it most of the time. This type of cover, suspended over the blade from a boom, doesn't hang up on stock like most standard guards that attach behind the sawblade. An overarm cover doesn't need to be removed when making rabbet or dado cuts because there is nothing attached to the saw itself to get in the way. Another good thing about overarm covers is that most of them have a dust-extraction hose.

It is in this last virtue that the new EXBC system from Excalibur by Sommerville Designs really shines. Instead of the typical 2-in.-dia. hose, the Excalibur hood accepts a 3-in.-dia. hose that directly feeds into the 4-in.-dia. hollow boom, which in turn hooks into the 4-in.-dia. hose running to the dust collector. The increased airflow makes a noticeable difference when compared with the efficiency of a 2-in.-dia. hose. Almost no dust escapes from under the hood, even when cutting medium-density fiberboard (MDF), which is notorious for its hard-to-capture fine dust. When cutting knotty pine, I don't even smell the aroma of hot pitch.

I also appreciate where and how easily the EXBC boom system mounts to my saw's side extension table. Unlike other versions, where the mounting post sits on the rip-fence system's back guide rail, which requires drilling or replacing the rear rail with a custom-made rail, the Excalibur's support post quickly mounts to a wood cross support of the extension table. And unlike other systems, the boom assembly attaches to the support post below the table surface. With the twist of a lever, the entire above-table system slips out of the post and out of the way. There is no vertical post to get in the way when crosscutting long, wide strips of sheet stock.

Bigger hose makes for better dust collection. *The Excalibur EXBC overarm tablesaw blade cover by Sommerville Designs has a 4-in.-dia. hollow column that connects to a dust collector.*

In one way, however, this system presents a drawback. Sometimes, such as when using fixtures, you need to move an overarm blade cover out of the way. With the EXBC system, you have to take off the entire boom assembly, not just the hood section. The assembly can be removed quickly, but it's a heavy and bulky piece of hardware. The manufacturer does offer optional hangers for stowing the unit, which is a good idea.

The EXBC blade cover sells for $369. For more information, contact Sommerville Designs at (800) 357-4118. *—Jim Tolpin*

All-in-one eye and ear protection

My eyeglasses have always been in my way when I'm using power tools or kicking up a dust storm while woodworking. Even if I didn't have to wear my prescription glasses, I'd still be irritated by the entanglements caused by wearing separate headphone-style ear protection and those strap-on goggles. Between tasks, one of them is always in the way. Add a dust mask, and I feel like I'm ready for war but not woodworking. My must-wear eyeglasses only make it worse. Nothing I had tried made me comfortable until I got a pair of Opti-Muff eye and ear protectors—an all-in-one piece of headgear.

Opti-Muffs protect against dust and noise. *These guards protect both eyes and ears and fit over standard prescription glasses.*

Opti-Muffs come in two models, one of which works with prescription glasses. I use them all the time now. If I need a better view between cuts, the lenses can be flipped up over my head without removing the unit. Opti-Muffs for use with glasses cost $34.99, and the standard models run $34.50. They're available from Woodcraft (800-225-1153). *—Tim Schreiner*

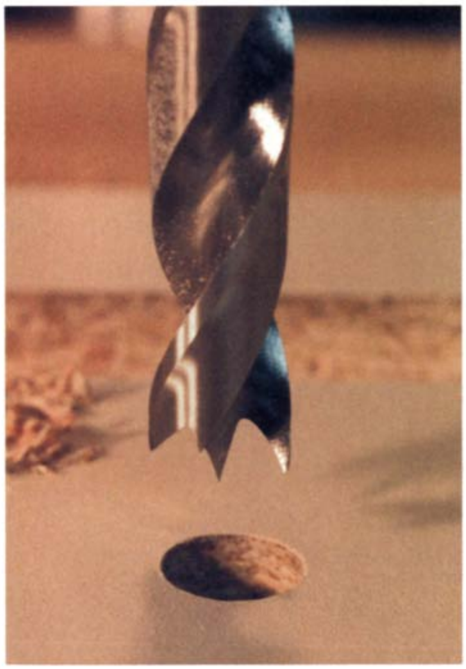
Photos, except where noted: Anatole Burkin; this page (top): Craig Wester

Fisch Vortex drill bits cut very cleanly

I still own the very first set of "discount" brad-point bits I ever bought. They look brand new, and that's because they practically are. After using them once, I realized these bargain bits, despite being labeled in fractional sizes, bored holes in sizes unknown to American manufacturers of dowels and plug cutters. Maybe I should have bought some imported dowels to go with the bits.

Although there are plenty of good drill bits on the market, Vortex-D, a new line of high-speed-steel spur and center-point bits from Fisch, are worth considering. Fisch is a name synonymous with high-quality cutting tools, and these U.S.-made bits are no exception. The bits are accurately sized and cut extremely clean-rimmed holes. Even the exit holes are remarkably clean.

Prices vary by size; a ⅛-in. bit costs about $6; a ½-in. bit is $18; a set of seven, which includes a nicely made wooden case, runs about $80. They're no bargain, but bargain-basement bits, as I found out, often end up costing you more in the long run. For more information, call Fisch (724-663-9072) or Woodcraft (800-225-1153). *—A.B.*



***Clean entry and exit.** Even when boring melamine surfaces, a Vortex-D bit leaves a clean entry hole and smooth walls.*

Quick-change planer/jointer knives

***Esta disposable knives are available for most jointers.** The retrofit kit includes all of the parts you need to simplify knife-changing.*

I got my first peek at the Esta Dispoz-A-Blade system when I was reviewing mid-sized thickness planers (see *FWW* #127, pp. 52-58). The system, which can be ordered as an option on some new planers and jointers, simplifies knife-changing.

Dispoz-A-Blades are available for many older machines as well. I tried them on my 10-year-old imported jointer. To install the blades, I had to use a 6mm bit to enlarge the six holes in the jointer's cutterhead that house the stock knife-support springs. (This may not be required on newer machines.) Then I replaced the springs with Acu-Set support screws, which came with the Dispoz-A-Blade knife set. Adjusting the screws that permanently position the knife holders at the correct height is the most time-consuming part of the job. The rest is easy: Insert the knives into their holders, then put them and the jointer's stock jibs in place and cinch everything down.

When the knives get dull, all you do is loosen the jib screws and lift out the knives and holders. The double-sided knives can be flipped over to expose a new edge. Because you replace—and don't sharpen—these knives, you never have to reset their height. Magnets and pins on the knife holders keep the cutters from shifting during handling. Dispoz-A-Blades are thinner than stock knives, but they seem durable.

Prices for Dispoz-A-Blade systems vary; for a 6-in. jointer, $140 gets you the kit, including three knives. A set of replacement 6-in. knives costs about $20. Call Esta-USA at (800) 557-8092 or visit the company's web site at www.estausa.com. *—A.B.*

Stanley introduces a more sensitive stud sensor

I imagine someday you'll be able to buy a stud sensor that will map out everything behind finished walls with the accuracy of a blueprint. But for now, the Stanley IntelliSensor Pro will have to do. With it you can detect live wires behind walls as well as find metal and wood framing. The IntelliSensor Pro will even detect metal up to 2 in. deep in concrete. The IntelliSensor doesn't pinpoint live wires as precisely as it finds studs, but live-wire detection is, nonetheless, a good safety feature. The IntelliSensor Pro, available at many hardware stores, costs $30. *—A.B.*

***IntelliSensor Pro from Stanley.** This new stud sensor finds wood and metal studs and also will detect live wires behind a wall.*

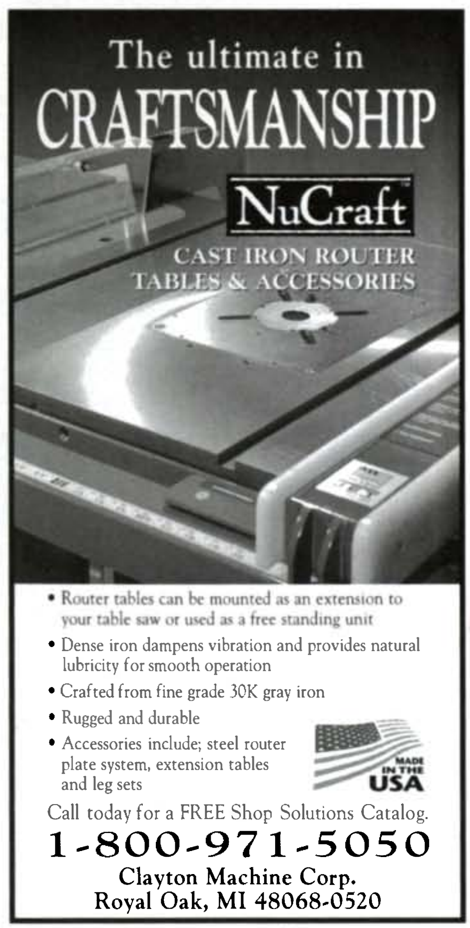
READER SERVICE NO. 162

READER SERVICE NO. 69

READER SERVICE NO. 155

READER SERVICE NO. 41

READER SERVICE NO. 99



READER SERVICE NO. 53

Miniplanes with big appeal

Exquisite finger planes from Christopher Laarman. *Shown are a ¾-in. plane (top) and two versions of the ⅜-in. plane, with and without the palm pusher.*

Some hand tools are irresistible to the touch. Maybe it's the heft or the wear patterns and patina from years of use. Perhaps it's the feel of the tool as it effortlessly cuts through a piece of wood. New finger planes from Christopher Laarman bring forth those feelings: They beg to be picked up and admired, then used.

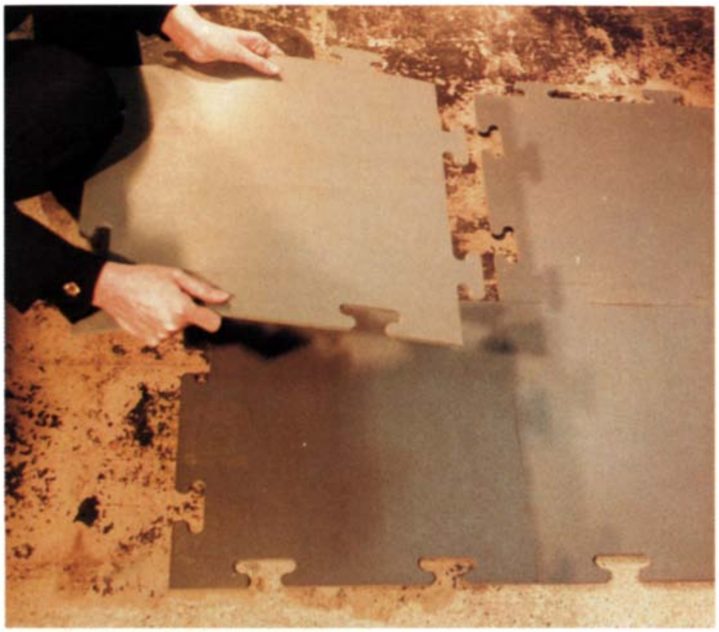
At first glance the brass planes appear to be pieces of fine jewelry, but the tools were designed with ergonomics and function in mind. Laarman currently makes four versions of a ⅜-in. plane (flat or radiused bottom, and each may be ordered with an optional palm pusher, which is an extended handle) and a ¾-in. radiused model with palm pusher included. The planes are sized by the width of the irons; the soles are slightly wider.

Other than requiring a little honing, the planes come ready to use. The irons, made by Ron Hock, are high-carbon steel and hold an edge quite well.

I found the planes to excel at planing arches and graduating the thicknesses of instrument parts, such as the tops and backs of violins and guitars. The tools could also be used in sculpting and carving.

The planes range in price from $125 for the basic ⅜-in. model to $155 for the ⅜-in. palm-pusher model to $220 for the ¾-in. tool. Additional planes, including ½-in. models and left- and right-handed versions of the ⅜-in. palm pushers, are in the works. You can visit Laarman's web site at www.tooltimer.com/laarman/index.html or call for more detailed information (800-242-4917). *—Brian Derber*

Industrial flooring for the workshop



Tough flooring for the shop. Protect-All resilient flooring can be ordered in 18-in. square interlocking tiles (pictured) or larger sheets and placed directly over a slab floor.

You may have seen Protect-All flooring in weight rooms, on tennis courts or at poolside. Protect-All also makes a good shop floor because it's resistant to most chemicals and has a nonslip surface, even when damp. Protect-All can be purchased as 18-in. by 18-in. interlocking tiles or in large sheets. Protect-All, which is ¼-in.-thick recycled vinyl, can be laid down as-is or cemented to practically any floor, including a concrete slab.

I tried Protect-All tiles in my shop for a few months and found it to be a tough surface. It's not quite as squishy as some antifatigue mats, but Protect-All does provide greater comfort than a plain slab floor. There's another good feature about Protect-All: If a chisel takes a nose-dive off the bench, the tip of the tool will survive just fine while leaving only a slight nick in the vinyl. Prices vary, depending on color; ¼-in. dark gray sheets run $2.20 per sq. ft., and tiles are $2.50 per sq. ft.; colored (burgundy, tan, blue) flooring costs slightly more. For more information, call Lin Mar Distributors at (800) 954-6627. *—A.B.*

Ernie Conover is a woodworking instructor in Parkman, Ohio; Anatole Burkin is a senior editor of Fine Woodworking; *Jim Tolpin is an author and woodworker in Port Townsend, Wash.; Tim Schreiner is the editor of* Fine Woodworking; *Brian Derber is a violin maker and teacher in Oconomowoc, Wis.*

Do this. *For turned vertical surfaces, always brush on the finish in horizontal strokes.*

Don't do this. *Brushing a finish onto a turned vertical surface using up-and-down strokes will invariably lead to messy drips.*

BY JEFF JEWITT

Real-World Finishing

Several years ago I was sitting in the audience while a noted finisher went through the paces of his class, demonstrating brushing, French polishing and so forth. The woman sitting next to me, Karen, was fidgety. At one point she whispered, "This isn't finishing!" Afterward, we strolled up to the instructor to shake hands and exchange pleasantries. Karen was less than enthusiastic. She came right out with what was on her mind. "You know, you people make me crazy. I came here to learn something about finishing, and all you showed me was how to finish flat sample pieces. That's easy. What about finishing real furniture?"

I never forgot what Karen said—she was right—not all surfaces are flat. If they were, finishing would be a piece of cake. There are two sides to doors, insides of cabinets with myriad right angles, vertical surfaces, molded edges, carvings and intricate shapes like those on chairs, spindles and turned legs.

There are several ways to put a finish on a complicated surface. Spraying on a finish addresses some of the challenges, but it's not the answer for all furniture. I believe that a sprayed finish simply doesn't look right on some pieces. One strategy is to finish all of the parts of your project before you glue it up, which renders a cleaner appearance and speeds up the finishing process. The concept of prefinishing is simple—protect areas that will be glued later so that finishing material doesn't interfere with the glue. Unfortunately, taking this approach is not always possible with more complicated furniture that you need to scrape and sand after assembly. And if you are refinishing furniture, you usually don't have the option of taking it apart. Another strategy is to adjust your approach to the surface of the finish, which involves some application techniques that you may not be familiar with—cross-brushing, padding and what I call the "brush-and-feather" technique for lacquer or shellac.

Lay it on left to right. *Cross-brushing, which works best with varnish, starts with a horizontal application of the finish.*

Tip it off top to bottom. *Use only the very tip of the bristles of a good-quality varnish brush to even out a cross-brushed finish and to keep it from sagging.*

Cross-brush vertical surfaces

I cross-brush varnish using a good-quality bristle brush (see the photos at right). I apply the varnish horizontally, then tip it off vertically, using only the very end of the bristles to smooth out the finish. This sequence avoids drips and prevents sagging in the finish as it dries.

To use this method, dip the brush only about a quarter to a third of the way into the varnish. Start at the bottom of a panel and brush the varnish horizontally in both directions. Continue this pattern, overlapping each stroke by about ½ in., and work all the way to the top. Then tip off the whole panel vertically, periodically wiping excess finish off the brush with a clean rag. You want to avoid thinning the varnish when cross-brushing because thinned varnish is more likely to drip and sag.

When cross-brushing a complicated vertical surface, like that of a frame-and-panel construction, start at the deepest areas, then work toward the higher ones. Finish the raised field of the panel last. Wipe any drips lightly with a dry brush. Also, excess varnish pooled in corners and moldings can be wicked up with a dry brush.

Pad onto round surfaces

Nothing works better on turned surfaces, such as those on the maple headboard below right, than a padding technique. In cases such as this, padding will give you a better finish than spraying. You can apply either varnish or shellac with a pad. I usually use shellac because it dries faster, when applied in thin coats. Because it dries so quickly, a padded shellac finish can be completed easily in one day and rubbed out and waxed the next.

Use a pad that is soft and absorbent and as lint-free as possible. I use a product called padding cloth, or trace cloth, but old cotton T-shirt cloth also works well. Make a pad with a flat bottom by wadding up some cloth so that it fits easily in your hand. The bottom should have no seams or wrinkles. Then squirt about an ounce of a 2-lb. cut of shellac onto the bottom of the pad (see the top left photo on p. 42). I use a squeeze-type bottle with a nozzle to dispense the shellac.

Wipe the shellac on the surface of the wood in light, smooth passes (see the top right photo on p. 42). On round, turned areas you can wrap the cloth around the wood, starting at the top of the workpiece and working your way down. When the surface gets tacky and the pad starts to stick, stop and let the surface dry. After about an hour, lightly sand the surface with 320-grit sandpaper and repeat the sequence. When the final coat is dry, leave it

When you're doing more than tabletops, adjust your technique to the surface at hand

A pad for shellac. *A wad of soft, absorbent, lint-free cloth is all you need to make a pad for applying shellac. You can use a plastic squeeze bottle to wet the pad or you can dip it into the finish. Wipe on the shellac in light, smooth passes.*

as is or rub it with 0000 steel wool to remove the gloss.

Brush and feather fast-drying finishes

Shellac and lacquer require a different brushing technique than varnish does. Varnish flows onto a surface and is then smoothed out in long strokes with the tip of the brush before it sets. For fast-drying lacquer and shellac, I prefer to brush on thin, light coats of finish quickly in short strokes, then feather each layer out before it dries. This technique works well for vertical surfaces and complicated furniture, like chairs (see the right photo, below).

With shellac, start with a 2-lb. cut. If you have problems, thin that a bit more to a 1½-lb. cut or so. Straight out of the can, most brushing lacquers are too thick for this technique and must be diluted with an equal part of lacquer thinner. Use a small brush with fine, soft bristles. Several manufacturers make brushes with Taklon bristles, a synthetic fiber resembling the finest sable-hair artist's brushes. Either china bristles or a synthetic nylon brush will also work fine. Get the widest brush you can: I use a 1½-in. Winsor & Newton No. 580.

Dip just the tip of the brush into the finish and press off the excess against an edge of the container. Bring the brush to the surface of the wood and start brushing lightly and quickly, flowing the wet finish off the brush. Work until the brush dries out, then replenish with more finish. When you start a new stroke, you'll have a puddle of thicker finish. Smooth that immediately into the rest of the finish with a flicking or whisking motion. Work the entire surface quickly with thin coats of finish. Because lacquer and shellac dry quickly, and because the coats are thin, you can recoat an area almost immediately.

When the brush starts to stick, stop and let the surface dry for at least an hour. Then, using 320-grit stearated paper, lightly sand the surface. Go easy on the edges

Storage trick prolongs brush life. *Squeeze excess shellac from the bristles and let the remaining finish harden on the bristles. A dip into alcohol will make the bristles soft and supple again.*

Short and simple. *Short, choppy strokes are required for a brush-and-feather technique, which works best with fast-drying finishes such as shellac and lacquer.*

***A toothbrush for tight crevices.** For tight spaces and intricately molded shapes, apply a gel varnish with a soft toothbrush, then brush off the excess finish with a large, dry bristle brush.*

because the finish film will be thin. Rub the surface with 000 steel wool or maroon synthetic steel wool. Remove the sanding dust with a tack rag. Repeat that same sequence, applying thin coats of finish. Extend the drying time to overnight after the second coat of finish has been applied. Six or seven applications will result in a durable, good-looking finish with great depth.

Round, vertical surfaces—I use a version of the brush-and-feather technique for some round, vertical surfaces, such as the tripod on p. 40. Using a brush for round legs and spindles is easy as long as you brush it round and round using a lightly loaded brush. Horizontal strokes are essential. If you brush turned shapes using up-and-down strokes, I guarantee you'll get a drip (see the inset photo on p. 40).

Insides of cabinets and drawers—If you must put a finish on the inside of cabinets and drawers, use only shellac or lacquer, if possible, because oil and oil-based varnishes take a long time to cure thoroughly. Also, in an enclosed space, the solvent smell will linger for a long time, being absorbed into stored clothing and linens. For these tight spaces with many corners, apply several coats of lacquer or shellac using the brush-and-feather technique (with a Taklon brush), then rub out the surface with 0000 steel wool and wax.

Brush carvings and moldings

To finish intricate carvings and moldings, apply gel varnish with a soft toothbrush (see the photos above). Scoop out the varnish with the brush and work it into the crevices. Then brush the excess off with a dry, soft natural bristle brush. This method yields a satin sheen that also preserves the details of carved or molded wood.

Finishing two sides at the same time

With doors, drop leaves and lids, it is necessary to put a finish on both sides relatively quickly. You can finish one side at a time, but in hot or humid weather, that could cause warping problems. To coat both sides at once, you can apply a finish with the doors installed on the cabinet. Or you can use a nail board—a piece of plywood with nails, brads or drywall screws driven through one side (see the photo below). Finish the back side first, then place that finished side down on the sharp points of the nails or screws to support it while you finish the other side. I prefer drywall screws to nails because their sharp points leave less of a dimple in the finish. □

Jeff Jewitt, a frequent contributor to Fine Woodworking, *restores furniture and sells finishing supplies for a living.*

***Two ways to finish both sides at once.** The doors on this walnut sideboard illustrate two ways to finish both sides of a component: Either leave the door in place for finishing or take it off the cabinet and place it on a nail board for finishing.*

Photos: William Duckworth

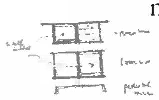
Component-Built Sideboard

Separate assemblies make construction manageable, and careful detailing produces a unified design

BY SETH JANOFSKY

I work alone in a very small shop. Actually, in two small shops. My machines rub elbows in a cramped basement room, while my workbench and hand tools are up on the first floor in another small room. The two shops are not connected by a stair, and getting from the machines to the workbench requires a walk outside, uphill around the house. So one of the things I try to do when making furniture is design for efficient construction, breaking things down into subassemblies that I can handle easily in my small space and work on comfortably by myself. I also like the finished pieces of furniture to be as easy to handle, pack and move as possible. I've developed ways of designing that take these things into account while still aiming to produce striking, useful pieces. The white oak sideboard I recently completed is a good example of the way I design to accommodate these various needs while bringing unity to a piece that, when finished, remains essentially a stack of separate components.

Design time: compromise begets good furniture

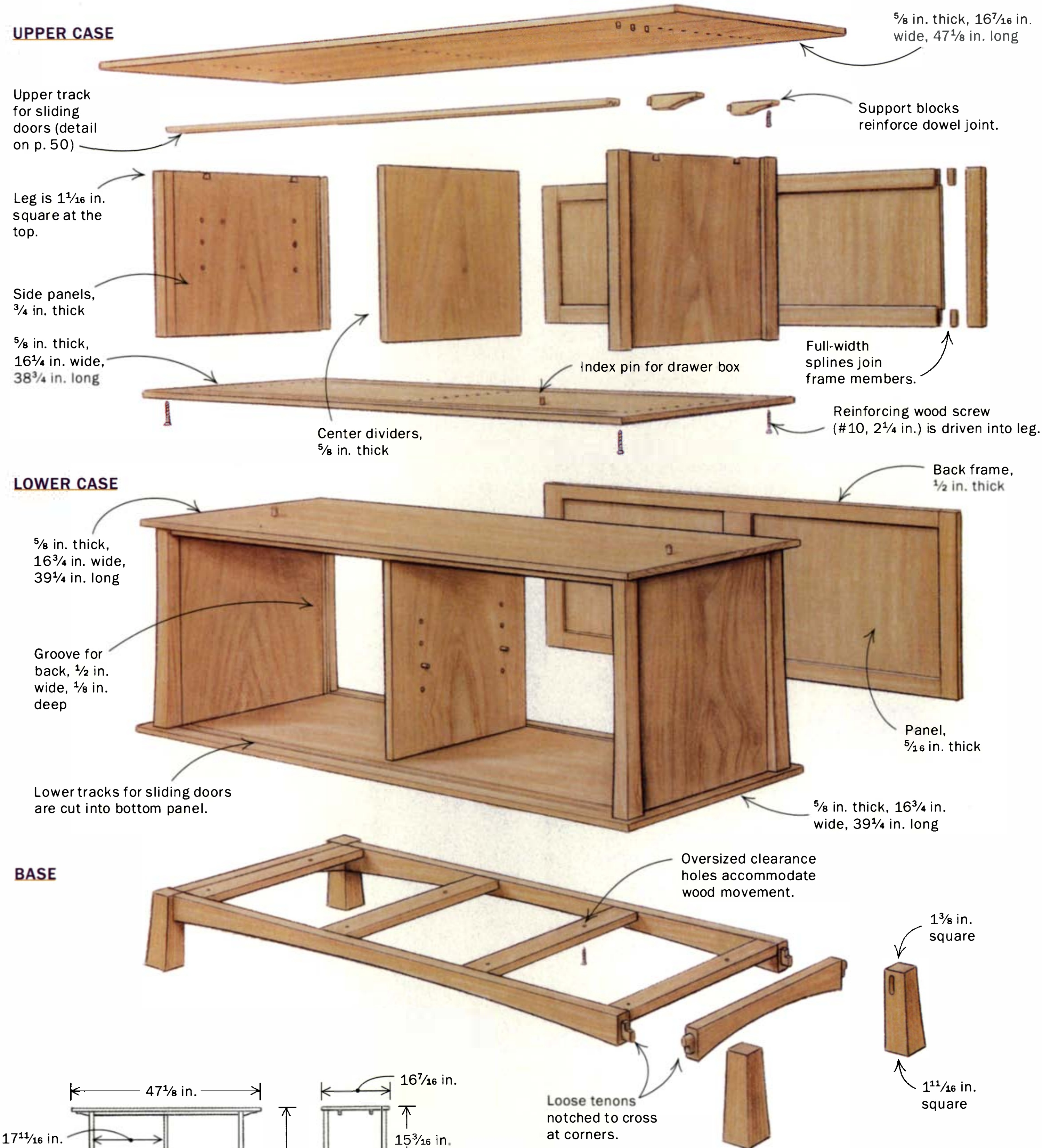


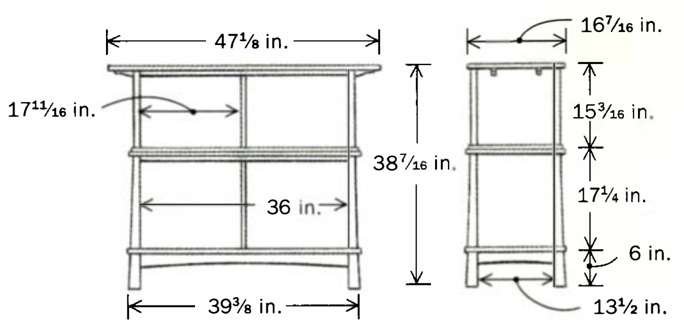
As odd as it may sound at first, I think the finest furniture is the result of a lot of compromise. Not the kind of compromise that leads to cutting corners and doing less than the best possible work, but rather the compromise that's involved when you strive to balance three things: the aesthetic needs of a piece, the requirements of function, and construction that is sound and efficient. There should be a back-and-forth between aesthetics, function and construction during the design process; the craftsman has to see to it that all three purposes are well served and that none of the three dominates at the expense of the others. With skill and conscientious effort, and a little luck, the end result will be a piece of furniture that sits, as it were, at the best possible balance point of these three demands.

When I set out to make this sideboard, I had a number of considerations in mind. In terms of function, I wanted a useful piece with a serving surface, compartments for dishes, probably with some adjustable shelves, and drawers for silverware. I didn't want a piece that was limited to use as a sideboard, however. I wanted one that could also function as a display cabinet for pottery or for other decorative objects. Aesthetically, I had in mind something light and delicate looking, even as it was strong and durable. Nothing flamboyant but rather a quiet, refined kind of thing. As for the specific style, I explored in the general direction of other cabinets I've made, which blend traditional Japanese and Scandinavian-modern influences. In terms of construction, I wanted solid, straightforward joinery—structurally sound, efficient to make, subjugated to the quiet design I envisioned.

Putting these factors together, I came up with a solid white oak sideboard that is, in its essence, simply two boxes on a base. To best use the beautiful wide boards I found, I opted for a solid wood structure, which is a hybrid of simple plank construction and post-and-panel construction. A top surface with long overhangs on both ends showcases the single-board top and establishes the visual tone of the piece. To give the separate boxes

Photos, except where noted: Jonathan Binzen; this page: Author





TWO CASES ON A BASE

For convenience of construction, the sideboard is built in stacking components. The upper case is indexed on the lower one by a pair of pins, and it can be lifted off; the base is screwed to the lower case. All parts are solid wood. To avoid wood-movement problems, the grain is run vertically on end panels and center partitions and end-to-end on horizontal panels.

Drawings, except where noted: Bob La Pointe; facing page and p. 49: Author visual unity and to create a vertical sweep to balance the strong horizontal line of the top, I designed curved legs that extend up through the piece. The legs have a powerful impact both on the aesthetics of the sideboard and on the method of construction. They provide just one example among many of how an aesthetic decision dictates to the technical, and how the technical responds to the aesthetic and exerts its influence. Likewise with the functional requirements. Back and forth, as the design comes together.

Legs and sides made as a unit

The success of the sideboard depended on getting the legs and sides just right; I needed to create a convincing sense of continuity up the sides to make the components of the sideboard read as a unified piece. To get the best possible continuity of grain and color and curvature, I decided to make the legs and the side panels full length, mark them carefully, do most of the machining and sanding and only then cut them apart into segments. It was necessary to think of and work on the legs and side panels as a unit.

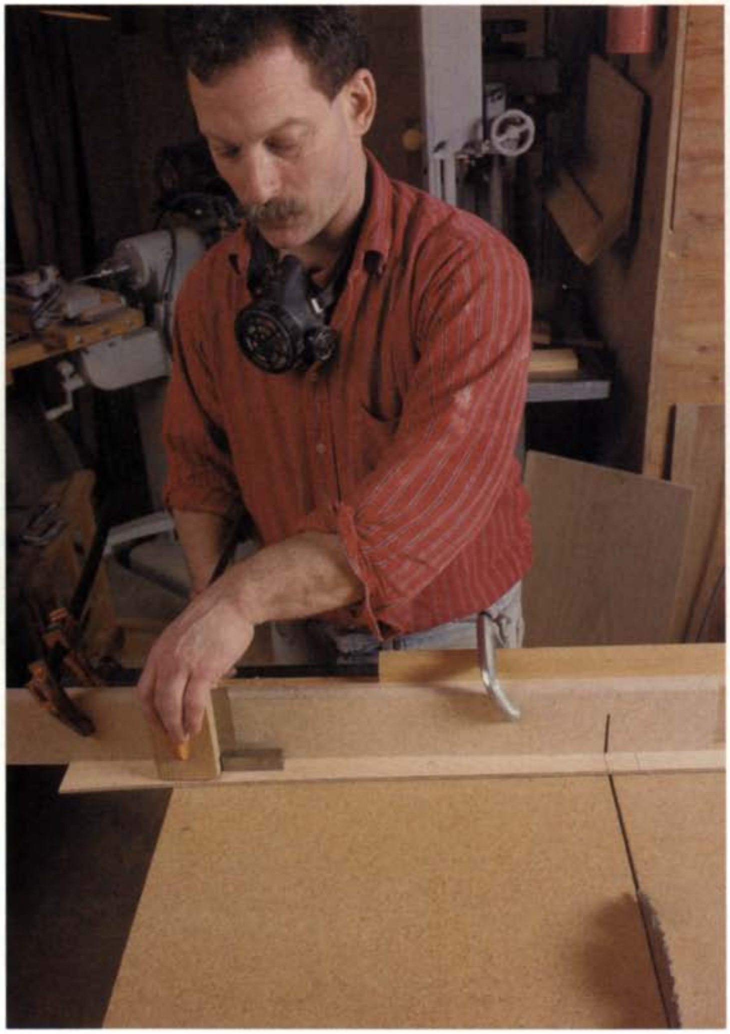
When I had sorted the wood for the project and laid out the basic parts, I began cutting and shaping the legs and preparing the side panels. After initial milling of the pieces, I cut the two side panels to exact width (but leaving them long) and put them aside. I made a full-sized template of the leg out of medium-density fiberboard (MDF) and marked it with the cabinet divisions so that it could be used as a story stick. Then I cut the leg blanks to length, traced the outer curve off the template and bandsawed them to rough shape. I clamped all four legs together on the top of the tablesaw and quickly smoothed the curve, first with a belt sander, then with a random-orbit sander. This is perhaps a somewhat inelegant method, but it brought the legs to a smooth, uniform curve very quickly. I touched up each leg individually with a block plane and scraper and finished by chamfering the edges with the block plane and sanding block. All of this was done before cutting the legs into their segments to ensure that when the sideboard was finished each leg would read as one uninterrupted, flowing curve, despite the divisions in it.

I had marked the sides and the legs carefully to preserve the orientation of all of the parts after they were cut into segments. Then I began the cutting. Using a crosscut sled on the tablesaw, I cut the legs and sides into their component parts. I set the stop blocks for these cuts directly from the marks on the leg template. Before leaving the tablesaw, I also cut grooves in the legs and sides for the splines that would align the parts during glue-up. Also, with a ½-in. dado set, I cut grooves in the rear legs for the case backs.

Before I could glue the legs to the side panels to make the completed case sides, I had to drill dowel holes in the side panels and

LEGS AND SIDES ARE FIRST LAID OUT AND CUT

Template with a brain. *Before bandsawing, the author traces the curve of the leg from a ¼-in.-thick MDF template. The template is also a story stick, marked with the locations of all of the horizontal elements in the sideboard.*



Clever measurement. *The leg template itself is used to set the stop block for crosscutting the case sides and legs. When the template is removed, there is a gap beneath the stop block for sawdust relief.*

Don't move that stop block. *After cutting the leg segments for the upper case, the author leaves the stop block where it is to cut the sides for the upper case.*

Photo, facing page (top): Author

prefinish the legs and panels (these processes are described below). Also, to solve the problem of clamping curved legs, I made a set of kerfed, cork-faced softwood cauls that would conform to the gentle curve of the legs under clamping pressure. As I glued up, the splines kept the sides and legs in plane, but I had to check carefully during the clamping to make sure I kept the end-to-end alignment of the parts exact.

Doweling: a great place for things to go wrong

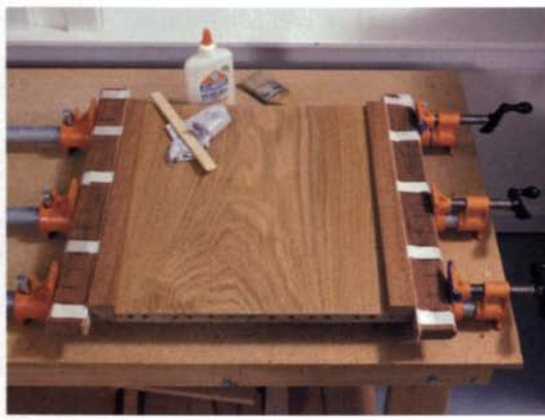
I often use dowels in carcase joinery. I prefer to use concealed joinery on many of the pieces I build, and dowel joints are straightforward to make and structurally sound. But I don't much like the actual work of doweling. It's nerve-wracking, and there's a lot of potential to botch things at this stage, especially when there are many parts involved and many holes to drill, with a lot of careful alignment to be kept. To counter the tendency to lose track of what holes need to be drilled where, I take the time to set things up very carefully indeed.

The job begins with making doweling jigs, new ones for each piece of furniture. The jigs are simply pieces of hardwood cut to the length of the joint to be made and sized to the thickness of the parts to be joined. The jigs don't take long to make, but I take care to make them precisely—a precise jig will save a lot of time and trouble. I drill the guide holes carefully at the drill press. Each jig has a block of wood at the back to reference it off of the back edge of the workpieces, keeping everything in alignment. For this sideboard I also needed a few spacers to locate the jigs properly when I was joining parts of differing widths. For the basic joinery in the sideboard, I made two jigs: one ¾-in.-thick jig for the case sides and one ⅝-in.-thick jig for the center partitions, to match the thickness of these components. Each vertical-to-horizontal joint in this sideboard has 12 to 14, 5⁄16-in. dowels spaced on approximately 1-in. centers. I chose a dowel diameter slightly on the small side to reduce the risk of corrugating the outside of the panels, which can be caused by dowel expansion and hydraulic pressure from the glue if the dowels are too close to the outer surface.

For setting the jigs on the horizontal parts with maximum accuracy, I made a ¼-in. plywood spacer sized exactly to the interior width of the sideboard. I marked the precise centerline of the spacer and marked centerlines on all of the horizontal parts. This enabled me to locate the doweling jigs accurately and easily even though the horizontal parts were all left long at the time of doweling. I wanted them long so that I could dry-assemble the cases and

THEN THEY ARE SPLINED AND GLUED

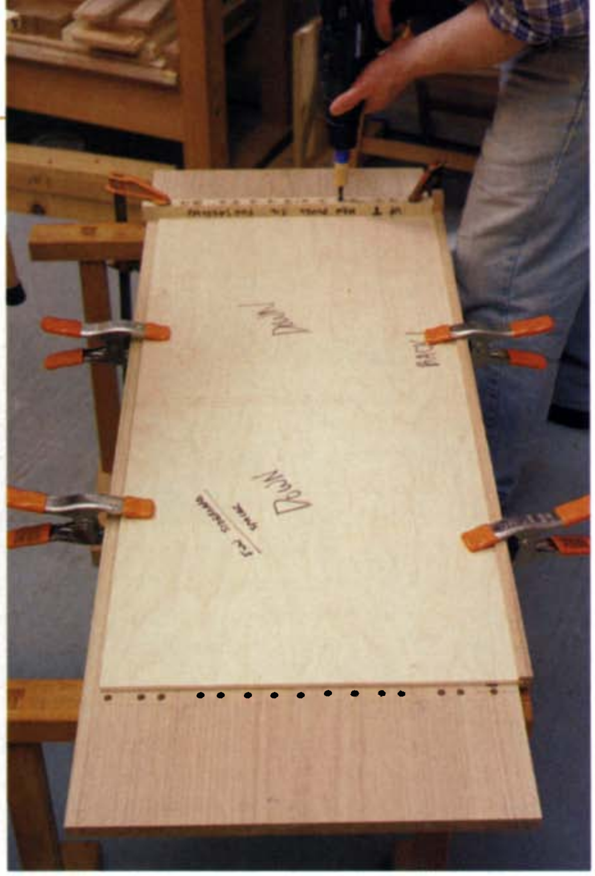
Legs: the heart of the design. *To bring visual unity to a sideboard comprised of stacked components, the author designed legs that carry through the cases and the base. He achieves continuity of grain and color by shaping the legs and the side panels as full-height pieces and cutting them apart. Where horizontal members interrupt the flow, he removes a matching amount of material from the legs and sides.*



Special cauls, kerfed and corked. *For gluing the legs to the case sides, the author makes kerfed cauls that conform to the curve of the legs. A layer of cork on the unkerfed edge protects the workpiece.*

DOWEL DUTY

Registration, quick and clean. *The author makes custom doweling jigs for each new piece he builds. He sizes the jigs to the thickness of the stock, so they are automatically in proper alignment when clamped to the workpiece. He uses a pair of shopmade depth stops, one for end-drilling and a longer one for the shallower face-drilling. A level in the drill body helps him keep the drill horizontal.*



Guide board eliminates layout. *With their varying setbacks and overhangs, the horizontals in the sideboard differ in length. But the author can dowel them all with the same template because it works off a centerline registration mark. A strip of wood tacked to one long edge of the template serves as a stop.*

look at them before deciding how long the various setbacks and overhangs should be.

Drilling the dowel holes took an entire day, the first part of it given over to making sure everything was properly prepared, clearly marked, at hand and thoroughly thought through. Then I spent about eight hours anxiously checking, double-checking and finally drilling some 320 holes.

The fit of the dowels in the holes is very critical in glue-ups with this many dowels (80 in each box); a bit too tight and it may be impossible to pull the joints together even with all of the clamps in the shop. In this case I ended up shaving all 160 dowels with a handplane to get them just right. Also, because of the time involved in actually applying the glue and getting the joints together, I glued each case in two separate operations; first gluing the sides to the bottom, then to the top.

I have considerable faith in the integrity of dowel joinery, but still I decided to reinforce the cases at each corner with a long wood screw driven into the center of each leg. These screws were insurance against mishandling of the sideboard. It's always possible someone might try to carry this sideboard away by its overhanging top, perhaps even full of heavy dishes. At the top I used a different method of reinforcement. Screws weren't appropriate there because even if the holes were carefully plugged with tapered face-grain plugs, they would have interrupted the pristine top surface. So instead I made a pair of supports for each end of the top. These supports are glued and screwed to the underside of the top and

PREFINISH BEFORE GLUE-UP

Tape it off and finish it up. *Finish is applied to some parts before assembly to make glue cleanup easier. Areas that will receive glue are taped off.*

Component construction greatly simplifies assembly. *Instead of one big, unwieldy, hair-raising glue-up, there are four smaller ones: two cases, one base and one drawer box.*

Photos, this page (bottom right) and facing page (top left, bottom right): Author

dovetailed into the case sides, mechanically locking the top to the sides.

Finish before reaching the end

I begin applying finish as the parts of a piece are made, before the gluing-together starts—sometimes even before the parts are completed. Although it is a little time-consuming at certain stages of the work, this method saves time in the long run by making errant glue so easy to clean up. Not all surfaces need to be prefinished—just those that are involved in gluing operations or those that will be difficult to finish after assembly. I tape the glue-joint areas before applying finish.

I use only two types of finish for fine furniture: oil finishes (usually a Danish oil) and shellac, both with an overcoat of wax. Either is suitable for use on white oak, but I think the padded-on shellac finish—sort of a French polish but without the intent to fill the pores fully and without the technique associated with that aim—is the more delicate of the two methods, so that's what I chose. For nearly all of the parts of this piece, I used two coats of padded-on shellac. The exceptions were the Port Orford cedar door panels, which required more, and the top surface of the sideboard, which, for durability in use, got a sealer coat of shellac and then several coats of oil. The visible end-grain areas generally needed an extra coat or two of shellac and some éxtra polishing between coats. When the shellacking was completed, I applied an overcoat of furniture wax and buffed up the sheen I wanted—a little, but not too much.

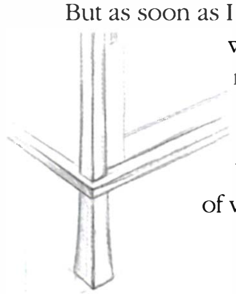
And now for my appalling confession: Despite being skilled with a handplane, I rely heavily on the use of a random-orbit sander to prepare wood for finishing and even between coats of finish. It simply is faster when there's a lot of work to do. I reach for the handplane whenever it looks as though I can get a job done quicker and better that way, but most surfaces get sanded with the random-orbit sander.

At the start of this sideboard job, I had the panels thicknessed by a wide belt sander, so now I could start the random-orbit sanding at 180 grit. I followed that with 320 grit. I used the random-orbit machine even after I'd begun applying the finish, knocking down each coat of shellac with progressively more worn 320-grit discs until I had the fine finish I wanted. On smaller parts I often sand by hand, but it's necessary to go to 400 or 600 grit and sometimes the finest steel wool to get a finish equivalent to the one produced by the sander at 320 grit.

I drilled the holes for the shelf pins after the parts were completely finished. To get a very clean, polished, slight chamfer around the rim of each hole, I used a pointed aluminum-oxide grinding tip in my cordless drill, instead of a countersink bit.

The base: expedient support

My original sketches of the sideboard (see the drawing at left) showed feet tenoned directly into the bottom of the lower case. But as soon as I looked at my mock-up, I could see that the piece would require some additional support underneath. I decided to make a base that was a separate structure screwed to the underside of the lower case. It seemed to me that a little additional mass below would be desirable from an aesthetic point of view as well. To link the base visually with the case

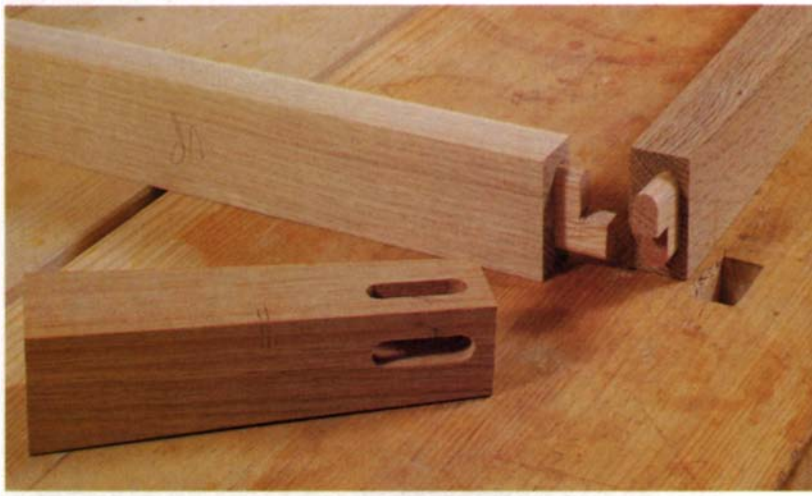


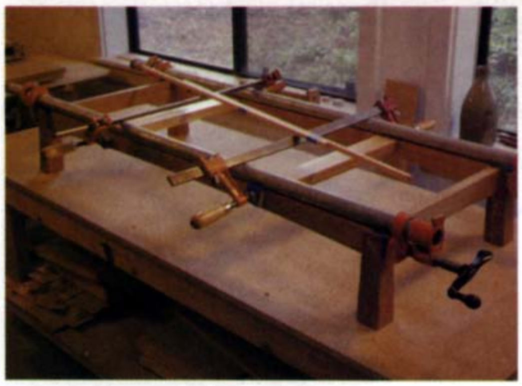
above, I bandsawed an arch along the bottom edge of the rails, echoing the curve of the legs. The rails are fairly thick, and cross braces between the front and back rails, directly under the center of each compartment, give additional support.

The base was assembled with spline-tenon joinery, a strong, simple method that allowed me to build the whole base in a couple of hours. With spline tenons, all of the parts can be cut to exact length on the tablesaw. This makes for great accuracy, and the construction is very expedient, with no tenon shoulders to cut and adjust. I cut all of the mortises on a horizontal mortising machine using a single setup.

To avoid an awkward look in the finished legs, I planed a very slight curve on the two inside faces of each foot to echo the more

BASE BASICS





Slim but strong. *To make a strong base without wide rails, the author made the rails $^{15}/_{16}$ in. thick, added cross braces and notched the spline tenons for deeper penetration into the legs.*

pronounced sweep of the two outer faces. This is a fine point, but it lightened the stance of the sideboard noticeably.

Sliding doors left open

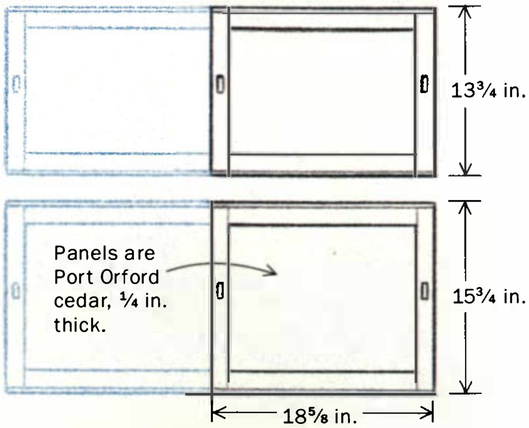
I like sliding cabinet doors. They suit my Japanese-inspired aesthetic, and they are basic to make and quick to fit. They work equally well as flat, unframed, veneered panels (even decorated with marquetry or inlay work) or, as in this case, traditional frame-and-panel constructions of solid wood. They do have limitations, both aesthetic and functional. Foremost among these are the (aesthetic) fact that two doors need to lie in separate planes, and the (functional) fact that, unless the doors are completely removed from the cabinet, only one side of it can be open at a time.

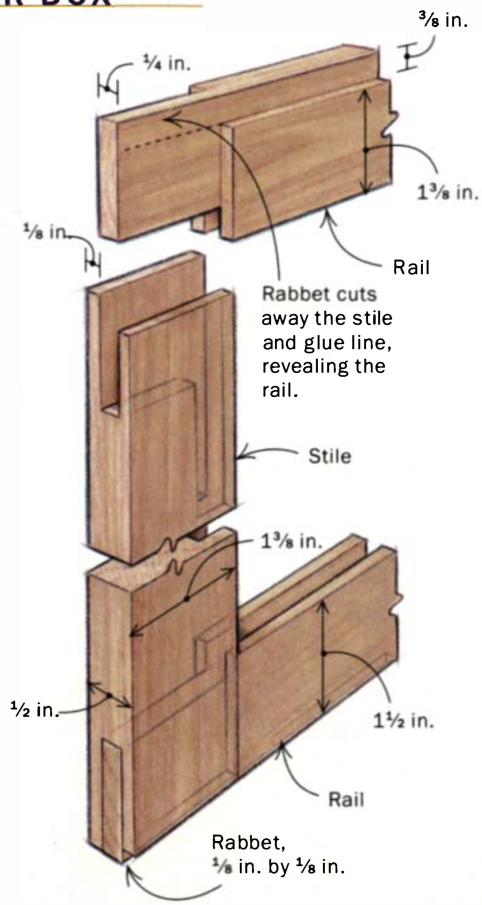
In this sideboard, these limitations worked to my advantage. Be-

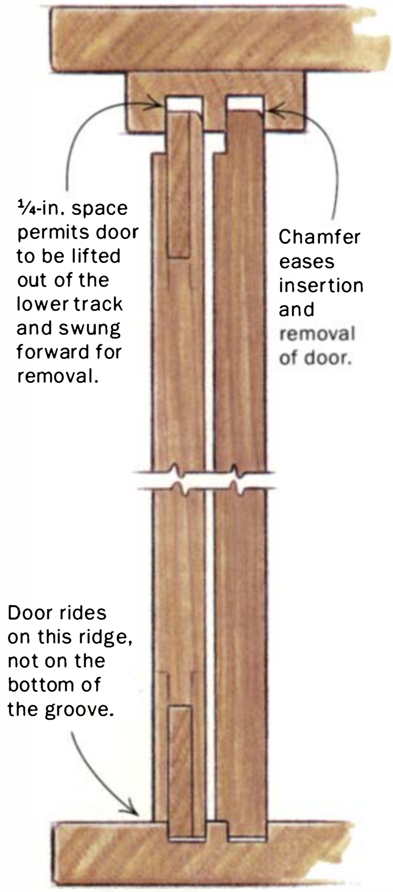
SLIDING DOORS AND THE DRAWER BOX

SLIDING DOORS

Providing closure without hardware, sliding doors are simple, functional and elegant. Bridle-joined white oak frames surround cedar panels. Handles are scooped out on a router table against a high fence.

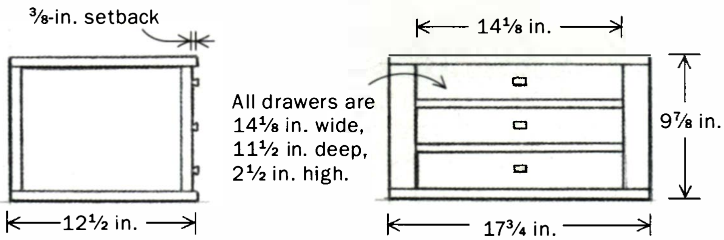


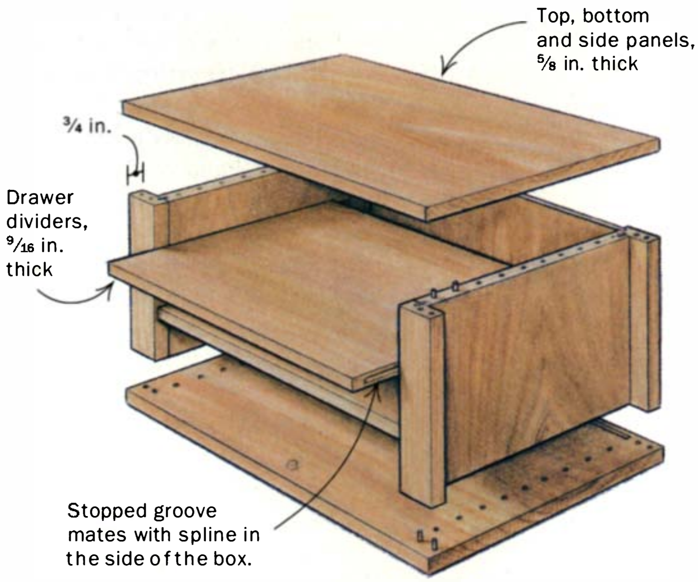




DRAWER BOX

The solid wood box is a separate component, which is indexed on a pin, and can be removed, if necessary. Inset sides facilitate fitting and create clearance on both sides of an opened drawer.





cause I was thinking of it in part as a display case, I had originally thought to have only one upper and one lower door, with a single track in each box, so that two of the four compartments would always be open. In the end I decided on four doors because it gives more versatility and still leaves open the option of using the sideboard for display and letting one door hide behind the other.

A technical point on sliding doors: I always construct them so that the tongue at the bottom of the door does not ride on the bottom surface of the lower groove. Rather, the shoulder in front of the tongue rides on the ledge just in front of the groove. This provides for very smooth running and prevents the door from jumping out of its track. It also prevents problems that might be caused when particles of grit accumulate in the groove.

The drawer box: a separate construction

Rather than building drawer pockets directly into the cases, I decided to fit the drawers into a separate structure that would sit inside the upper right compartment. I liked the idea of this

Photos, this page: Author

DRAWERS

Seth Janofsky doesn't argue the effectiveness of the dovetail joint, but for a change of pace he sometimes substitutes a handsome, half-blind, multiple through-tenon joint of his own devising.

Start with a square groove. *The joint begins with blade-width grooves cut in the drawer sides. Blade height is set to half the thickness of the side. A flat-topped rip blade creates a clean, square-topped kerf.*

Minimortises. *Using a horizontal mortiser and a ⅛-in.-dia. end mill bit, the author cuts through-mortises in the drawer sides exactly aligned with the tablesawn groove.*

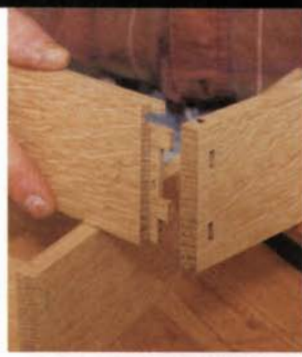
Long tongue. *In the first step toward making tenons, a tongue is made at each end of the drawer fronts and backs with two cuts on the tablesaw. The tongue is as long as the sides are thick.*

File it away. *A file is used to square up the round corners left by the mortiser. This takes time, so be sure to use a sharp file small enough to maneuver easily.*

Mark through the mortises. *To mark out the tenons, the author pushes the tongues into the grooves. Then he traces the mortises with a sharp pencil.*

Quick saw. *A thin saw makes quick work of cutting the tenons.*

Chisel out the middle. *Between the tenons where the handsaw won't reach, the author chops out the waste with a bench chisel. The waste can also be removed with the part held upright on a tablesaw crosscut sled.*



Going home. *The completed drawer, ready to be glued up and then veneered front and back.*

A new face. *Thick, shop-sawn veneers are glued to the front and back, tidying up and strengthening the joint.*

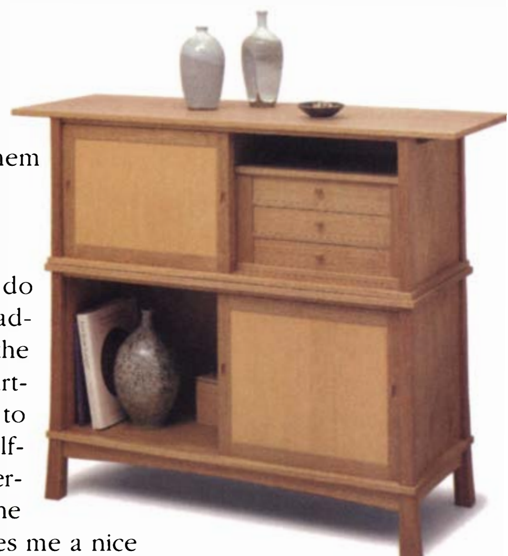
Apt joinery. *Squared-off tenons suit the author's largely rectilinear sideboard.*

aesthetically, and it would simplify the construction as well, breaking it into discrete subassemblies as I like to do.

The construction of the drawer box is similar to that of the two larger cases—a basic solid wood box doweled together. But the drawer box's sides are U-shaped in plan. This permitted the box to be trimmed more easily to fit into the compartment and provided clearance on both sides of the drawers, so there is less risk of the drawers being opened into the back side of a not-quite fully opened door.

The drawer box has two solid wood horizontal dividers in it to create three drawer pockets. To hang the dividers I glued splines in stopped grooves in the box sides and cut mating grooves, stopped at the front, in the ends of the dividers.

When I was fitting the dividers, I first cut them so that they fit tightly between the box sides. Then I took the dividers to the jointer and, standing the pieces on the end grain, I took a fine pass off each end—all but the front 2 in. With the dividers trimmed this way, I could slide them home in the box easily with a little glue in the groove and have them snug up at the front nicely.

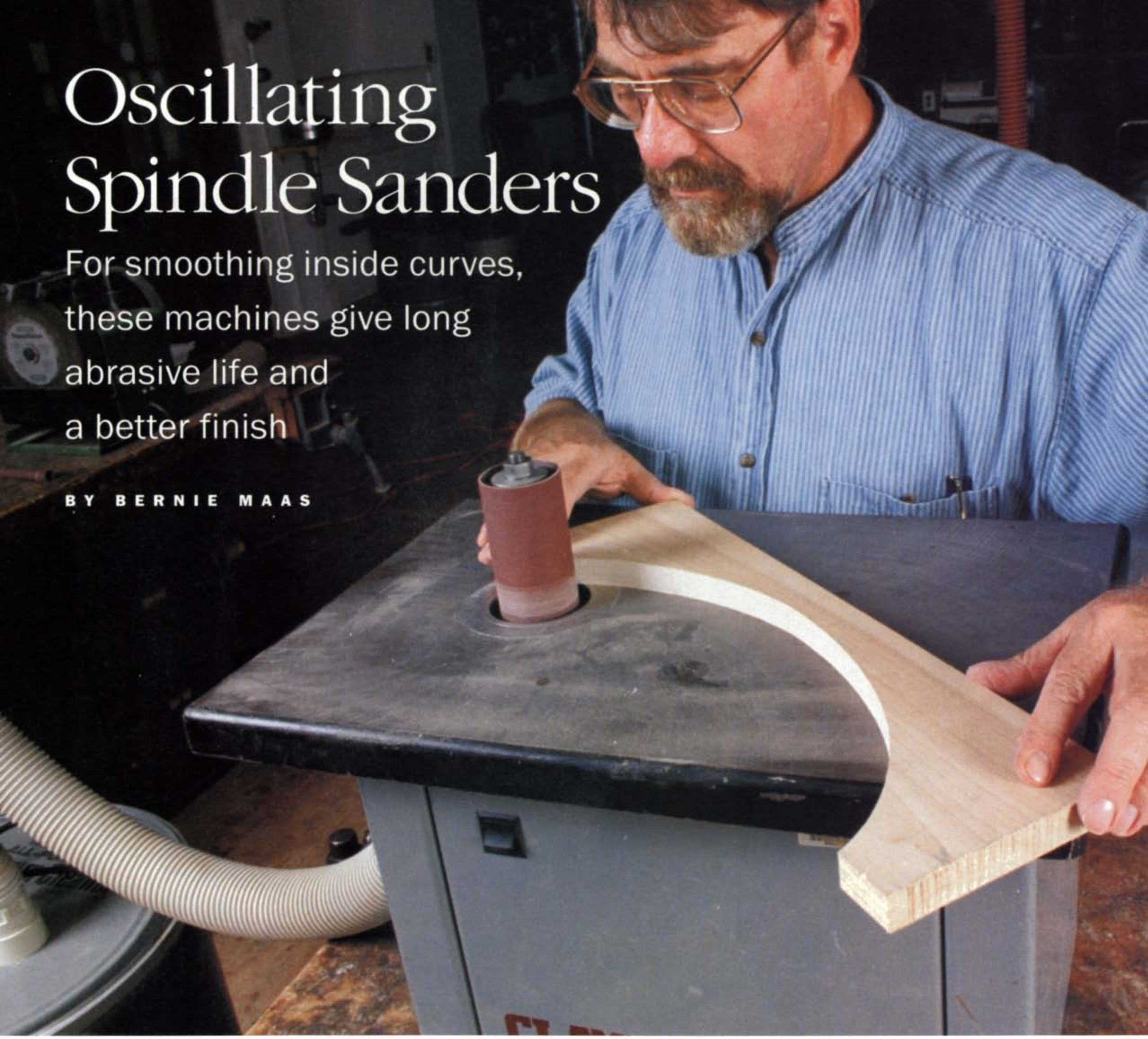


Last bit

Among the last things to do was to install the two adjustable shelves. I fitted the shelves to their compartments and made brass pins to hang them on. I cut half-round notches in the underside of each shelf to fit the pins. This little touch gives me a nice feeling: to drop a shelf on its pins and feel it secure itself snugly in place. This somehow let me finally stand back and admire the completed sideboard. □

Seth Janofsky is a furniture craftsman in Fort Bragg, Calif.

Photos, this page, top (second from left), middle (last two on right) and bottom: Author



Oscillating Spindle Sanders

For smoothing inside curves, these machines give long abrasive life and a better finish

BY BERNIE MAAS

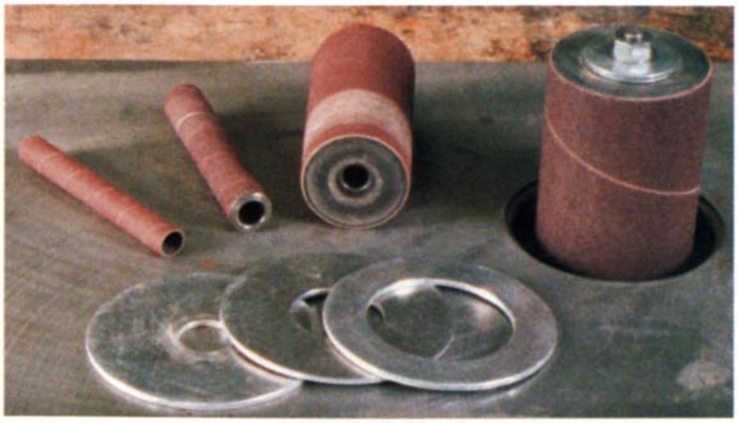
Smoothing concave surfaces can be a chore. If you've tried sanding these areas by hand, you know what I mean. A belt sander works well on outside curves, but it can't follow a concave surface. However, a spindle-mounted drum sander will take the pain out of cleaning up after the bandsaw and jigsaw.

Maybe you've made do with a sanding drum mounted on a drill press or a radial-arm saw. Though inexpensive, this type of drum-sander attachment has several disadvantages. First, the size of the work is limited by the distance between the spindle and the machine's support column. Second, stock removal is slow. With the sanding drum always buried in the work, the abrasive is quickly clogged and glazed. Finally, high spindle speed accelerates the heat buildup and glazing. If you have to sand a lot of interior curves, you'll want a benchtop oscillating spindle sander.

Pick drums to fit the work

An oscillating spindle sander is an ingenious marriage of a drill-press-like quill and cam or crank that allows the sanding drum to move up and down and spin simultaneously. This cyclic motion speeds stock removal by bringing more abrasive into play and allowing some of the abrasive to exit the work briefly for cooling. With a rate of about 60 to 75 oscillations per minute, the reciprocating action minimizes deep scratching. And because the spindle sticks out of the machine's table, like a shaper, there's no structure above the table to limit your work.

All oscillating spindle sanders accept sev-



That's a big drum. *Use the largest drum that fits the work and the correct-size insert for stock support. Large drums produce the best finish in the least amount of time. Some work may require using several drums of different diameters.*

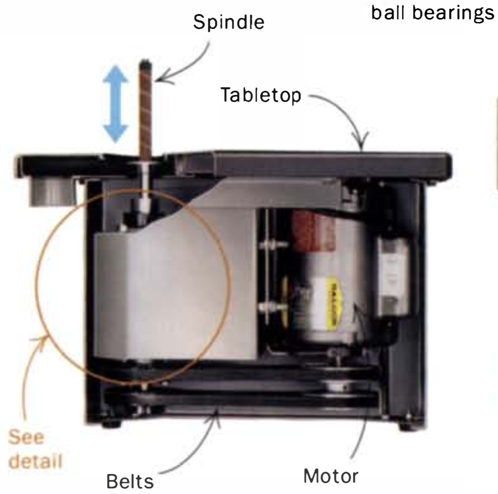
eral different diameter drums. When I lay out interior curves, I try to size each radius to fit one of my array of sanding drums. Usually, I aim for the largest drum that fits. The bigger the drum, the smoother the finished curve. Larger-diameter sanding sleeves, with greater abrasive area, also last longer. Sanding drums are available in standard diameters, from ½ in. to 3 in. Because the sleeves fit over the drums, the actual sleeve outside diameter is about ⅛ in. larger than the nominal diameter.

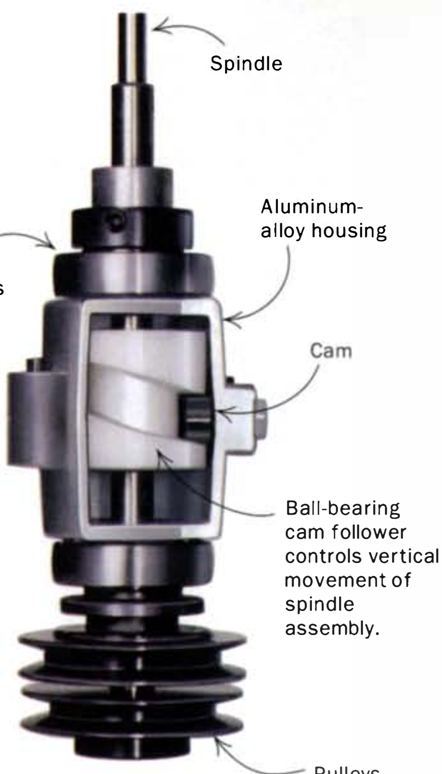
To mount a sanding drum, simply slip the abrasive sleeve over the drum and then slide the drum over the spindle. The retaining nut should be tightened just enough that the sleeve doesn't slip. Overtightening the retaining nut can distort the sleeve.

There are many sizes of table inserts available to close the gap between the drum outside diameter and the table opening. A table insert is critical for stock support and helps vacuum draw for under-the-table dust collection.

ANATOMY OF A SPINDLE SANDER

A drill-press column limits access to interior cutouts. *And with the drum constantly buried in the work, the abrasive will quickly clog, heat up and glaze over.*





DETAIL

A few tips on using the sander

There's no steep learning curve to this machine, but here are a few tips. For the best control, feed against the spindle rotation. Feed pressure should be tangent to the drum, not radial. What's that mean? As you feed, don't push heavily toward the center of the spindle; instead, feed with even pressure both against the drum and in line with the edge of the drum. Pushing toward the center of the spindle produces a washboard surface that is difficult to remove. To reduce heat buildup, work the entire piece from one end to the other, back and forth, allowing one area to cool down while sanding another.

Also, take care in approaching inside corners, where the drum can catch and whip the work out of your hands. Snagging the edge of holes or interior cutouts is possible if the work is cocked. Pick a drum that gives sufficient clearance with the opening.

Take the usual safety precautions for rotating machinery. Stop the machine before placing the work over the spindle. Keep your hair back and avoid dangling clothing and jewelry. Wear eye protection and keep your hands away from the drum. ☐

Bernie Maas is a professor in the art department of Edinboro University, Edinboro, Pa.

Photos, except where noted: Dennis Preston; this page (bottom left and right): Courtesy of Clayton Machine Corp.

Joinery for Curved Work

Full-scale drawings and custom-made hold-down jigs are the keys to cutting accurate joints in curved parts

BY GARRETT HACK

Full-scale drawings help eliminate mistakes. *In addition to helping figure out exactly how a piece goes together, the drawings can be used to transfer layout marks onto stock.*

Many of us began our woodworking journey by building Shaker and Craftsman furniture. The predominantly square edges and flat surfaces common to these styles are ideal for laying out and cutting accurate joinery. But as you mature as a woodworker, you may wish to make curves a part of your repertoire, too.

The slightest curve adds elegance to any furniture design. To my eye, straight lines are nowhere as interesting as curved lines, which capture the imagination. Curved parts can add physical strength to a design while preserving its visual lightness.

Curved surfaces open a whole new realm of furniture styles: Chippendale, Federal and Hepplewhite, for starters. Yes, curves add complexity, especially when it comes to joinery. But with full-scale drawings and custom-made jigs, you can work out the problems of angled joints and cut them using machines and hand tools.

Full-scale drawings are crucial

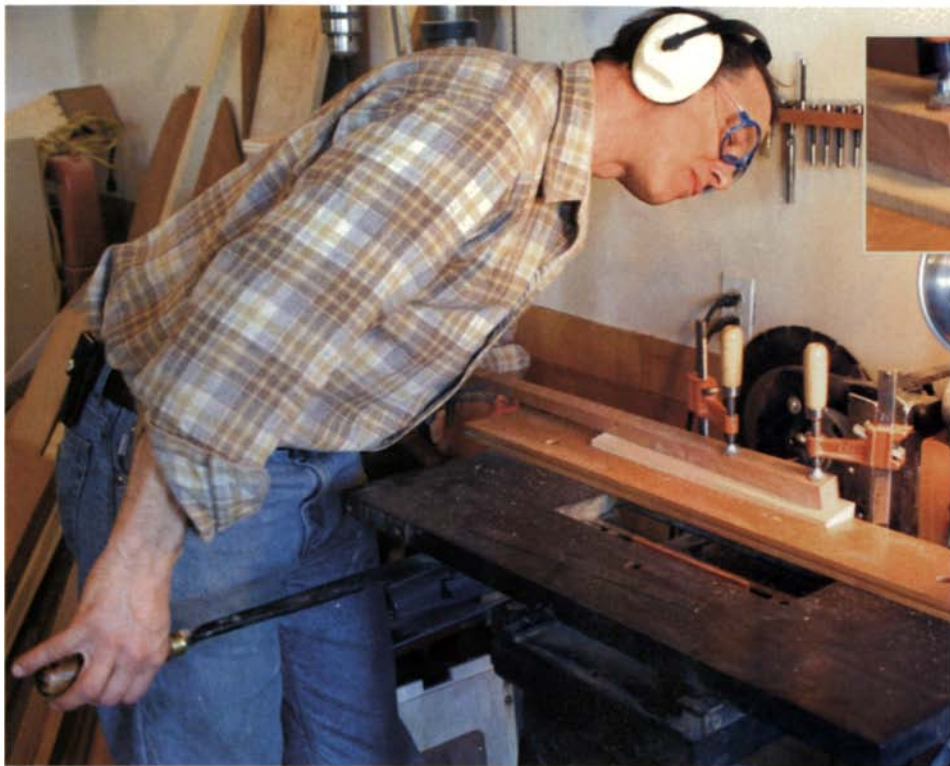
It is difficult to visualize the joinery of curved parts without making drawings. I often start with quarter-scale drawings to work out the overall design, then move on to full-scale drawings to figure out the particulars, which includes joinery.

A project may require one or more views. Two-dimensional curves, such as the edge of a tabletop or the rails of a chair, can be fully rendered in a top (plan) view. The curving back leg of a chair, a common three-dimensional shape, usually requires both front and side views to be fully visualized.

For laying out curves I use thin, flexible wood battens. A typical batten is about ¾ in. wide and 3⁄16 in. thick and is made of a good bending wood such as oak or ash. A steel ruler also works, but it's not very flexible for tight curves. Besides, I prefer the natural curve of a wooden batten. Perhaps I get a slightly less precise curve than I would with a steel ruler, but that is, after all, the way the wooden parts themselves behave when steam-bending or laminating.

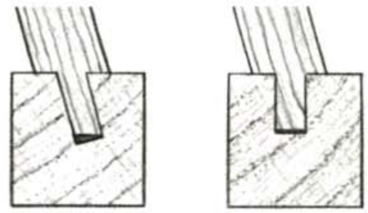
The dilemma of working with curved parts is that they often end up meeting at odd angles. Try to make all of your joinery decisions during the drawing stage, including whether you wish to angle mortises, tenons or both. As a rule, I prefer to angle the mortise and keep the tenon at right angles to its shoulders. That rule is based on the fact that it's easy to get an angled mortise using a horizontal mortiser or a hollow-chisel mortiser. But if I were to cut mortises by hand, I'd lean toward keeping the mortises square because it's tough to chop at a consistent angle using chisels.

During the design stage it's important to visualize how the piece will be assembled. Can you get all of those angled joints together



Machine mortising. *To cut an angled mortise with a horizontal mortiser, orient the stock using angled wedges. The same method will work if you use a vertically mounted hollow-chisel mortiser.*

MORTISE OPTIONS



BY MACHINE | BY HAND

It's easier to cut an angled mortise (left) using a machine. When chopping a mortise by hand, it's easier to keep the mortise straight. Be aware that a severe angle on the tenon may result in weak short grain.

in an orderly progression without stressing some part? And is there a way to jig a part to make the necessary cuts?

Once the drawings are complete, it's a good idea to make patterns of some parts using thin, flexible pieces of wood or plywood. Flexible patterns make it easy to transfer layout marks onto parts, especially when dealing with pieces that have compound curves.

Cut the mortises first using shims to hold parts at the correct angle

Mortises are cut first because it's a lot easier to handplane a tenon to fit than it is to enlarge a mortise by a whisker. I use an old horizontal mortiser modified to accept a router for cutting mortises. Although the sliding table doesn't tilt, I have no trouble cutting angled mortises. I make up wedges or use shims to hold the workpiece at the proper angle (see the photo above). If you use a hollow-chisel mortiser, the same techniques would apply.

Transfer layout marks for the mortises directly from the drawing or from patterns you've copied from the drawing. On a part with compound curves, it's best to use a pattern that can be clamped to the part, then transfer layout marks.

Steam-bent or laminated parts with compound curves usually do not have any true flat surfaces, which can make it difficult to mark out joints accurately as well as to cut parts that mate tightly. To overcome this difficulty, once I've steam-bent or laminated the parts, I plane small flats at the joints. Take, for example, the laminated rear leg of a chair (see the photos at right). After the glue dries, clean up the leg using handplanes. Then use a pattern taken from the drawing to mark the location of joints. Don't mark all of the joinery at once. First, mark the outside edges of where the rail meets the leg. Then plane that section flat, which makes it possible to rest a square or bevel gauge solidly to both lay out the joint and

When possible, design a joint to come together with flat mating surfaces. *Using a block plane, the author planes a flat spot where this compound-curve laminated leg mates with a chair rail.*

Mark the mortise using the matching piece. *Layout marks are transferred from a chair rail onto the leg.*

Cut the mortise. *Depending on the shape of the piece, sometimes it's easier to clamp the workpiece in a vise and chop the mortise by hand than it is to build a complex jig to hold it steady for machining.*

Photos: Anatole Burkin; drawings: Michael Pekovich

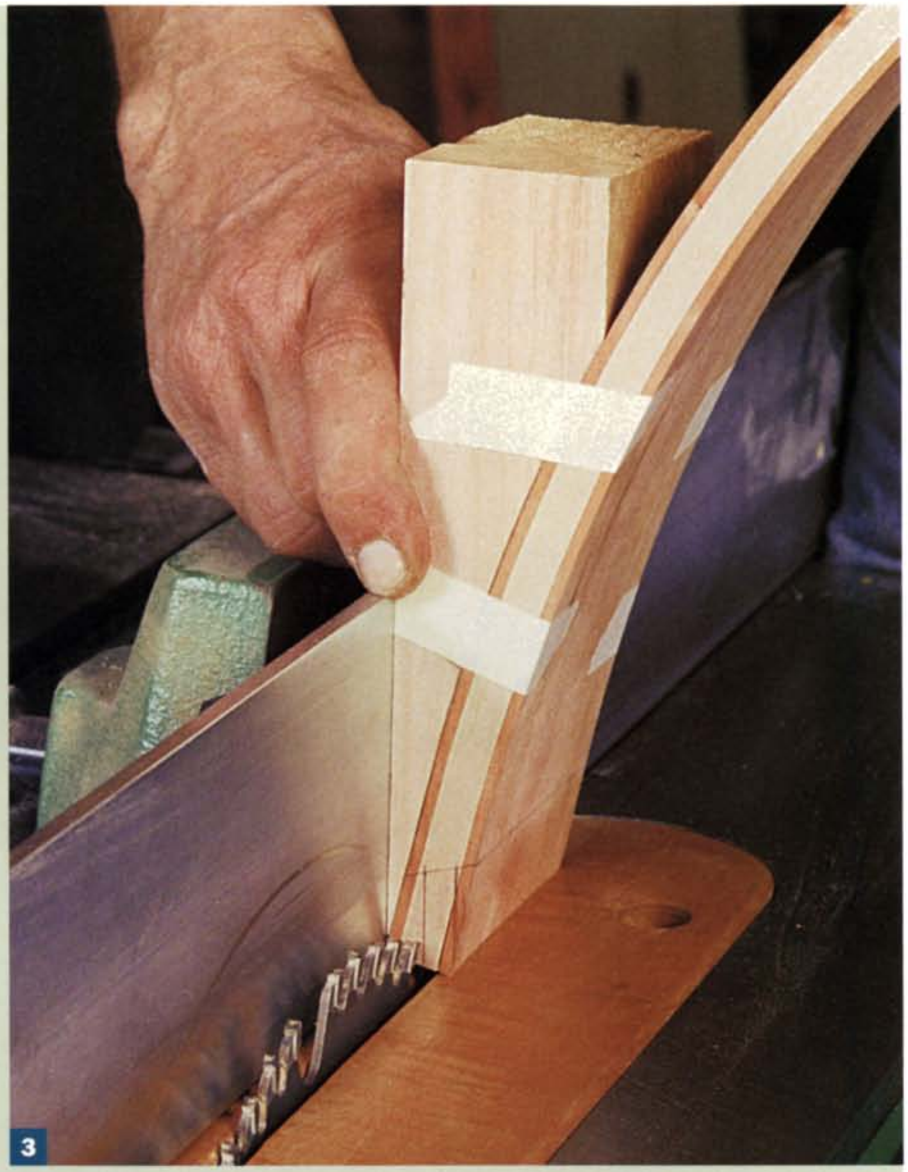
A combination of machines, shop-made jigs and hand tools are often required to cut tenons on curved parts.

1

Use a full-scale drawing to transfer layout marks to a curved piece. *The line to the immediate right of the ruler is an extension of the tenon. The one next to it is a parallel line. Sight the ruler by eye using the lines for guides and mark the tenon.*

2

Mark the shoulder. *Hold a sliding bevel gauge steady against the concave section of a curved piece, such as this table apron.*



3

A large, curved part needs a jig to hold it steady when cutting tenons. *Cut a large shim that mates to a curved part and use the tablesaw's rip fence as a guide when cutting a tenon. Attach the shim using tape.*

4

5

Cut an angled shoulder using a handsaw held at the correct angle. *Refer to the layout marks on the top and edges of the stock when guiding the saw (left). Clean up the shoulder using a handplane.*

Using a tenoning jig

When possible, cut joints before cutting all of the curves. *This chair rail still has one flat face, which goes against the tenoning jig. Bandsaw the convex curve after cutting the tenons.*

If parts are laminated or steam-bent, make a jig for a jig. *A simple jig supports this curved piece at the correct angle and still makes it possible to use a tenoning jig.*

check it as you cut. Shoulder lines will then be straight and a lot easier to cut than if they were curved. At a minimum, I like to leave a flat surface and one—or preferably two—edges square to it.

Once the area has been planed flat, finish the layout and cut the joint. When working with oddly shaped parts, it may be easier to hand-chop a few mortises than it would be to make a complicated hold-down jig. It depends on how many duplicate parts are required in a project.

Parts to be tenoned also require hold-down devices

Curved work frequently relies on parts made from laminations or steam-bending. These parts are generally formed before you can lay out and cut the joinery.

Once the part has been formed, check to see whether it indeed follows the drawing exactly. If it does not, don't worry. Steam-bent or laminated parts don't always obey drawings. If there's a slight deviation due to springback, make changes using the actual part as a drawing template and revise the angles of joints if necessary.

Although I make patterns of many curved parts to aid in transferring layout marks, often all that's necessary is the drawing itself. Just lay parts on the drawing and transfer the layout (see the photos on the facing page). I often add extra lines to the drawing to help with transferring layout lines. For example, in the case of an angled tenon on a curved apron, I extend the lines marking the tenons as well as add a line parallel to it. That way, I can lay a ruler on top of the apron, line it up with the extra lines of the drawing and accurately mark the locations of the tenons.

I prefer to cut tenons on the tablesaw. I have a tenoning jig that works fine with square stock. If possible, I cut tenons using the jig before shaping the curve (see the left photo, above). But when working with already curved pieces, I have to get inventive.

A wide, laminated table apron won't fit in a tenoning jig no matter how hard you try. To cut the tenons on a piece like this on a tablesaw, find some scrap and cut a large shim that will allow you to guide the workpiece safely along the saw's rip fence. Attach the shim to the workpiece with masking tape or double-sided tape.

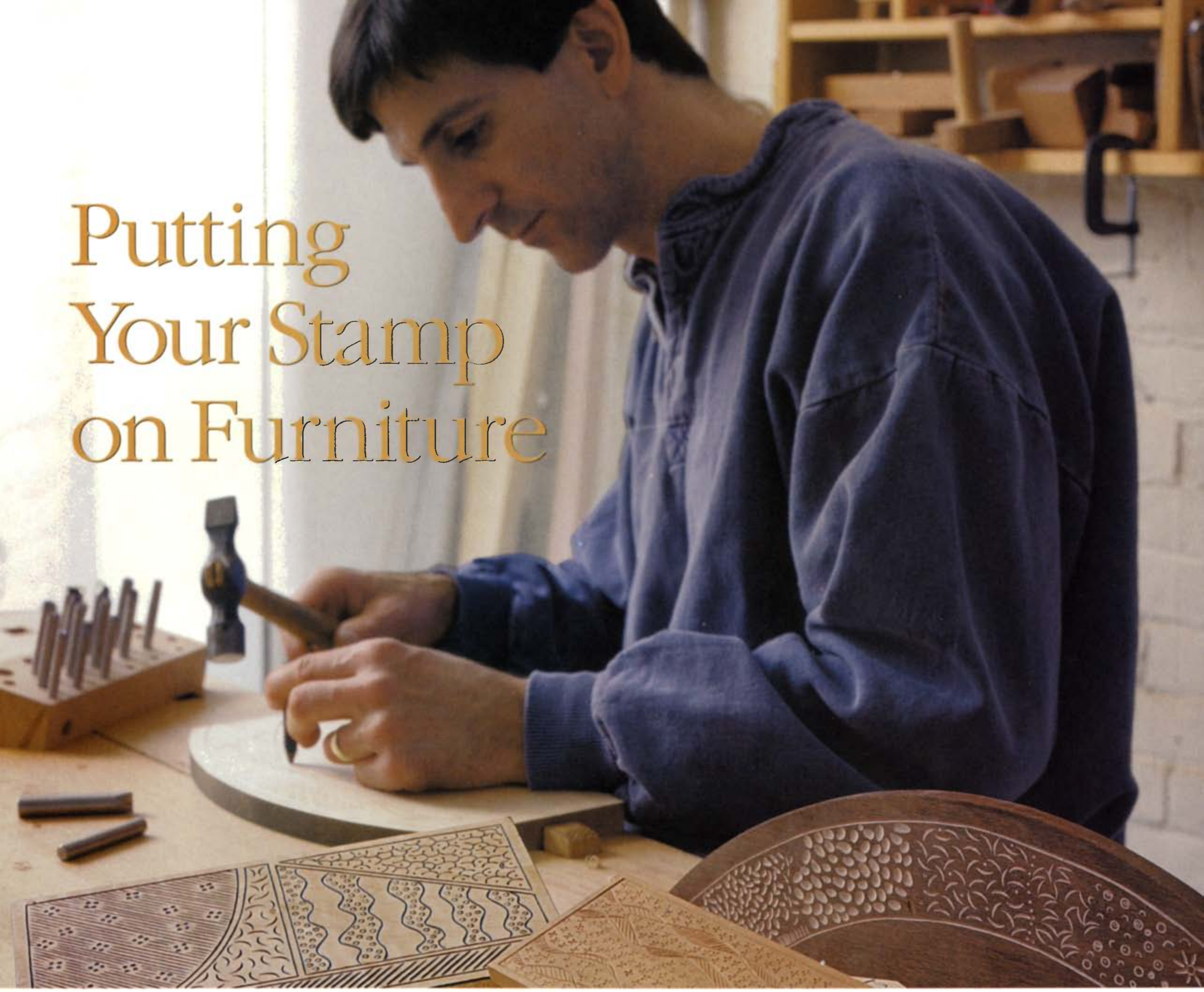
If the workpiece is small and curved slightly, such as a rail of a chair, I make a jig that lets me use my tenoning jig (see the right photo, above). Whenever possible, I design the piece and the jig so that the tenon is cut with the tablesaw blade at 90°. Some designs, however, necessitate tilting the blade, too.

Once the cheeks have been cut, go back to the drawing and transfer layout marks for the shoulders. If the shoulders are angled, transfer the angle using a sliding bevel gauge and marking knife. Cut the shoulders a hair proud using a handsaw and trim them to the line using a shoulder plane.

In the construction of complex, curved work, there are bound to be slight deviations from the drawing. Take time to see how parts are fitting together, and be prepared to make changes. I call this working from reality. Dry-fit parts as you go, and make a new pattern for an adjoining part if something is off slightly. This is good advice in much of furniture building. Using an accurate pattern is a good strategy whenever you have a tricky part to fit. □

Garrett Hack is an author, furniture maker and teacher from Thetford Center, Vt.

Putting Your Stamp on Furniture



A hammer and a few steel stamps are all you need to create striking embellishment on woodwork

BY TIMOTHY COLEMAN

I live in a Massachusetts town that has deep roots in manufacturing, especially in the toolmaking industry. Several years ago I moved my shop to an 1820s brick mill building on the banks of the Green River. Most recently the building was occupied by the Greenfield Steel Stamp Co., a manufacturer of number and letter stamps. The day after the company moved out, I moved in.

While renovating the space, I found steel stamps everywhere: in the cracks of the floor, on window ledges, in abandoned storage shelves. Some were imperfect castoffs; others were in fine condition. Soon I had collected a large box of them. My 3-year-old daughter used the stamps as toys, stacking them like blocks and rattling them in a plastic bucket. I showed her how to hit the stamps with a hammer to make a mark in wood. One day I joined her in playing with them, and it was not long before I was making patterns with the letters and numbers. The patterns were abstract, hieroglyphic, spontaneous and, above all, fun to make. Stamping on wood scraps became part of the daily

Photos, except where noted: Jonathan Binzen routine for my daughter and me, and the more we stamped, the more possibilities I saw for stamping on furniture.

There is a rich tradition in furniture making of creating decorative surfaces with marquetry, inlay, carving and patterned veneer. I use them all. But I have learned that each of these techniques demands a great deal of planning and precise work to achieve the desired effect.

Windfall mill. *The author stumbled upon a cache of steel stamps and a new way of decorating furniture when he rented space in this mill previously occupied by a stamp-making company.*

While I enjoy working this way, I also crave a more spontaneous way of embellishing a surface—one where the planning can happen right on the work. My windfall of steel stamps gave me this freedom. With a few stamps, a small steel hammer and a V-parting tool, I found that I had all I needed to create my own vast catalog of patterns.

A world of patterns

Hit the stamp with a hammer. That's about all you need to know about how to use steel stamps on wood. There is a learning curve with this technique, but it has more to do with creating patterns, selecting wood and designing and making the stamps.

As I began to create my own patterns with stamps and carving tools, I noticed patterns everywhere—on wallpaper, textiles and ceramics, on the pages of children's books, on coffee mugs and on billboards. Once turned on, this awareness could not be turned off. I would record patterns on scraps of paper. I bought books on patterns, and I worked out my own with crayons and markers when I colored with my kids.

What most captivated me was the way a few simple shapes could be combined to create a striking overall effect. A crescent shape, a dot and a letter O, for example, could be arranged in dozens of combinations. Lately I have been working with patterns that resemble lacework. I have found these three shapes to be remarkably versatile in this kind of pattern work.

I develop most of my patterns on sample boards. The samples have become my sketchbook, and I have filled boxes with them. I begin with a few stamps and combine them in different arrangements until an interesting pattern emerges. I experiment with both random and ordered effects. I arrange the marks loosely, and I cluster them tightly. I put them in rows. I invert the rows. I add a V-groove to break up a row or to separate a stamped section from an open field. I border a random arrangement of shapes with an ordered arrangement of the same shapes. I create a grid or add a few strategically placed lines with a V-parting tool or a veiner to add definition. I work quickly and by eye with very little marking out. I am spontaneous and playful and often surprised by what emerges.

I try to carry this spontaneity onto my finished pieces, working with as few layout lines as possible. It's not difficult to fill a space with reasonably regular marks. If I'm stamping along a line, for instance, I simply estimate the center point and make a stamp there. Then I estimate the center points of the two halves and stamp them and continue this way until the

BUILDING THE PATTERN

Begin with a V-groove. *The author follows a pencil line with a V-parting tool to cut grooves that establish the radius of the pattern.*

Crescent lays the groundwork. *Referring occasionally to his sample pattern, the author begins a pattern by stamping the large crescent, judging the spaces between marks by eye.*

Filling in. *With the grooves and the first stamp having established a framework, building the rest of the pattern is a matter of filling in.*

continued on p. 60

Photos, this page: Author (left) and Dean Powell (top right)

BUILDING THE PATTERN (continued)


Circle stamp. *A letter O stamp on the waves of crescent stamps provides definition on the outside edge of the pattern.*


Making lace. *The small floral stamp fills the band between the grooves, adding to the impression that this embellishment might have been sewn rather than stamped.*


Black makes it jump. *Applied after a coat of sealer, black lacquer amplifies the stamped pattern. A scraper makes quick work of removing the black lacquer from the unstamped surfaces.*

space is filled. The slight irregularities that come from working by eye give the patterns a lively, handworked feeling.

Woods and colors

The woods I prefer are light colored, have a firm texture and have closed pores. Maple, pear, English sycamore, beech and cherry all work well. I have had limited success on open-pored woods such as mahogany and walnut. I must choose stamps carefully for these woods because small, delicate shapes stamped in them tend to lose their definition.

Sometimes I add color to the patterns. While color is not necessary to make stamping an interesting addition to a piece of furniture, it can make certain patterns jump. I have used colored lacquer and gesso, as well as tinted varnish and shellac. After I have done the carving and stamping, I apply a sanding sealer to the surface to keep the colored finish from migrating into the wood's pores. If I will be spraying lacquer, I use a vinyl sealer; with the other finishes, I simply use a thinned, untinted coat of the main finish as a sealer coat. Then I spray or brush the color medium. When it dries, I scrape or sand off the color from the surface, revealing the color-filled stamped pattern underneath. I have spent many months developing coloring techniques, and I have had as much failure as success. The difficult part is keeping the color from migrating into the surrounding wood.

How to make steel stamps

When I first used my inherited stamps, I covered sample boards with various patterns of letters and numbers. I discovered that some of the stamps worked well as I found them, particularly zeros and Xs. But most of the stamps, designed to make an imprint on metal, did not make a mark in wood that was as crisp and defined as I wanted. I thought that if I could modify them and create my own stamp figures they would be much more useful to me.

The stamps I found were made of hardened steel. I knew that I should be able to soften, or anneal, the tip of a steel stamp by heating it red hot with a torch and letting it cool. The stamp could then be worked easily with conventional files. Using this method, I made a collection of reworked stamps in a variety of shapes and sizes.

Recently I have been making stamps from new steel. I buy unhardened O-1 steel in 36-in. rods from an industrial supplier (McMaster-Carr: 732-329-3200). I have a machinist cut the rod into 3-in. pieces. On some of the pieces I have him grind facets on one end to create a four-sided or six-sided blank; this gives me some stamps that create round patterns and others that create square or hexagonal ones. Recently I bought a selection of ¼-in., 5/16-in., 3/8-in. and ½-in. rods, and I had them cut to length and faceted. I ended up with some 120 stamp blanks for a total of about $150. The rods can also be cut with a hacksaw and worked with a flat file to create the facets.

To create the figures on the blanks, I usually begin by drawing the shape on the end of the blank. I then use a variety of half-round, triangular and knife-edged files to create the shapes. I have three sets of needle files in varying degrees of coarseness for roughing out and finishing off the shapes. I use flat mill files to work the outside edges of shapes.

I can make most stamps very quickly—it takes about 20 minutes to make a simple shape such as the one in the photos on the facing page, and up to an hour to make a more complex shape such as a five-pointed star with a hole in the middle. Along the way I try them out to see what kind of mark they make and refine them as needed. Perhaps the angle on the sides needs to be changed or the size of the figure itself needs to be larger or smaller. In the same way I am always reworking my old stamps. A stamp that works in one circumstance may need to be altered to perform well in another.

If you prefer to buy steel stamps that are ready-made, there are a variety of mail-order sources. MSC machinists' catalog (800-645-7270) carries number, letter and a few symbol stamps. The Highland Hardware catalog (800-241-6748) has a selection of decorative stamps in hardened steel made expressly for use on wood.

Which shapes are best?

I have learned that some stamp shapes work better than others and that stamps behave differently in different woods. I try to keep the amount of steel that enters the wood to a minimum. Sometimes I drill a hole in the center of the blank. This reduces the bulk of the stamp, and it also allows me to create a circle stamp or to use the hole as the nucleus for a figure.

I file fairly steep angles on the edges. This creates a slight wedge effect and makes a mark that is larger than the tip as the stamp goes deeper into the wood. The idea is to make a clean impression in the wood. A stamp with a rounded tip or ragged edges will tend to crush the wood fibers and distort the intended shape. Often I bring the tip of a sharp, chisel-edged shape (such as a crescent) to a polish with sharpening stones and a buffing wheel so that it enters the wood more cleanly. On shapes with a blunt tip (stars, parallel lines), I make sure that the stamp face is very smooth and flat. To do so I hold the stamp in a right-angle jig and use a mill file to establish the initial flat. I then use the same jig on a sharpening stone to remove the file marks.

I am drawn to simple shapes rather than to complex ones. I have come to favor arcs and crescents in various sizes, sharp and blunt dots, star shapes, circles, parallel lines and checkerboards. Simple shapes also make clean marks. I keep several sizes of the same shape so that a pattern can be scaled to different uses—on a border, filling a field or adding texture.

My work with steel stamps has been an adventure. From my first encounter with the stamps through my immersion in the world of patterns, I have been pulled along by the excitement of new discoveries. The technique is fresh and versatile, and as my pattern vocabulary grows, I find more ways to use stamping on my furniture. What began as a very primitive way of playing with tools and wood has become an essential component in my repertoire of decorative techniques. □

Timothy Coleman designs furniture in Greenfield, Mass.

STAMP MAKING

Worked with an assortment of small files, a raw blank of tool steel becomes a finished stamp in a matter of minutes.

1. Blank layout. *Pencil lines guide the initial file cuts.*

2. Thin goes in. *The author uses a Japanese saw file to score the end of the blank in a star pattern.*

3. File me deep. *A variety of wider files create the V-grooves that take the blank to its final shape.*

4-5. A quick jig. *A right-angle jig and a flat file make quick work of flattening the end of the finished stamp. The same jig is used on the sharpening stones to bring the end of the stamp to a polish.*

6. I got the opposite impression. *As with other kinds of printing, designing stamps requires you to envision the reverse of the shape you want to create in wood.*

Turbine HVLP Sprayers

(high-volume low-pressure)

We take a look at several units that sell for under $500

BY CHRIS A. MINICK

My mother bought a new vacuum cleaner about 40 years ago. Packed in the box with the accessories was a crude, plastic spray-gun attachment. The gun attached to one end of the vacuum-cleaner hose that was also mounted to the blower of the vacuum-cleaner motor. One afternoon when Mom was out of the house, I dragged her new vacuum cleaner to the basement and spray painted several of my model airplanes. I didn't know it at the time, but this was my first experience with high-volume low-pressure (HVLP) spray equipment.

HVLP technology may have remained that simple had it not been for the South Coast Air Quality Management District (SCAQMD) in Los Angeles. For decades, high-pressure, compressor-driven spray equipment was the only game on the block. The equipment is extremely versatile, spraying anything from water-thin liquids to molasses-thick paste. However, this versatility comes at a price: The spray gun must be tethered to a large, high-output, high-pressure compressor. Also, the transfer efficiency—a measure of how well the gun delivers the finish—of these spray guns is notoriously bad.

In the early 1980s, SCAQMD and other air-quality agencies across the country enacted stringent regulations that require spray guns to have transfer efficiencies of 65% or higher, running at air pressures of 10 psi or less. High transfer efficiency and low overspray translate into more coating on the project and less in the air—better for the sprayer operator and the environment.

Compact, self-contained and portable

Unlike conventional high-pressure spray guns that hook up to large-volume compressors and are sold separately, HVLP sprayers are sold as complete units consisting of a gun, a turbine and an air hose.

HVLP turbines are smaller than most compressors. This unit weighs less than 13 lbs. and is less than 12 in. high.

The limiting factor for HVLP systems is the amount of atomization pressure at the tip of the gun. A gun with only 2.8 psi, for example, cannot spray undiluted conversion varnish.

TURBINE POWERED

HVLP sprayers are driven by high-speed compression fans that rotate at about 20,000 rpm. Each fan is called a "stage." In general, the more stages, the more varieties and thicknesses of finish the unit can spray.

Photos, except where noted: Michael Pekovich; this page (top): William Duckworth

Keep Getting Better

WHAT TO LOOK FOR BEFORE YOU BUY

Most stores will let you check out an HVLP sprayer before you plunk down your cash. Here are six things to look for:

1 Check the atomization pressure at the spray gun's tip with an inexpensive pressure gauge: 2 psi is the minimum required to spray most finishes successfully.

2 With the turbine running and gun attached, check air-hose flexibility. You should be able to maneuver the gun into tight spaces without straining your arm and without the hose getting in the way.

3 Measure the air temperature at the end of the hose with the gun detached. Temperatures higher than 120°F tend to clog the nozzle and air cap, especially with water-based finishes.

4 Inspect the spray-gun air cap. It should have clean air holes and a smooth surface.

5 Smell the air exiting the gun. Vapors from the plasticizers used in the manufacturing of the air hose may be irritating.

6 Inspect the spray-gun cup for corrosion; don't buy a corroded cup.

To comply with the new regulations, companies developed two distinctly different spray-gun systems. Manufacturers of high-pressure sprayers, such as Binks and DeVilbiss, modified their basic high-pressure guns, creating one that converts high-pressure, compressor-supplied air to low-pressure (10 psi or less) air at the air cap. This type of gun, for obvious reasons, is known as a conversion HVLP spray gun. The original conversion guns met all regulatory requirements, but they were tremendous air hogs. Consuming air at a rate of 20 cu. ft. per minute (cfm) or higher, just one spray gun required a 10-hp compressor. Large shops could accommodate conversion guns, but small, custom shops did not have the air power to run them.

This sprayer runs on hot air, too. *Since 1938, some vacuums have come with a spray-gun attachment.*

To answer that market need, the turbine HVLP spray gun was born. In this system a small, high-output blower (the turbine) supplies a high volume of low-pressure warm air through a fairly large-diameter hose. Each component—turbine, hose and spray gun—plays a critical role in the overall performance, which is why turbine HVLP sprayers are sold as a complete system rather than as individual components. These compact, self-contained, portable spray systems are increasingly popular with wood workers, especially as the prices continue to drop. I looked at five HVLP turbine systems that sell for under $500. Here I'll share the results of my tests and give you some tips on selecting a system that will work for you.

Turbines drive the air supply

Turbine, in HVLP vernacular, is a fancy term for a vacuum-cleaner motor. Motors manufactured by the Ametek Lamb Electric

American Turbine AT 950

PRICE: $495

Pros
The AT 950 is the most compact, portable system of those tested. The gun is made of metal, and the system has an air-reducing valve to regulate atomization pressure.

Con
The air hose is slightly stiff.

Campbell Hausfeld HV 3000

PRICE: $399

Pros
The HV 3000 has a convenient built-in hose-storage rack on the turbine, and an interchangeable fluid nozzle and fluid needle are supplied. The system also has an air-reducing valve to regulate atomization pressure.

Cons
The air hose on the HV 3000 is located at the top of the gun, making the unit awkward to use. The trigger is located too far forward for comfortable use, and a squared-off grip adds to the discomfort. The air hose spews a high concentration of plasticizer vapors during use. The air cap causes an irregular spray pattern, and the gun produces a large volume of overspray. Overall, the unit has poor transfer efficiency. The spray-gun cup of the unit tested was corroded out of the package.

Lemmer T-55

PRICE: $375

Pros
The T-55 is an extremely comfortable sprayer to use, and it comes with a well-written, informative instruction manual. Of the units tested, the T-55 has the best turbine filtration. The sprayer comes with a viscosity drip cup and is equipped with a 14-ft. power cord.

Cons
The T-55 has a slightly stiff air hose and no air-reducing valve.

Apollo 700

PRICE: $499

Pros
The 700 is the most comfortable sprayer to use. It has an extremely flexible air hose, filters are easy to replace, and the plastic handle stays cool during use.

Cons
On the downside, the 700 has no air-reducing valve to regulate atomization pressure, and it produces a spray pattern that's not elliptical (left). Also, I found the manual to be poorly written.

Wagner 2600

PRICE: $499

Pros
The 2600 is a well-balanced sprayer with an industrial-quality, nonbleeder gun. The sprayer has a flexible rubber air hose, which makes the unit easy to maneuver. The system has an air-reducing valve to regulate atomization pressure and achieves very fine atomization. The 2600 had the least amount of overspray in the test (left). For convenience, the spray gun is stored in the turbine housing.

Con
The only problem with the 2600 is that it has small turbine filters.

MODEL	APOLLO 700	LEMMER T-55	CAMPBELL HAUSFELD HV 3000	WAGNER 2600	AMERICAN TURBINE AT 950
TURBINE INFO					
Amps	10	8	12.5	11	8
Stages	2	2	3	3	2
Diameter	5.7 in.	5.7 in.	5.7 in.	5.7 in.	5.7 in.
AIR OUTPUT					
Per manufacturer	112 cfm	55 cfm	65 cfm	80 cfm	52 cfm
Measured at hose	23 cfm	25 cfm	38 cfm	40 cfm	31 cfm
Measured at gun	11 cfm	15 cfm	13 cfm	15 cfm	13 cfm
AIR PRESSURE					
Per manufacturer	4.5 psi	3.9 psi	6 psi	6 psi	4.25 psi
Maximum	3.75 psi	3.5 psi	5.25 psi	5.75 psi	3.5 psi
Atomization	2.8 psi	2.5 psi	4.25 psi	4 psi	2.8 psi
TEMPERATURE					
Measured at hose	134°F	104°F	126°F	112°F	99°F
Measured at gun air cap	114°F	88°F	115°F	84°F	85°F
SPRAY GUN INFO					
Type	Bleeder	Bleeder	Bleeder	Nonbleeder	Bleeder
Hose connection	Handle	Handle	Top	Handle	Handle
Fluid nozzle orifice size	1mm	1.4mm	General purpose	1.3mm	1mm
Gun body (material)	Aluminum	Aluminum	Plastic	Aluminum	Aluminum
Gun cup (material)	Aluminum/ Teflon	Aluminum	Aluminum	Aluminum	Aluminum
Air-reducing valve	No	No	Yes	Yes	Yes
Transfer efficiency	60%	65%	50%	67%	69%
Overspray	17%	14%	34%	11%	16%
Atomization	Fine	Fine	Coarse	Very fine	Fine

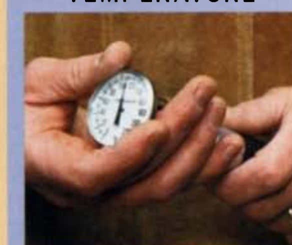
AIR OUTPUT

Measurements of actual air output, made with an anemometer, did not agree with those of most of the manufacturers.

AIR PRESSURE

The air pressure at the **spray-gun tip** is what counts. A small difference in this atomization pressure can make a big difference in how well these systems work, especially with some water-based finishes.

TEMPERATURE



Turbine systems throw out a lot of hot air. Some manufacturers assert that the warm air generated by the turbines causes the finish to flow out more smoothly—a claim the author disputes.

Co. propel the majority of HVLP systems produced in North America. The motors drive small, high-speed compression fans. Turbines are rated by the number of fans—called stages—attached to the central motor shaft. Single-stage turbines have one fan, two-stage turbines have two fans, etc. More stages translate to higher airflow and higher air pressure at the spray gun. You might reason that the airflow figures would be a good way to compare turbine power of different HVLP systems, but this is not necessarily true. I found the air-output ratings in the manufacturers' literature to be practically useless for comparison purposes. For example, the air output for the Apollo 700, a two-stage unit, is rated at 112 cfm while the output for the Lemmer T-55, another two-stage unit, is rated at 55 cfm. According to the Ametek Lamb data sheets, the outputs should be almost identical.

I talked with an airflow engineer to find out how to determine accurate airflow values. Following his advice, I constructed a test chamber with a 6-ft. section of 6-in.-dia. heating duct and ran my own airflow tests. I borrowed a hot-wire anemometer—a device used to measure airflow—to measure the air output of each HVLP turbine at the end of the air hose and at the air cap of

Photos, this page: William Duckworth

the spray gun. The results startled me. According to my measurements, Apollo's air-output values dropped 80%, to 23 cfm, when measured at the end of the hose and to 11 cfm when measured at the spray gun. However, the Apollo unit was not alone. I concluded that all of the manufacturers in this test dramatically overstated the air output of their respective turbines (see the chart on p. 65). Clearly, air-output numbers published in the manufacturers' literature are of little value to the consumer. But fortunately, airflow figures don't mean as much as the atomization pressure, which is the real key to successful spray finishing.

Atomization pressure at the spray gun is the best measurement to use to compare turbine HVLP spray systems. Best of all, you can check it in the store before you lay your cash on the line. All you need is an accurate pressure gauge that will measure from 0 psi to 10 psi.

I purchased a fuel-pump gauge at an auto-parts store for $15 and used it to measure the air pressure at the end of the supply hose and the atomization pressure at the air cap on the spray gun. Once again, I found little correlation between my measured pressures and the manufacturers' published atomization pressures. On average, my figures were about a third less than those claimed by each manufacturer. The notable exception was Lemmer, which actually understated the atomization pressure on its model T-55 gun by about a third. The difference between 4.25 psi and 2.8 psi may not sound like much, but it makes a big difference in gun performance. To put these numbers in perspective, at 4 psi you can spray an undiluted conversion varnish; at 2.8 psi you cannot.

The fans in a typical HVLP turbine rotate at about 20,000 rpm. That much speed generates a lot of heat, warming the air supply to the gun. As far as I can tell, warm air is more of a nuisance than a benefit. Some manufacturers claim that the heat helps the finish flow out better, but I doubt the finish is in the airstream long enough to warm up appreciably. However, the warm air does heat up the air cap and the fluid nozzle, drying out and eventually clogging the gun with any overspray that may land on those parts. This is not a serious spraying problem; it's just a cleanup problem, especially on the units that generate higher temperatures. Still, if all else were even, I'd purchase the cooler outfit. After 10 minutes of operation, I measured the temperature with a dial thermometer.

A spray test of three finishes

I sprayed almost 6 gal. of finish (polyurethane varnish, nitrocellulose lacquer and a spray-grade water-based finish) with the five HVLP systems I looked at. None of the units had trouble spraying any of the finishes. However, some systems performed better than others.

I was particularly impressed with the low overspray and fine atomization pressure of the Wagner 2600. The American Turbine AT 950 and Lemmer T-55 were close second choices. I had trouble adjusting the needle-packing gland on the Apollo 700 spray gun, and I never did get it adjusted to my complete satisfaction. Either the packing was too tight, which prevented the needle from stopping the fluid flow, or it was too loose, and finish dripped onto my hand. The Campbell Hausfeld HV 3000 produced a coarse spray that left noticeable orange peel on the sprayed surface. It also left heavy stripes in the finish because of a poor air-cap design.

Unfortunately, the HVLP sprayer industry does not adhere to any standard test methods for evaluating spray-gun performance. Each manufacturer develops its own spray tests, which makes it difficult to compare systems based on manufacturers' claims. To determine how well these systems lived up to the claim of high transfer efficiency and low overspray, I conducted a series of quasiscientific tests in my shop.

High transfer efficiency and low overspray are the hallmarks of HVLP sprayers. I've seen claims of 90% transfer efficiency for some industrial sprayers. It may be possible to achieve 90% transfer efficiency if you spray only the center of a large, flat panel, but few of us rarely have to do only that—we finish three-dimensional furniture.

For my tests I built three plywood boxes, 24 in. long by 12 in. wide by 10 in. high, to simulate a piece of furniture. By weighing the spray gun and the boxes before and after each test, I was able to calculate the transfer efficiency. I tested each HVLP unit three times, then I averaged the results to arrive at the transfer efficiency shown in the chart on p. 65. To keep things fair, I sprayed the same finish with each gun after adjusting each one to produce a 6-in. spray pattern. I was surprised at the high transfer efficiency achieved by all of the units I tested. A 69% transfer efficiency is great in anybody's book.

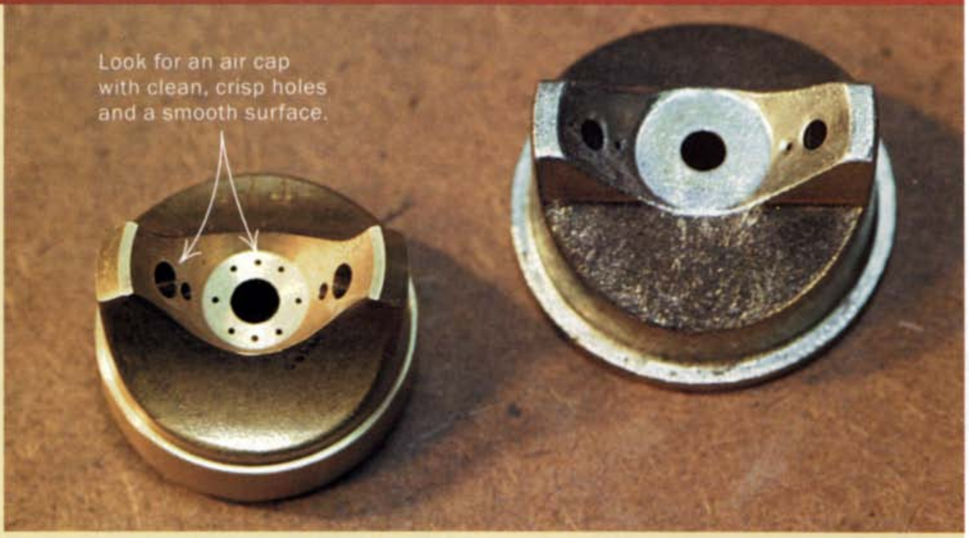
Overspray and atomization are more subjective measures. Overspray means different things to different finishers. To me, overspray is that small amount of finish that falls back onto the sprayed surface, giving a rough tex-

Hoses should be flexible

Crush resistance and flexibility are two things I look for in an air-supply hose of an HVLP system. Invariably, you will step on the hose while spraying, and a crushed hose will cut off the air supply at the gun. All units passed my crush test with flying colors. Hose flexibility is another matter.

A stiff hose makes the spray gun difficult to maneuver, which may result in a poor spray job. Apollo attaches a short length of highly flexible hose between the gun and the air-supply hose. This arrangement provided the best maneuverability and made it the most comfortable sprayer to handle. The Wagner unit is equipped with a heavy-duty rubber hose that provided nearly the same flexibility. The hoses of the other three sprayers felt a bit stiff by comparison.

Except for Wagner, all of the manufacturers provide plasticized vinyl air hoses with their sprayers. Vinyl hoses tend to stiffen as they age—especially at the elevated operating temperatures of these sprayers—because the vinyl emits the plasticizers that make it flexible. During normal operation, all of the vinyl hoses gave off an irritating smell. The concentration of plasticizer vapors spewing from the Campbell Hausfeld



Which air cap delivers a better finish? *A well-machined air cap, such as the Lemmer (left), had a more efficient spray pattern with less overspray than the Campbell Hausfeld cap (right).*

ture to the finished piece. To evaluate this elusive but important parameter, I placed a grid over the test spray pattern and simply compared the number of squares inside the central spray pattern to the total number of squares with finish in them. Simple division yielded a percentage. Although this test may not be absolutely accurate, the overspray values I calculated reflect what I observed in my spray booth. Overspray of 20% or less is acceptable in most cases. Atomization is a purely arbitrary value based on my spraying experience with high-pressure and other HVLP systems. Very fine atomization is similar to that of a high-pressure gun; coarse atomization is not suitable for furniture finishing.

To compare the test sprayers with standard high-pressure equipment, I conducted the same series of tests with my Binks model 95 high-pressure spray gun. My trusty Binks was the hands-down winner of the atomization contest, but it exhibited a miserable 42% transfer efficiency and an immeasurably high overspray.

The air cap has a major influence on transfer efficiency, overspray and overall performance of any spray gun. A good-quality air cap will have clean, crisp holes in the air horns and a smooth surface without any bumps (see the photo above).

unit during my air-output tests was high enough to make my eyes water and my breathing difficult. I had to turn on a ventilation fan and leave the shop. By contrast, the rubber hose on the Wagner gave off no detectable smell.

Low-pressure guns work differently

Turbine-driven HVLP spray guns and conventional high-pressure spray guns look the same, but the insides are entirely different. The large air passages inside an HVLP gun make it beefier than a conventional spray gun. (I prefer the added bulk, because it fits my hand better.) But that's not the only difference between the two designs. The HVLP guns lack the fan-pattern adjustment knob commonly found on high-pressure spray guns. Instead, the fan pattern of an HVLP gun is adjusted by moving the air cap in or out, relative to the fluid nozzle. Unlike high-pressure guns, most HVLP guns are bleeder-type guns. Air flows (or bleeds) through the gun continuously, even when you're not spraying the finish. For that reason, I find bleeder guns bothersome. The constant flow of air stirs up dust in my shop, and the noise is annoying. Nonbleeder, turbine-driven HVLP guns, in which all airflow stops when you release the trigger, are usually found only on high-priced industrial spray systems. But to my surprise, the Wagner 2600 system comes with an industrial-quality, nonbleeder gun as standard equipment.

A basic tenet of spray finishing is that thinner finishes require less atomization pressure than thicker finishes. By keeping the pressure set to the minimum required to atomize a finish, you can greatly improve transfer efficiency and decrease the amount of overspray. To adjust atomization pressure on a compressor-driven sprayer, simply adjust the regulator. But turbine-driven HVLP systems don't have a pressure regulator. American Turbine, Campbell Hausfeld and Wagner have solved that problem by building an air-reducing valve into their spray guns. Slightly closing the valve to reduce atomization pressure at the spray tip improves the performance of these guns, especially when you want to spray thin finishes.

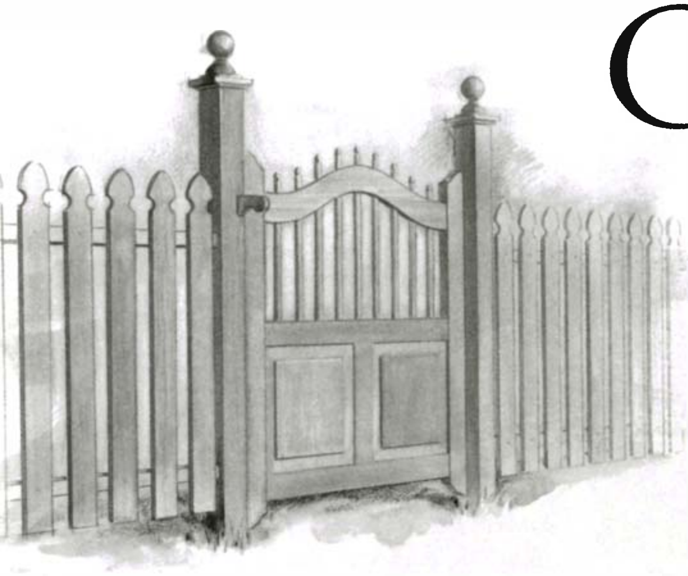
How does it feel?

Not surprisingly, the handle design and air-hose placement affect the ease with which a spray gun is used. Simply put, the better it feels in the hand, the easier it is to use. The air hose connects at the bottom of the handle and hangs down toward the floor on the American Turbine, Apollo, Lemmer and Wagner guns. This arrangement keeps the hose out of the way and allows maximum maneuverability. The air hose on the Campbell Hausfeld connects at the top of the gun and points backward over the operator's arm. I found that design awkward to use, and it would clearly make spraying inside cabinet carcases especially difficult.

The handle design of the Lemmer T-55 made this gun feel like an extension of my arm. The trigger was comfortable and positioned perfectly, and the grip rested nicely in the palm of my hand. The Campbell Hausfeld gun was the opposite. It had an uncomfortable, squared-off grip, and the trigger was too far forward and dug into my finger. My hand hurt after spraying with the Campbell Hausfeld gun for an hour or so. Worse yet, when I first unpacked the gun, the inside of the aluminum cup was severely corroded and contained some unknown brown liquid. I checked two other Campbell Hausfeld HV 3000 sprayers at two different stores, locally, and found the same conditions on both. □

Chris A. Minick is a contributing editor to Fine Woodworking.

Photo, this page: William Duckworth



Garden Gate made of White Cedar

Jigs simplify construction of this elegant outdoor gateway

BY MARIO RODRIGUEZ

I like to think that a gate is the portal to a special place. In a garden or private outdoor spot, one often labors for months, lifting stones, turning soil, preparing beds and spreading fertilizer, all in the hopes that fruits and flowers will grow. A place like this deserves a special entrance. I wanted a gate that was sturdy but lightweight and not overbuilt. I also wanted it to be joined as a piece of fine furniture would be, not simply nailed together. I set out to create a traditional design that was graceful and inviting, something that would age well instead of becoming an eyesore in the years to come.

ROUTED SPINDLES

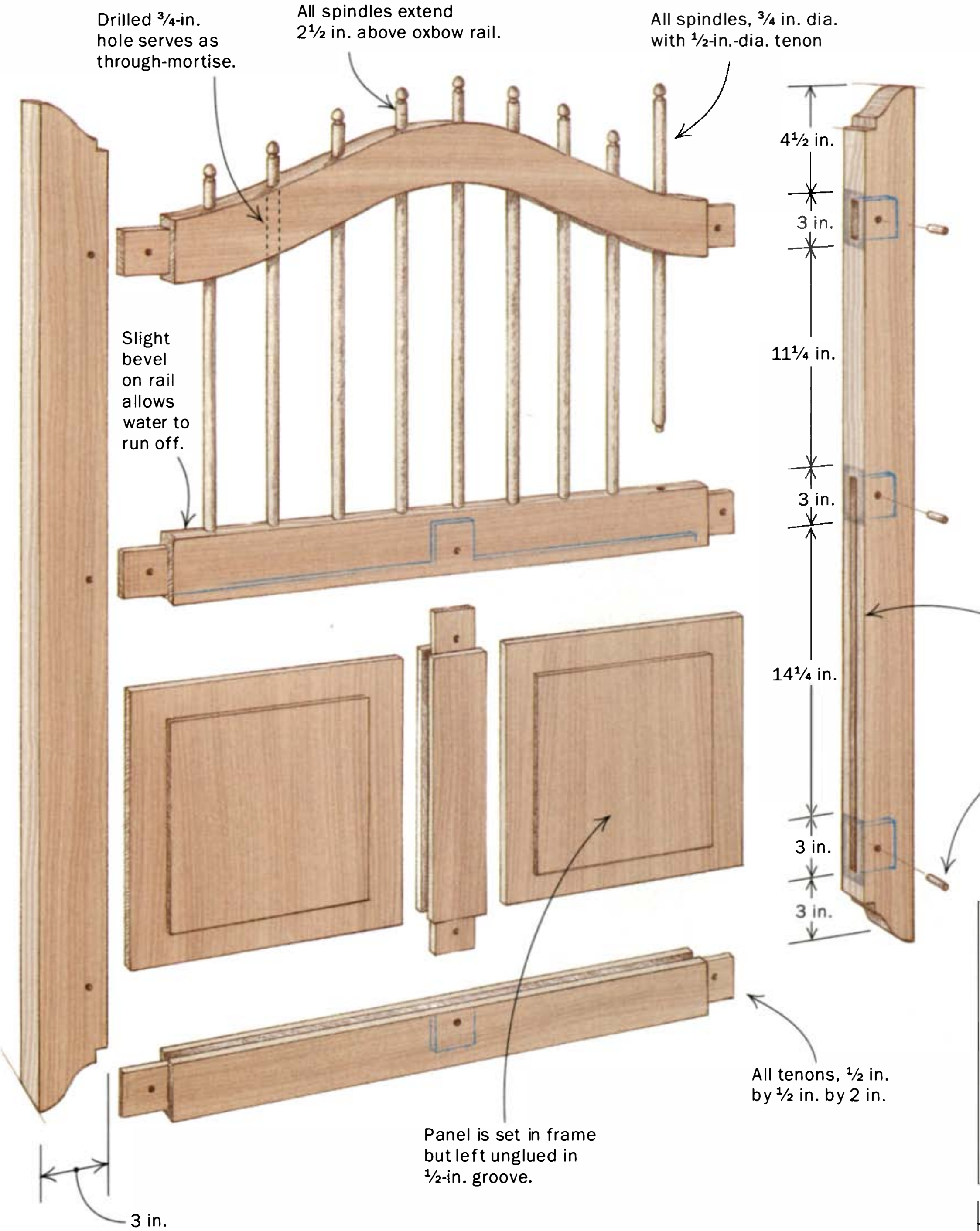
HAND-BORED RAIL

INSTALLATION

I designed this gate for a 36-in.-wide opening—large enough to accommodate a wheelbarrow yet narrow enough to give the garden area an intimate feel. I wanted to create the feeling of a private, almost hidden passage to a lush, little patch. At the same time, I didn't want a forbidding barrier. Toward this end, I designed the gate with a gently curving oxbow upper rail that suggests a rolling landscape.

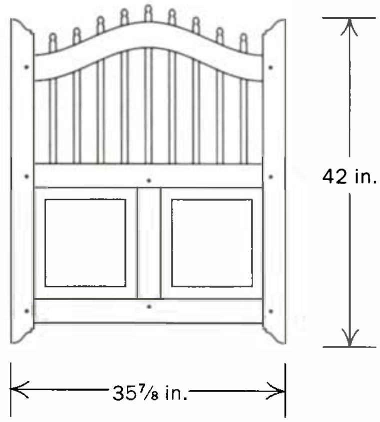
The design of the gate draws on the very idea of a garden. The upper half is made up of delicate, round spindles ending in elegant finials, suggesting flowers. The curved oxbow rail joins the upper half of the gate and supports the ends of the spindles. I designed the bottom half of the gate with twin panels that are deeply set into grooves in the rails and stiles but are free to move within the frame. The frame is constructed with pegged mortise-and-tenon joints, which give it a clean and structured appearance, similar to a graceful English-style garden bench.

Photos, except where noted: Matthew Teague; drawing, this page: Tim Langenderfer



CONSISTENT DIMENSIONS ARE EASILY RECALLED

The author uses a centered groove, 1/2 in. wide, to house the panels in the frame. The same centered dimensions are used to define the mortises and tenons throughout the piece.



I don't believe in skimping on material. I chose 1 1/2-in.-thick clear cedar, pulling boards from the lumberyard stock with nice, straight grain and even color. This prime material cost me a bundle, but it virtually guarantees a straight and clean project that will stand up beautifully over time.

Mill the rails and stiles

The construction of the gate is based on a 1/2-in. groove centered on the 1 1/2-in. thickness of the stock. After ripping the straight stiles and rails to 3 in. and a wider 8-in. piece for the oxbow rail, cut them to length, remembering to add the length of the tenons to each piece. All of the rails and stiles are then grooved along their lengths to accept the solid panels on the bottom half of the gate.

Lay out carefully for the groove, using a marking gauge and scrap stock to make sure the groove falls dead center on the thickness of the stock. With the groove centered, the parts can be turned around during assembly so that you get the best appearance without having to worry about the position of the groove. Cut the groove in a single pass using a dado blade set for a cut that is 1/2 in. wide and 3/4 in. deep.

Because the gate's panels are housed only on the bottom half of the stiles, be sure to stop the groove at the mortise for the center rail (see the top left photo on p. 70). Place tape on the tablesaw fence so that you know where the dado blade begins and ends. Lower the rail onto the blade,

Drawings, this page: Melanie Powell

Grooves in the stiles are stopped. *Use tape to mark the beginning, center and end of the cut. Lower the stock carefully onto the blade, cut the groove and lift the stock off the table.*

Cut the raised panels on the tablesaw. *A shallow shoulder is cut 2 in. from the edge of the panel. Blade marks are cleaned up with a shoulder plane and then sanded.*

mill the groove, then lift it off the blade where the center rail ends.

Cutting straight mortises is critical. If they're cut at an angle to the sides of the stile, the frame won't lie flat when assembled. Many woodworkers employ slot or hollow-chisel mortisers for this work. These machines cut straight, square mortises quickly. But on this project, because of the softness of the wood, you can simply rough out the mortises with a sharp ½-in. Forstner bit, use a ½-in. mortise chisel to square the ends, then clean up the walls with a 1½-in. bench chisel and a fine rasp. By working carefully and frequently checking your progress, you can execute the few required mortises easily enough. The previously milled groove, cut to a depth of ¾ in., is a great help in guiding your chisel as you clean up the mortises.

After cutting the mortises, prepare all of the rails (straight and oxbow) and the short medial stile for the tenons. It's easier to cut tenons on straight, square boards than it is to cut them on curved ones, so remember to cut the tenons on the oxbow rail before cutting the oxbow contour.

Cut the tenon shoulders on the tablesaw to a depth of ½ in. Use the miter gauge to ensure squareness of the shoulder and the fence to set the length of the tenon. Remember, it's safe to use the miter gauge and fence at the same time *only* when you're not cutting through the material. When the shoulders have been completed, cut the cheeks of the tenons on the bandsaw. I suggest cutting the tenons a little fat to ensure a snug fit even if your hand-cut mortises turn out a little wider than ½ in.

Make a solid raised panel

Because of the prominence of the panels, choose clean, straight-grained material. Glue it up to the required 14¾-in. width. When the panels are dry, remove the glue and fair the seams with a smooth plane set for a fine cut. Cut a shallow shoulder 2 in. from the edges of the panel. Then complete the raised panel by carefully standing the panel on edge and holding it tightly to the fence (see the bottom photo at left). Blade marks on the panels can be removed with a shoulder plane, then sanded.

Simple jigs help make custom spindles

I wanted spindles made of cedar, like the rest of the gate. I also wanted a decorative spear point on the end of each spindle. I thought it would be a nice touch if the spindles had a small ¼-in. reel, or neck, cut about ¾ in. from the end, then a rounded, tapered end with a blunt point.

I wasn't worried about executing a finial design on the end of a spindle. But I was concerned about turning a long, smooth spindle (23½ in.) to a uniform ¾ in. dia. without excessive whip snapping the spindle blank during turning. In the end, I designed a few jigs to help shape the spindles with a router table and a few common bits (see the photos and drawings at right).

Cut a dozen ¾-in. square blanks on the

Router bits

A router table and a few common bits are used to form the gate's spindles as well as the tenons and delicate finials.

BULLNOSE BIT

¾-in.-dia. bullnose (full radius) bit forms the dowel.

CORE-BOX BIT

¼-in. dia. core-box bit cuts the reel.

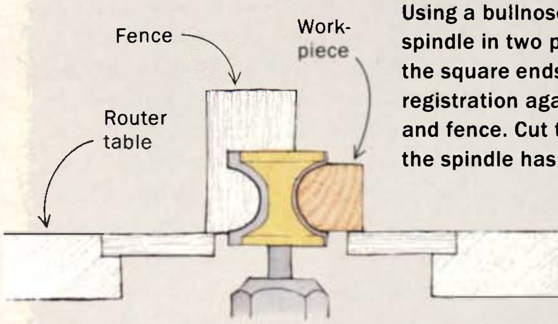
ROUNDOVER BIT

⅜-in. radius roundover bit shapes the finial.

STRAIGHT BIT

½-in. dia. straight bit cuts the tenon.

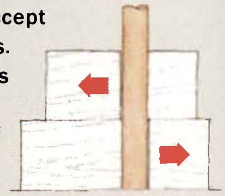
1. ROUTER-MADE DOWELS FROM SQUARE BLANKS



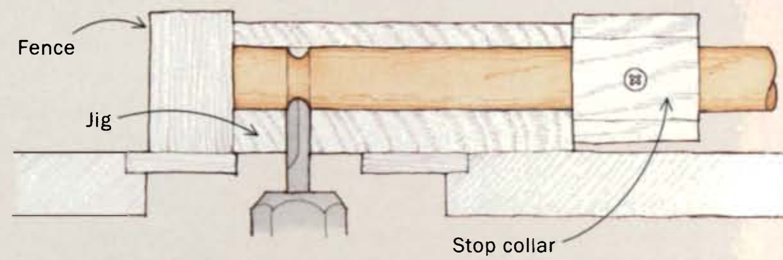
Using a bullnose bit, cut each spindle in two passes. Leave the square ends uncut for easy registration against the table and fence. Cut them away once the spindle has been formed.

2. TIGHT JIGS FOR CUTTING THE REEL

All spindle jigs are drilled to accept the spindles. The spindles fit tighter in the jigs if the jigs are cut apart and glued up with the hole slightly offset.

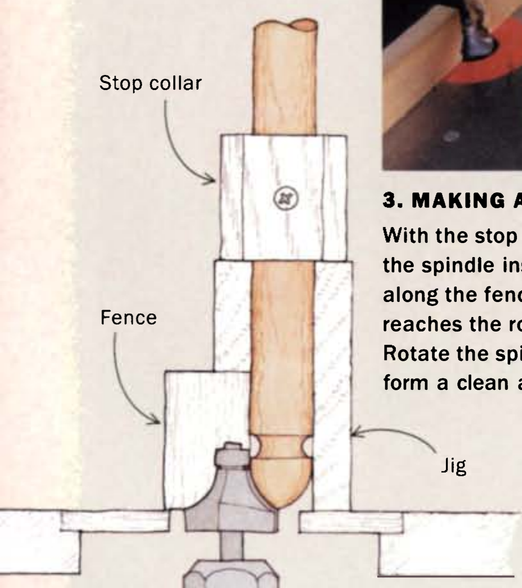


Slide the spindle into a ¾-in.-dia. hole in a block of wood and screw a wooden stop collar to the spindle to hold it at the correct depth. Slide the jig over a small core-box bit and then rotate the spindle 360° until the reel is cut evenly all the way around.



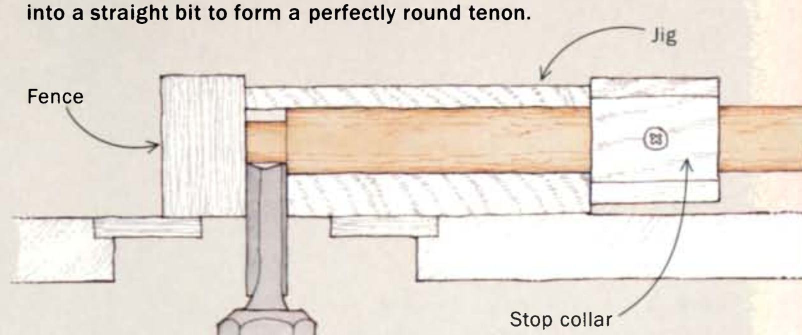
3. MAKING A POINT

With the stop collar in place and the spindle inserted, the jig rides along the fence until the spindle reaches the roundover bit. Rotate the spindle 360° again to form a clean and delicate finial.



4. ROUTING ROUND TENONS

Trim the spindle to length, then insert it into a jig and rotate it into a straight bit to form a perfectly round tenon.



Drawings, this page: Jim Richey

Straight holes in curved parts. *Line a piece of plywood with blocks to help drill round through-mortises in the oxbow rail. The author uses a brace and auger bit, but an extralong bit in a drill would work as well. To avoid tearout, leave the bottom of the rail unshaped until the mortises have been drilled.*

tablesaw to 26-in. lengths. The longest spindle is 23½ in., but leave extra material on the ends of the spindles to serve as reference blocks later. On a router table with a fence, load a ¾-in.-dia. bullnose (full radius) bit with a ½-in. shank (Woodworkers Warehouse #CT1318K). Shape one side of the blank to a half-round profile, then flip the blank 180° and repeat. Leave about 1 in. of square at each end so that you can reference the spindle against the fence and table. The process produces a near-perfect ¾-in.-dia. spindle. After shaping the spindle, cut off the square at each end.

Three simple jigs help cut the decorative finial on one end and the shouldered tenon on the other. After the spindle has been rounded to a dowel, insert it in a block of wood with a ¾-in.-dia. hole drilled through it. A wooden stop collar prevents the spindle from advancing further in the jig. With a small core-box bit (Eagle America #130-0402), move the jig into the spinning router bit, then rotate the spindle blank 360° until the reel is cut all the way through.

To round the end of the spindle, use a roundover bit (Eagle America #156-0602) with a vertically oriented jig. Then employ the same technique of rotating the spindle 360° to shape the end.

The last operation, tenoning, is performed similarly with a straight bit and a horizontally oriented jig. Before tenoning the spindles, cut them to length so that each one projects about 2½ in. above the curved rail in the assembled gate.

These simple jigs help produce spindles that require only minimal sanding. Make a few extra spindles, then select the best-looking ones for the project. Because of some variation in the exact thickness of each spindle and the softness of the cedar, there was some play when I inserted the spindles into the jigs. This sometimes resulted in a bumpy profile. To reduce the play and improve the quality of the profile, I ripped the jigs in two, then glued the parts back together, offsetting each slightly. This adjustment exerted just enough pressure on the spindles to eliminate any play and hold them snug in the jigs.

Drill and shape the oxbow rail

After cutting the tenons on the oxbow piece, mark the complete outline of the curved shape onto the oxbow rail, using a full-sized template prepared from the drawing. Transfer the exact position of each spindle onto the edge of the rail and onto the face. Then cut out only the top half of the oxbow rail on the bandsaw and leave the bottom half intact for now.

I made a jig for drilling the through-mortises in the oxbow rail. It consists of a series of 2-in.-long guide blocks, placed horizontally on the jig. The cedar was soft, and the project didn't require many holes, so I used a brace and auger. A drill with a long bit would work as well. Drill all of the holes before you cut the bottom of the oxbow contour on the bandsaw. Then transfer the position of the spindle holes from the oxbow rail to the medial rail and drill corresponding holes—½ in. dia. and ½ in. deep—to accept the spindle tenons.

Ready-made posts, finials and hinges

For the gateposts I used 4x4 clear cedar. I left 50 in. above ground and buried 24 in.

Glue-up is a snap. *As long as everything is cut square, the process should go smoothly.*

To mark these dimensions, I cut a shallow groove around each post as a quick guide when setting the posts into the ground. The finials for the gateposts can be either turned or purchased from a lumberyard. If you decide to purchase them, as I did, be sure they're clean (not nicked, chipped or torn), have no checks or cracks and have a crisp, pleasing shape. I also purchased the flat molded caps that fit over the post ends. Another option is to use copper caps, which are considerably more expensive but really give a gatepost a classy look.

There are several types of hinges that can be used on a gate, but for this gate I opted for pintle-and-eve hinges. Pintle-and-eve hinges are comprised of a spike or screw that is driven into the post. An upright projection on the spike engages the eye on the end of the hinge, which is attached to the gate. These hinges are available in endless variety. Because of an obvious absence of metal hardware on this gate, I've chosen the least obtrusive of these.

To ensure easy and true operation of the hinges, drill the post hinge holes with a drill guide to support and guide your drill at 90°. For the gate holes, use a doweling jig to make sure the holes line up.

Hang the gate, then bury the posts

I decided to prehang the gate on the posts because I didn't want to have any large gaps between them. Proper alignment is also critical to the smooth operation of the latch I designed (see the story at right). To position the parts properly and to ease installation, I devised a couple of plywood yokes that temporarily attach to the posts and hold them in place squarely. Once the gate went into the ground, it swung beautifully, and the latch worked like a clock—the gate opens smoothly and virtually closes itself. I applied a clear, penetrating, preservative finish and left the gate to take on a weathered patina in the seasons to come. □

Mario Rodriguez is a contributing editor to Fine Woodworking.

Plywood yokes help plant the gate. *With the gate prehung on the posts, the author uses plywood yokes to ensure that everything goes squarely into the ground.*

Yokes prehang the gate; a shopmade latch closes itself

I liked the idea of a wooden latch that would age and change color with the surrounding wood. But I wanted a latch that was easy to operate—something that would require only light pressure to open and then practically close itself.

I designed a double-ended lever that pivots inside a recess cut into the side of the gatepost. On the underside of the lever is a vertical slot that engages and holds a metal pin set into the edge of the gate. When the handle of the lever is depressed, it releases the pin on the other end of the latch so that the gate can be opened. Once passage through the gate is completed, a return spring attached to both the gate and the post returns the gate to its closed position. On its return trip, the gate pin contacts the lever and travels along the underside, raising the lever gradually until the pin reaches the vertical slot. Then the lever falls, locking the pin and the gate in place.

I planned to hang the gate so the bottom would be about 4 in. from the ground, and I chose to locate the lever near the oxbow rail. I laid out a ¾-in.-deep recess that would easily accommodate the lever and allow its upward travel. I roughed out the recess on a sliding-arm chopsaw with a depth stop, then cleaned it up with a 2-in. chisel and a shoulder plane. Through the lever, I drilled a ¾-in. countersink hole and a $\frac{3}{16}$-in. screw hole.

I then mounted the lever into the recess with a #10, 1½-in. wood screw. To ensure easy movement of the lever, I placed one flat metal washer between the lever and the post and another in the bottom of the countersink hole. The lever must be secured to the post yet be able to travel up and down easily. All of this can be done before the posts and gate are planted in the ground. I waited until the gate and posts had been installed, then tested the lever and plugged the countersink hole.

It bugs me to see a gate leaning one way and the posts leaning another. To alleviate this worry and to make sure the latch would engage smoothly, I made two simple plywood yokes that hold the posts square and parallel to each other as they go into the ground. This way, I was guaranteed that everything would fall into place.

Once the posts were set into the ground and the gate was checked for easy operation, I marked the hole for the latch-lever pin to be drilled into the edge of the gate. This must be done with great care; if the pin is set out of square, too high or too low, it will not engage the lever properly, and nothing will operate as planned. I used a doweling jig to get an accurate hole the first time, but a drill guide block would have worked as well.

Pain-Free Woodworking

Perfect wood, a dream shop and all of the tools in the world won't help your woodworking if you're hurt

BY THOMAS P. LeROY

How many times has this happened to you: You're bent over for only two minutes, reaching under your router table to make that final depth adjustment. When you try to stand up—yeow!—it feels like someone has stuck a chisel in your back. It's not just age; it can be a sign of cumulative trauma. Pain is a warning. Your back has just told you that the position you've worked in is a no-no. Keep it up, and someday the pain might not go away so fast.

I'm both a physical therapist and a member of the Guild of New Hampshire Woodworkers. Fellow members frequently tell me about aching backs, stiff necks and sore shoulders. These injuries don't necessarily result from one specific incident, but rather they are often caused by prolonged overuse or misuse of your body. They are the proverbial piling on of straws that break the camel's back. These injuries can happen to any body part, and they can range in seriousness from a small annoyance that decreases your enjoyment of woodworking to a debilitation that keeps you away from your workbench for long periods of time. Cumulative is the key word here. (The advice that I give in this article has to be somewhat general. If you have specific, intense injuries, you should consult your doctor.)

Get in neutral before you gear up

To get a good idea of how you can prevent cumulative trauma to your body while working, you will need to be comfortable with a few general concepts. First, each joint—a joint is where two or more bones meet—has a neutral position. This position exists roughly at the midway point between the joint's extremes of motion. When a joint is in neutral, it is in its least-stressed position. Think of a balanced seesaw, with the plank horizontal, and you have a simplified paradigm of a joint in neutral. Turn your head as far to the right as you can and then to the left. The neutral position for your neck in this plane of motion is facing straight ahead, midway between the extremes.

The farther a joint is out of neutral, the more stress there is on the joint surfaces, the surrounding muscles and their tendons. The more time spent out of neutral also increases the load on these structures. Stress and load cause fatigue and, possibly, pain. These facts lead us to the second concept: To decrease the factors that can lead to cumulative trauma injuries (read pain), you must spend more time closer to your neutral positions.

Often, mere awareness of proper work positions is not enough. Your overused muscles can get tight during a day in the shop. This creates a situation much like twist in a board that pulls it out of a true plane. Tightened muscles can pull joints farther out of neutral and make it difficult, if not impossible, to modify how you work. For a simple stretching program that targets some of the major muscle groups of the shoulders, neck and back, see the story and photos on pp. 76-77.

Your head weighs 15 lbs.

When you work wood, the primary function of the neck is to position your eyes so that you can use your hands. A problem arises because your eyes are encased in your head, which weighs about 15 lbs. The neutral position of the neck is ear hole over the shoulder. If you were to hold 15 lbs. in your hand close to your body and then hold your arm in front of you, you would quickly realize the greater effort needed to maintain the second position.

Now I'm the first to realize that woodworkers won't be walking around shops with books balanced on the tops of their heads. I merely want you to lessen the stress on your neck whenever possible by staying closer to the neutral position. Some early warning signs of too much nonneutral head-holding are fatigue in neck muscles, headaches centered around the base of your skull or neck stiffness, especially in the morning. Because nerves pass through your neck, staying closer to neutral will also help protect your arms.

Would you try to thread a needle while holding it at waist level? I doubt it. Remember: Head position is intimately linked to vision. Dimly lit areas or lighting that casts shadows across work surfaces cause you to bring your eyes closer to the work and your neck farther out of neutral. Mobile task lighting is a simple, inexpensive solution to this problem. Also, you can either lower your body toward the work or raise your work off the bench (see the photos on the facing page).

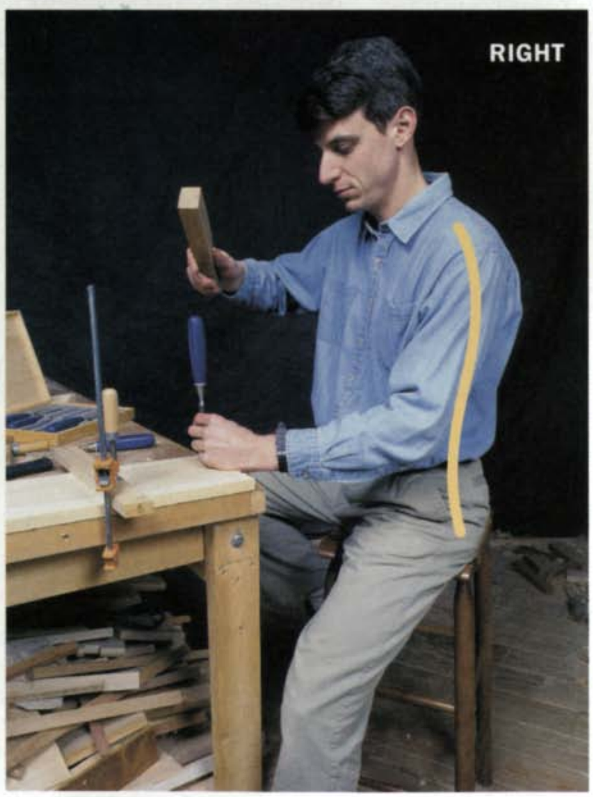
Because the neck and shoulder blades have some muscles in common, arm position can be another factor that leads to a forward head position. The more you reach away from your body—such as when spraying or hand-applying finish deep in a cabinet—the tendency increases to have your head forward from neutral.

Tipping your head too far back so that you can look up is painful, too. And if you have just started to use bifocals, be cau-

Raise the work ...

Cutting dovetails can be a pain in the neck. *Canting your head forward to get your eyes closer to your work puts tremendous strain on your neck muscles (left), leading to headaches and muscle pain. For backsaw cutting, the author made a jig that raises his work off the bench (right), enabling him to stand straighter with his neck closer to neutral.*

... or lower your body



Have a seat. *Don't bend forward to get a closer look at your work. This position (left) puts a lot of stress on your back and neck. It's better to sit on a stool to bring your head and eyes closer to the work at hand. Sitting also allows your back and neck to remain in their neutral positions.*

tious about working with your head tipped back for prolonged periods of time.

The rotator cuff is the shoulder's weak link

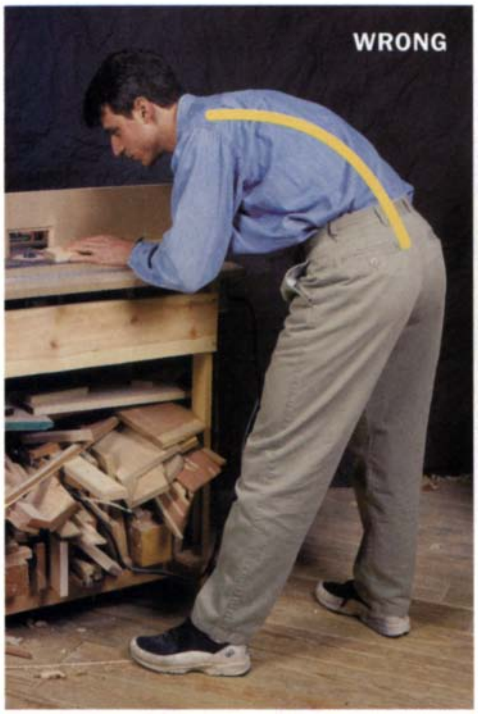
Your shoulders function to place your arms and hands where they are needed and provide force to move an object in your hands, be it a 4x8 sheet of plywood or a cabinet scraper. The amazing trait of the shoulder is its mobility and range of motion. Compared to the hip, the shoulder is almost infinitely more mobile; think of all of the places you can put your hands that you can't put your feet.

To be able to move as it does, the shoulder sacrifices stability; it is one of the joints most frequently dislocated. This makes the muscles that surround the shoulder responsible not only for moving the joint but also for keeping the bones aligned properly. The rotator cuff—a term referring to four specific muscles—assists in the precise control needed to keep this most mobile of joints working properly. For the rotator cuff to function best, correct position of the shoulder blade is important.

Let's look at how common woodworking tasks can cause problems. Activities that involve using your hands close together—

Photos: Michael Pekovich

Bend your knees, not your back



Stand up straight, and you'll feel great. *Bending over a router table for long periods of time can lead to an aching back. Bend at the waist and bend your knees to get closer to your work, but keep your back in neutral.*

planing, scraping, routing, lathe work—can lead to tight chest muscles. This tightness tends to cause the shoulder blades to round forward, which in turn makes the rotator cuffs less efficient. You now have a situation in which every instance of lifting an arm causes a little damage, especially if heavy weight is involved or the hand is significantly above shoulder level. This example of cumulative trauma illustrates the importance of stretching muscles that our activities tend to make tight.

Careful planning of your shop can decrease the wear and tear on the shoulders and their muscles. Any heavy object—a jointer plane, a router—should be stored below shoulder level. Lighter objects can be kept higher, but I try to avoid placing frequently used objects above eye level no matter how little they weigh.

Also, be cautious about how much time you spend with your arms overhead. This can lead to the rotator-cuff tendons rubbing against bone spurs. Finishing a tall piece or installing overhead ductwork for a dust-collection system are both examples of situations in which you should raise yourself up to the level of the task, just as I talked about in the neck section.

The lower back is the body's keystone

Your lower back works as a stable base from which your arms and legs move and generate force. As in the neck, the neutral position is important. When viewed from the side, your back in neutral should have a slight curvature—convexity facing forward. It's helpful to envision two extremes: The Pink Panther has a flat back with no curve, and Donald Duck's back has excessive curve, rump feathers sticking out in the air. As is the case with most joints, the lower back's neutral position is roughly in the middle of the two. It's not just a matter of posture; you can incline your body far forward and still keep your back in neutral by hinging at the hips like a waiter's bow.

One of the most important concepts for long-term back safety is proper work-surface height. Different tasks require different heights. No one magical percentage of your inseam exists to determine what is best. Instead you must choose a height that keeps

Stretch it out

Less than five minutes—that's how long these exercises take to stretch and loosen up your muscles. That's less time than it takes to sharpen a chisel. You wouldn't think of starting work with a dull chisel, and you shouldn't think of starting work with tight muscles.

Hold each of these stretches for 15 seconds (except where noted), and do each one for three repetitions. Remember that you're stretching, not really pushing or pulling. And never bounce your way into a stretch. Slow and easy. You'll feel your tight muscles, and as you hold the stretch, you'll feel them loosen a little. You can do these exercises any time during the day if you start to feel stiffness or pain. You'll feel better and, possibly, be able to work a longer day.

Shoulder stretch. *This stretch will loosen your chest muscles. Place your hands on both sides of a doorway, a little above shoulder level. Step into the doorway with one foot. Shift your weight onto the forward foot, leaning into the doorway, keeping your back straight. Hold for 15 seconds. Repeat two more times.*

Hamstring stretch. *Place your heel on a low stool. While keeping your knee and your back straight, lean forward at the hips. You'll feel the muscles in the back of your thigh stretch. Hold for 15 seconds. Now do the same thing with your other leg. Repeat two more times for each leg.*

you as close to neutral as possible while being able to work comfortably. Keep in mind that machine and bench manufacturers try to find a height that's fairly suitable for most people. That leaves some of us having to raise the working heights, while others must lower their heights.

Just as in the shoulder and neck, a lower-back concern is spending too much time toward the extremes. Pain is a sign that you are overtaxing your lower back. An insidious cause of the opposite extreme—bending back for too long—can occur with prolonged standing. Once your trunk muscles fatigue, the hips often sway forward to gain stability by leaning against the bench or a countertop. To maintain balance the upper back leans back, which exaggerates the lower back's normal curvature. This can also happen when you're working on a ladder.

Additional suggestions don't require the modification of machinery or the building of jigs. A cluttered shop increases the chance that you'll bend improperly—flex with twist—or reach excessively. Also, pay attention your feet. They should point in the direction your center of gravity is moving. Woodworkers often do this reflexively when hand-planing or ripping a board on the tablesaw. This allows us to shift weight from the back foot to the front and use the large muscles of the leg to do the work. When standing for long periods of time, it is common to shift more weight on one foot than on another. This is okay as long as you don't bend the unweighted knee so much as to allow that side of your pelvis to drop (see the photos above).

To conclude, become aware of how you move and position yourself. Whenever possible, try to stay closer to those neutral positions. It may seem awkward at first, but you should relearn correct positions if you want to avoid pain. Also, the old cliché about variety being the spice of life applies; even while doing the same activity, try to introduce some variability. Be creative; build a jig or modify a task, get a comfortable stool. And if you start to hurt, take a little break and stretch. The body you save will be your own. □

Thomas P. LeRoy is a physical therapist and woodworker in Chester, N.H.

Keep your belt parallel to the floor

Don't cant your hips. *If you stand at a bench for a long time, fatigue will make you cant your hips, leading to back pain. Try standing with one foot on something. When your belt is parallel to the floor, it's a good sign that your hips are straight.*

Neck side stretch. *Rest your right hand behind your back to keep your shoulder down. With your left hand on top of your head, tilt your head toward the left. Make sure your neck is straight, not canted forward or backward. Hold for 15 seconds. Now do the same thing to the right. Repeat two more times in each direction.*

Standing back stretch. *This is an excellent stretch after being bent forward for a long time. Keeping your knees straight, bend backward at the waist. Hold for five to 10 seconds. Repeat two more times.*

Backward neck stretch. *Without tipping your head, bring your head straight back so that your ears are directly over your shoulders. Hold for 15 seconds. Repeat two more times.*

House and furniture share common elements. Working with large timbers raised concerns for the author. What appears to be a solid-board top is actually a clever sandwich of MDF and veneer. Through-mortised legs are another clever deception. The breadboard ends (facing page) also have an unusual design.

Hefty Sofa Table with a Delicate Touch

Understand the quirks of large timber before cutting the first board

BY ERIC KEIL

Of the 23 pieces of furniture I made for a house in the Pennsylvania Poconos, this sofa table was the most gratifying to build and the best designed. Large members make up the tabletop and legs, and a 5/4 cabinet rests below. It's a hefty design built in a light, natural cherry, with unique exposed joinery that complements other furniture I installed in the home. The table's effect is at once traditional and contemporary, as are the processes used to build it.

The sofa table is my favorite piece in the house, but I did have a few concerns with the initial design. I spoke with Robert McLaughlin, the architect who designed the table, and it was apparent that he had a lot of woodworking savvy. He anticipated many of my concerns and accepted some compromises to improve the joinery and chances that the table age gracefully.

Design compromises

As I looked at the preliminary drawings, there were three unconventional design elements that seemed troublesome. The configuration of the boards that made up the top was specific and unusual: two 2-in. by 5-in. pieces surrounded by a butt-jointed frame. Instead of a traditional breadboard design, the long outermost side boards sandwiched the end boards. This kind of joinery with solid lumber would have caused the joints between the end boards and the center of the table to fail over time. The architect had no problem with my solution to replace the center pieces with a stable substrate and veneer.

Another concern was that the design called for the legs to come through the top in a full through-tenon. Even if I consistently and accurately cut the mortises and through-tenons on the legs, I couldn't comfortably glue and clamp the top to the assembled cabinet and legs below. And housing the solid legs in a veneered substrate wouldn't allow for seasonal wood movement. We decided to make the tenons false. The legs would butt the bottom of the tabletop, and corresponding end-grain inserts could be carefully fit to shallow mortises on the top of the table.

Breadboards with a twist. *The unique breadboard design of the tabletop calls for the long side boards to sandwich the short end boards.*

The carcase of the cabinet itself was to be made of 5/4 solid cherry boards. The design called for the cabinet to be joined at the corners with an oversized finger or box joint. The fingers were 4 in. wide, corresponding with the seams between each 4-in.-wide board and its neighbor. The problem with this design was that the only long-grain-to-long-grain glue bond occurs every 4 in., which simply isn't sufficient. I added two biscuits to each finger (dowels or splines could have been used instead), which solved the problem of insufficient bonding surface but created another dilemma that I will address later.

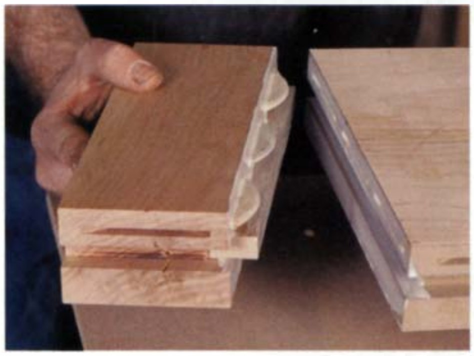
An unconventional tabletop

The tabletop's 2-in.-thick center was made by laminating three pieces of medium-density fiberboard (MDF)—two pieces ¾ in. thick and one piece ⅜ in. thick—then skinning both sides with $\frac{1}{16}$-in.-thick cherry veneer. I glued up the veneer in two pieces so that it appears to be two 5-in.-wide boards. The veneer was cut about ¾ in. oversized on the tablesaw and then seamed. Making the substrate, cauls and veneer the same approximate size allowed for easy alignment and control of the pieces as they went into the vacuum bag. It was also quicker and less obnoxious to trim the ¾-in. oversized panels on a tablesaw than it would have been to trim

Photos: Michael Pekovich

TABLETOP HAS HEART OF MDF

Veneer sandwiches MDF. *Three layers of MDF and two layers of veneer are all coated in glue and set into the vacuum bag at the same time. Glued up slightly oversized, the entire center panel of the tabletop is later trimmed to size on the tablesaw.*



Short ends first. *Fitted with a spline and biscuits, the short ends of the table are clamped to the top. With the end boards glued into place, a spline is cut slightly short of the top's length.*

Tight splines are exposed. *Small lengths of spline are tapped into place to ensure that the conspicuous table ends fit tightly.*

glue squeeze-out and oversized veneer with a router and trimmer bit.

Placing the vacuum bag on an absolutely flat surface and laminating multiple layers of the substrate material produced a flat panel with no warp, cup or twist. After several hours in the vacuum bag, the veneered panel needed only a quick cleanup before it was cut to size. Trying to get clean edges of MDF on a jointer is fruitless, and it dulls knives instantly. So I measured out from the centerline (seam) of the top veneers to establish parallel lines, then tacked a straightedge to the unexposed bottom surface. I ripped the panel several times on the tablesaw until I was sure the edges were straight, square and parallel, but I left them about ¼ in. oversized for now.

I used the tablesaw to crosscut the panel to length, again taking several test passes to check the quality of cut. If the veneer was going to chip, it would be at the end of a crosscut. I ripped the panel to its final width last, which ensured crisp corners. When ripping, raising the blade higher than normal produces a cleaner top cut (and coarser bottom cut) because of the related angle at which the saw cuts through the material. When cutting with a raised blade, be sure the blade guard is in place.

I milled the solid frame pieces 1⁄32 in. thicker than the center panel. This, along with careful glue-up, made it easier to handplane the massive frame flush to the veneer. Frame members were cut to length and then grooved on the tablesaw. Although spline joinery by itself might have been sufficient, I added biscuits above the spline so that any discrepancies in flushness would show on the unexposed bottom of the tabletop rather than on top.

Because of the relative sloppiness of biscuit joinery, excess glue got trapped in the joint when the tabletop was glued up. This, coupled with the swelling of the biscuits,

A word from the architect

BY ROBERT McLAUGHLIN

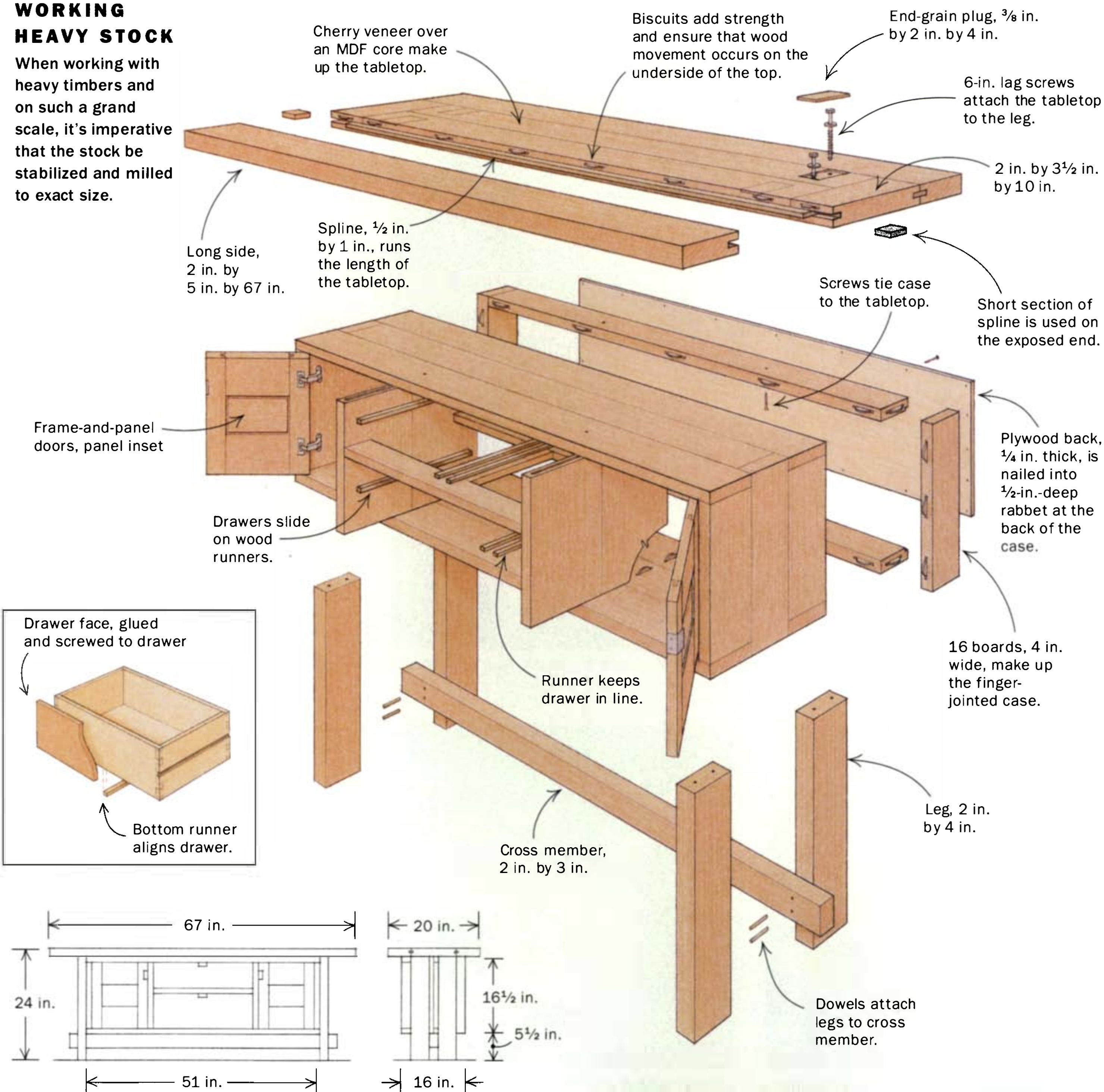
I've always tried to create houses and furniture that express the nature of both the materials and the construction process. Whether it's exposing bolts in steelwork or leaving the joinery uncovered in wood, the effect is always powerful.

The monumental scale of some of the rooms in the house led principal architect Peter Bohlin and me to these furniture designs. We needed sizable legs and cross members so that the furniture wouldn't seem lost against the 9-in. square columns that frame the house. We also designed overlapping and penetrating connections to match the Arts-and-Crafts or Japanese-like joinery seen throughout the home. It was clear early on that Eric Kell understood the styles that we were trying to create.

One aspect of this project that was amazingly successful was the collaboration between an owner, a craftsman and designers. Often, when too many people become involved in a project, the outcome becomes diluted. But that never happened. All parties were involved at each phase of the work, including full-sized mock-ups to see how the pieces would fit in the room. The work between Eric and me was almost always

WORKING HEAVY STOCK

When working with heavy timbers and on such a grand scale, it's imperative that the stock be stabilized and milled to exact size.



hands-on. I'd visit his shop at least every other week, and sometimes more.

Toward the end of the project, our sketches to Eric consisted only of the major dimensions and no notes. Eric knew what we wanted, and we trusted his judgment, so we didn't have to waste time mapping out every detail. This process led to the successful execution of all of the furniture, including this sofa table. □

Robert McLaughlin, formerly with Bohlin Cywinski Jackson Architects in Wilkes-Barre, Pa., is now principal of McLaughlin Design Associates in Kansas City, Kan.

A meeting of minds. *Furniture maker Eric Keil (right) and architect Robert McLaughlin discuss concerns about the sofa table's design.*

Drawings: Vince Babak

A race against curing glue. *The cabinet must be glued up in one swift process. Four-board boxes are biscuited, coated in white glue, then set onto similar assemblies.*

Plunge-cut the groove. *To cut a groove, the biscuit machine slides like a router along the edge of the divider.*

Like a hand in a glove. *Biscuits are glued into the cabinet frame, then the grooved divider slides easily into place.*

meant that I had to allow the swelling to go down before working the tabletop. Sanding or scraping the surface before the swelling had subsided would have left biscuit-shaped depressions in the finish.

After I milled splines to fit the grooves, I beveled the corners slightly to ease assembly. Splines can also be milled a little shy in width to allow excess glue to escape—and to ensure that the visible top joints pull tight. I cut the long splines 2 in. short in length so that the exposed spline could be hand-fitted. During clamping, I used a straightedge to make sure the slightly proud faces of the solid frame were parallel to the center panel.

Where the splines are exposed on the end of the table, a 1-in. length of spline was tightly fitted and set into place. I did this before the glue from the tabletop assembly had a chance to harden, eliminating the need to chisel dried glue out of the mortise. I tapped the 1-in. spline home, trimmed it flush and left the assembly to set overnight.

Faux finger joints

The 16-in.-deep cabinet under the sofa table was the most labor intensive part of the project. When I make a finger-jointed box, I typically cut the sides to size, machine the joinery and assemble it all at once. But this cabinet wouldn't go together that way. It was made by stacking four 4-in.-deep butt-jointed boxes (see the photos at left). Alternately butted and stacked, the boxes create a strong cabinet.

Rather than gluing up each of the four boxes separately and then stacking them in a subsequent operation, I had to glue together the 16 individual pieces at the same time. The process is nerve-racking and fast paced, but it was much easier to manipulate 16 loose pieces than to try to force four rigid boxes to come together as one. Slow-setting white glue, calm preparation and special clamping blocks helped everything go smoothly. I also cut the biscuit slots so that the exposed end grain would be a hair proud.

After flushing up these end-grain surfaces with a jack plane, I was ready to make the interior dividers. By using a biscuit machine as a groove cutter, I was able to slide the interior dividers into place after the exterior box had been assembled. After that, the cabinet needed only a quick scraping and some final sanding.

End-grain inserts in the tabletop

The legs were doweled to the cross member that supports the cabinet, then set into place under the tabletop. Waiting to cut mortises until the legs were attached to the cabinet ensured that the end-grain inserts would align with the legs below. A router with a template guide and a small-diameter straight-cutting bit made it easy to cut the mortises (see the top photo on the facing page). The small-diameter bit reduced the radius of the mortise corners, so I only had to chop them square with a chisel.

In a previous project with the same detail, I made the end-grain inserts too thin. During clamping, glue worked its way to the top surface. The glue-saturated pieces had to be removed and redone—a lesson not soon forgotten. This time, I left the 3/8-in.-thick end-grain inserts a hair thicker than the depth of the mortises so that I could plane them flush later.

With a lower assembly of such weight, I worried that small screws would pull away from the MDF if the table was lifted by the top. To be safe, I used lag screws. The mortises for the end-grain inserts were drilled to accept 6-in. lag screws and washers. After attaching the tabletop to the lower assembly, the holes were filled to the bottom of the mortises with auto-body filler (see the middle photo at right). This eliminated any swelling caused by pockets of excess glue. It also prohibited any metal-to-glue contact that might discolor the end-grain inserts. I didn't use common wood fillers because they tend to shrink, which would have left depressions in the tabletop.

I carefully fit the inserts and fine-tuned them with a rigid sanding block. Yellow glue might eventually fail, allowing the inserts to pull away from their housings, so I coated the end-grain inserts with polyurethane glue and clamped them tightly into place (see the bottom photo at right).

A final touch

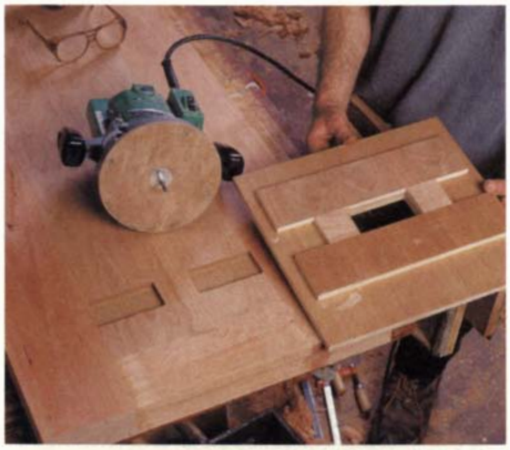
I made two frame-and-panel doors and dovetailed maple drawers with cherry bottoms. They were then fitted and sanded. Doors were hung on concealed hinges, and drawers were fitted to maple slides.

I finished the entire table with a coat of vinyl sealer and two light coats of catalyzed lacquer sprayed on with a low-pressure system. I cut the lacquer and sealer with retarder thinner, which allows more time for a finish to level out. The retarder thinner also prevents the more porous veins in the wood from filling up, leaving a more natural appearance, akin to that of an oil finish.

Four years after I made the piece, the sofa table looks as pristine as it did the day it was delivered. The techniques utilized seem to have been time worthy. When I reflect on this project, I still get gratification from how tightly crafted this table is. Another thing that makes this table so intriguing is the weight of the large cherry timbers and Robert McLaughlin's design. In the large room where it lives, the table appears to grow gracefully from the floor. □

Eric Keil designs and builds custom furniture in Wilkes-Barre, Pa.

INSERTS MIMIC THROUGH-TENONS



Mortises that match. *A small-diameter straight-cutting bit and a simple template make easy work of cutting the mortises in the tabletop.*

Bolts and Bondo. *The tabletop is secured to the legs with 6-in. lag screws, then covered with auto-body filler. More common wood fillers might shrink, leaving depressions in the tabletop.*

Faux leg ends. *End-grain inserts are coated with polyurethane glue and then tapped into place.*

Router-Bit Matchup

We put 17 brands of straight bits to the test

Fishing lures and router bits have a lot in common: There are more varieties to choose from than I'll ever need. Dressed up in slick packaging with exotic names like Trout Teaser or Roman Orgy, new lures and bits ignite dreams of pride and passion. Bigger catches. Sexier moldings. I've amassed an embarrassingly rich collection of both. But when it comes time to attach one to the end of a rod or router, more often than not I pick the ordinary over the exotic.

For tried-and-true router tackle, nothing beats straight bits. These workhorses are good for a host of tasks, and I use them for rabbeting, dadoing, trimming, mortising and even tenoning. I've tried

Photos, except where noted: Michael Pekovich

Computer-controlled router-bit test track

Straight bits were chosen because they're used for many woodworking tasks. The bits tested were all ½ in. dia., ½ in. shank and double fluted with carbide tips.

A CNC router was used to run all of the bits. *At Harris Enterprises in Manchester, Conn., an industrial router was programmed to run all of the bits at the same speed and feed rate to ensure test consistency.*

Some bits cut very cleanly. *There's virtually no chipout on this panel.*

Others wore down prematurely. *This panel looks as if it were scraped by a claw.*

BY ANATOLE BURKIN

many brands of bits and have a few personal favorites, but I've never been sure if I was spending my money on the best. It's impossible to compare bits when you buy them at different times and use them for operations in dissimilar materials.

I set out to develop an objective test to compare router bits and to settle the question of which bits are best. Along the way I learned there are a lot of scientific ways of testing metal and carbide, but most of them require expensive equipment and an even more expensive education to operate. But with the help of a metallurgical engineer, a mill-shop operator and representatives from router manufacturing companies, I came up with a fairly simple

Photo, this page (top right): Anatole Burkin test to measure what woodworkers really care about most: which bits last the longest and cut the cleanest.

To keep the size of the test manageable, I chose only ½-in.-dia., ½-in. shank, double-fluted carbide-tipped straight bits. This style of bit ought to be indicative of the kind of effort a manufacturer puts into the rest of its line. Most bits had 1½-in.-long tips. I bought the bits through retail outlets and mail-order companies. I paid anywhere from a scant $7.65 (Carb-Tech from Trendlines) to $23.10 (Jesada), but the cost averaged out to about $14 per bit. Right out of the box there were some notable differences. Many of the bits under $10 had thinner carbide tips than the more expensive bits. The bits were manufactured in many locales, including Israel, Italy, Taiwan and the United States.

A CNC router put the bits to the test

I delivered the bits to Harris Enterprises, a mill shop and retail outlet in Manchester, Conn. There, a computer numerically controlled (CNC) router ran the bits through 248 lineal ft. of ¾-in.-thick melamine-coated flakeboard at the same depth (¼ in.) and speed and under the same load. The flakeboard was purchased from one manufacturer. Flakeboard from the same lot has a pretty consistent density, unlike solid wood, which can vary greatly because of irregularities. The melamine requires a very sharp bit to cut without chipping. As a bit dulls, chipout increases, and the missing chunks of melamine make it easy to see how well a bit is holding up. Depending on many factors, including type of wood, cutting technique and imperfections such as knots, you may get more or less life out of a bit when cutting solid wood.

A note on melamine-coated flakeboard: The best bit for cutting grooves in this material, according to some, is a down-cut spiral bit, which will minimize chipping of the thin melamine surface. But I wasn't trying to find the best bit for cutting melamine. In the end, some of these bits were right at home with the material and sliced away with surgical precision. Other bits tore away at the thin skin of melamine like old sharks with blunt teeth.

Results varied greatly among bits

After the bits were run, I took them and the sheet goods back to the *Fine Woodworking* shop and pored over the damage. To simplify the data and not turn this into a science-fair project, I counted the number of chips (chipout) per foot on the edges of the grooves. I focused on the first 25 ft., when the bits were fresh, and on the last 25 ft., when most of the bits were near the end of their lives. I relied on my eyes and index finger. If I could see or feel a chip, I counted it. The chips ranged in size from a grain of salt to a chunk of coarsely ground black pepper.

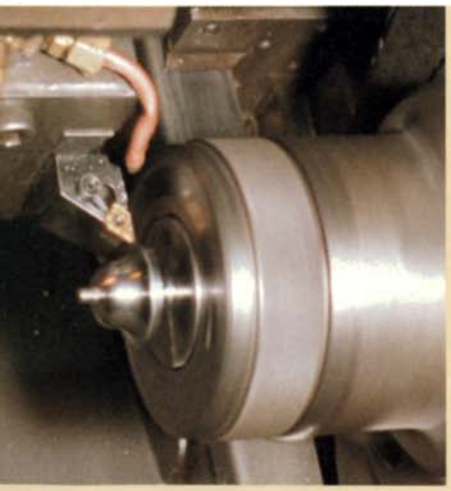
I added the number of chips from the first 25 ft. to the number of chips from the last 25 ft. and came up with an average number. Comparing the overall averages gave me an idea of how a bit did both in quality of cut and in longevity. But a more important rating might be the first number—the number of chips per foot that a bit produced at the beginning of the test run. Depending on the job or

ROUTER-BIT SCORECARD

Chips per foot (CPF) was our way of measuring each bit's performance against the others. We ran 17 double-fluted, carbide-tipped straight bits through 248 ft. of melamine-coated flakeboard at a depth of ¼ in. using a CNC (computerized) router. The best-performing bits caused the least amount of chipout, measured in CPF. We recorded CPF numbers for the first 25 ft. and the last 25 ft. of the run, and an average was computed. The bits are ranked based on this average. (NA indicates that the bit wore out and produced continuous chipping.)

WHITESIDE	
Price:	$18.50
CPF first 25 ft.:	0
CPF last 25 ft.:	0.4
CPF average:	0.2

RIDGE CARBIDE/ LIBERTY	
Price:	$15.95
CPF first 25 ft.:	0
CPF last 25 ft.:	0.5
CPF average:	0.25



Oldham Viper bits are manufactured at a new factory in North Carolina. *An automated lathe shapes the outer profiles of the bits, one at a time.*

From bar stock to router bit

Making router bits is a labor-intensive undertaking, even in a modern plant. To get an idea of what goes into making bits, I took a tour of Oldham's new router-bit and sawblade manufacturing plant nestled in the foothills of the Appalachian mountains in West Jefferson, N.C. The plant runs night and day, turning out thousands of Viper-brand router bits and sawblades per week.

Two main ingredients go into making carbide-tipped steel-shank router bits: carbide and steel bar. Steel bars as long as a pickup truck are plunged into a self-feeding turning center, which via computer instructions turns the bit's profile. Each bit takes a few minutes to turn. When done, the machine cuts the blank, ejects it, feeds some more bar stock and begins turning another bit.

Flutes must be cut into the blanks at a milling machine. From there, the bits are carted to a brazing station. Depending on the type of bit and size of

FREUD	
Price:	$15.95
CPF first 25 ft.:	0.4
CPF last 25 ft.:	0.8
CPF average:	**0.6**

MLCS	
Price:	$13
CPF first 25 ft.:	0.1
CPF last 25 ft.:	3.1
CPF average:	**1.6**

OLDHAM VIPER	
Price:	$13.95
CPF first 25 ft.:	0.4
CPF last 25 ft.:	0.5
CPF average:	**0.45**

AMANA	
Price:	$15
CPF first 25 ft.:	0.9
CPF last 25 ft.:	2.1
CPF average:	**1.5**

CMT	
Price:	$19.75
CPF first 25 ft.:	1.3
CPF last 25 ft.:	2.2
CPF average:	**1.8**

what bits are readily available, it might be more important to have extremely clean cuts and toss out the bit as soon as it shows signs of wear. Decide for yourself.

Using overall average as a measure, the top four finishers were the Whiteside, with an average of 0.2 chips per ft.; the Liberty, with an average of 0.3; the Oldham Viper, which averaged 0.5; and the Freud, which came in at 0.6. These bits cut cleanly at the start and at the end of the test. It's important to note that both the Whiteside and Liberty bits cut chip-free for the first 25 ft.

The next group of bits that stood out included the Amana (1.5 chips per ft.), the Carb-Tech (0.9), the MLCS (1.6) and the CMT (1.8). A third group of bits, including the Bosch, Eagle America, Porter-Cable and Woodworker's Choice, cut very cleanly when new but wore out sooner than the top four finishers.

There appears to be a relationship between the noise a bit makes and the quality of cut it produces. The CNC router operator noted that the cleanest-cutting bits were also the quietest. That means the bits were machined to tight tolerances, with very little runout and hence little vibration.

The Jesada bit snapped about halfway through the test. Prob-

run, they go either to an automated brazing machine or to a table where workers braze the carbide tips onto the bits, one by one.

After brazing, the bits are sprayed with polytetrafluoroethylene (PTFE), an antistick coating, and then put in an oven to bake the finish.

After baking, the bits are allowed to cool off. Then they are placed in a centerless grinder, which trues the shank, and then the ends of the bit are shaped. The faces of the carbide tips are ground flat, and the relief angle and outside diameter are ground to their final shapes, all within a few ten thousandths of an inch.

All along the way, sample bits are withdrawn from the assembly line and tested on scraps of wood. Once a lot passes inspection, it's carted off to the packaging center. To make a typical run of 500 bits that are all the same shape, it takes three to four hours from start to finish.

Carbide tips are brazed onto the steel body. *Although automated machines perform the bulk of brazing tasks, some bits require a human touch.*

Photos, this page and facing page (bottom): Anatole Burkin

WOODWORKER'S CHOICE

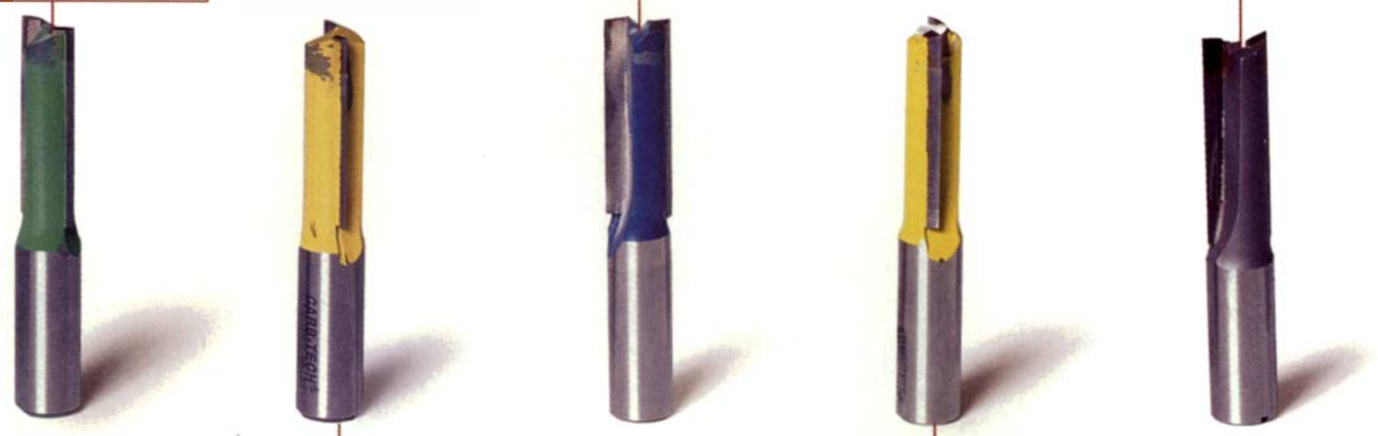
Price:	$7.95
CPF first 25 ft.:	0.5
CPF last 25 ft.:	4.6
CPF average:	**2.6**

WOODLINE

Price:	$10
CPF first 25 ft.:	1.4
CPF last 25 ft.:	7.9
CPF average:	**4.7**

BOSCH

Price:	$14.14
CPF first 25 ft.:	0.3
CPF last 25 ft.:	12.9
CPF average:	**6.6**



CARB-TECH

Price:	$7.65
CPF first 25 ft.:	0.9
CPF last 25 ft.:	6.3
CPF average:	**3.6**

WOODTEK

Price:	$12.95
CPF first 25 ft.:	3.6
CPF last 25 ft.:	6.9
CPF average:	**5.3**

lems, however, surfaced right at the start. The router operator noted that the bit was very noisy and cut poorly. I bought a second Jesada bit, and the same thing happened. I called Carlo Venditto, the president of Jesada, who acknowledged that the company's 1½-in.-long bits were improperly engineered, and they were subsequently recalled. Venditto explained that the rake angle was insufficient (causing chipout), and too much material had been machined off the shank (resulting in a weak point). I bought a third bit, which had been reengineered, and although it didn't snap, it also performed relatively poorly.

It's not clear whether there's a relationship between price and quality. One of the cheapest bits, the Grizzly S-Y ($7.95), performed poorly (7.4 chips per ft.). But The Woodworker's Choice bit, which also cost $7.95, did quite well at the outset (0.5) but suffered heavy wear by the test's end. For small jobs, the Woodworker's Choice might be a good value. But better bits generally cost about $15 or more. Ironically, the most expensive bit, the $23.10 Jesada, performed poorly.

The relationship between quality and country of origin is good news for the national pride: The Oldham, Whiteside and Liberty

The right carbide affects a bit's quality of life

Most router bits are either carbide tipped (with steel bodies) or solid carbide, which stays sharper longer. Industrial users spring for even tougher bits made of diamonds, but they're 10 times more expensive than carbide, not a viable alternative for a small shop.

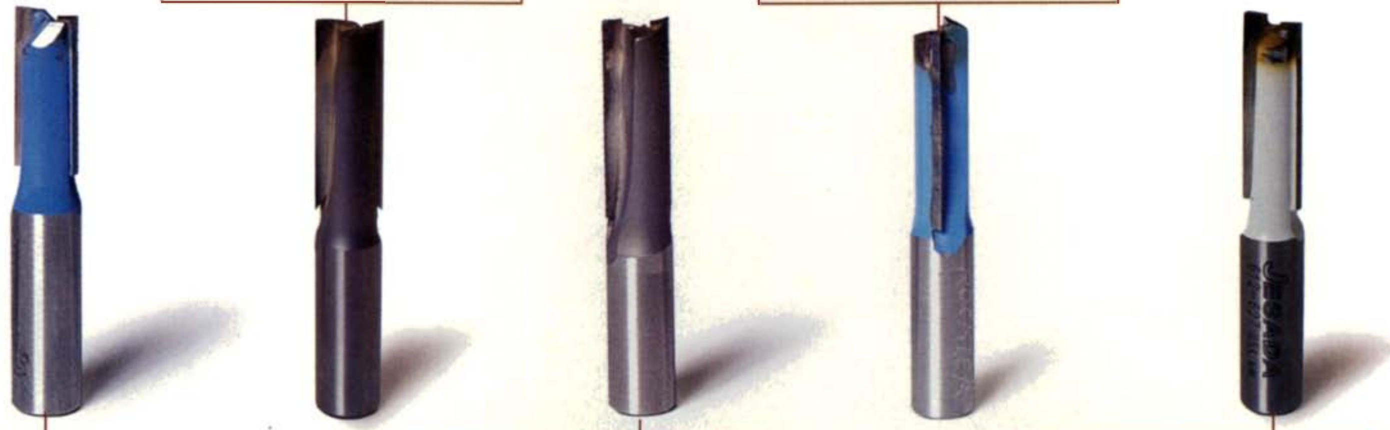
The carbide used to manufacture router bits is tungsten carbide, a compound made up of carbon, tungsten and other trace metals. In its raw form, the material is a fine powder (particles under 1 micron) that looks much like the dry ink found in copying machines. The properties of a carbide are dependent on many things, including the mix of compounds. Hardness is a critical property.

Trace amounts of other metals such as cobalt act as binders and are added to the carbide. The powder is placed in a form and pressed, then baked in a furnace under high pressure and high temperature, a process known as sintering. On steel-shank tools, carbide tips are attached by brazing.

Carbide must have a balance of two key qualities: wearability and impact strength. Wearability refers to the hardness of the carbide or its ability to stay sharp. Impact strength is just that: the ability to withstand a sudden shock, such as running into a knot. Very hard carbide is brittle and may shatter upon impact with a knot. Softer carbide can take impact, but the

EAGLE AMERICA
Price: $16.99
CPF first 25 ft.: 0.2
CPF last 25 ft.: Continuous
CPF average: NA*
*Bit wore out after 140 ft.

ROCKLER
Price: $13.49
CPF first 25 ft.: 1.4
CPF last 25 ft.: Continuous
CPF average: NA*
*Bit wore out after 130 ft.



GRIZZLY S-Y
Price: $7.95
CPF first 25 ft.: 5.9
CPF last 25 ft.: 8.8
CPF average: 7.4

PORTER-CABLE
Price: $18.50
CPF first 25 ft.: 0.3
CPF last 25 ft.: Continuous
CPF average: NA*
*Bit wore out after 190 ft.

JESADA
Price: $23.10
CPF first 25 ft.: 2.2
CPF last 25 ft.: Continuous
CPF average: NA*
*Bit wore out after 120 ft.

bits, which performed well, are made in the United States. But you can also find good bits imported from Italy (CMT and Freud) and Israel (Amana). Most of the Taiwanese bits (Carb-Tech, Grizzly S-Y, Rockler, Woodline, Woodtek, Woodworker's Choice) didn't perform as well. One exception was the MLCS bit, which did well.

There does seem to be a relationship between carbide thickness and performance. The Taiwanese bits generally use thinner (about 0.03 in. to 0.05 in. thick) carbide tips. The better-performing bits all have 0.06-in.-thick to 0.08-in.-thick carbide tips.

Is it fair to draw conclusions about a company's entire line of bits based on testing one randomly picked straight bit? Yes and no. Sure, every company runs into quality-control problems occasionally. But when I'm in the middle of a project using expensive materials, and the clock is ticking, I don't want excuses. I'll go with the manufacturer whose products worked well for me on the first try. For the time being I'll presume that if a manufacturer's straight bits are good, then I'll be more inclined to invest in its other products as well. □

Anatole Burkin is a senior editor of Fine Woodworking.

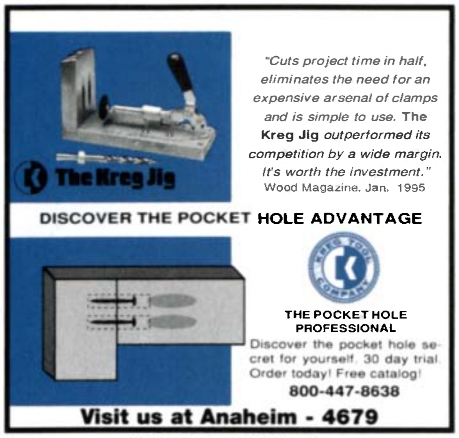
edge won't last as long. Manufacturers settle on a carbide grade that they believe strikes a balance between these two characteristics based on the material that the tool will be used to machine.

Jim Brewer, director of operations for Freud, explained how carbide wears. "Particles of carbide actually break off, exposing fresh particles. Anything that attacks the binder allows more particles to break off because the binder gives up. The binder is ultimately what fails."

The finer the micrograin, the longer a cutting edge will remain sharp. "The analogy would go like this," explained Brewer. "Take a handful of sand and a handful of gravel. If you remove a few grains of sand, there's still a lot of sand left over. But remove a few chunks of gravel, there's not much left."

ROUTER-BIT SOURCES

Amana (800) 445-0077
Bosch (877) 267-2499
Carb-Tech (800) 767-9999
CMT (888) 268-2487
Eagle America (800) 872-2511
Freud (800) 334-4107
Grizzly S-Y (800) 541-5537
Jesada (800) 531-5559
MLCS (800) 533-9298
Oldham Viper (800) 828-9000
Porter-Cable (800) 487-8665
Ridge Carbide (800) 443-0992
Rockler (800) 279-4441
Whiteside (800) 225-3982
Woodline (800) 472-6950
Woodtek (800) 645-9292
Woodworker's Choice (800) 892-4866



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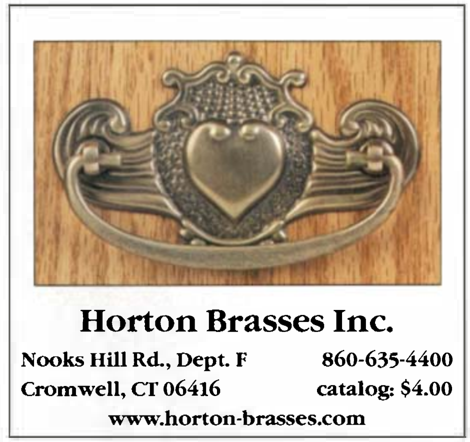
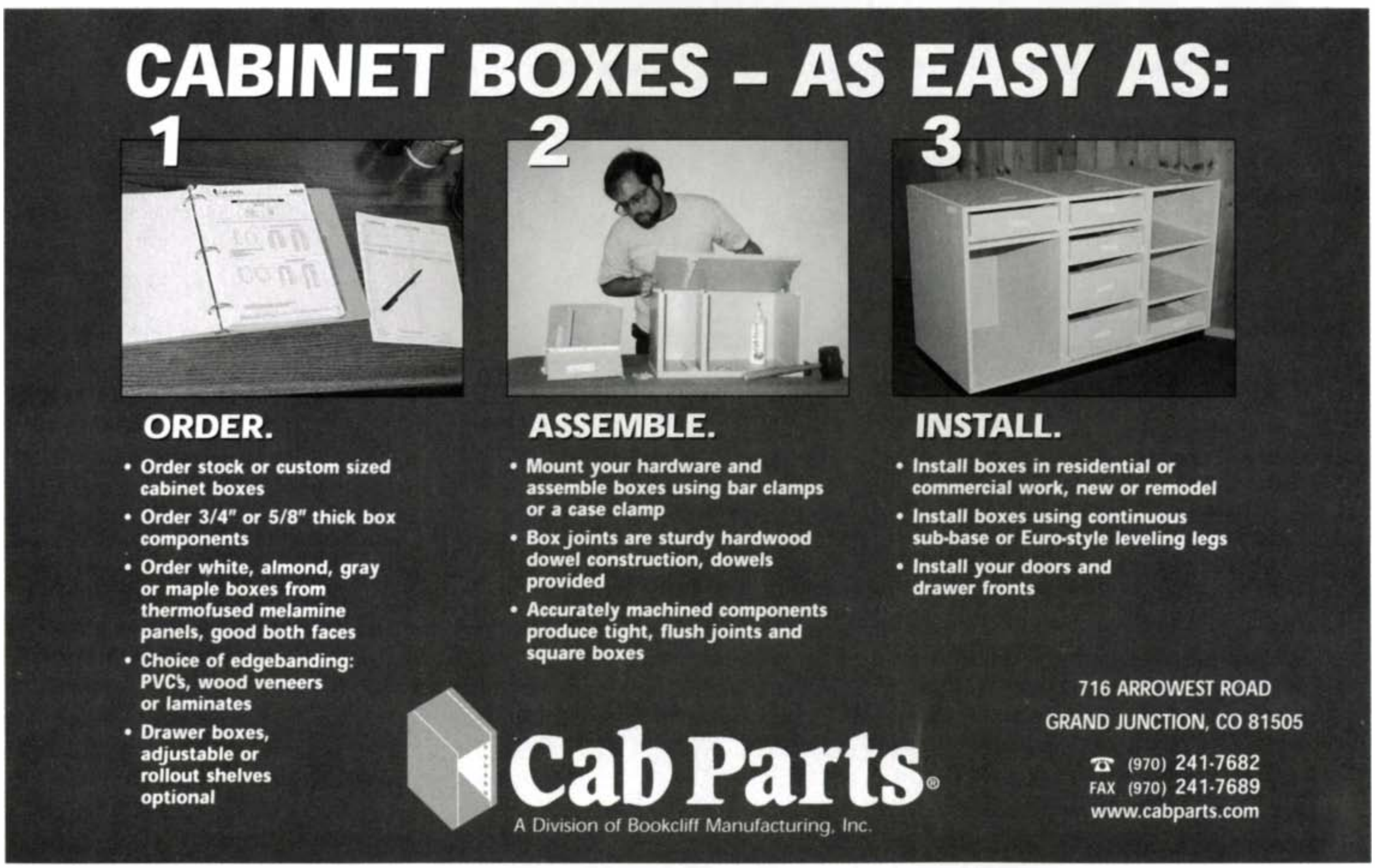




READER SERVICE NO. 158

BY MIKE DUNBAR

The test of time

When scientists or engineers test the reliability of a method, they go into a laboratory and simulate the circumstances under which that method will be used. Woodworkers do not have that option. It is not practical for us to keep a piece of furniture for a decade or more just so we can see how it holds up. If we make furniture that fails as a result of use or changes in humidity, the customer is unhappy, and we have to fix the piece. However, there is a laboratory available to us where just about every conceivable method of construction has been tested. That lab is the past. Examining period furniture is a fast, risk-free way of determining what works and what does not.

Glue is not enough

There's a reason why your neighbors and friends always ask if you can reglue their factory-made chairs. The chairs are probably held together with socket joints—a round tenon in a round hole—a joint that manufacturers keep trying to make work by using better adhesives. A socket joint works only as a mechanical joint; in other words, it requires something other than glue to hold it together. Joined with only an adhesive, a socket joint will almost always fail.

The early chair makers used a variety of methods to create mechanical joints. Their joinery relied on compression rather than on tension for strength. For instance, they used locking tapers in chairs. A locking taper is a round, tapered, wedged-shaped mortise and through-tenon that gets tighter as it is compressed. (The joint is similar to the locking taper that secures the drive center in a lathe.) If you study old chairs, you will know better than to rely on glue alone to hold socket joints together.

Through the centuries woodworkers have been forced to contend with the constant tension between good construction and the demands of the current fashion. Often, fashion won. By studying period furniture, you'll see the same forces at work in the furniture we make today. In the classic period of Windsor chair making (1760-1800), legs were secured to seats with locking tapers. These chairs have lasted 200 years as tight as the day they were made. In the early 19th century, fashion shifted in favor of painted decorations on furniture. This new, trendy finish required perfectly smooth surfaces. To eliminate the exposed joints in seats, chair makers began to use blind socket joints that relied only on glue. These latter chairs did not survive in the same number as the earlier, locking-taper chairs did. Many that are still around have nails and screws driven into the leg tenons in a desperate effort by frustrated owners to tighten the wobbly joints.

Socket: glue me. *A glued socket joint—a round tenon in a round hole—is destined to fail. Chair makers from the past never relied solely on adhesives to fasten this joint; instead, they used mechanical means to secure it.*

Carcase construction evolved

In the second quarter of the 19th century, carcase construction changed. Previously, cabinetmakers made the sides of a desk or chest of drawers from a single, wide board. The top was screwed in place, and the back boards were nailed. Suddenly, in historical terms, construction shifted in favor of two very different techniques. The first retained the slab sides but secured the top to the sides with long sliding dovetails. Instead of being nailed in place, back boards with feathered edges floated in grooves run in the rear inside edges of the sides. The second technique was the frame and panel that we all know.

If you look at earlier chests, you'll see why these changes were made. The sides of many early chests have split or cracked. The change in construction to floating wide panels coincides with the rapidly expanding use of the cast-iron stove. A fireplace did not heat a room as well as a stove did, so furniture did not have to endure wide swings in moisture content. Once the stove was introduced, chest sides started cracking, and cabinetmakers had to select alternative methods of construction that allowed the wood to move more freely. Because we live in heated (and air-conditioned) houses, the changes these cabinetmakers were forced to adopt are still very good ways to construct a chest carcase. It is hard to fault the earlier guys for not anticipating the advent of central heating, but it is instructive to recognize the limitations of their construction techniques.

Studying the construction of old furniture will also contradict some of the

Photos, except where noted: Jefferson Kolle

things we in the late 20th century consider gospel. For example, we all believe that it is important to finish both sides of a board to equalize its response to changes in the relative humidity. You will observe plenty of tabletops and chest lids that are one or more centuries old and are still flat. However, these components are finished only on one side. The current practice of finishing all surfaces probably dates to the development of spray finishes. Before that, woodworkers did not waste time brushing a finish on hidden surfaces.

Dovetails and bed bolts make lasting impressions

Observing how well mortise-and-tenon joints or dovetails have held up over the centuries will give you an added appreciation for them. It may also make you a little more wary of new and easier construction methods that are yet to be proven over time. Biscuit joinery is quick and easy, but I am skeptical about the longevity of that fastening method. I guess time will tell.

You'll find there are plenty of 20th-century, machine-made chests with drawers held together with box joints and glue. Anyone who owns one of these chests has probably sworn up and down when opening a drawer and having it rack out of square and jam in its opening. Box joints have no interlocking surfaces; rather, the perpendicular drawer pieces meet in a series of parallel fingers, and they rely on glue to hold them rigid. Opening a box-joint drawer a couple of hundred times breaks the glue joint, and the drawer starts to rack. On the other hand, tightly fit, wedge-shaped dovetails are strengthened by glue but don't rely on it for security. Dovetails are a superior method for holding together drawers, to which thousands of antique chests will attest.

You can also learn about bed construction by studying antiques. Many of the beds being made today are held together with stamped steel clips that are screwed to the rails, the headboard and the footboard. The clips slip over each other like fingers. I saw a new bed in a furniture store. Two kids were jumping on the mattress, much to the dismay of the salesman. The bed was creaking and rocking, with the steel clips already working themselves loose.

The common way to hold together antique beds was to use bed bolts. These long bolts were passed through the legs and screwed into nuts captured in the rails. This surefire attachment method rarely loosened, and if it did, all you had to do was get out a wrench and give the bolt a fractional turn.

Floating panels don't split. *These two bow-front chests are very similar in form and age but not in construction. The top chest, with a single-board side fixed to the legs, top and bottom, has cracked due to fluctuations in heat and humidity. The side of the chest in the middle—a floating panel held in stiles and rails—hasn't cracked.*

Fastened back boards split, too. *The back of the chest with the split sides is screwed to the top and nailed to the bottom of the chest. A paneled back would have fared better.*

Early furniture makers knew their wood

Studying old furniture will also teach you about wood and its properties. For example, a preindustrial Windsor chair made of a single wood is rare. Chairs with hardwood seats are also unusual. Windsor chair makers used the various properties of different species of wood to engineer a chair that is legendary for its strength. Maple and birch turn well and produce crisp details on legs and stretchers. Ash, oak and hickory are flexible and bend well. They are ideal for backs and arms that appear delicate but are tough and flex under the sitter's weight. Soft pine seats carve easily, and faceted tenons on the hardwood spindles will bite into the softer wood, creating yet another type of mechanical joint.

You will also notice that early woodworkers used glue blocks more often than we do. These fasteners accommodate movement across wide tabletops. Affixed between the leg and a rail or between the rails and top, glue blocks can strengthen mechanical joints. Many woodworkers today forego glue blocks because they look somewhat sloppy. Oftentimes these craftsmen are sacrificing added strength for a clean, uncluttered surface that no one will ever see. To my mind, part of the beauty of a piece of furniture is a function of how well it has stood the test of time, developing patina as its owner uses it, lives with it and enjoys it.

Photo, this page (middle): William Wheeler

A breadboard drop lid

I have a 40-year-old secretary-style desk made of hard maple. The drop lid—the portion that folds down—is about 36 in. long and 14 in. wide, with a bead that runs along the top and side edges. A breadboard band is applied at each side. Over the years the breadboard bands stayed the same length, but the drop lid expanded and broke the glue joints. If I reglue the breadboard bands, the bead won't line up. If I cut the lid down about 1⁄16 in., what will prevent the main panel from shrinking back to its original size and then be offset by 1⁄16 in. later?

—Mike Morocco, Irwin, Pa.

Mario Rodriguez replies: It was common practice to attach breadboard ends to the drop lid of a secretary or desk. The idea was that the breadboard ends would keep the lid flat and true while allowing it to expand and contract with changing climate conditions. An unavoidable consequence of this technique is that in summer, as the center panel expands in width across the grain, its edges extend past the ends of the breadboard supports. In winter, the reverse condition develops, and the breadboard ends jut past the edges of the panel.

If this method is going to work on a drop-lid desk, the breadboards must be joined to the lid with a pegged tongue-and-groove joint that's not glued along the entire length of the joint. If the movement between the parts is restricted or prohibited by gluing, the construction will crack (see the drawings below).

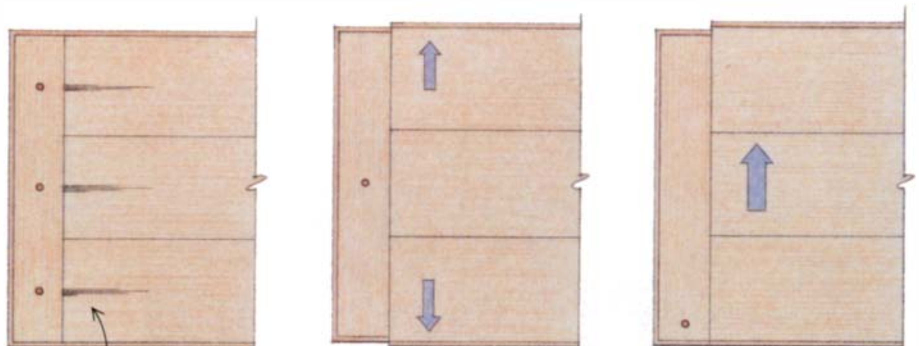
On a drop-lid desk, the usual practice was to glue the tongue-and-groove joint about a third or half the distance from the front to the back, peg the joint near the front, then mold the three free edges of the drop lid. This would allow the panel to move toward the back, or hinged side, of the lid while keeping the molded front edge properly aligned.

If the drop lid is hinged on the breadboard ends as it should be, you might be able to remedy the situation. Free the glue with water or solvent, then pull the front of the panel flush to the ends and peg it in place. This will force all of the movement to the back of the panel without sacrificing strength.

Unfortunately, it sounds to me like the maker of your desk glued the entire length of the breadboard supports to the drop-lid panel, preventing normal but controlled wood movement. He might have justified his decision to do so by referring to a particular antique desk he once inspected, in perfect condition, that employed this same technique.

All I can say is that 200 years ago, a room was heated by a fireplace or stove, and most of the heat generated was restricted to the immediate area surrounding the heat source. Furniture responded more gradually to the subtle changes in temperature or humidity that took place. Today, the extreme climate conditions in modern homes created by central heating systems and super-insulation often wreak havoc on period construction methods.

[Mario Rodriguez is a contributing editor to *Fine Woodworking*.]



PEGS REGULATE BREADBOARD MOVEMENT

While there is no avoiding the seasonal expansion and contraction of wood, carefully placing pegs ensures that the movement won't be noticed.

Making oak young again

A couple of years ago, I made some porch swings out of red oak. All of the wood parts were finished with two coats of polyurethane indoor/outdoor varnish and have been on covered porches—exposed to outdoor humidity and temperature but not to rain or snow. The wood has turned dark and taken on an unsightly, weathered look. Can I restore it to its original appearance, and how do I prevent it from happening again?

—Bill Casto, St. Albans, W. Va.

Jeff Jewitt replies: The short answer to your question is simply that you did not apply enough varnish to protect the wood against moisture. Four or five coats are recommended for a more complete barrier to protect the wood outdoors.

Unfortunately, clear coatings on wood destined for outdoor use need to be periodically reapplied or stripped and refinished. Although direct sun is the biggest source of damage, I doubt you can expect more than several years before some maintenance is required.

Red oak and other woods rich in tannins are susceptible to color change because moisture eventually gets into the wood, even though it's finished with

Drawings: Vince Babak

varnish. Another damaging culprit is UV rays, even though the wood is shaded. Even the most fastidious finishing and maintenance thereafter won't keep the wood from picking up some gray cast.

Remove the original varnish and sand the wood to 180 grit. Then apply a solution of oxalic acid dissolved in water. This will remove the dark stains. Rinse the wood with clean water and, when dry, apply a minimum of four coats of a good-quality marine spar finish.

You can maintain a more consistent color over time by applying a transparent wood stain similar to the stains for decks and porches. The pigment in these stains—iron oxide—is a great UV inhibitor and will protect the wood from graying. [Jeff Jewitt refinishes furniture in North Royalton, Ohio.]

Sharpening Japanese chisels

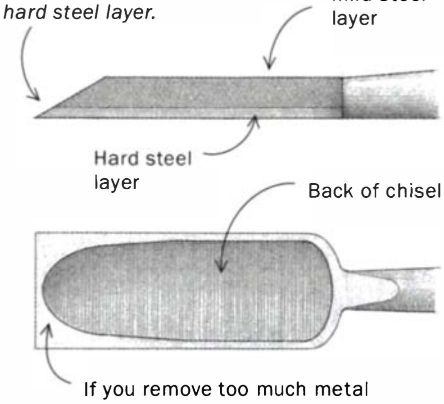
I recently purchased a few Japanese chisels of supposed high quality, but their cutting edges don't hold up to hardwoods as well as I'd like. I sharpen them the same way I sharpen any other chisel: on a progression of diamond stones. Is there some subtlety to sharpening Japanese chisels that I've overlooked?

—Andrew Green, Cincinnati, Ohio

William Tandy Young replies: Japanese chisels are usually sold with a low bevel angle (around 25°), which is great for softwoods but too fragile for oak and other hardwoods. To cut hardwoods, you need to increase the bevel angle to around 30° (see the drawings at right)

Some Japanese chisels require steeper bevel angles than others. Start with an angle of 28° and gradually increase the bevel angle until the chisel holds an edge well when you cut hardwoods. Don't make the angle any steeper than necessary. As you increase the bevel angle, keep the bevel flat—don't hollow-grind it as you would a Western chisel. The laminated blade's hard steel layer should be backed by the full mass of the mild steel layer to give the edge maximum durability. A flat bevel also allows you to use the tool with its bevel down to pare accurately into tight spaces.

THE RIGHT BEVEL FOR HARDWOODS



I grind Japanese chisel bevels with a low-rpm disc sander and a shop-made jig that runs in the sander's miter-gauge slot. Grind with a light touch to avoid burning the steel and to avoid removing any more

steel than necessary. If you remove too much steel, the cutting edge will retreat into the hollow-ground area on the back of the chisel, and you'll have to lap the back on a coarse stone to reestablish it.

I prefer to hone Japanese chisels on synthetic Japanese waterstones. As you hone the bevel side of a chisel, focus pressure at the very tip of the blade. This prevents the mild steel layer toward the rear of the bevel from wearing away more quickly than the hard steel layer at the tip, which would lower the bevel angle and make the edge more fragile.

When making chopping cuts with a Japanese chisel, it will also help to use a small steel hammer instead of a wooden mallet. The hammer delivers a compact, precise blow that drives the chisel blade crisply and cleanly through the wood. This keeps the blade from fracturing, because cutting pressure is applied only where the edge is reinforced by softer steel. (For more information on caring for Japanese chisels, see *FWW* #115, pp. 58-61.) One final note: Low-quality Japanese chisels contain brittle steel that won't hold an edge properly no matter how well you sharpen them.
[William Tandy Young wrote *The Glue Book*, published by The Taunton Press.]

Avoid compression wood

While flipping through some boards at the sawmill, the mill owner suggested I stay away from a few boards because they had compression wood all through them. What is compression wood?
—Charles Houser, Port Townsend, Wash.

Jon Arno replies: The term compression, as it relates to wood anatomy, typically describes a particular kind of reaction wood. Reaction wood is abnormal wood tissue produced by a tree when it attempts to alter its direction of growth. The initial stimulus might be a change in the prevailing source of light, as when a neighboring tree is felled. A chemical signal then causes plant hormones to migrate to one side of the stem or the other, affecting the rate of cell growth.

Softwoods and hardwoods have separate strategies for getting the job done, and as a result there are two forms of reaction wood. One is called compression wood, and it is found in conifer species on the lower side of the bend. The other form, called tension wood, is found in hardwoods, but it is usually located on the upper side of the bend.

When reaction wood is seasoned, longitudinal shrinkage (in the direction of the grain) is many times greater than that of normal wood. As a result, boards containing reaction wood are more likely to warp. Also, reaction wood causes significant problems in the finishing process.

With experience, it is possible to spot reaction wood in an unfinished board: Look for patches of dull, opaque wood, often containing fine cross-grain checks. If you find these patches, don't use the wood for anything important. And be sure to keep shopping at that sawmill—it sounds like the owner did you a favor.
[Jon Arno is a wood consultant in Troy, Mich.]

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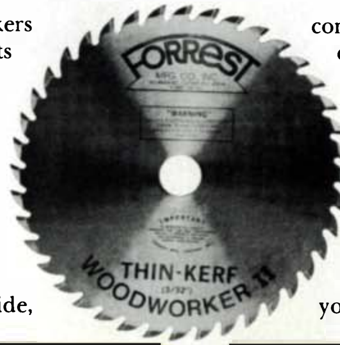

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Shaping the arm of a chair

BY SAM MALOOF

What do I use to shape the arm of a chair? The best tool for the job. I don't get hung up on using all power tools or all hand tools. If you get too mechanized, you have to design around the capabilities of the machines, and your furniture won't have the feel of handmade work. If you move to the other extreme and become a purist who won't use power tools at all, well, that's okay. But be prepared—you may starve to death. My philosophy is closer to Wharton Esherick's. He once said to me, "I use any tool that'll do the job. If I have to use my teeth, I use my teeth."

When I started woodworking, I used to cut out the arms of my chairs with a handsaw. I didn't have any power tools back then. I bought a little keyhole saw, and I cut out chair arms with that. Then I used a drawknife and a spokeshave and a rasp to take it to its final shape. My technique now isn't that different; the main thing is I use a bandsaw instead of a keyhole saw. And it's a lot faster.

Picking the wood

When I select the wood for a chair arm, I aim for uniformity. I don't mix quartersawn stock with slash-cut, and I try to get the same color all the way through because I don't use stains on my pieces. I usually try to match the wood of the arms and the wood of the seat. If the seat has a lot of beautiful grain in it, I want the arms to have the same beautiful grain. I'll pick the same wood for the crest rail, too, because the crest rail, the seat and the arms are the places where the character of the wood is most prominently displayed.

Most wood I use is first air-dried and then kiln-dried. Sometimes I get some

Patterns of the past. *As the author starts making a chair, he can choose among the hundreds of patterns of past chairs hanging in his shop.*

Interlocking layout. *Tracing a plan-view pattern, the author lays out chair arms in a 12/4 walnut board. He flops the pattern and nests the layouts to get as many arms as possible from the board.*

Adding another dimension. *With the arm blank jointed and planed, the author traces a second pattern to establish the general contours of the arm's elevation.*

Good references. *The compound angle where the arm will join the chair's back leg is cut on the tablesaw while the arm is still flat on the top and bottom. A simple, curved plywood jig steadies the curved side of the arm for the cut.*

Photos: Jonathan Binzen




MAESTRO OF THE BANDSAW

Impressive work ... but not advisable. With 50 years of constant practice, the author has developed extraordinary skill in a hazardous art: freehand shaping on the bandsaw. We present these photos to document a remarkable skill but strongly caution against emulating what is plainly a dangerous technique.

purely air-dried walnut, and I find—now this is my own notion—that it seems to retain more of the original color. Air-dried walnut tends to have redder tones, whereas walnut that is air-dried and then steamed and kiln-dried tends to be a sort of grayish brown. I really like both of them, but I don't mix them.

Of all of the woods that I've used, walnut is the friendliest for making furniture. People talk about this exotic wood or that exotic wood, but walnut is still my favorite.

Shaping the arm

I do most of the shaping of chair arms freehand on the bandsaw. I can shape a pair of arms in about 15 minutes. It works well for me, but I do not recommend this method. It's very dangerous because the workpiece is inadequately supported as you cut. The only reason I do it this way is that I didn't know any better when I started. I'm very careful when I do it, but being careful doesn't remove the danger. I have had a piece of wood slam down on my fingers and thought I had broken a finger or two. If I feel the blade grabbing, I take my hands off the piece of wood immediately and sacrifice the workpiece if I have to.

I have had people tell me they shape a chair's arm with a router, following a pattern. I have never tried that. The only alternative I can advise is to use a keyhole saw, a drawknife and a spokeshave—the way I did when I started out.

Once I have roughed out the arm on the bandsaw, I use a Surform (Stanley model No. 295). This tool does about the same job as a spokeshave—it can take off a lot of wood very quickly—but I can use it without worrying about grain direction. I'm not taking out a lot of wood with it; I'm mainly fairing the curves and straightening the lines I cut on the bandsaw (see the top photos on p. 106). As soon as I buy a new Surform, I cut its handle off so that I can control it better. With the handle removed I can really feel the work and get into it.

The Surform cuts quickly, taking little, noodlelike shavings and leaving a rough surface. To clean up after it, I use a very coarse cabinetmaker's rasp. I have a range of rasps, but typically I'll use three rasps to finish an arm, perhaps starting with a Nicholson No. 11, then using a No. 48 and finishing up with a No. 1. Depending on the contours I'm smoothing, I use both the flat and rounded sides of the rasps.

With the rasp work done, I go over the arm with a Japanese tool that is a cross between a Surform and a rasp. Called a saw rasp, it is made by Shinto and has a cutting surface that is comprised of sawblades in a waffle pattern. They are sold in coarse and fine and are available in the Japan Woodworker catalog (800-537-7820).

To do all of this hand-shaping, I hold the workpiece in a regular bench vise. I do have two old pattern maker's vises, which work beautifully for clamping odd-shaped pieces. But I'm not doing production, so I just use the regular vise that is on the bench where I usually work.

Sanding and finishing

With the shaping finished, I attach the arm to the chair. After the chair has been glued

FROM BANDSAW TO FINAL SHAPE IN MINUTES

Once an arm has been bandsawn to shape, it takes the author about 15 minutes to refine the shape with a Surform, rasps and a Japanese saw rasp until it is ready to be attached to the chair. With the arm fresh off the bandsaw, the author uses a Surform to fair the curves and smooth the bumps. He removes the Surform's handle to give him a better feel for the work. Next, he uses a range of progressively finer cabinetmaker's rasps to refine the shape. The saw rasp presents a flat face to the work and completes the smoothing-tool sequence.

up, I do the final shaping and scraping. Then the sanding begins. I start out with an air-powered random-orbit pad sander. But 80% of the sanding is done by hand, beginning with 80-grit paper and going through the steps—100, 150, 220. Then I'll use a 400-grit wet-or-dry paper without lubricant. I can spend up to a week just sanding a chair. I think if I used lacquer I would not need to be nearly so thorough. But when putting an oil finish on, like the one I use, you see every single scratch.

After sanding with 400-grit paper, I rub down the whole chair with 0000 steel wool and follow that by burnishing it with a cloth. The cloth is equivalent to about 2,000-grit paper, and its effect is amazing. You think you have a wonderful smoothness in the piece of furniture, but after you rub it down with a plain cloth, there's a sheen that is just unbelievable.

All of my chairs receive an oil finish, except the ones made from exotic woods such as zircote, rosewood and ebony (I apply a wax finish to these woods). I developed the finish years ago, and it's now available commercially from the Rockler catalog (800-279-4441), formerly The Woodworkers' Store. It is a mixture of one-third linseed oil, one-third raw tung oil and one-third semigloss urethane varnish. I apply it generously and then rub it off completely so there isn't a wet spot left anywhere. I let it sit overnight and then add another coat. The process is repeated about four times. Then I make a batch of finish that is half linseed oil and half tung oil with some shredded beeswax mixed in. I put two coats of that finish on, and the chair's finished, ready to be used.

Rubbed the right way. *The author's chairs get four coats of oil finish and two coats of wax, each coat thoroughly rubbed out.*

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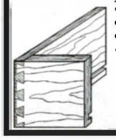

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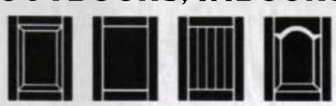

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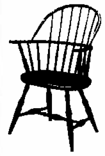

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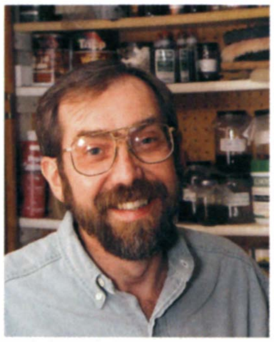
BY CHRIS MINICK

Blotch-free staining



To stain, or not to stain: That is the question. This question has a simple answer if you used walnut or oak for your latest project. Not so if you made your intended heirloom of cherry, soft maple, aspen, alder, birch or pine. These woods have a nasty tendency to stain unevenly, usually resulting in unsightly dark blotches (see the top photo at right).

The reason why some woods blotch when stained while others don't is hotly debated, and theories abound. Some woodworkers claim that wild, swirled grain is the culprit. Others insist that unseen resin pockets formed during kiln-drying are to blame. The latter explanation makes more sense to me. However, the precise botanical cause of the blotching phenomenon is unimportant. As woodworkers we must deal with the problem no matter what the cause. Whichever technique you use—and there are several—the secret to blotch-free staining is to control the depth of penetration of the stain and to keep the color close to the wood surface.

Commercial products have limits

A stain controller, a mixture of linseed oil, alkyd resin and solvent, is one solution to the problem. When a stain controller is applied to wood, more of the solution is absorbed into the blotchy areas of the wood and less into the nonblotchy areas. The effect is to even out stain absorption and to minimize blotching. Stain controllers do have some drawbacks, though: They are not compatible with water-based, alcohol or lacquer stains, and the end color of a stained piece often appears too light.

Gel stains prevent blotching by virtue of their inherent viscosity: Thick stains will not easily penetrate the wood. The color you get from gel stains usually looks better than what you get by using stain controllers, and gel stains are available in water- or solvent-based varieties. But neither of these methods controls blotching to my satisfaction, so I've developed a finishing ritual for blotch-prone wood that fits my style of finishing.

Applying a glue-size. *A washcoat of hide glue, thinned to a liquid at room temperature, not only reduces blotches, but it also improves the finish surface of thirsty, fuzz-prone woods such as black willow (shown).*

Glue-sizing, an old-timer's solution

Glue-sizing is an effective method to control stain penetration into wood, and it's my first choice for cherry or other woods prone to blotching. Glue-sizing may seem a little strange at first. After all, who in his right mind would ask a woodworker to smear a washcoat of glue all over a newly assembled masterpiece? Before you commit me to the funny farm, hear me out.

Glue-sizing as a finishing technique for controlling stain penetration has been around for a long time. I have a finishing manual published in 1903 that expounds the virtues of glue-sizing. However, glue to a woodworker in 1903 meant animal hide glue, not the white or yellow glues we most often use today. Protein-based animal hide glue will take a stain much the same way that dyes will stain your fingers, but white and yellow glues will not take a stain at all.

How does it work? The liquid glue-size is absorbed into and around the cellulose fiber bundles in the top few millimeters of wood. Once dry and sanded flat, this homogeneous glue and wood layer acts as a partial sealer to prevent deep or uneven stain penetration into the wood. But unlike a conventional sealer, this layer of glue and wood will take a stain. The net result is an even, blotch-free color over the entire surface.

Sizing the wood with glue is a straightforward procedure (see the photo at left). Add about ¼ cup of hide-glue granules to a quart jar and fill the jar with cool water. Let this mixture sit overnight to soften the granules, then warm it up in a microwave oven to dissolve the softened glue. Shake to homogenize the glue and let it cool to room temperature. The exact proportion of hide glue to water is not critical, but the glue-size must be liquid at room temperature. If yours is not, add a little more water. Store-bought liquid hide glue diluted with four to five parts water is an acceptable substitute for the granules.

Brush, spray or wipe on a liberal coat of size over the wood surface. After about five minutes, wipe off the excess and let the wood dry

Most people agree: Dark blotches are ugly. *Both pieces of this resawn slab of birch were finished with the same non-grain-raising stain and water-based lacquer. The blotch-free sample was treated first with a washcoat of hide-glue-size.*

Photos: William Duckworth

Spray on dye stain in thin coats. *The author chose an air brush to apply stain to this small poplar box, but the principle is the same if you're using a large spray gun. Build up the color gradually in many thin coats.*

overnight. Lightly sand the raised grain flat and apply stain as you normally would. I get the best results when I stain the glue-sized wood with a water-soluble dye stain, but I've also had good luck with premixed non-grain-raising stains. Avoid alcohol-based dye stains, though, because there's a slight chance that the alcohol will crystallize the glue.

Spraying on the color

If you have spray equipment, managing blotch-prone woods can be even easier. Simply spray several thin coats of stain onto the raw wood (see the photo above). Spraying thin coats allows you to control the depth of stain penetration precisely and to prevent blotches. Inspect the wood after each spray pass. If you see a blotch developing, spray less on those areas on the next pass.

The operative words here are *several* and *thin*. Flooding the stain on with a spray gun is no better than brushing it on with a paint brush. (You could even argue that it's worse, because you're left with a spray gun to clean.) Sneak up on the color slowly and make sure each coat is dry before proceeding with the next coat. Almost any stain can be sprayed, but I favor fast-drying alcohol-based dye stains, because they dry quickly and stay right on the wood surface.

Toning is another blotch-control technique that I employ. Instead of spraying the color directly onto raw wood, seal the wood first (with shellac or lacquer sanding sealer), then apply toner on top of the sealer. Toners are essentially nothing more than colored lacquer finishes. But because all of the color resides in the finish and the toner is applied over a fully sealed surface, blotches are virtually eliminated.

Avoid the temptation to apply a heavy coat of toner. Drips, runs and fat edges will show up as colored streaks on the finished wood and are very difficult to sand out. In fact, sanding between toner coats should be avoided, if possible. Apply several thin coats to arrive at the desired final color. You can make your own toning lacquers easily by tinting a regular nitrocellulose lacquer with a non-grain-raising dye stain. You can also buy them in aerosol cans through a mail-order catalog, such as Woodworker's Supply, Inc. (800-645-9292).

Both of these spray techniques result in a very even overall color, and the wood is blotch-free, but it also looks kind of bland. The stain has done little to enhance the grain or change the character of the wood. One more finishing step, glazing, will add life back into the wood.

Glazing adds depth

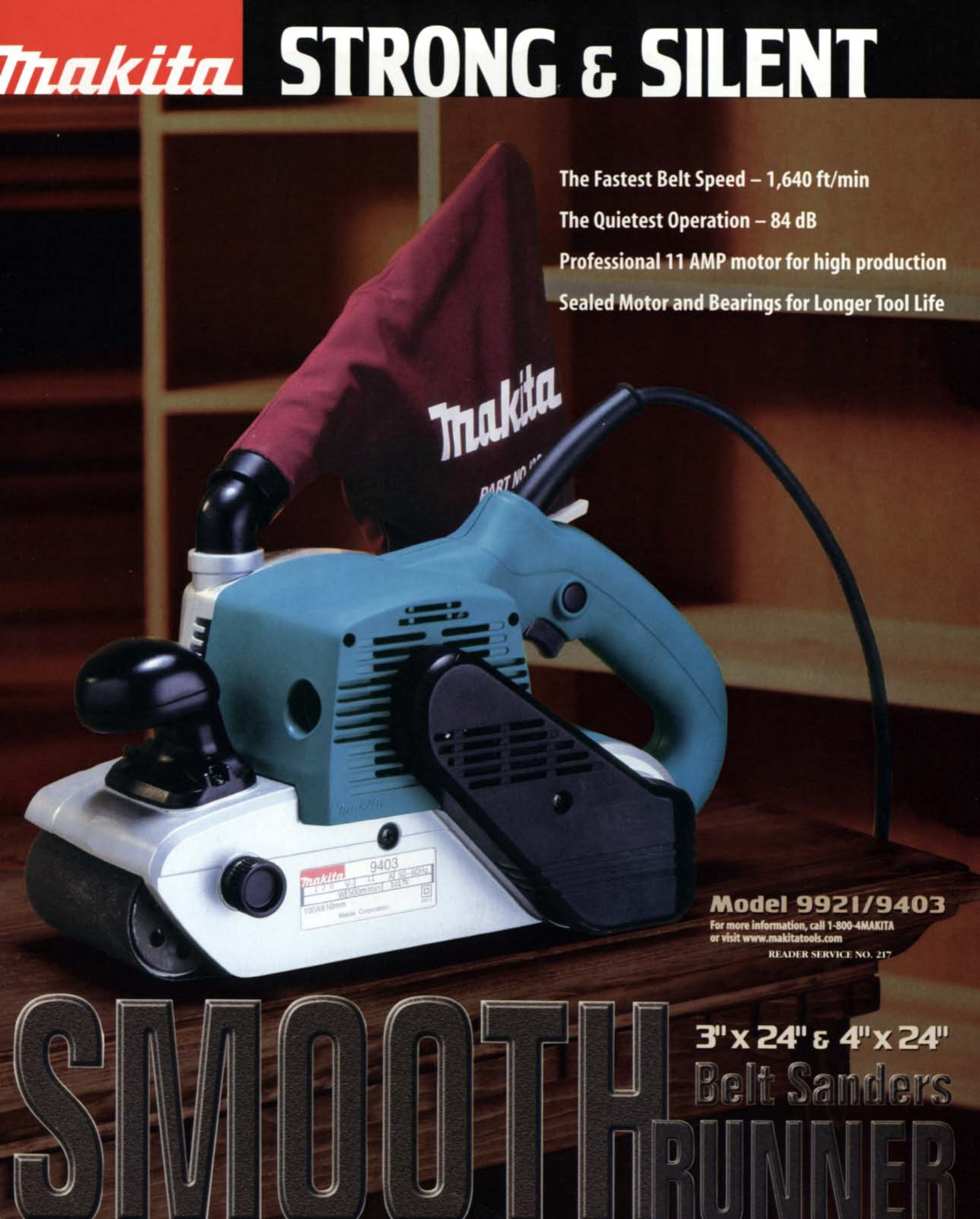
Glazing is one of those finishing techniques worth learning, even if you don't use blotch-prone woods. A coat of glaze will add depth and richness to toned wood, and it will create interesting structure and color in wood that has none. In essence, glazes are just slow-drying, thickly pigmented stains. However, unlike conventional stains, glazes are applied between coats of finish—not to raw wood. The procedure is simple, as well as reversible. If you don't like the results, wipe off the glaze with a rag soaked with thinner and start over.

Glazing works best over a fully sealed surface, so apply a thin coat of finish to the toned wood before glazing it. Over that you can apply a thin coat of glaze with a rag, brush or spray gun. Keep it thin! Too much glaze will obscure the underlying wood. I find it helpful to dampen the sealed wood with mineral spirits before applying the glaze, which helps the glaze flow out to a thin, streak-free layer.

Once the glaze has leveled out, you have several options: Leave all of the glaze on, selectively remove some of it or remove all except the glaze that remains in the pores. Leaving the glaze layer undisturbed will darken the wood but add little to its character. More often than not, glazes are applied and then removed selectively with a rag or brush to create highlights, to blend in color variations or to mask sapwood. You can achieve a simulated grain effect by selectively removing the glaze with coarse steel wool. The final option, removing all of the glaze except for that which remains in the pores, is useful for adding a visual contrast to dye-stained open-pored woods. When you are satisfied with the appearance of the glaze layer, allow it to dry for at least 24 hours before applying a coat of protective finish.

Shop-made glaze is easy to make. Add about 1½ tablespoons of universal tinting color and 1½ tablespoons of boiled linseed oil to one cup of slow-drying varnish. Thin this mixture to the consistency of heavy cream for a wipe-on application—a little thinner for spraying. Ready-made glazes are available at most paint stores that cater to professional finishers or by mail order from Mohawk Finishing Products (518-843-1380).

Glazes add depth to any finish. *The glaze applied to this plant-stand top was made by adding universal tinting colors and boiled linseed oil to slow-drying varnish. How hard you wipe will determine how much color you leave on the surface.*



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UNPROGRAMMABLE PATTERNS

With the proliferation of computerized routers and programmable laser cutting machines capable of cranking out complex shapes and patterns in seconds, isn't it comforting to know that some of the best embellishment around is produced by someone whacking a few homemade steel stamps with a hammer? On his maple side table and a range of other pieces, Massachusetts furniture maker Timothy Coleman has been using a caveman-simple technique to produce stunning patterns. Coleman wields the stamps quickly and judges spacing by eye, which keeps the work fun and keeps the patterns from a sterile perfection. To give some of his patterns an extra jolt, he fills the stamped areas with colored lacquer. For more on how Coleman makes his stamps and patterns, see the article on p. 58. ■

Photos: Dean Powell (bottom left and right); Jonathan Binzen (all others)