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April 1994, No. 105
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94-105

Fine WoodWorking

March/April 1994 No. 105

DEPARTMENTS

ARTICLES

Working figured wood, p. 44

A "no-finish" finish, p. 64

Shop storage solutions, p. 79

On the Cover: *Mark Nels of Canton, Georgia, built this striking round-top toolbox. For a gallery of readers' toolboxes, see p. 53. For more on Nels' box, see p. 4. Photo: Alec Waters*

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Readers respond—Readers' contributions and comments are the lifeblood of *Fine Woodworking* and often where the information sharing about woodworking gets the most exciting. We've had a few examples recently that bring that message home in ways ranging from toolboxes to jewelry boxes to sources of unusual wood.

Tale of the toolboxes—This issue's cover story (p.53), a gallery of toolboxes submitted by readers, is a case in point. Associate Editor Vincent Laurence shepherded the project. He said he wasn't sure what kind of response he would get when he devoted some space in this column in *FWW* #100 to ask readers to send in photos and information about their tool chests.

"Nearly a year and over 30 toolboxes later, it's obvious there's a lot of talent and passion for excellence out there," said Laurence. Readers from all parts of the United States and Canada responded. "It was difficult narrowing the field to fit five magazine pages, and many fine toolboxes had to be excluded," he added.

The toolbox featured on the cover of this issue is a fine example of the kind of work *Fine Woodworking* readers are doing. Made by Mark Nels, an architectural woodworker who lives outside Atlanta, Ga., the box has a coopered top, pulls made from buffalo nickel belt studs, and handmade hardware, including a spring-release locking mechanism. When it came to adding another personal touch, Nels turned to his computer and a word processing program to complement his woodworking tools.

"I found long ago I don't enjoy carving, but since I wanted my last name and the year on the box (toolbox tradition), I found Word for Windows some help," Nels said. "I found the font and the size of the letters I wanted, printed them and used double-stick tape to hold it on the curve of the handles. I cut out the letters with a razor blade and used a scratch awl to texturize the bottom of the cutout."

Jewels of knowledge are stored along with other valuables in the jewelry box that Jacqui Lunde of Hastings, Minn., made (see the photo above). Lunde said she learned woodworking "from scratch after my family of many children was raised. I am a 63-year-old grandmother, and wood is now my main interest." She cites *Fine Woodworking* as one of her prime teachers in learning the craft.

Her creation combines and incorporates techniques she culled from the magazine: wooden box hinges (*Fine Woodworking* #52), dowel hinges (#70), circular drawers (#59), shopmade inlay (#59), bandsawn compartments (#65), hidden drawers (#72, #84), sculptural inlay (#51), miniatures (#99) and box joints (#89).

Photo: Jacqui Lunde

***A treasury of techniques**, ranging from box joints to hidden drawers, all learned from the pages of* Fine Woodworking, *were combined by Jacqui Lunde to make this jewelry box.*

Now Lunde is working to pass on some of the skills she has acquired. "Since I enjoy woodworking so much, I now teach ladies 60 to 70 years old who all enjoy my hobby along with me," she writes. "Building things with our own hands makes us all feel a little better about ourselves."

Paulownia plaudits—Another good example of reader response comes from Peter R. Beckjord, research silviculturist and consultant for the National Paulownia Center. Beckjord wrote a letter to the editor in *FWW* #95 responding to the article in *FWW* #92 about paulownia wood. He offered seeds and information to help people cultivate fast-growing paulownia trees for woodworking.

"I received over 2,000 letters from woodworkers (your readers) around the world," Beckjord wrote. "I sent seeds and instructions to them all and now would like to hear from them on how well their seedlings have done, as well as if any of them have made anything out of paulownia wood."

Beckjord would like to offer more help to anyone with questions about growing their trees. "All I ask is if they drop me a note on what they have done or heard about paulownia, please send me a self-addressed, stamped envelope, so I can respond to them."

Those interested in more information about paulownia can write to Beckjord at the National Paulownia Center, 4303 Kenny St., Beltsville, Md. 20705-2738.

—William Sampson, editor.

Fine WoodWorking

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Writing an article

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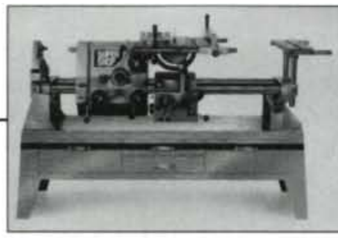

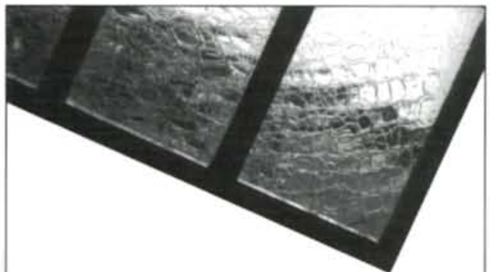

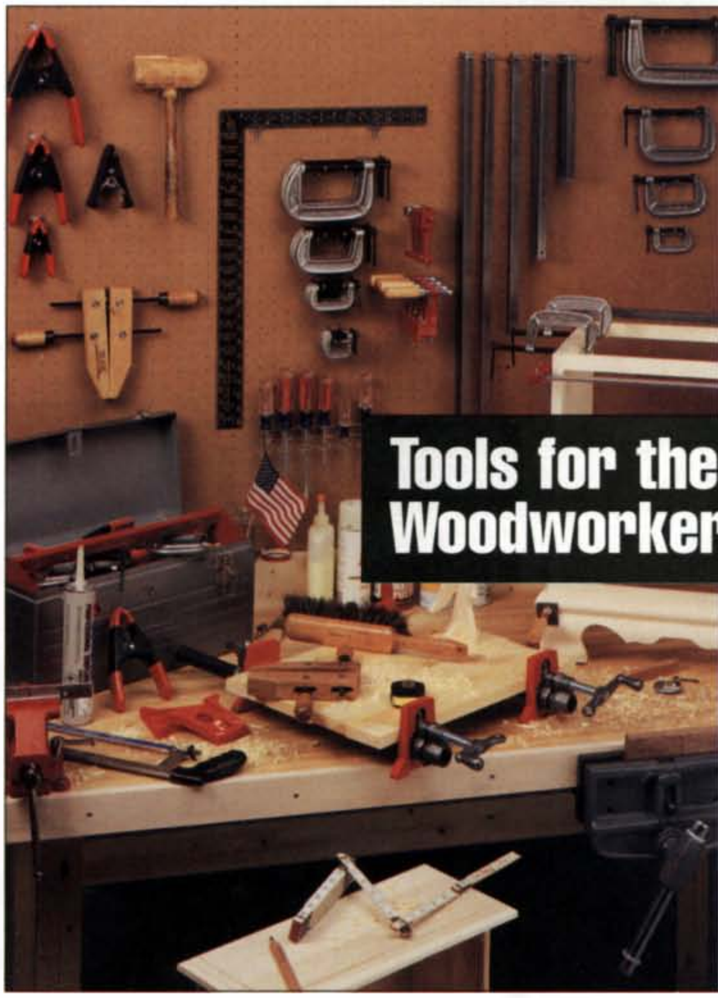

Finally smooth jointing—Like many woodworkers, I was pleased to read a straightforward approach to setting jointer knives as outlined by Robert M. Vaughan (*FWW* #103).

For 25 years, I have run wood through my Shopsmith jointer with limited to disappointed success. I, too, had tried straightedges, triangles and magnets, but nothing I did gave me a perfect edge for gluing up an invisible joint. It was against my religion to buy one of those $150 knife-setting jigs, which is half of what I had paid for the jointer.

Besides being a woodworker, I'm a pack rat, and I had a dial indicator that had been in my possession at least 50 years. The face had yellowed with age but still worked. Scraps of mahogany, two round magnets, a ¼-in.- by 1½-in.-long stove bolt were all that was needed for a suitable support for the dial indicator.

The procedure outlined in Mr. Vaughan's article was followed, and now I am producing surfaces I never thought possible on my Shopsmith jointer. Many thanks to Mr. Vaughan and *Fine Woodworking.* *—R.D. Gravatt, Houston, Texas.*

Another jointer knife-setting tip—I enjoyed reading Robert Vaughan's article in *FWW* #103, "Setting Jointer Knives." I have been using a dial indicator to set both my planer and jointer knives for several years now and found the article to be quite accurate. I use one additional tool in my setting process: the steel square. Having located top dead center (TDC) of the jointer knives, I clamp the square to the outfeed table at just the right place to maintain the dial indicator at the TDC point. This eliminates the need to find TDC each time you check the height of the knives. *—Sid Fleisher, Troy, N.Y.*

Glass-smooth method—Let someone share his good ideas with the rest of us and somebody always tries to rain on his parade. Such is the case of Robert Vaughan's article on setting jointer knives. I couldn't resist getting my dipper in his bucket and sending a snapshot of my method.

I use two strips of glass approximately ¾ in. wide and 12 in. long and lay them on the outfeed table, so each strip is over the cutterhead near the end of the knife. I add a weight across them on the outfeed table. Set the dial-indicator plunger on the glass directly over the cutter at top dead center. Calibrate the dial indicator, begin rocking the cutterhead back and forth and start raising the knife. Just as the knife kisses the underside of the glass strip, the dial indicator will twitch. With a little practice, you can get all knives within .0005 in. of each other.

—Lowell Chaney, Hobart, Okla.

Step up to avoid back pain—I have worked 10 years as a chiropractor, and I deal with back pain on a daily basis. So regarding the letter in *FWW* #102 on back pain and workbenches, I have a quick and easy tip for people who are working and standing by a workbench. Always place one foot on a small bench or stool that's approximately 15 to 20 in. off the ground, so your knee is in a bent position. Every few minutes (when you tire) change legs. This decreases the low back curve, relaxes the back muscles and allows you to work pain-free for extended periods of time. *—Dan Serota, chiropractor, Netanya, Israel.*

Holster that drill, pardner—In reading Vincent Laurence's review of cordless drills in *FWW* #103, I feel he overlooked one important item: the availability of holsters for any of these drills. After all, what good is a drill that is so portable you can use it anywhere, but you have to carry it in your hand?

Working in a small woodshop, a holster might not be so important, but how often would the drill leave the shop to work on a ladder or a roof? The drills are great, but I feel there is a lot to improve for holster development or at least holster availability. I have tried to approach this subject with salespeople and factory representatives, but have not been able to adequately make my point. Meanwhile, I'll keep my 9-year-old Makita 6012 and holster. *—Alan S. Raistrick, Kansas City, Mo.*

Axial drills better than T-handles—One of the characteristics of the drills evaluated by Vincent Laurence in his article "Powerful Cordless Drill/Drivers" (*FWW* #103) concerned "balance and feel." I think there is a problem with his conclusions. How a drill/driver feels when you are carrying it around the shop is totally irrelevant to its intended function. What is relevant is the ease with which the operator can apply the driving force needed when the tool is being used.

The most efficient tool design is one that places the junction of the thumb and hand of the operator in line, or as close as practical to in line, with the axis of the bit/driver in the chuck. This will result in the least stress on the wrist as the operator increases the force on the tool The AEG and the two Freud tools shown are very well designed in this area, although with most of the axial designs evaluated, it appears that at least an attempt was made to permit placing the hand fairly high on the back of the tool and in line with the axis. The 9.6v Model 6093D Makita that I use is still one of the best I've seen. It's not an accident that 75% of the drill/drivers mentioned in the article are axial design rather than T-handle.

One more comment. The photographs in the article show someone using both a T-handle drill/driver and an axial drill/driver. That person appears to be more comfortable using two hands with the T-handle tool to apply the necessary axial force. This would be less likely to happen if an axial type were used.

—Eugene McDonald, Kings Park, N.Y.

Another vote against T-handles—In Vincent Laurence's article on cordless drills (*FWW* #103), he expresses a preference for those drills with a T-handle, stating they were "by far the most comfortable, well-balanced and pleasant to use."

Later, he downgrades the Metabo drill because its pistol grip wasn't comfortable unless he placed his thumb and forefinger

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alongside the motor housing in grooves "seemingly provided for that purpose." Similarly he pans the AEG because its grip left his pinky and ring finger hanging out.

For his information and for those out there who don't regularly drive and drill hundreds of screws and holes, these drills are designed to be held by the motor housing. With your hand directly behind the motor, the drilling/driving action is aligned with your forearm, causing much less fatigue, truer holes and allowing much more force to be exerted without racking your wrist. Also, the nose-heaviness of the downgraded drills disappears once the drill begins to work—a more important criterion.

—Jim Mattson, Silver Spring, Md.

Facts of wood movement—Referring to the *FWW* #103 letter about face-to-face gluing: In your August 1993 issue, Bruce Hoadley's response to Mr. Tanzi's question on face-to-face gluing was correct. Brian Whitehead's explanation is wrong.

Wood expansion and shrinkage is not a matter of opinion; it is a fact. I recommend R. Bruce Hoadley's book *Understanding Wood* by The Taunton Press to Brian Whitehead and anyone else who wants to know more about wood movement.

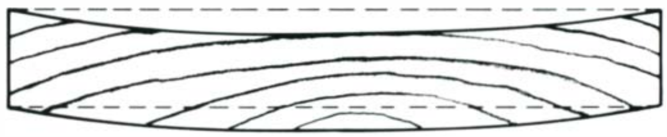
—Frank Klausz, master cabinetmaker, Pluckemin, N.J.

Hoadley was right—In the letters column of the November/December issue of *Fine Woodworking* (*FWW* #103), Brian Whitehead claimed that Professor Bruce Hoadley had made a mistake when he advised an earlier writer how to glue two boards together.

It was a good strategy on your part not to have Professor Hoadley respond to Whitehead's comment. It would have been difficult for him to do so without using words like "stupid" and "wrong" because these describe Whitehead's letter.

A more polite response might have been to refer Whitehead to pp. 3-12 and G-2 of *The Encyclopedia of Wood*, originally published as *The Wood Handbook* by the USDA Forest Service. Page 3-12 shows how flat-grained boards are most likely to distort (away from the pith side, as shown in the drawing below), and page G-2 defines a check as a "lengthwise separation of the grain that usually extends across the rings of annual growth."

Wood cups away from heart side.



So it appears that Hoadley was correct. The boards should be glued with the growth rings in the opposite orientation and with the two pith sides facing away from each other because "the boards might hold one another flat." Hoadley didn't deal with the issue of checking, but a check would not usually be parallel to the growth rings, causing the innermost ring to fall out.

—Warren Walters, Walnut Creek, Calif.

Spaces vs. centers—I enjoyed the article by Jim Tolpin, "Organize Your Projects" in *FWW* #103. I could not agree with him more. However, I go about spacing slats, shelves and drawers a little differently, and I think for the most part, it is simpler, more easily understood and just as accurate.

Jim locates centers, and I locate spaces. Centers are often cov-

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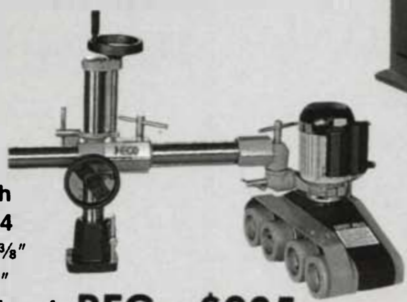

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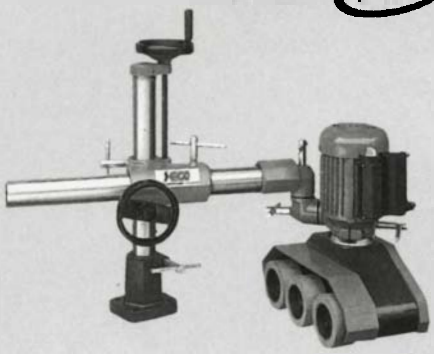

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ered by the piece to be centered. Spaces are generally available. Sometimes I will cut space blocks to separate the pieces first for a look-see and make adjustments from there if necessary.

—John Plank, Waupun, Wis.

Dancing with tulip—Your beautiful article, "Tulip: Wallflower at the Hardwood Ball" (*Fine Woodworking* #102, p. 65), took my mind to our hutch, circa 1840. We have always loved that hutch since we rescued it from an old barn in Pennsylvania. The upper carcase is made of tulip wood, the rest in cherry. Some ancient woodworker knew the beauty of tulip, and he matched it to his cherry case. "Suddenly it looked like a cherry board," wrote John Sillick.

I went to my antique charmer, and sure enough, Mr. Sillick was on target: wide even grain, stable, easy to mill. I thought back to my first introduction to *Liriodendron tulipifera* in high school when I first saw the olive tinge, and I used it to make my first chair at the age of 17 in the 1940s.

Mr. Sillick had the same taste as my cabinetmaker, so I hung to his words, knowing tulip has certainly been to the ball and back. I danced with his article a few times, and I bow to your good taste to include it in *FWW*. *—Kenneth F. Gambone, Oyster Bay, N.Y.*

Safer jointing of chamfers and bevels—I wanted to comment on the jointing of chamfers and bevels in the article by Bernie Maas (*Fine Woodworking* #102, p. 48). He shows a technique where the material lies on top of the fence. There is an inherent danger in this technique, particularly if you keep your table and fence waxed. The material wants to ride out away from the fence.

I think that it's safer and more accurate to flop the fence the other direction and trap the material between the table and the fence where it can't slip. *—Kirt Brown, Mount Shasta, Calif.*

BERNIE MAAS REPLIES—Because the business of woodworking does carry with it implicit dangers, you are right to be concerned with safety. However, your fears as to chamfering on the jointer with an obtusely angled fence are misplaced. Both Delta's combination usage manual on the circular saw and jointer and Hammond, Donnelly, Harrod and Rayner in *Woodworking Technology* identify chamfering with an outwardly angled fence as an appropriate technique. Additionally, John Feirer in his classic text, *Cabinetmaking and Millwork* concurs. However, he does suggest it is a more advanced procedure.

After all, advanced usage was the thrust of the article. I've been using an outward angled fence for bevel jointing for some 35 years because I discovered early on it gave me greater reliability and flexibility in the manipulation of stock. I've dealt with workpieces from 1-in. by 1-in. moldings to 12-in.-sq. turning billets and have always found the procedure to be stable, safe and secure.

About your safety:
Working wood is inherently dangerous. Using hand or power tools improperly or neglecting standard safety practices can lead to permanent injury or death. So don't try to perform operations you learn about here (or elsewhere) *until you're certain that they are safe for you and your shop situation.* We want you to enjoy your craft and to find satisfaction in the doing as well as in the finished work. So please keep safety foremost in your mind whenever you're in the shop.

—James P. Chiavelli, associate publisher

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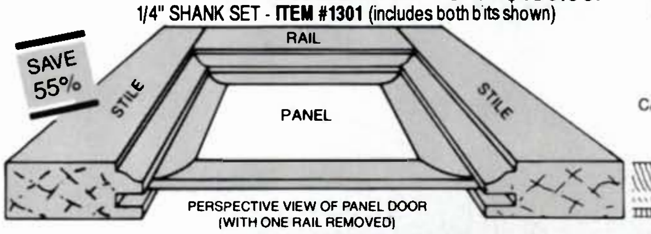

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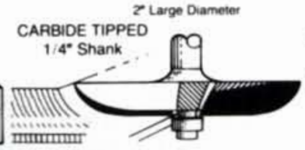

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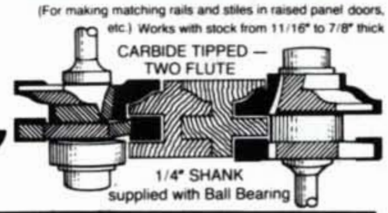

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#1307	CLASSICAL - 1/4" Radius — 3/4" Cutting Length	1/4"	$25.00
#1308	CLASSICAL - 3/16" Radius — 5/8" Cutting Length	1/2"	$22.50
#1309	45° CHAMFER - 3/8" Cutting Length	1/4"	$13.00
#1310	45° CHAMFER - 5/8" Cutting Length NEW !	1/4"	$15.00
#1311	45° CHAMFER - 5/8" Cutting Length	1/2"	$17.00
#1312	THUMBNAIL - 1- 3/16" Large Diameter	1/4"	$18.50
#1313	THUMBNAIL - 2-1/2" Large Diameter	1/2"	$35.00
#1314	ROUND OVER - 1/8" Radius	1/4"	$11.00
#1315	ROUND OVER - 3/16" Radius	1/4"	$11.00
#1316	ROUND OVER - 5/16" Radius	1/4"	$14.00
#1317	ROUND OVER - 1/4" Radius NEW !	1/2"	$12.00
#1318	ROUND OVER - 3/8" Radius	1/2"	$15.50
#1319	ROUND OVER - 1/2" Radius	1/2"	$17.00
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#1322	MULTIFORM MOULDING - 2" Carbide Height	1/2"	$40.00
#1323	SLOT CUTTER - 3/8" Deep	1/4"	$14.00
#1324	RABBETING - 1/4" Deep	1/4"	$15.00
#1325	RABBETING - 3/8" Deep NEW !	1/4"	$13.00
#1326	RABBETING - 3/8" Deep	1/2"	$13.00
#1327	CORE BOX - 3/8" Large Diameter	1/4"	$11.00
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#1332	BULL NOSE - 3/4" Diameter of Circle	1/2"	$21.00
#1333	TONGUE & GROOVE - Straight	1/4"	$29.00
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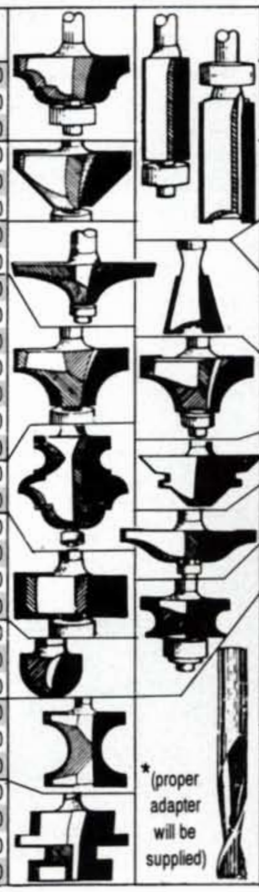

*(proper adapter will be supplied)

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#1338	FLUSH TRIM - 1/2" Diameter — 1" Cutting Length	1/4"	$ 8.00
#1339	FLUSH TRIM - 1/2" Diameter — 1-3/16" Cut.Length	1/2"	$ 8.00
#1340	PATTERN / FLUSH TRIM - 1/2" Diameter	1/4"	$15.00
#1341	PATTERN / FLUSH TRIM - 3/4" Diameter NEW !	1/4"	$17.00
#1342	PATTERN / FLUSH TRIM - 3/4" Diameter	1/2"	$19.00
#1343	KEYHOLE CUTTER - 3/8" (bit not	1/4"	$ 8.50
#1344	KEYHOLE CUTTER - 1/2" shown)	1/4"	$ 9.00
#1345	DOVETAIL (HSS) - 1/4" Diameter — 7-1/2°	1/4"	$ 6.50
#1346	DOVETAIL - 1/2" Diameter — 14° NEW !	1/4"	$ 6.00
#1347	DOVETAIL - 1/2" Diameter — 14°	1/2"	$ 6.50
#1348	BEADING - 1/4" Radius	1/4"	$13.00
#1349	BEADING - 3/8" Radius	1/4"	$15.50
#1350	BEADING - 1/2" Radius	1/4"	$17.00
#1351	LOCKMITRE - 7/8" Cutting Length NEW !	1/4"	$32.00
#1352	LOCKMITRE - 1-1/8" Cutting Length	1/2"	$45.00
#1353	OGEE RAISED PANEL - 2" Large Diameter	1/4"	$28.00
#1354	OGEE RAISED PANEL - 2-3/4" Large Diameter	1/2"	$32.95
#1355	EDGE BEADING - 3/16" Diameter of Circle	1/4"	$15.00
#1356	EDGE BEADING - 5/16" Diameter of Circle	1/4"	$15.50
#1357	SPIRAL UPCUT - 1/8" Diameter (solid carbide)	1/4"*	$ 9.00
#1358	SPIRAL UPCUT - 1/4" Diameter (solid carbide)	1/4"	$12.00
#1359	SPIRAL UPCUT - 1/4" Diameter (solid carbide)	1/2"*	$12.00
#1360	SPIRAL UPCUT - 3/8" Diameter (solid carbide)	1/2"*	$24.00
#1361	SPIRAL UPCUT - 1/2" Diameter (solid carbide)	1/2"	$29.00
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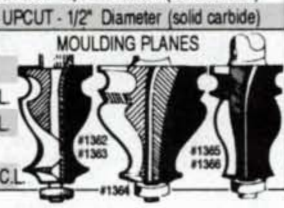
#1365	1" C.L.	1/4"	$31.95
#1366	1-11/16" C.L.	1/2"	$31.95



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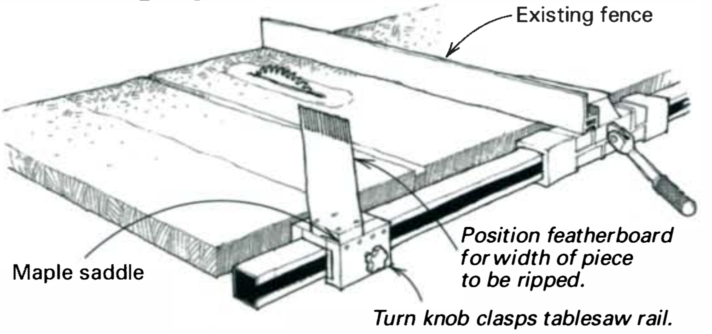
READER SERVICE NO. 68

edited and drawn by Jim Richey

Rail-clamping featherboard

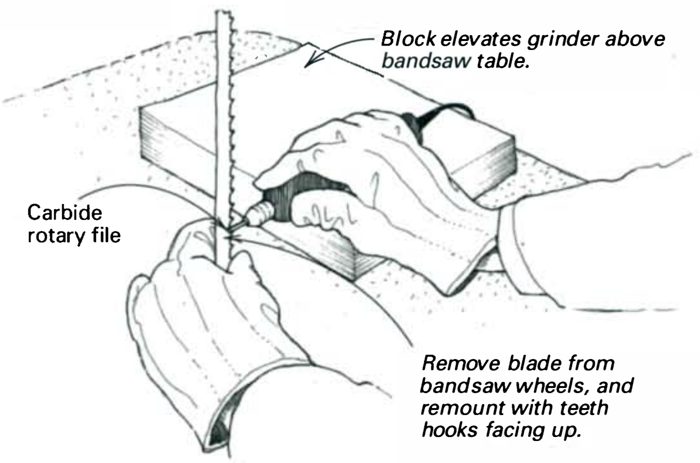


I regularly use a featherboard when ripping stock in my shop. However, it is often difficult to clamp a traditional loose featherboard to the table quickly and securely. To eliminate this problem, I made a hard maple saddle that rides on my rectangular fence rail and screwed a featherboard to the top of the saddle at about 45°. I salvaged the locking knob from an old compressor regulator, but similar knobs are available from The Woodworkers' Store (21801 Industrial Blvd., Rogers, Minn. 55374-9514). To prevent damage to the fence rail, I inset a wooden strip under the knob stud, which is counterbored to accept two loosely fitting screws. I can quickly lock the featherboard assembly in any position along the fence rail and, with a quick twist of the knob, remove the whole assembly to make way for crosscutting. By varying the saddle design, this method could be used with any fence rail, such as the tubular type. *—Bert B. Boyd, Salem, Va.*

Quick tip: Grind one of the spurs on your lathe's live center to a point. This will allow you to reposition the work to exactly the same position if you have to remove it.

—C. A. Robson, Ont., Canada

Sharpening bandsaw blades

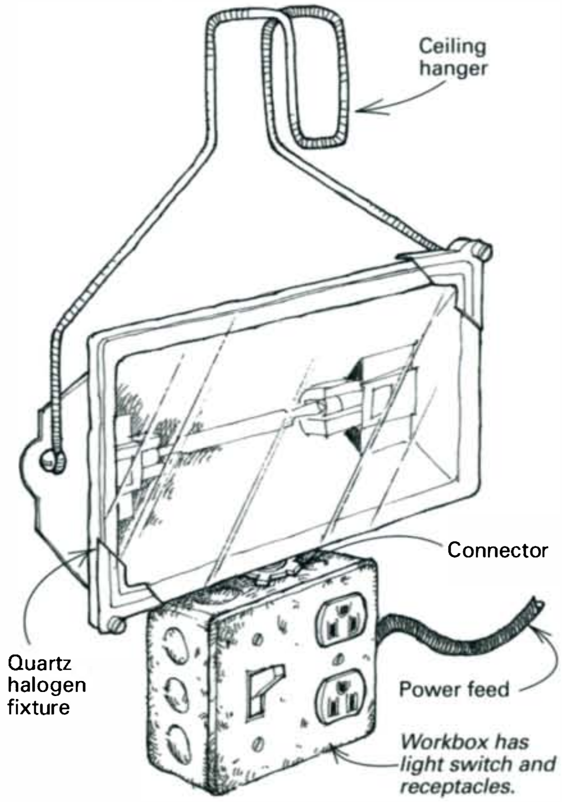


I use this simple procedure for accurately and quickly re-sharpening bandsaw blades. Compared with the commercial rate of $16, it is certainly worth the 20 minutes. Perhaps more important, it is liberating to know I'll never run out of bandsaw blades over a busy weekend.

The first step is to unplug the machine. Take the blade off, turn it inside out and replace it on the wheels with the hooks up. Then, using a carbide rotary file mounted in a Dremel grinder, grind the hook and top of each tooth. Hold the grinder straight to the front, as shown in the sketch. No odd angles are needed. Support the grinder on a book or scrap of wood. Set the grinder to just below maximum rpm.

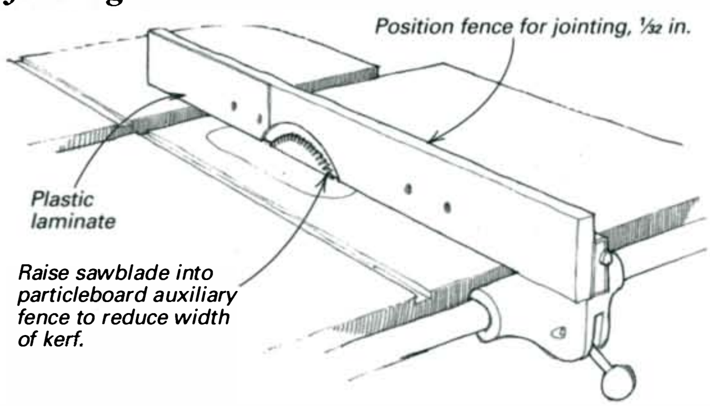
The technique works well on the 4-teeth-per-inch, ¾-in. blades I commonly use, but it gets a bit tedious on smaller blades with finer teeth. —John Grew-Sheridan, San Francisco, Calif.

Portable flood lights revisited



Here's how I redesigned Lester Lavy's portable flood lights (*FWW* #101, p. 16) to sidestep any potential problems from the heat these lamps generate. I placed the connection box below the lamp and added a long, heavy steel-wire hook to hang the unit about 10 to 12 in. from the ceiling. This arrangement reduces the chances of melting the power cord and minimizes heat buildup in the circuit box. I also chose to use a larger 4-in. electrical box so that I could switch the light and power outlet on and off. *—Jim Allen, Atlanta, Ga.*

Jointing on the tablesaw



I needed to joint the edge of a 1½-in.-thick tabletop laminated up from two pieces of ¾-in. particleboard. The piece was too long and unwieldy for my jointer, and I didn't want to dull my knives on the particleboard. So I used this technique to joint the workpiece on the tablesaw.

Make an auxiliary fence the same height as your saw's rip fence. Contact cement a strip of 1/32-in.-thick plastic laminate to the face of the auxiliary fence. Screw the auxiliary fence to the rip fence, lower the blade and adjust the fence location until the plastic laminate is flush with the edge of the blade. Turn on the saw, and slowly raise the blade, cutting a kerf into the auxiliary fence.

Place the piece to be jointed flat on the saw table, hold the

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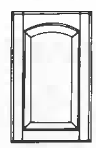

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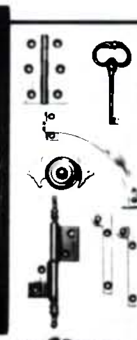

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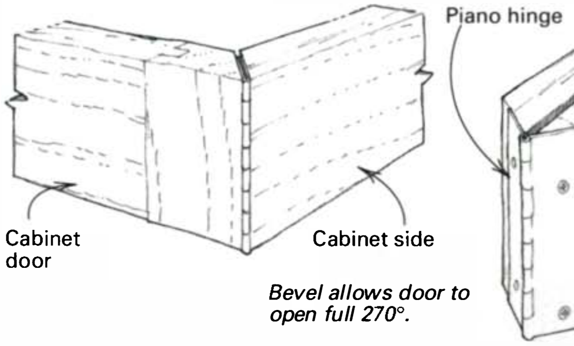
workpiece against the fence and push it through the blade. The far end of the fence will act as an outfeed table. Each pass will remove about 1/32 in. of material, the same thickness as the laminate.

—Gary P. Westmoreland, Apple Valley, Calif.

270° cabinet doors



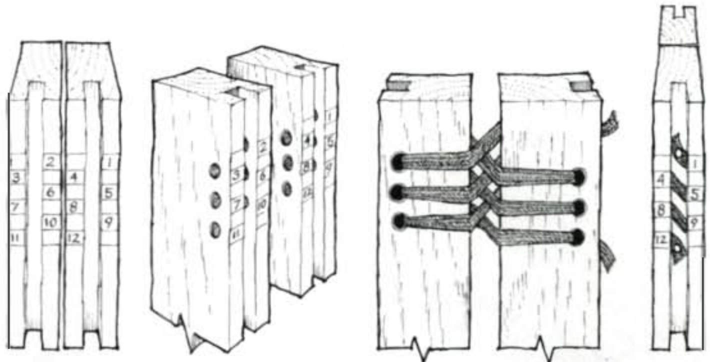
For freestanding cabinets, it is often useful for their doors to open 270° so that they will lay flat against the side of the cabinet. However, most common ways of attaching doors allow the doors to open only to 90° or 180°, even when 270° hinges are used. To enable the full 270°, bevel both the door and the side of the cabinet at 45°. Attach the hinges on the bevel as shown.

—Jafar Syed Hasan, Tawas City, Mich.

Quick tip: In the article "How to Build a Barrister's Bookcase" (*FWW* #96, p. 51) the author mentions a problem of drilling hardened steel. Drilling spring steel without shattering it can be easily done if the steel is first softened. Heat the place where the hole is to be drilled with a propane torch to a bright red glow and allow it to cool slowly by gradually withdrawing the heat. Take care to localize the softening only to the area to be drilled.

—Howard C. Lawrence, Cherry Hill, N.J

Japanese textile-tape hinge



1) Mark lines across edges of frame and add lacing sequence numbers. 2) Drill holes in line with numbers. 3) Lace fabric tape through holes in sequence. 4) Pull ends tight and tack in groove.

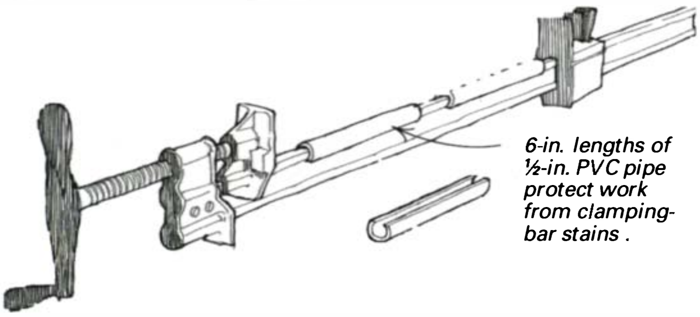
I recently had the chance to repair a turn-of-the-century Japanese *shoji* screen and was intrigued by the laced textile-tape hinges, which were different from anything I remember seeing. To reproduce the hinge, start by picking the lacing material. Twill tape available at sewing shops is nearly identical to the tape I found on the original screen. But shoestrings, rawhide or any flat flexible cordage would work as well. Lay the grooved panel frame rails side by side, and mark seven evenly spaced

READER SERVICE NO. 52

lines across the edge of both pieces. The distance between these lines should be the width of the cloth tape. Mark the lacing sequence numbers on the edge of the rails, and drill holes as shown in the sketch. Hole pairs 1-2 are in line with each other, as are 3-4, 5-6 and so on. To complete the hinge, lace the textile tape through the holes in the sequence marked. Pull the lacing tight, and tack the ends to secure them.

A big advantage of this hinge is that it allows full movement in either direction, which is not possible with a regular pinned hinge. Another clever feature is the hiding of the diagonal lace offset within the grooves, making the laces parallel on the outside. On the original screen, the lace holes were rectangular and bushed with rectangular eyelets, but round holes work just fine. Besides *shoji* screens, the hinges would also work in furniture where a full rotation is needed, such as for a room divider or shutters. *—Erwin O. Deimel, New Hartford, N.Y.*

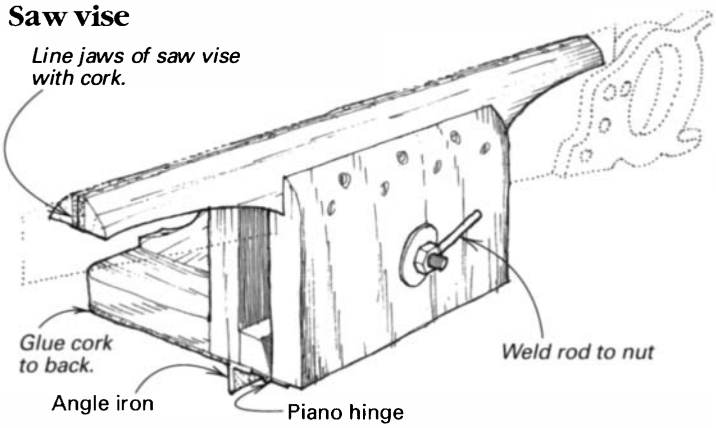
Bar-clamp stain protectors



In the process of collecting materials to glue up a tabletop, I discovered that I was out of waxed paper. I had always put waxed paper between my work and the bar clamps to prevent the black stains that invariably result when aliphatic-resin glue, iron and wood combine for any length of time.

In looking around for a suitable alternative, I remembered a short length of ½-in. schedule 40 PVC pipe I had. I cut the pipe lengthwise with my bandsaw to reveal a slot just under ½-in. Then I cut the pipe into convenient 6-in. segments and snapped the segments over the iron bars of the clamps. If the slot is the right width, the segments will grip the bars and stay in place even when the clamps are turned over or hung up to store. *—Thornton Traise, Omaha, Neb.*

Saw vise



When my partner brought in a saw vise he had built, I was so impressed by its utility and appearance I asked to copy it.

To build the vise, first select a strong hardwood such as birch, 1¼ in. thick for the jaws and at least 1 in. thick for the legs and

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2600	3/8" VSR Drill 4.5 amp motor	$167/ $85
3158K	Jig Saw Kit 4.5 amp	$277/$133
3379	Elu Plate Joiner Kit 6.5 amp motor	$429/$235
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6140	$4^{1/2}$" Angle Grinder Max. 10,000 RPM	$165/ $94
6527	Super Sawzall Kit VS with case. 8 amp	$309/$174
6507	Sawzall Kit VS with case. 4 amp	$259/$145
6365	$7^{1/4}$" Circular Saw 13 amp motor	$214/$120
5397	3/8" Hammer Drill Kit VSR. 5.0 amp motor	$250/$144
6755-1	Drywall Screwdriver VSR. 5.0 amp motor	$167/ $99
0235-1	1/2" VSR Holeshooter keyless chuck. 5.2 amp	$229/$130

Call for pricing on other Milwaukee tools.

PORTER◆CABLE

7 1/4" Top Handle Circular Saw
Model 315-1
Mfg. Sug. Price $225.00
TDT Price: $123.00

7/8 Horsepower Router
Model 100
Mfg. Sug. Price $190.00
TDT Price: $104.00

Model	Description	List/TDT
347	NEW $7^{1/4}$" Circlesaw 15 amp motor	$225/$129
447	NEW $7^{1/4}$" Circlesaw 15 amp with brake	$245/$139
330	Block Sander 1.2 amp motor	$110/ $58
505	Finishing Sander orbital action 2.3 amp	$230/$126
333	Quicksand Dustless Sander. 1.7 amp	$135/ $74
7549	Bayonet Jig Saw VS 1" stroke, 4 amp motor	$270/$146
555	Plate joiner with case 5 amp with free fence*	$320/$179
7334	Random Orbit Sander 3.7 amp motor	$225/$123
7335	Random Orbit Sander 5" vari-speed, 3.7 amp	$245/$134
9647	Tiger Cub Saw Kit 4.5 amp motor	$210/$115
690	$1^{1/2}$ H.P. Router 10 amp motor	$260/$142
9367	$3^{1/4}$" Plane Kit with case	$250/$142

Call for pricing on other Porter Cable tools.

BOSCH

2 HP Variable Speed Plunge Router
Model 1613EVS
Mfg. Sug. Price $339.00
TDT Price: $189.00

All Bosch Router Bits Are
40% OFF
Current Factory List Price

Model	Description	List/TDT
1023VSR	1/2" VSR Drill 4.8 amp motor	$277/$114
3000VSRK	3/8" Drill Kit w/case 2 batteries, 9.6 volt	$261/$125
3050VSRK	3/8" ScruDrill w/case 2 batteries, 9.6 volt	$288/$139
1581VS	Top Handle Jig Saw VS orbital, 4.8 amp	$275/$149
3283DVS	5" Dustless Sander random orbit 2.3 amp	$169/ $103
12730	Dustless Belt Sander 4"x 24", 10.5 amp	$380/$203
1615EVS	$3^{1/4}$ H.P. Plunge Router VS, 15 amp motor	$505/$257
1604A	$1^{3/4}$ H.P. Router 11 amp motor	$250/$140
1606	$1^{3/4}$ H.P. 0 Handle Router, 10 amp motor	$295/$169
1614	1 HP Plunge Router 7.8 amp motor	$245/$129
1614EVS	$1^{1/4}$ HP Plunge Router VS 7.8 amp motor	$283/$149

Call for pricing on other Bosch tools.

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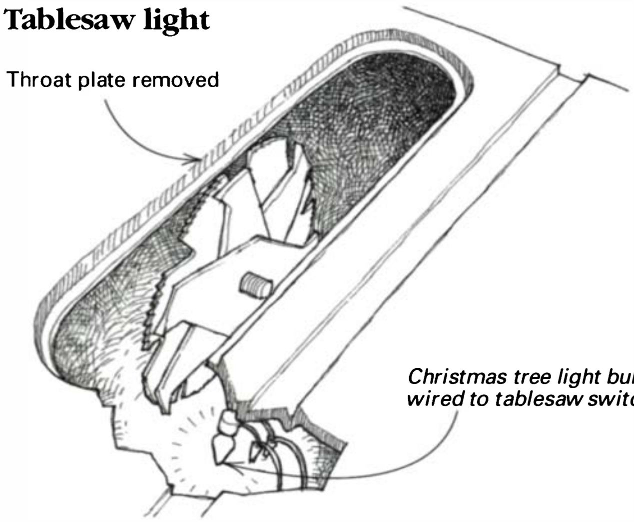
base. Laminate a layer of ¼-in. cork to the jaw faces and to the base of the vise to provide a firm grip on the sawblade and to reduce chatter. Install a ½-in. carriage bolt through the jaws to tighten them. To provide extra tightening leverage, weld a 3-in. length of steel rod to one face of the nut as shown. Finish your vise with a coat of varnish. *—Jerome A. Jahnke, Milwaukee, Wis.*

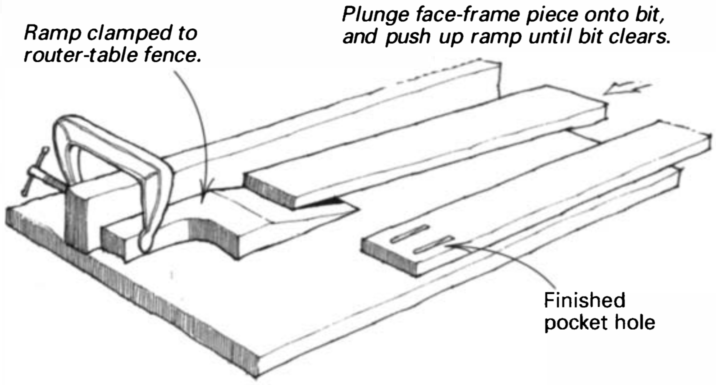
Tablesaw light



For many years, my tablesaw sat outside. I didn't realize how much I used the natural light flooding through the frame of the saw until I moved the saw into my newly completed garage and enclosed the sides to contain the sawdust. To replace the natural light I lost, I installed a clear Christmas tree light bulb inside the saw near the right front corner of the blade insert opening. Then I wired the light directly to the saw switch.

I like to sight down the surface of the blade with one eye to align the blade with the pencil mark on the wood. That was impossible to do when the void below the top was in darkness. By unplugging the motor cord from the switch box and then turning the switch back on, I have all the light I need for changing the blade. *—Donald Switzer, San Diego, Calif.*

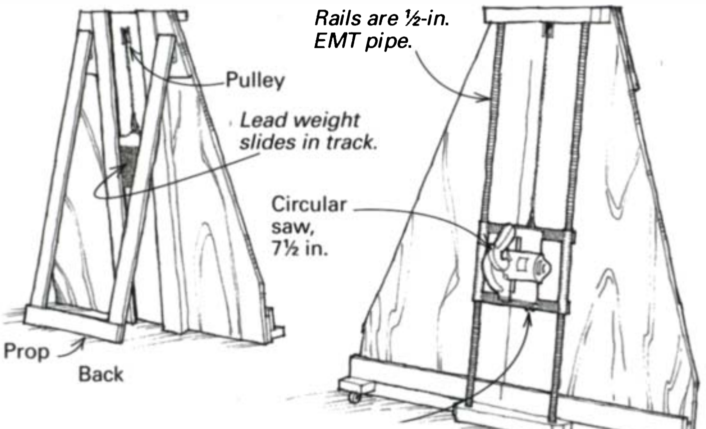
Cutting pocket holes on a router table



Not too long ago, I went down to the tool store on a wishing trip. I saw a pocket cutter, which I really don't need for the five or six screw pockets that I cut in a year. But something pushed my Rube Goldberg button, and I rushed back to the shop to build a complicated pocket-cutting contraption that used an old router suspended from a shaft like a pendulum. Well, after I cut pockets in all my scrap lumber, I began to wonder "Now what do I do with the machine—put it on a shelf to collect dust?"

About this time, the Goldberg fever left me, and I remembered something my dad told me: "Maybe you don't need another machine. Just figure out how to do the job with something you already have." So after some thought, I came up with a markedly simpler method using a ramp and my router table. I simply position the work and the bit depth where I want the pocket to start. Then, keeping my hands well back from where the bit is, I plunge the piece onto the table and push it up the ramp until the bit quits cutting. *—Vernon Todd, Springfield, Mo.*

Shop-built panel saw



Carriage made from straps of iron and ⅝-in. EMT pipe (electrical conduit).

After wrestling 4x8 plywood panels around my shop for 45 years, I decided to build a panel saw. The design I used is simple and inexpensive. The fixture's components and construction details are shown in the sketch below. The only tricky part is the carriage.

For the carriage sliders, split two pieces of ⅝-in. EMT pipe (electrical conduit) end to end. Spread the cut, or squeeze until the sliders have a nice sliding fit on the ½-in. rails. Bend the ends of the crosspieces up to conform to the radius of the tubing. With the sliders and crosspieces clamped in place on the rails, tack-weld the pieces together. Check the carriage to make sure it is square and slides smoothly. If all is well, remove the carriage, and braze all four corners. Now position your saw on the carriage, drill mounting holes and fasten the saw to the carriage. To keep the carriage running smoothly, keep a little paraffin or light grease on the rails.

I made the saw counterbalance weight by melting down some lead and pouring it into a rectangular mold. The counterbalance should be slightly heavier than the saw so that the saw will stay parked at the top of the rails.

—William Skinner, Everett, Wash.

Quick tip: Even if you use a file card, occasionally you will encounter stubborn bits of waste lodged in the teeth of your file. Run the head of a 6d finishing nail along each tooth groove. Because the metal in the nail is softer than that of the file, the head will conform to the tooth configuration and remove anything that the file card missed. *—Mario Rodriguez, Brooklyn, N.Y.*

Methods of Work buys readers' tips, jigs and tricks. Send details, sketches (we'll redraw them) and photos to Methods, Fine Woodworking, *PO Box 5506, Newtown, Conn. 06470-5506. We'll return only those contributions that include an SASE.*

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333K	333 W/CASE & 50 SHEETS PAPER	99
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334K	334 W/CASE & 100 SHEETS PAPER	99
345	SAW BOSS 6" CIRCULAR SAW	104
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352VS	3" X 21" VS BELT SANDR W/DUST BAG	158
360	3" X 24" BELT SANDER W/DUST BAG	182
361	3" X 24" BELT SANDER	174
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363	4" X 24" BELT SANDER	184
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9690	1 1/2 HP ROUTER W/CASE	139
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693	PLUNGE BASE ROUTER, 1 1/2 HP	164
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696	SHAPER TABLE	123
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7310	LAMINATE TRIMMER, 5.6 AMP	88
7312	OFFSET TRIMMER	122
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7335	5" RANDOM ORBIT SANDER, VS	128
7335K	7335 W/CS, DUST EX SYS, 100 SHTS PPR	172
7336	6" RANDOM ORBIT SANDER, VS	132
7336K	7336 W/CS, DUST EX SYS, 100 SHTS PPR	179
73333	RANDOM ORBIT DUST EXTRACTION	24
7518	3 1/4 HP FIXED BASE ROUTER-5 SPEED	262
7519	3 1/4 HP FIXED BASE ROUTER-1 SP	228
7536	2 1/2 HP FIXED BASE ROUTER	197
7537	2 1/2 HP FIXED BASE "D" HNDL RTR	207
7538	3 1/4 HP PLUNGE ROUTER-1 SPEED	228
7539	3 1/4 HP PLUNGE ROUTER-5 SPEED	262
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7649	BARREL GRIP BAYONET SAW	143
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9315	7 1/4" BUILDERS SAW KIT	136
9345	SAW BOSS 6" CIRCULAR SAW KIT	122
9637	TIGER SAW VAR SPD RECIP SAW KIT	138
9647	TIGER CUB RECIP SAW KIT	115
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9853S	SAME AS ABOVE BUT W/2 BATTERIES!	177
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97751	1/2" VS, 2 SPD HAMMER DRILL KIT	145

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0407-1	SAME AS ABOVE BUT 12 VOLT	174
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6017	1/4 SHEET FINISHING SANDER W/BAG	55
6125	5" RANDOM ORBIT SANDER	112
6126	6" RANDOM ORBIT SANDER	115
6256	TOP HANDLE JIG SAW	148
6365	7 1/4" CIRCULAR SAW, 13 AMP	120
6490	10" MITER SAW	257
6491	10" MITER SAW W/BAG & 80T BLADE	298
6492	10" MITER SAW KIT COMPLETE	334
6507	VAR SPEED SAWZALL W/BLADES & CSE	143
6508	SAME AS 6507 BUT W/PERMANENT CRD	143
6527	SUPER SAWZALL W/BLADES & CASE	169
6528	SAME AS 6527 BUT W/PERMANENT CRD	169

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DW430	3" X 21" DUSTLESS BELT SANDER	164
DW431	3" X 21" DSTLS BELT SANDER VAR SP	182
DW610	1 1/2 HP ROUTER, 9 AMP	147
DW614	1 1/4 HP PLUNGE ROUTER	143
DW615	1 1/4 HP PLUNGE ROUTER, VAR SP	158
DW624	3 HP HVY DUTY PLUNGE ROUTER	245
DW625	3 HP HVY DTY PLUNGE RTR, VAR SP	275
DW682K	BISCUIT JOINER KIT W/100 BISCUITS	234
DW705	12" COMPOUND MITER SAW	389
DW944K2	9.6V CORDLESS KIT W/2 BATTERIES	169
DW945K2	12V CORDLESS KIT W/2 BATTERIES	189

HITACHI

D10DFKBE	9.6V, CRDLS DRILL KIT W/2BAT & CS-KYLS	148
DS10DVAKBE	12V CORDLESS DRILL KIT W/2 BAT	189
D10VC	3/8" DRILL VAR SP, REV, 3.2 AMPS	59
SV12SA	4 3/8" PALM GRIP SANDER	49
SB75	3"x21", 2 SPEED BELT SANDER	136
SB10T	4"x24", 2 SPEED BELT SANDER	180
CJ65V2	TOP HANDLE JIG SAW W/CASE	155
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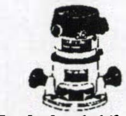

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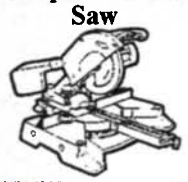

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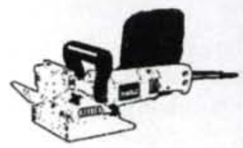

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TK906	10" X 50T THIN KERF CROSSCUT	30
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WC104	4 PC WOOD CHISEL SET	46
WC106	6 PC WOOD CHISEL SET W/CASE	56
WC110	10 PC WOOD CHISEL SET	86
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D38VSR	3/8" VSR DRILL, 4.0 AMP, 0-2500 RPM	59

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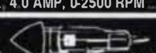

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READER SERVICE NO. 106

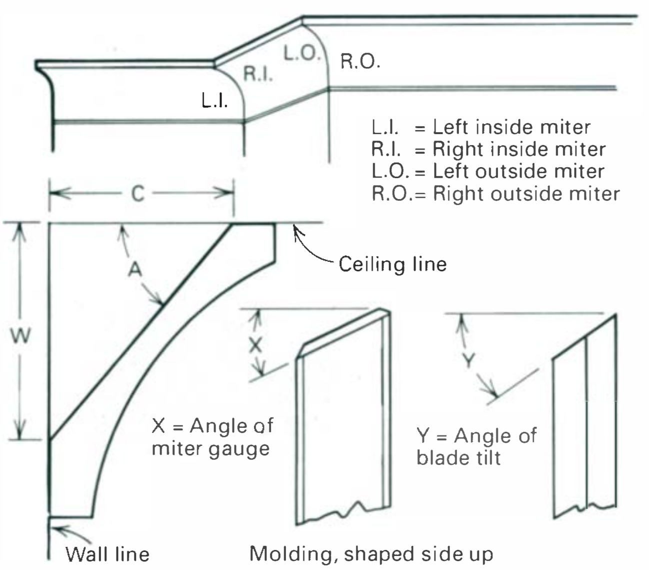
Mitering moldings: what's the angle?

What formula can I use to compute the miter and bevel for flat-cutting hollow cove moldings? Different coves sit at different angles, and most are too tall for cutting upright in a chopsaw. The trigonometry is beyond me.

—Michael Beaudette, New York, N.Y.

Bill Lego replies: I have two answers for your question. First I'll give you a mathematical explanation followed by a more practical solution to your problem. To help clarify the mathematical answer, I refer you to the drawings below. Figure 1 labels the elements of the moldings along with specified angles. I am showing moldings mounted as crown moldings in a room. The idea can be extended for figuring picture frames, however.

Fig. 1: Determining cove cuts: Defining the angles



Use A as your base angle for figuring X and Y. If you do not know A, then divide W by C and take the $\tan^{-1}$ function of the quotient. This will give you A.

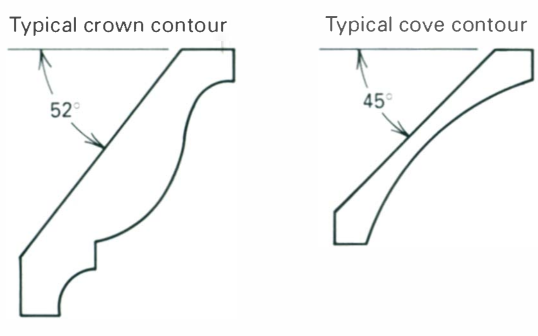
An inexpensive calculator (I recommend the Texas Instruments model TI-35X for about $18) is a big help for figuring the trigonometry functions, and it is readily available at most discount department stores.

For any $0° < A < 90°$:

$X = \tan^{-1}(\cos A)$ and $Y = \sin^{-1}(\sin A/\sqrt{2})$

The two most common crown moldings are shown in figure 2. I will use them as examples in figuring angles X and Y.

Fig. 2: Common molding details



For 45° cove:

$X = \tan^{-1}(\cos 45°)$; $X = \tan^{-1}(\sqrt{2}/2)$; $X = 35.3°$

$Y = \sin^{-1}(\sin 45°/\sqrt{2})$; $Y = \sin^{-1}(.5)$; $Y = 30°$

For the 52° crown:

$X = \tan^{-1}(\cos 52°)$; $X = \tan^{-1}(.6157)$; $X = 31.6°$

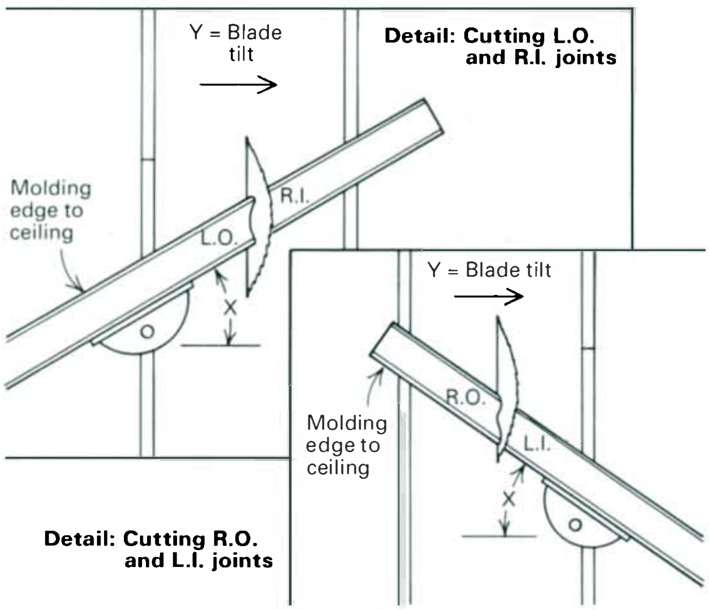
$Y = \sin^{-1}(\sin 52°/\sqrt{2})$; $Y = \sin^{-1}(.5572)$; $Y = 33.9°$

The mathematician in me having answered, the finish carpenter steps forward...

In my 20 years of cutting and installing moldings, I have never seen angles other than those that I have illustrated. (This is not to say that they do not exist.) Just as a bit of guidance, I would recommend that you take a good look at the moldings that you are cutting. I am guessing that they are either one or the other of the illustrated angles. If so, just use the angles figured in my examples.

I'm also guessing that the reason you're asking about flat cutting moldings is you're either using a tablesaw for picture frame sized work or you have a new sliding compound miter saw. Figure 3 shows how to flat cut the various miter joints on a tablesaw. From this you can extrapolate positions for a sliding compound miter saw.

Fig. 3: Flat-cutting miters on the tablesaw



Most of the professional carpenters that I know prefer a single action power miter saw because they require only setting one angle per cut. The molding is cut inverted relative to its installed position, but it's held against the fence and table, tilted as it will be when installed. The most popular kind of miter box in the trade is a 10-in. saw that will cut up to a 4⅝-in.-wide crown. But even a 10-in. saw can make elaborate crowns by layering smaller molding patterns. Large moldings constructed as multiple layers of smaller patterns have the additional advantage of being able to expand and contract with humidity without cracking. [Bill Lego is a woodworker and teacher of Industrial Mathematics in Rockford, Ill.]

More horsepower, less amps

I recently took delivery of a new Delta Unisaw model 34-802. The catalog listing for this machine shows a motor nameplate amperage of 17, but the actual motor supplied is 12.4 amps. When I inquired of Delta how this can be, they replied that they now have a proprietary motor design that allows them to rate the motor at 3 hp under continuous load, yet it draws only 12.4 amps. Can this be true?

In my area, the electrical building codes require a 30-amp breaker and #10 wire for a 17-amp motor, but only a 20-amp breaker and #12 wire for the 12.4-amp motor. My electrical contractor installed new wiring based on the actual motor values (230v, 12.4 amps, 60 cycles), yet his local code book shows that a 3-hp motor should be wired for 17 (or more) amps. So he was also confused by this new proprietary motor.

There was no specific recommendation in the installation instructions from Delta other than to have a local electrician wire in a new circuit.

The saw operates fine. —Richard J. Yezek, Shorewood, Wis.

Edward Cowern replies: Yes, it is possible to build a 3-hp motor with full load amps of 12.4. As Delta confirms, this is a specialized motor that is a "2-value capacitor motor." These single-phase motors are designed to operate with both starting and running capacitors. The addition of the running capacitor improves the efficiency of the motor somewhat, but more importantly, it improves the power factor of the motor. The combination of these two improvements of power factor and efficiency, drives the full load amps down to a lower value than it would be if it were just a pure capacitor start motor.

You would not be making any mistake to install the 30-amp breaker with the #10 wire though. With the heavier wire, the voltage would tend to be more stable and, thus, the motor somewhat more powerful.

[Ed Cowern is an electrical engineer in Wallingford, Conn., and president of EMS, distributors of Baldor electric motors.]

Laurel cherry, a backyard favorite

I intend to cut down a laurel cherry that is about 8 in. dia. Is the wood good or useful? —Pat Swatek, Melbourne, Fla.

Jon Arno replies: The range of the Carolina laurel cherry, *Prunus caroliniana*, extends from southeastern North Carolina westward through the Gulf States to eastern Texas. It is an attractive, fast-growing but short-lived species that is sometimes used as a landscape cultivar. As a medium-sized tree capable of reaching perhaps 40 ft. in height and about 12 in. in diameter, it has never been a major lumber species.

Its close relative, American black cherry (*P. serotina*), is the source of nearly all commercially available cherry cabinetwood. While not exactly a giant itself, black cherry is capable of reaching 80 ft. to 90 ft. tall and up to about 3 ft. dia., making it a far better species for lumber production. The cherry genus, *Prunus*, belongs to the rose family, Rosaceae, and virtually all of the trees in this family share a common shortcoming in that they are too small to produce much in the way of usable timber.

This is indeed a shame, because many members of this family yield wood of fine quality. Among them are apple, hawthorn, pear, almond, peach and plum. In cabinetmaking circles they are sometimes referred to collectively as "fruit woods." Those belonging to the apple side of the family, which would include the crab apples, serviceberry, hawthorn and pear, tend to be very hard, fine textured and usually blond in color. And almond, peach plum and cherry tend to have a pinkish blush and a coarser, more figured appearance.

With the exception of cherry, these woods are seldom commercially available. So it becomes necessary to forage for them in suburban backyards and local orchards and to learn through trial and error the subtle art of air-drying small batches of wood.

In most cases, problems with these woods, such as warping and checking, relate to improper drying techniques or the presence of abnormal wood tissue commonly found in orchard trees where two species have been grafted together to promote fruit production. Cherry is actually one of our most stable domestic cabinetwoods. In fact, blocks of cherry were once used in the printing industry to set lead type because the plates could then be stored with little risk of warping.

Getting back to laurel cherry in particular, its wood is almost indistinguishable from that of American black cherry. Owing to

its more rapid growth and wider spaced annual rings, it is less intricately figured, but it is usually one of the darker of our native cherry woods. An 8-in.-dia. laurel cherry log is definitely worth trying to season for use in the shop. It will provide experience in air-drying fruit woods, and even if you fail, it will make great, slow-burning and fragrant firewood.
[John Arno is a wood technologist and consultant in Troy, Mich.]

Wood finishes vs. moisture movement

I enjoyed Bruce Hoadley's book **Understanding Wood,** ***but have some questions after reading it. Hoadley suggests that big dimensional changes due to changing moisture content can be suppressed if the wood is finished.***

Can this suppression be quantified? For example, "with three coats of lacquer, the yearly oscillation of moisture content of unfinished wood drops by a third." This information could then be used to adjust wood movement calculations when designing furniture. If such information is not available, what is the best design strategy? *—Bill Brace, Concord, Mass.*

Bruce Hoadley replies: I regret that I cannot—and would dare not—give you the numerical answers we would all hope to have. The reason is that every situation is a different one, and so many factors are involved: the species of wood, the dimensions of the piece, the type of coating, the method of application and resulting build (thickness) of the coating, and the conditions and extremes of exposure. Perhaps the most critical is the time of exposure because wood, regardless of the finish, will eventually reach equilibrium if it is exposed long enough. For this reason, where we would want to prepare for the worst, a conservative approach is to design for unfinished wood.

But back to your quest for quantified moisture excluding effectiveness of specific finishes. Perhaps the closest estimates can be formulated by considering test results of various finishes where all other things are held equal. Such information under defined, controlled conditions is presented in an excellent publication, *The Moisture-Excluding Effectiveness of Finishes on Wood Surfaces*, by W.C. Feist, J.K. Little and J.M. Wennesheimer (Res. Pap. 462, USDA Forest Products Laboratory, Madison, Wis.). An article, *Protecting Wood from Humidity* by William Feist and Gary Peterson also appeared in *FWW* #64, pp. 59-61.
[Bruce Hoadley is a contributing editor to *FWW* and a professor of wood technology at the University of Massachusetts at Amherst, Mass.]

Shellac's shelf life

I'm having trouble dissolving some shellac flakes I bought about a year and a half ago. Some of the flakes dissolve, but then it acts the same as a saturated solution and won't take any more. Any ideas on what might be the problem?
—Earl L. Gregory, Rising City, Neb.

Chris Minick replies: Freshly prepared shellac is a wonderful finishing material, one of my favorites. It sands well, seals oily woods better than most other sealers and easily buffs to a high-gloss finish. Shellac is also one of the few materials that is compatible with both solvent-based and water-based finishes.

Unfortunately, shellac suffers from shelf-life problems. Once dissolved in ethyl alcohol, shellac undergoes a slow chemical reaction. The by-products of this reaction act as plasticizers for the shellac resin. After about six months, the concentration of by-products is so high the shellac resin will not properly dry.

Dry shellac flakes undergo a different but similar slow chemical change. This chemical reaction (called polymerization) in-

creases the molecular weight of the resin while at the same time decreasing the resin's solubility in alcohol. Those undissolved flakes you noticed in your shellac jar resulted from this chemical polymerization reaction. Although this reaction is usually slow (on the order of several years at room temperature), improper processing or improper storage by the manufacturer can dramatically increase the reaction rate. I suspect your shellac flakes were either very old or had been exposed to excessive temperatures during manufacturing. I would return the remainder of the flakes to your supplier, and ask for a refund.
[Chris Minick is a product development chemist and amateur woodworker in Stillwater, Minn.]

Sharpening disposable planer knives

I recently purchased a Delta 22-540, 12-in. portable planer that has double-edged, throwaway knives. Can these knives be sharpened? It seems a waste, especially at $24 a pair, to throw away knives that could be sharpened even if they are advertised as disposable. —*David Elsea, Winchester, Va.*

Lou Brickner replies: We designed the knives for the Delta 22-540 12-in. planer so that they are double-edged. We priced them so a set of knives would be less than the typical charge for sharpening because we expected that most users of this type planer would prefer not to have to sharpen their knives.

As it happens, we hear from many woodworkers who are sharpening the "throwaway" knives at least once before discarding them. One caution: Do not remove more than about 2-mm (.080-in.) from the total width of the knives because there is limited extra width for height adjustment.

If both knives have nicks in them, from hitting a nail or staple, do not try to grind the entire defect away—just shift the knives slightly, one right and one left, or use the other edge of the double-edged knives to avoid a ridge on your planed surface.
[Lou Brickner is in charge of product development at Delta, was involved in the development of Delta's (then Rockwell) RC-33 planer and also worked on the 22-540 12-in. planer.]

Solvents for waterborne adhesives

Out of concern for the environment, I've been using water-based products when possible. But I've been having problems cleaning up waterborne contact cement on plastic laminate jobs. Lacquer thinner or toluene worked well on solvent-based cements, but I've found that lacquer thinner doesn't work well on the water-based cement, and I am unable to find a source for toluene, if, in fact, it would even work. I would greatly appreciate any help that you can offer in finding a suitable solvent (preferably a green solution) to solve my arm-weary problem. —*Brian R. Blackie, Edmonton, Alta., Canada*

Jim Tolpin replies: The easiest and safest way to clean up a waterborne contact adhesive (and indeed any waterborne product) is to get at it before it dries. Wet a cotton rag or sheet of absorbent paper in a mild soap solution (such as Pine Sol detergent) and wipe away the excess. If you wish to avoid wetting the surface to be cleaned, wait until the glue has set to a rubbery consistency (usually about one to two hours—do not wait overnight) and then roll it off with your fingers.

You should be aware that waterborne contact adhesives are not entirely non-toxic; most contain small amounts of toluene, methyl alcohol and zinc oxide. While nowhere near as volatile as the solvent-based products, their vapors should still be avoided. And don't get the stuff on your skin.

Unfortunately, if you let the glue dry completely, I am not

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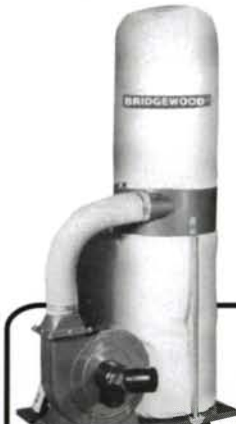

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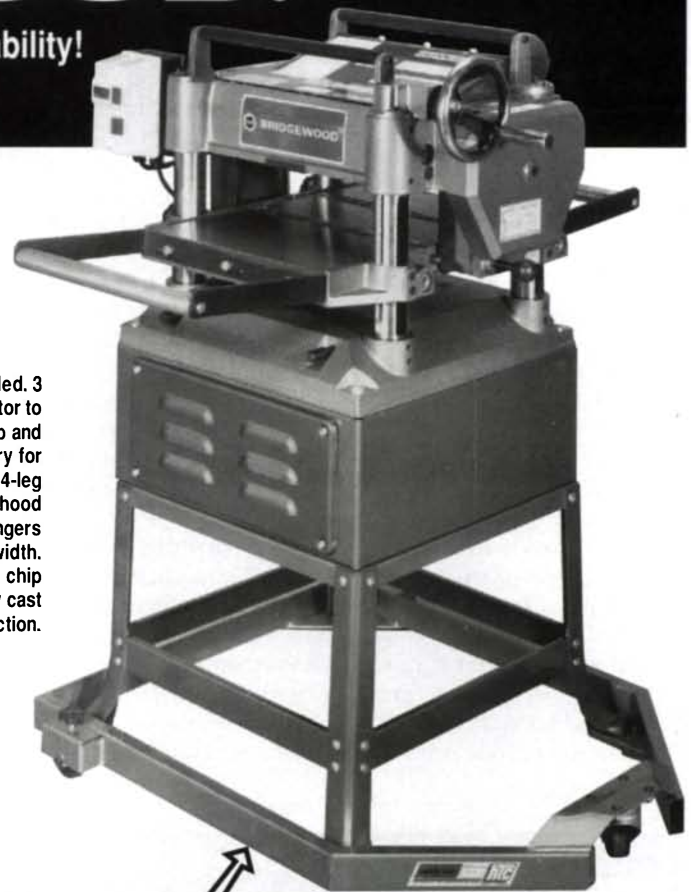

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aware of any nontoxic, fast-acting solvent. 3M, the makers of Fastbond waterborne contact adhesive, recommend using their citrus-based industrial cleaner as a solvent. I find that this product works well, quickly dissolving a fully dried glue film. Containing nontoxic citrus oils, the stuff has a pleasant smell. Indeed, almost too good: You may be tempted to smell the fumes that do contain propane as a propellant—a known eye and skin irritant and a central nervous system depressant.

As an alternative to using industrial cleaners or heavy-duty solvents like toluene, try spraying a liberal amount of a household-type cleaning fluid (I use Formula 409) on the dried glue, and let it penetrate a couple of minutes. Then rub the glue off with a wad of very fine steel wool or a nylon scrub pad. It goes rather slowly and is a bit messy, but it works.
[Jim Tolpin is a woodworker and technical journalist in Port Townsend, Wash.]

Hazy oil finish

I built an open-shelf bookcase of padauk and finished it with Watco Danish oil finish (natural). After eight months in my living room, I've noticed a white haze forming on the surfaces of both the shelves and the uprights. The haze is easily removed by wiping with a dry rag. Is this normal? Is there anything I can do to stop the haze from forming, or do I have to live with it? —Ernest L. Umbrico, St. Catharines, Ont., Canada

Nancy A. Lindquist replies: A white haze forming on the surface of the oil finish is not normal. It could be a case of "blooming," which is the migration of some component of the finish to the surface where it interferes with the reflectance of light. I have not seen any problems from oil finishes on padauk with any of the brand-name formulations, so I think this is an anomaly. Although it may be difficult to say what is causing the haze, here are some simple procedures to find a solution.

First put a question mark with a permanent marker on the can of Watco, and use it up on odd jobs, not on anything special. Accept the idea that it's hard to track down the cause of the problem either in the can or in the application environment. When using this oil, proceed in small steps, making sure the surface is clean, dry and smooth before putting on any oil. This should take care of most problems without creating new ones.

Next pick a shelf not easily seen in day-to-day use, and test it in this manner. Wash the shelf with naphtha and a clean cloth, and let it dry. Sand it lightly as you did between coats of the original finish. Remove the dust from the surface, and apply a coat from a fresh can of Watco. Be sure to shake it up well, and follow the directions on the can. Let it dry, and see if the hazing returns in the following months. By sticking to the same formulation, the appearance of the finish is not changed as it might be if you switched to another brand with a different clarity or sheen.

Finally, when you are satisfied with the sample shelf, continue to clean and recoat the rest of the bookcase. The finish might have been contaminated in some way that prevented it from drying thoroughly. The driers in the additional coat could promote further curing or seal in the problem. Should this prove unsatisfactory, the next step would be to refinish the bookcase.
[Nancy Lindquist is a woodworker, designer and finishing specialist in Chicago, Ill.]

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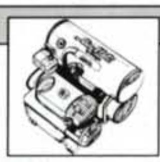
1609KX	Deluxe InstallersTrimKit	229.
1615EVS	NEW! 3-1/4" HP EFC VS Plunge Router	265.
1273D	4" x 24" Dustless Belt Sander	198.
1273DVS	4" x 24" VS Dustless Sander	219.
1370DEVSK	6" VS Random Orbit sander w/Access	299.
3270D	3" x 21" Dustless Belt Sander	148.
3283DVS	5" Dustless R/O Sander	105.
1613EVS	2HP VS Plunge Router	199.
1614EVS	1-1/4 HP Plunge Router	159.
1581DVS	VS, Var. Orbit Jigsaw, Dustless	179.
1581VS	Vs, Var. Orbit Jigsaw. D-Handle	145.
1582VS	VS, Var. Orbit Jigsaw w/CLIC	145.
1632VSK	VS Panther Recip. Saw Kit	145.
1420VSR	VSR Drywall Driver, 0-4000RPM	88.

Emglo



AM39HC4V 3/4 HP Vert. Twin Tank **295.**

AM78HC4	1-1/2 HP Twin Tank	299.
AM78HC4V	1-1/2 HP Vertical Twin Tank	309.
AM99HC4	2 HP Twin Tank	369.
K15A8P	1-1/2 HP Portable Compressor	669.
K5HGA8P	5 HP Honda Gas Portable Compressor	729.

Lamello

TOP-10	Joining Machine w/Asst Biscuits	589.
Standard-10	Hand Joining Machine w/Asst Biscuits	429.
COBRA	NEW! Plate Joiner	299.
PLATES	#0, #10, #20, 1000/Box	35.

freud

LM72M010	10" x 24T Rip	39.
LU73M010	10" x 60T ATB	47.
LU84M008	8" x 40T Combination	44.
LU84M011	10" x 50T Combination	40.
LU85M008	8" x 64T ATB Fine Cut Off	49.
LU85M010	10" x 80T ATB Fine Cut Off	59.
LU85M014	14" x 108T ATB Fine Cut Off	105.
LU85M015	15" x 108T ATB Fine Cut Off	105.
LU87M008	8" x 22T Thin Kerf	43.
LU87M010	10" x 24T Thin Kerf	44.
LU88M010	10" x 60T Thin Kerf	45.
LU91M008	8-1/2" Miter Saw Blade	42.
LU91M010	10" Miter Saw Blade	59.
LU98M010	10" x 80T TCG	68.
TK203	7-1/4" x 24T Framing Blade	18.
TK204	8-1/4" x 24T Framing Blade	23.
TK303	7-1/4" x 40T Finish Blade	23.
TK304	8-1/4" x 40T Finish Blade	24.
TK906	10" x 50T Combination Blade	29.
TK406	10" x 60T Cut Off Blade	35.
SD308	8" Dado Set	117.
SD506	6" Super Dado	165.
SD508	8" Super Dado	194.
F410	10"x40" Quiet Blade	54.
F810	10"x80" Que=iet Blade	76.

makita

BO5000	NEW! 5" Dustless R/O Sander	69.
DA391DW	VSR Cordless Angle Drill, 9.6v,keyless	159.
5090DW	3-3/8" Saw Kit, 9.6v	139.
6093DW	3/8" VSR Driver/Drill Kit, 9.6v	139.
6095DWE	3/8" VSR Cordless Driver/Drill w/Keyless Chuck, 2 batteries	149.
6201DWE	3/8" VSR Hi-Torq Driver/Drill Kit	159.
DA3000R	3/8" VSR Angle Drill	148.
6404	3/8" VSR Drill, 0-2100 RPM	58.
G3500R	3500w Generator	1075.*
9207SPC	7" Electronic Sander Polisher	159.
1805B	6-1/8" Planer w/Case	449.
N1900B	3-1/4" Planer Kit	129.
1911B	4-3/8" Planer Kit	145.
9820-2	Blade Sharpener	199.
3612BR	3 HP Plunge Router	179.
BO4510	1/4 Sheet Finishing Sander	57.
BO4550	1/4 Sheet Dustless Finishing Sander	54.
9401	4"x24" Dustless Belt Sander	189.
9900B	3"x21" Dustless Belt Sander	155.
LS1011	10" Compound Miter Saw	529.
LS1030	10" Miter Box	229.
LS1440	14" Miter Saw	435.
4200N	4-3/8" Trim Saw	135.
5007NBA	7-1/4" Circular Saw, Elec. Brake	129.
5077B	7-1/4" Hypoid Framers Saw	139.
5402A	16" Circular Saw	449.
2012	12" Portable Planer	499.
2708W	8-1/4" Table Saw	279.
2711	10" Table Saw w/Brake	535.

Milwaukee

0402-1	VSR 12v Driver/Drill w/Keyless Chuck	168.
6539-1	Cordless Screwdriver	75.
6546-1	Cordless Screwdriver, 2-spd	82.
0222-1	3/8" VSR Drill, 0-1000 RPM	107.
0224-1	3/8" Magnum Holeshooter, 0-1200 RPM	114.
0230-1	3/8" Pistol Drill, 0-1700 RPM	112.
0234-1	1/2" Magnum Holeshooter, 0-850 RPM	119.
0238-1	1/2" Pistol, 0-650 RPM	119.
0239-1	VSR Keyless Chuck Drill	125.
0244-1	1/2" Magnum Holeshooter, 0-600 RPM	119.
0375-1	3/8" Close Quarter Drill	127.
0379-1	1/2" Close Quarter Drill	145.
0567-1	Drain Cleaner Kit	235.
1676-1	Hole Hawg Kit	247.
3002-1	Electricians Rt. Angle Drill Kit	197.
6140	4-1/2" Angle Grinder	99.
6141	5" Angle Grinder	109.
5352	1-1/2" TSC Eagle Rotary Hammer	455.
3102-1	Plumbers Rt. Angle Drill Kit	197.
3107-1	VS Right Angle Drill Kit	204.
5371-1	1/2" Rev. Hammerdrill Kit	185.
5397-1	3/8" VS Hammerdrill Kit	139.
5192	Die Grinder, 4.5 Amp	175.
5455	7"/9" Polisher, 1750 RPM	140.
6072	9" Sander, 5000 RPM	130.
5362-1	1" TSCR Hawk Rotary Hammer	319.
8975	Heat Gun	59.
5936	4"x24" Dustless Belt Sander	228.
6008	1/3 Sheet Finishing Sander	115.
6010	1/2 Sheet Finishing Sander	119.
6016	1/4 Sheet Finishing Sander	52.
6126	6" Random Orbit Sander	125.
6215	16" Electric Chainsaw	172.
6215	16" Electric Chainsaw	172.
6365	7-1/4" Circular Saw	120.
6377	7-1/4" Wormdrive Saw	175.
6460	10-1/4" Circular Saw	259.
6507	VS Sawzall w/Quik-Lok	132.
6508	VS Sawzall	132.
6511	2-spd Sawzall	129.
6527	VS Super Sawzall w/Quik-Lok	164.
6528	VS Super Sawzall	164.
6750-1	VSR Drywall Driver	93.
6754-1	VSR Magnum Drywall	114.
6798-1	TEK Screwdriver	109.
8911	9 Gal. Wet/Dry Vac, H.D. Steel	329.

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550 POCKET CUTTER **209.**

6611	3/8" VSR Drill, 5.5 amp	135.
6614	1/2" VSR Drill, 5.5 amp	139.
6615	1/2" Keyless VSR Drill, 5.5 amp	139.
6640	VSR Drywall Driver, 5.5 amp	119.
7700	10" LaserLOC Miter Saw	369.
9852	3/8" 12v Magnequench Cordless drill	149.
9853	12v Magnequench w/keyless chuck	149.
9854	1/2" Magnequench cordless drill	159.
666	3/8" VSR T-Handle Drill	125.
320	Abrasive Plane	119.
9118	Porta-Plane Kit	205.
9367	3-1/4" Plane Kit	159.
9652	Versa-Plane Kit	299.
555	Plate Joiner Kit	169.
100	7/8 HP Router	105.
690	1-1/2 HP Router	139.
691	1-1/2 HP D-Handle Router	155.
693	1-1/2 HP Plunge Base Router	175.
7310	Laminate Trimmer	88.
7312	Offset Base Laminate Trimmer	122.
7319	Tilt Base Laminate Trimmer	100.
7399	Drywall Cut-Out Tool	79.
7518	3-1/4 HP 5-spd Router	269.
7519	3-1/4 HP Router	235.
7536	2-1/2 HP Router	209.
7537	2-1/2 HP D-Handle Router	219.
7539	3-1/4 HP VS Plunge Router	270.
97310	Laminate Trimmer Kit	199.
330	Speed-Bloc Finishing Sander	58.
352	3"x21" Dustless Belt Sander	142.
360	3"x24" Dustless Belt Sander	182.
362	4"x24" Dustless Belt Sander	189.
504	3"x24" Wormdrive Belt Sander	329.
505	1/2 Sheet Finishing Sander	118.
7334	5" Random Orbit Sander	119.
7335	5" VS Random Orbit Sander	129.
7336	6" VS Random Orbit Sander	135.
314	4-1/2" Trim Saw	138.
315-1	7-1/4" Top Handle Circular Saw	118.
345	6" Saw Boss Circular Saw	104.
7549	VS, Var-Orbit D-Handle Jigsaw	145.
9345	Saw Boss Kit	124.
9637	VS Tigersaw Kit	138.
9647	Tiger Cub Reciprocating Saw	115.

DEWALT

DW945K-2	12v Cordl.,Keyless, 2 batteries	175.
DW100	3/8" VSR Drill, 4 AMP	68.
DW106	3/8" VSR Drill, Keyless	75.
DW124K	1/2" Right Angle Drill, 8 AMP	299.
DW270W	Drywall Screwdriver w/50' Cord	127.
DW280K	Screwdriver Kit	117.
DW290	1/2" Impact Wrench	175.
DW705	12" Compound Miter Saw	358.
DW306K	VS Recip,. Saw Kit, 8 AMP	159.
DW318K	VS, VO Jigsaw Kit	148.
DW402	4-1/2" Minigrinder, 6 AMP	94.

Elu

3379K	New Plate Joiner Kit	229.
3380	Joiner/Spliner Kit	289.
3338	2-1/4 HP VS Plunge Router	255.
4024	3" x 21" VS Belt Sander	179.

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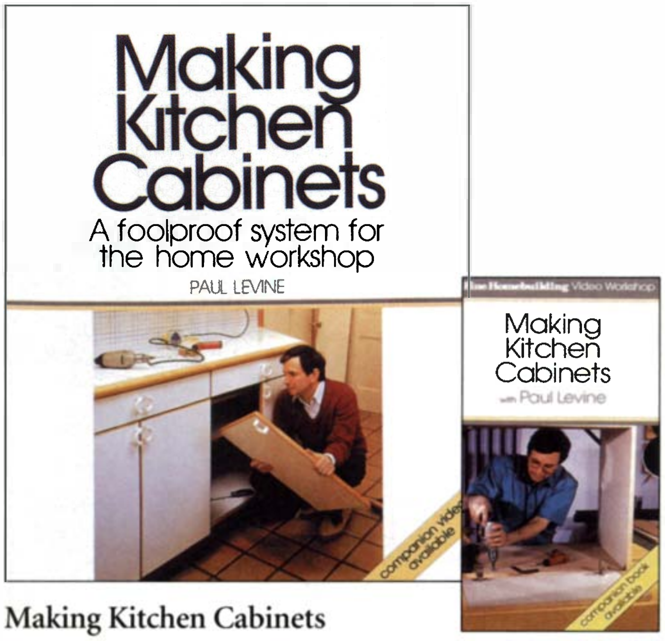

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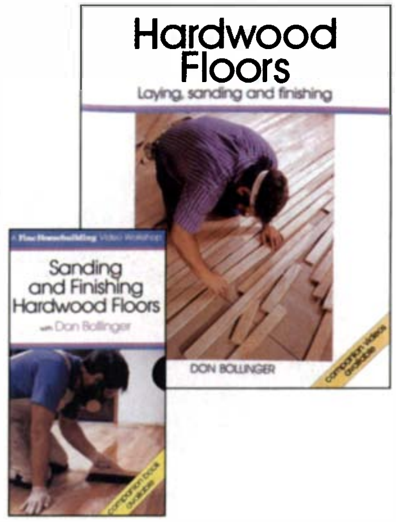

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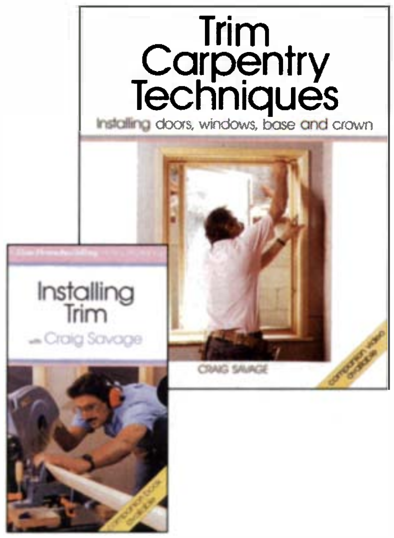

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Building On Tradition

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Traditional details suit a modern bed design. *The simple shapes and light component sizes of this bed's cherry frame allow it to be easily situated in any bedroom. Whether the size is king, queen, full or twin (as shown here), the authors prefer this same basic box-spring-less construction. A sheet of ¾-in. melamine, resting on slats, supports the bed's mattress.*

Construct a Classic Bed

Flexible frame design allows wood movement and easy take down

by Doug Mooberry and Steve Latta

We build four-poster bed frames using the same basic construction that has held together for over 200 years: Mortise-and-tenon joinery connects the head and foot rails to the posts; both side- and end-rail tenons are held in their post mortises by bed bolts and nuts. This lets us easily assemble and knockdown the frame, and it allows us to tighten up the joints when the wood moves. To improve the traditional construction methods, we use modern tools and production techniques when shaping components and cutting joinery. And unlike a conventional bed frame that supports the mattress on a box spring, we prefer a different mattress-suspension system, which eliminates the box spring and allows us greater design opportunities (see the photo on the facing page).

We came up with a way to support a mattress on a sheet of melamine, which rests on slats (see the drawing on p. 38). Then we can downsize the rails because they no longer have to cover a box spring (see the near right photo). This construction, called a platform bed, permits the rails to be located higher on the post, which enables more shaping of the leg section. Having higher rails also makes it easier to clean under the bed, and you're less likely to knock your shins when you get into the bed. While discussing the frame design we use, including how we allow for headboard wood movement, we'll describe the setups we use to simplify and speed up the bed-building process in our shop.

***Box spring or not?** These foot rail-to-post assemblies (above) are similar. However, the mahogany frame (front) requires a box spring while the maple frame (rear) does not. Because the left assembly's rails do not have to cover a box spring, they can be narrower and located higher on the post, which allows better shaping of the leg.*

***You can create a wide range of turned or shaped bed posts (right).** Here are a sampling of post sizes and styles in cherry. From the left: New England traditional (yet to be finished), country Sheraton, fluted Chippendale, pencil post and contemporary (with a bed-bolt hole showing).*

Bed design

Before we mill any wood for a bed, we completely work up the design with the customer, offering historical research when necessary. It's important that the post style and headboard shape complement the existing furniture of a bedroom (see the photo on the facing page). To get traditional ideas, we often look in antique magazines, museums and Wallace Nutting's *Furniture Treasury* (Macmillan Publishing Co., Inc., 866 Third Ave., New York, N.Y. 10022; 1933). For contemporary ideas, we look at old *Design Books* (The Taunton Press) or in back issues of *Architectural Digest*. We never just reproduce a bed, though. By refining proportions, using unusually figured wood or choosing a special finish, we can significantly improve a bed's appearance.

We encourage customers to order platform beds (those without box springs). There are other reasons to eliminate the box spring besides the disadvantages previously mentioned. First, box springs cost money. Second, you may need to hang a ruffle to disguise the box spring or to make the bedspread look right (a frame without a box spring allows you to extend the mattress over the rails, so the covers hang nicely). Third, box springs make moving a challenge. Just ask any mover who has confronted a curved stairway with a queen-sized bed.

Our platform beds get their influence from early 18th-century beds. This style remained popular up through the late 1700s. At that time, Thomas Sheraton developed "field beds," which were used in military tents because the frames could be easily disassembled and relocated. Aside from their ability to knock down, the best feature of a bolt-together bed is its versatility. By swapping different post styles (see the photo at right above), we've made everything from traditional canopy beds to contemporary low-post beds—in sizes from twin to king. (Refer to the chart on p. 39 for overall frame and component dimensions based on typical mattress sizes).

Stock preparation

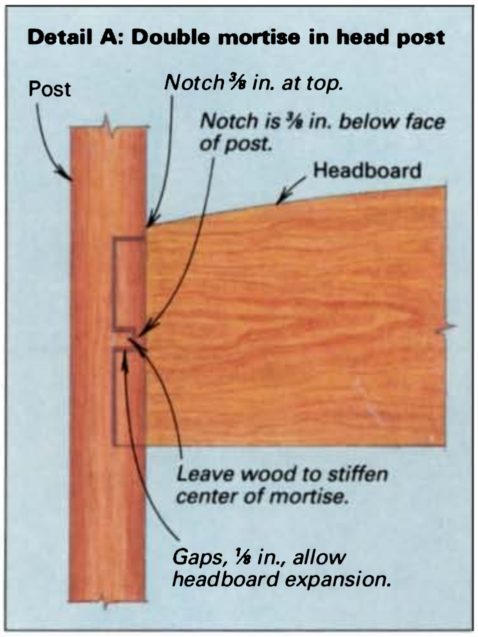
After we've arrived at a bed's size and style, the next step is to measure the mattress exactly. We once built a bed from dimensions that were given to us by a mattress salesman. Because he gave us the wrong height, we wound up with a bed whose headboard barely showed above the pillows. Now we always measure the mattress twice, and we usually yell at the salesman once. This is also the time we order the bed hardware, such as bed bolts and their covers (available from Ball & Ball, 463 W. Lincoln Highway, Exton, Pa. 19341; 215-363-7330 or Horton Brasses Inc., Nooks Hill Road, P.O. Box 95, Cromwell, Conn. 06416; 203-635-4400).

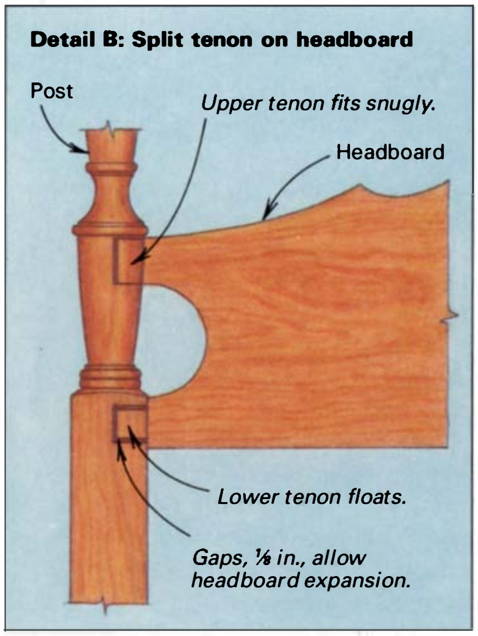
Depending on what a customer prefers, we usually select bed-frame stock from wood stored in our barn. We use common hardwoods like cherry, maple, walnut and mahogany. Generally, we allow thick green wood to dry a year to reach about 13% moisture content before we kiln-dry it. We make sure that all four bed posts come from the same log (glued up posts

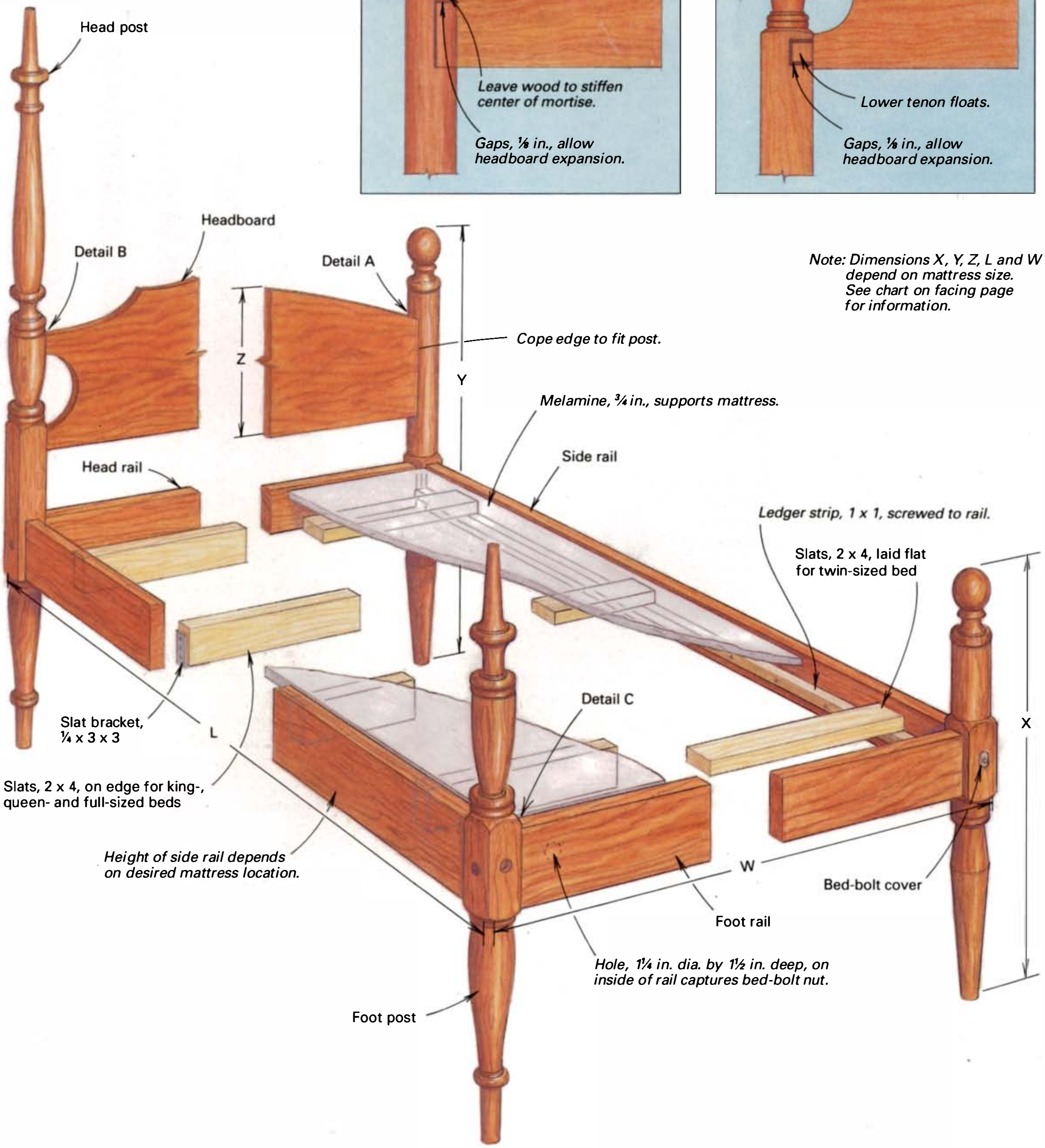
Photos: Alec Waters

Bed frame options

These two basic bed frames support their mattresses on melamine resting on slats. The two headboard-to-post connections (see details A & B) show how the frames handle wood movement. Like a conventional box spring bed frame, the posts and rails assemble with bed bolts (see detail C).

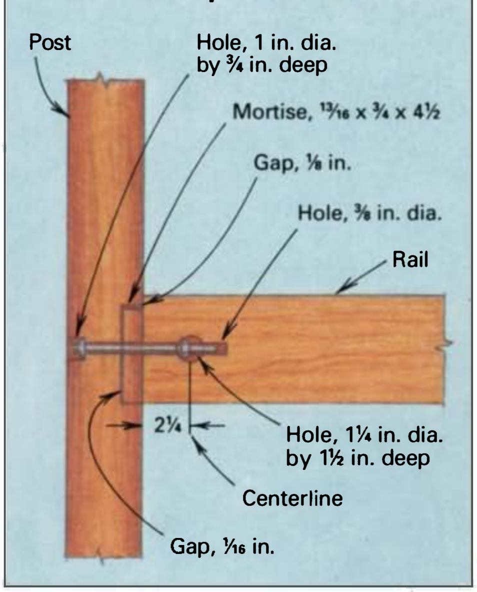






Drawings: Lee Hov

Detail C: Rail-to-post bed bolt



Bed proportions

Mattress size ✷ (w x l)	King (76 x 80)	Queen (60 x 80)	Full (54 x 75)	Twin (39 x 75)
Length of side rails ◆	80½	80½	75½	75½
Length of head and foot rails ◆◗	73½	56½	50½	37
Head-post height (Y)✚				
Top	24	22	20	17
Block	6	6	6	5
Leg	14	14	14	14
Foot-post height (X)✚				
Top	9	9	9	9
Block	6	6	6	5
Leg	14	14	14	14
Post section (square)✚	2¾ to 3½	2¾ to 3½	2¾ to 3½	2¾ to 3½
Rail section (w x t)✚	5 x 1¾	5 x 1¾	5 x 1¾	4 x 1¾
Headboard width (Z)✚	20	18	16	13

Notes:
- ◆ Length of rails includes tenons.
- ✷ Frames shown require no box spring. Mattress sizes shown are industry standards.
- ✚ Post, rail and headboard sizes are for traditional bed (see photo on p. 36).
- ◗ Add two rail thicknesses to frame width if you want mattress inset from rails.

are unacceptable in our shop). In addition, we carefully match the headboard stock to the posts, and we try to select rail stock that is similar in grain and color to the posts. Next we rough-cut the stock, allowing extra length for rail tenons and for parting off posts if they're to be turned. Then we let the stock sit in the shop a while before we mill it.

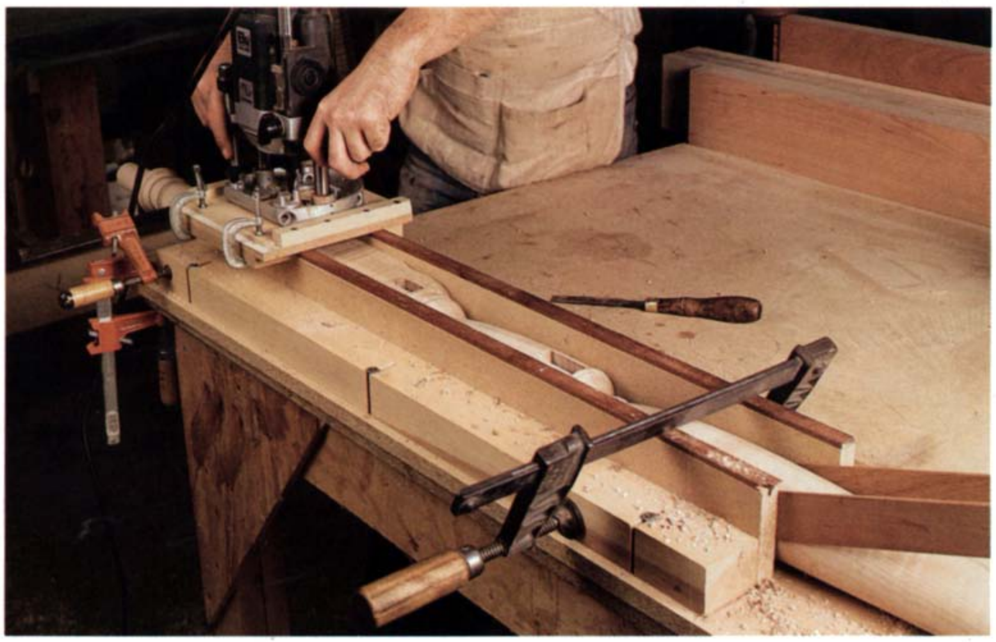
Frame construction

The mattress-suspension system we use begins with 2x4 slats; three laid on their side for a twin bed, four laid on edge for a double or queen and five on edge for a king-sized bed. To hold up the slats on a twin frame, we screw a ledger strip around the interior of the rails (see the drawing on the facing page). For larger beds, we install slat-hanging brackets (angle iron) above the bottom of the rail. On top of the base of slats, we lay a sheet of ¾-in. melamine. The melamine stiffens and squares the frame, supports the mattress and, because it is smooth, prevents the mattress cover from tearing. We screw the slats to the brackets so that the top of the melamine lies at or just below the top of the rails.

Posts—Each post has three sections: the leg, the block and the top. The leg likes to be at least 14 in. long to allow for proper shaping (see the photo at left on p. 37) and to strengthen the rail connection by reducing the lever-arm of the upper post. The center block needs to be at least 1 in. longer than the rail height (longer if you want to shape transitional lamb's tongues). The block size should also look proportionate to the rest of the post (see the photo at right on p. 37). The top section of the post carries the headboard and is the most visible area of the bed. To figure the length of the top of a head post, we place headboard and post patterns against the stock to make sure the connection will occur at a sensible place. To figure the length of foot posts, we mark the posts a couple of inches above where the mattress top will be.

We send 90% of our bed posts to local turner Mark Taylor to do the shaping. Along with stock for the posts, we give him a full-scale pattern showing the spindle design. Once the posts have been shaped, we determine the rail height. Then we lay out the center of the mortises on the correct faces of the post. We extend a bottom line around all the faces to use as a reference line for drilling bed-bolt holes later (see drawing detail C above).

To waste the bed-post mortises, you can use a plunge router and the jig shown in the photo below. The jig is easy to construct and is adjustable to fit most posts. We made our jig's base out of particleboard and poplar, and we capped the rails with hardwood runners. We screwed together plywood and scraps to make the router carriage. If a post is tapered, we insert a couple of shims before clamping it between the jig's rails. Next we double-check each mortise layout because the post is scrap if the location is wrong. Then, using a ½-in., two-spiral end mill (Forest City Tool Co., 620 23rd St. N.W., Hickory,



Routing bed-post mortises*—With a post wedged in this jig, you can easily rout mortises for the rail tenons whether the post is turned or shaped. Then just use a chisel to square the mortises' corners. For adjustability, the router base slides in tracks in the carriage, and one of the jig's rails has slots for its mounting screws.*

NC 28601; 704-322-4266), we rout one side of the mortise, rotate the setup 180° and rout the other side. Although the bit leaves rounded ends, it's quick and easy to square the mortises with a hand chisel.

Rails—After we dimension the rails, we cut their tenons on a radial-arm saw fitted with a 10-in. dado head. To prevent transferring inaccuracies from slightly bowed or twisted stock, we space out the work from the saw's fence, and we butt the end of the rail against a pointed stop (see the top photo below). The stop contacts the same (center) spot on the rail when we flip it to cut the other cheek. To ensure a snug fit in the mortises, we cut the tenons thick, and we shave them down with a rabbet plane. After we have cleaned up the shoulders, we set the rail on edge, raise the sawblade and then notch 5/8-in. on the top (but not the bottom) of the tenon. The notch allows the rail to expand and contract without exposing the post mortise. This orientation also helps us to tell which side of the rail is up during assembly (see drawing detail C on the previous page).

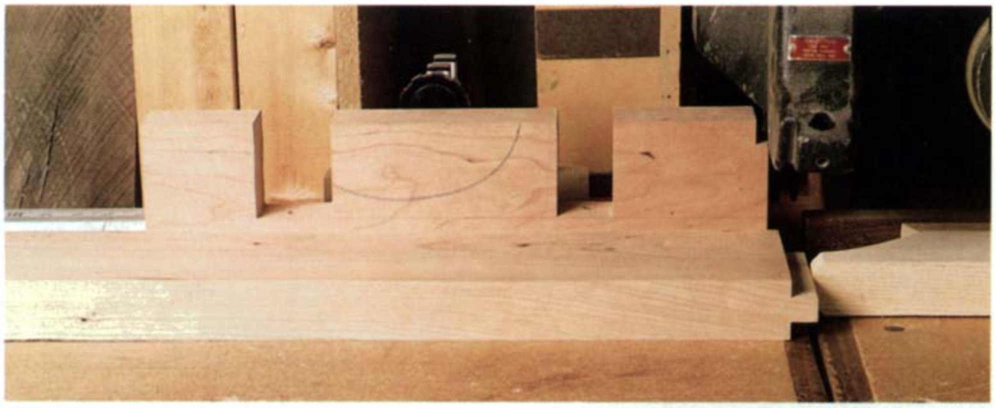
Headboard—Because headboards are wide, lots of wood movement will occur. Cutting a long mortise to accept a slightly under-width tenon will handle the problem, but it's likely that the mortise will open up and leave an unsightly gap where the headboard meets the post. Therefore, we allow for expansion and contraction at the (cross grain) post-to-headboard joints by doing one of two things: We either shape a double mortise (leaving a center section of wood to stiffen the mortise) and notch the headboard ends to form twin tenons (see drawing detail A on p. 38), or we split the tenons on the headboard and undersize the lower tenons, so they float in their post mortises (as shown in drawing detail B on p. 38).

With split-tenon headboards, we lay out the tenons so that the lower one falls onto a flat and the upper (snug) tenon falls just under a bead or other detail. Tapering the 13/16-in. headboard thickness on the tenons ensures that they'll fit tightly into the 3/4-in.-wide post mortises. We cope both the top and bottom of the lower tenons, so the mortises will be covered no matter which way the wood moves. If we use a double-mortise, we undersize both of the tenons, notch the top of the headboard and cope the shoulder to fit the post. This enables the wood to move without being seen.

To form the shape of a headboard, we make a full-scale template out of medium-density fiberboard (MDF). Each template, which we keep, is half of a headboard: We trace the left side, and then flip it to get the right side. This lets us fudge the length of a headboard, such as for larger bed frames. After we score the shape on the stock with an Exacto knife, we sabersaw close to the line. Then we clamp the pattern to the stock and flush-trim the shape using a bearing-guided router bit. To prevent tearout, we always rout down the headboard's slope.

Bed bolts—Because we use authentic bed bolts in our frames, we provide the customer with a traditional wrench when we deliver the bed. We lay out the bed-bolt holes so the bolts will clear each other inside the post. A 1/2 in. offset spacing works well because this lets us hang adjacent bed-bolt covers at the same height. Boring the holes is a three-step process: First, we bore a hole in the post to recess the bolt head. The hole is large enough to fit the bed-bolt wrench, but small enough to be hidden by a bed-bolt cover. Second, we bore a 1 1/2-in.-deep hole in the side of the rail (to house the nut), using a 1 1/4-in. Forstner bit chucked in our drill press. Having a rounded seat for the nut instead of a flat allows greater adjustment when it comes time to assemble the frame (see the bottom right photo). And third, using the post hole as a guide, we center-bore a 3/8-in. hole (slightly larger than the bolt) through the post into the rail end using a 10-in.-long twist bit. To do this, we lay the post on its side, fit the tenon in its mortise, mark the mating parts on the inside with a punch, and then bore the hole with a hand drill (see the bottom left photo). If the layout is accurate, the bit will emerge in the center of the nut hole. We continue drilling into the rail to provide enough depth for the entire bed bolt (see drawing detail C on p. 39).

We assemble the posts, headboard and rails before we sand and finish the frame. Once on site, we loosely assemble the frame and install the melamine, which squares up the frame. Then we snug all the bed bolts and lay down the mattress. □



***Sawing bed-rail tenons**—A 10-in. dado set in the radial-arm saw makes quick work of tenons. To ensure proper registration on bowed rail stock, the authors screwed a spacer block to the left fence (with clearance for the guard), and they shaped the right stop so that it contacts only the center of the tenon end.*

***Boring bed-bolt holes**—Steve Latta drills through a post into the end of a rail (see example at right). The post hole is counterbored for the bed-bolt head (foreground).*

***Assembling the head of the bed**—After Latta loosely tightens the bed bolts between the head rail and posts (bottom), he checks the fit of the headboard.*

Doug Mooberry and Steve Latta build beds and other furniture at Kinloch Woodworking in Unionville, Pa.

***Making a new tool handle** doesn't take a lot of time, and the benefits are well worth it. A new handle (see inset) will make the tool more comfortable and easier to control, contributing to better woodworking.*

Get a Grip on Your Tools

Making and modifying handles for comfort and control

by Christian H. Becksvoort

I had my dovetail saw for some time before I gave it its first real workout. I was making a large case piece with almost 400 hand-cut dovetails. Halfway through the first day of sawing, I began to notice blisters forming. I realized my high-priced, brass-backed, British dovetail saw needed some serious customizing if I was ever to finish the piece. Out came the knife, rasp, file, sandpaper and gouge. I then chopped and carved the handle until it fit my hand. A little more scraping and sanding, followed by a coat of oil completed the project.

In about an hour, I had converted the stock saw handle from a painful tool into one that I look forward to using because it fits like a glove. But if your stock handle is beyond hope or just plain ugly, another option is to start from scratch and create a unique custom handle for your saw, as discussed in the box on p. 43.

Tool handles are the link between you and the tool. This is where control takes place. If the hand is not perfectly comfortable and at ease, then you lose some of that control. Consequently, a well-fitted handle can make you a better woodworker.

That saw was my first venture into customizing handles, which has since spread throughout my toolbox (see the photo on p. 42). Since that time, I have modified or replaced handles on tools such as chisels, planes, drills and braces, clamps and screwdrivers.

The decision of whether to modify or replace is an individual one. I have an aversion to plastic handles. They get replaced immediately. I also dislike garish bright paint and tinted lacquer. For instance, I scraped and sanded off the finish on my wooden handled screwdrivers, and in the process, I also filed and sanded their rough ends. Carving tools received the same treatment. Anyone who has ever held a gouge for more than 10 minutes can appreciate the comfort of a smooth, rounded handle end against the palm.

I couldn't find a wooden handled, square-drive screwdriver, so I salvaged the wooden handle from a worn-out Phillips-head screwdriver. The wooden handle pulled off the shaft relatively easily, but I had to cut the plastic handle off the square-drive screwdriver using a worn-out blade on the bandsaw. I then drove the square-drive's shaft into the salvaged wooden handle.

Photos except where noted: Charley Robinson

Rehandling planes

Years ago, planes had rosewood handles and knobs, then walnut, then stained beech or birch, and now, many handles are plastic. The rosewood handles I leave alone, and I usually don't change walnut handles unless they're damaged. But I do replace the others. I usually turn a new front knob first. The existing knob is a rough guide, but now's the time to adapt it to your grip. The only fixed diameter is where the knob mates to the plane body.

To drill the centered, counterbored hole into the top of the round knob, I first clamp a piece of scrapwood to the drill-press table. Then I drill a flat-bottomed hole, the same diameter as the knob base, about ¼ in. deep into the scrapwood. I change bits to fit the bolt head, place the knob in the hole and drill the countersink for the bolt head. The depth is critical to get the bolt perfectly flush with the surrounding knob. Finally, I change bits again and drill for the bolt shaft. Then all the knob needs is a little oil, and it's ready to screw onto the plane.

The back handle or tote is just as easy. I bandsaw the rough shape, drill the countersunk hole for the long bolt and then shape the handle to suit with a rasp, file and sandpaper. I carved the last handle I made, as shown in the photo on p. 41 and left the facets (see the inset photo on p. 41). I liked the look of the carved handle, and I thought the hewn texture would improve the grip. Finally, I drill the hole for the short, front-mounting bolt. After a coat of oil, I attach the handle to the plane. As with other handles, I add a few more coats of oil over the next few days.

Turning chisel handles

My first effort involved a set of Greenlee socket chisels, which I reshaped by chucking the tapered end of the handle into a three-jaw chuck on my lathe. I turned the handles into smooth cones with a gentle curve and sanded and finished them in a few minutes.

New socket handles are almost as easy to make. I cut my rough stock to 1½-in.-sq. blanks, 6 in. long and place it into my toaster oven (set to 200°F) for one or two days. This dries the wood to 0% moisture content. Then I turn the blank to shape and cut a taper on one end to fit the chisel's socket. I turn the other end for a stainless-steel hoop to prevent the handle from splitting when hit with a mallet. I prefer stainless steel to brass or copper for hoops because it doesn't tarnish, and the silver color goes well with any wood. I buy ¾-in.-ID stainless pipe at a local machine shop, have them cut it to ⅜-in. lengths and radius the edges of the resulting hoops. I then polish the hoops before fitting them to the handle.

It's important to turn the handle to fit the hoop immediately after drying and to have the hoops on hand to test the fit. If you get a good, snug fit at this stage, when the wood returns to equilibrium moisture content, it will swell and securely anchor the hoop.

Tang chisels are even easier. I select the stock and drill the hole for the tang. The hole should be undersized to get a good fit. The only critical dimension on the turning is at the bottom to accommodate the ferrule, either salvaged or new, that keeps the handle from splitting when the tang is forced into the handle.

Split-handle installations

My most challenging handle replacement was for a set of Stanley #40 chisels. The handles on these chisels consist of a metal strike cap on the top of a 1-in.-dia. metal shaft that was forced into the top of a hollow polycarbonate handle. The chisel shaft was forced into the other end of the handle until it met the strike-cap shaft. It does not require an advanced degree in metallurgy to figure out that two pieces of steel shaft forced against each other by constant pounding will eventually mushroom. Indeed, one handle in my set would split every three to six months. I would send the chisel back to Stanley and they would dutifully send me a new one.

They stopped making the #40s in the late '70s. At that point, I bandsawed the plastic handles off and pondered a solution. I had a machinist friend and neighbor turn new strike caps with long, oversized shafts, which he drilled out to accept the chisel shafts. I took a wooden blank, cut straight at both ends to the correct length. Then I drilled it from the top to accept the strike cap sleeve and from the bottom to accept the remaining chisel shaft. Next I turned the handle to approximate the old plastic handle. After oiling the hollow handle, I took a wide chisel and split it lengthwise. Finally, I epoxied and clamped the two halves around the shafts of the chisel and strike cap. With a little more sanding and oiling, the split line is virtually invisible. I used the same split handle technique to replace the plastic handle on the swing arm of a brace after bandsawing off the old handle.

Rehandling machines

Wooden handles on stationary power tools are a pleasure to use. For odd sized bars or control levers, I usually drill the mounting hole into my wooden handle blank the next larger size, turn the knob and epoxy it into place. For screw-on knobs, I use threaded brass inserts of the correct size, fitted into the knob. □

Christian H. Becksvoort builds custom furniture in New Gloucester, Maine, and is a contributing editor to FWW.

Rehandling a shopful of tools—Shown here are before (on the left) and after examples of tools that have modified or new handles. From the left, Pfeil carving gouges (edges eased and sanded), Stanley #40 chisels (handle replaced, new steel cap), Stanley #750 socket chisels (handle replaced, stainless steel hoop), Greenlee chisel (handle reshaped), Allway Tools scraper (handle replaced), Stanley #923 brace (handles replaced), Shopmade lathe knock-out bar with black locust knob.

Regrip your saws

by Mario Rodriguez

We've all admired the beautiful handles on antique woodworking saws. Their flourishes, rooster tails and swirling cusps suggest movement and speed. Usually made of beech, apple or pear, these handles are minor works of art. Today, most saws are fitted with blister-raising slabs of wood that cramp the hand and fatigue the arm.

A custom handle will improve the performance as well as the look of your saw. A comfortable and properly shaped grip makes it easier to guide the saw for more accurate cuts and excellent results.

Choosing your material: Handle making requires only a small piece of wood, so you might as well use some wildly spectacular stock. I've salvaged most of my handle stock from the scrap bin or firewood pile. Start with a piece of ⅞-in.-thick, unusual or figured wood that's about 6 in. by 7 in., orienting the grain lengthwise.

Choosing a handle pattern: Small backsaws have pistol grip handles. Large backsaws and full-length handsaws usually have a closed or hollow handle. I have six handle patterns I use (see the photo at right), and I'm always looking for new ones. I frequently make a tracing of interesting designs. Sometimes I copy a design from an old tool catalog and have it enlarged. Experiment and anticipate changing the handle more than once until you find a grip that works for you. A good design evolves after some use and time for evaluation.

A pistol grip pattern is easy to make and will work for most small backsaws measuring 8 in. to 12 in. long. The shape is easy to cut out. There are no interior cuts, and it can be done on the bandsaw.

A closed or hollow handle requires an interior cutout. First drill pilot holes, and then complete the cut on a scroll or jig saw. Or you can cut the blank into two pieces, make your interior cutout, and reglue and complete your exterior silhouette.

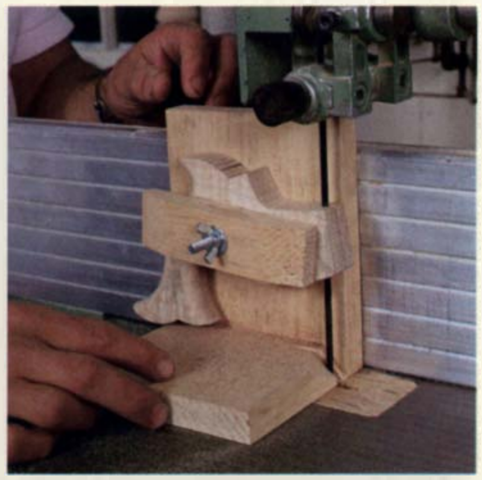
Shaping the handle: You can quickly round corners using a table-mounted router with a ball bearing-guided bit. Taking several shallow cuts, round the interior cutout and the back of the grip. Don't eliminate the flat surfaces. A handle that is too round tends to be slippery. For the rooster tail, I prefer a thumbnail profile cut by hand with chisels and files. Try for crisp, sharp edges.

Plotting the cut for the sawblade: Lay the sawblade onto your handle. Mark the top and bottom corners of the sawblade onto the handle, and draw a line connecting the two. This should be the baseline of the cut into the handle for the blade.

Photo: Sloan Howard

I usually pitch the handle forward at 50° to 60°in relation to the cutting edge, as opposed to the stock angle of about 70°. This helps me to direct the force of my stroke directly behind the blade for easier, more controlled cutting.

Cutting the blade slot: For speed and accuracy, I usually cut the slot on a bandsaw fitted with a ¼-in.-wide, 6-teeth-per-inch blade. Although a bandsaw leaves a kerf wider than the thickness of the handsaw blade, the difference is negligible and ultimately will not affect the fit of the blade. For safety, I use a jig (see the photo above right)



***A special jig holds the handle blank** (above) when bandsawing the sawblade kerf. Although a bandsaw kerf is slightly oversized, it doesn't affect the final fit of blade to handle.*

***Old patterns for new handles**—The author finds patterns for his new handles by tracing directly from an old saw that he likes or in old catalogs (left).*

to securely hold the handle with the blade slot baseline parallel to the bandsaw blade.

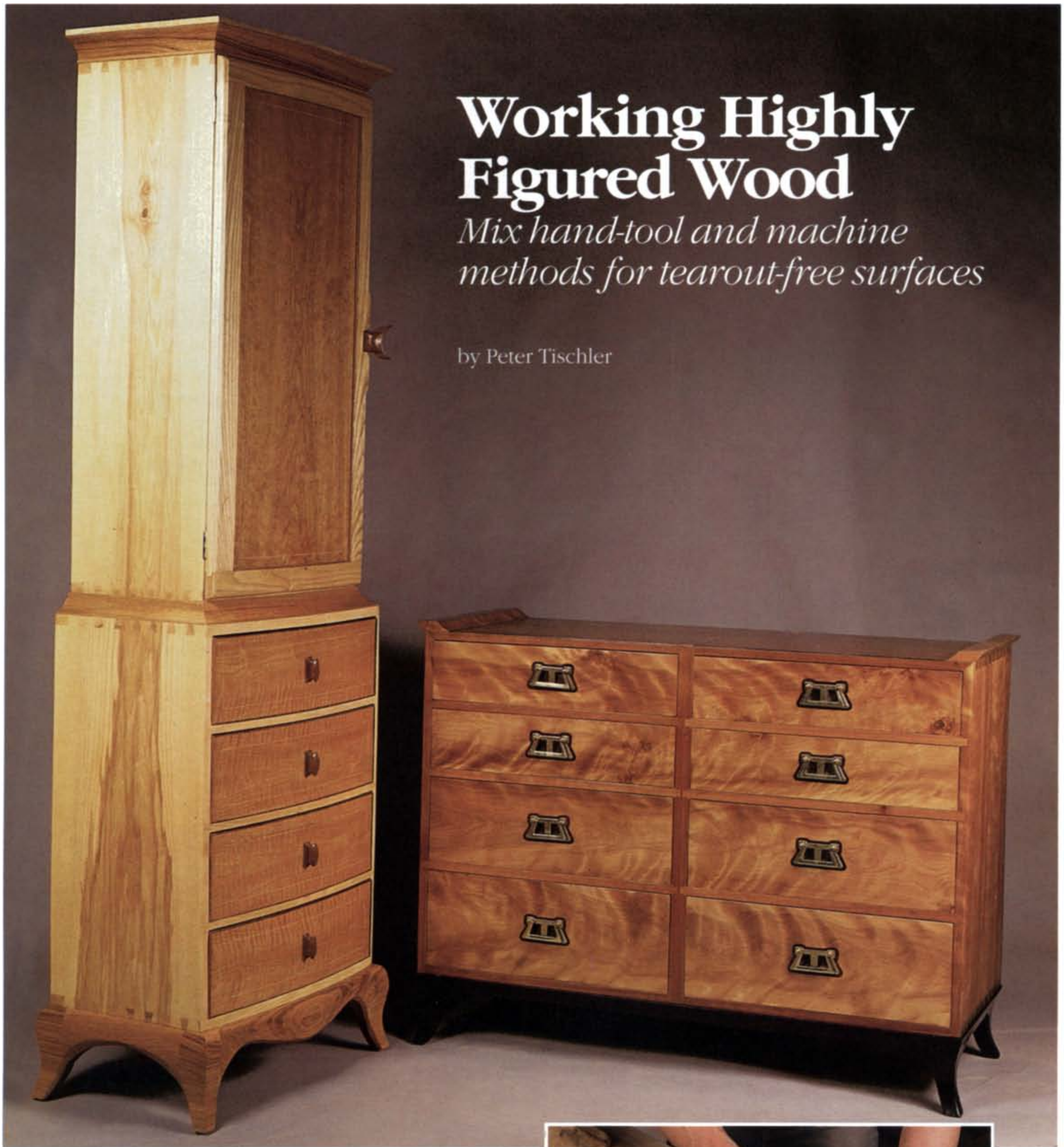
I sometimes cut the slot by hand for a tighter fit. I use the saw to be rehandled with the old handle reattached temporarily. However, this method requires extreme care because if your cut is off line, it will force a kink into your blade when you fit it to the handle.

Spine mortise: If you're working with a backsaw, you'll have to cut a narrow open-ended mortise into the top of your handle to accommodate the spine. Mark on each side of the blade slot for the width of the spine, and carry the mark down the front of the handle. Cut the sides of the mortise with a small dovetail saw, and then carefully, pare out the waste with a ¼-in. chisel. Periodically, set the blade into the handle to check for fit. Cut this mortise on the small side and enlarge as necessary to avoid any gaps in the finished job.

Drilling the holes: Make a cardboard template of the heel end of the blade, including the blade holes. Line up the template to the blade baseline drawn on the handle. Drill the screw and nut holes slightly oversized for an easy fit. For a cleaner look, you should countersink the saw nuts almost flush with the handle.

Finishing the handle: After sanding with 320-grit paper, I spray a light coat of lacquer sander/sealer, followed by a coat of gloss lacquer. Sometimes, I brush on two coats of shellac instead. When dry, rub the finish with "0000" steel wool, then wax. □

Mario Rodriguez is a contributing editor to FWW *and a cabinetmaker, teacher and woodworking consultant.*



Working Highly Figured Wood

Mix hand-tool and machine methods for tearout-free surfaces

by Peter Tischler

Figured wood makes beautiful furniture but can be tough to work. *Peter Tischler's two-section ash chest with its vertical cabinet and holly inlay (left) has curly oak drawers, while his low cherry bureau with its black horizontal base (right) has flame birch drawers. In both pieces, Tischler relied on hand-tool and machine methods to surface the figured wood.*

Working difficult wood by hand—*With three favorite hand tools, the author smooths this plank of walnut. First he skews a #4½ smoothing plane (with paraffin-waxed sole) to flatten the board. Next he'll use the cabinet scraper at various angles to work the knot area. Last he'll smooth out tool marks with the scraper blade.*

Photos except where noted: Alec Waters

Cabinetmakers usually save woods with high figure and bold grain to showcase the prominent features of their work, such as tabletops, door panels or drawer fronts (see the top photo on the facing page). But until I became familiar with the underlying structure and reasons behind beautiful grain and figure, I had difficulties working the surfaces of such solid woods.

I've since built many furniture pieces using wood with pronounced grain and figure. Along the way, I developed some unusual methods to cope with these showy woods. I've found a combination of hand-tool and machine techniques can overcome tearout and make surfacing go more smoothly. I'll share these tips as well as what I've learned about what causes some common figures and grain patterns and offer suggestions for working them (see the story on p. 48).

Understanding grain and figure

Because descriptions can be ambiguous, it's helpful to first define a few terms that describe wood's characteristics. Consider grain as the cell arrangement and direction of the fibers in the wood. (For more on this, see *FWW* #95, p. 58.) Texture is the differences in cell size and density between early (spring) wood growth and late (summer) wood growth. Early and late wood account for contrasts in color, as shown in the chair seat photo on p. 46. Color differences can also occur as you move outward in a log. The heartwood (center) of a tree is usually darker than the sapwood nearer the bark. Figure is a little harder to define. It refers to the patterns that appear on the radial and tangential faces of a board. Figure actually has to do with the light-reflecting properties of the wood. A further explanation of this is given in R. Bruce Hoadley's book, *Understanding Wood* (The Taunton Press).

Highly figured woods are also highly prized, so the best quality logs usually go to the veneer mills. This allows more of us to see and work the woods that have distinct signatures of nature. (For a gallery of figured veneers, see *FWW* #89, pp. 44.) For many furniture applications, however, veneers limit a piece's design and durability. Working figured wood in its solid form lets me reveal

Tearout-free block-planing

by John Henry Harper

Block planes offer many advantages for smoothing figured hardwoods. Because a block plane's iron is bevel side up, it requires no chipbreaker. The blade's bevel itself rolls the shaving over. Having the flat side down allows the iron to be supported from underneath, close to the cutting edge (see the drawing below), which dampens most of the tool's chatter. In addition, the ability to close the throat enables you to produce ultra-fine shavings, even in the most difficult woods. This is because the plane can be set to support the wood close to the cutter, which prevents the shaving from lifting and tearing out.

Standard vs. low angle: I prefer the higher quality block planes that have adjustable mouths. There are two basic models available: The low-angle (12 or 12½°) block plane, which is intended for end grain, but also works well at paring softwood, and the standard-angle (20°) block plane. The angle designation refers to the slope between the plane's iron and its sole. I've found that a well-tuned standard-angle block plane with a sharp, lightly set iron is the most suitable for surfacing figured woods. I actually modify the tool's edge somewhat to produce a steeper cut, which causes less tearout.

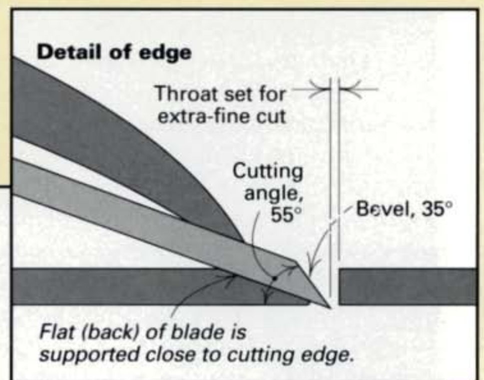
The cutting angle is the angle between a plane's sole and the direction that the shaving is diverted by the blade. On bench planes, this angle is fixed by the angle of the frog. By contrast, with a block plane you can change the cutting angle simply by grinding the bevel at the angle you want.

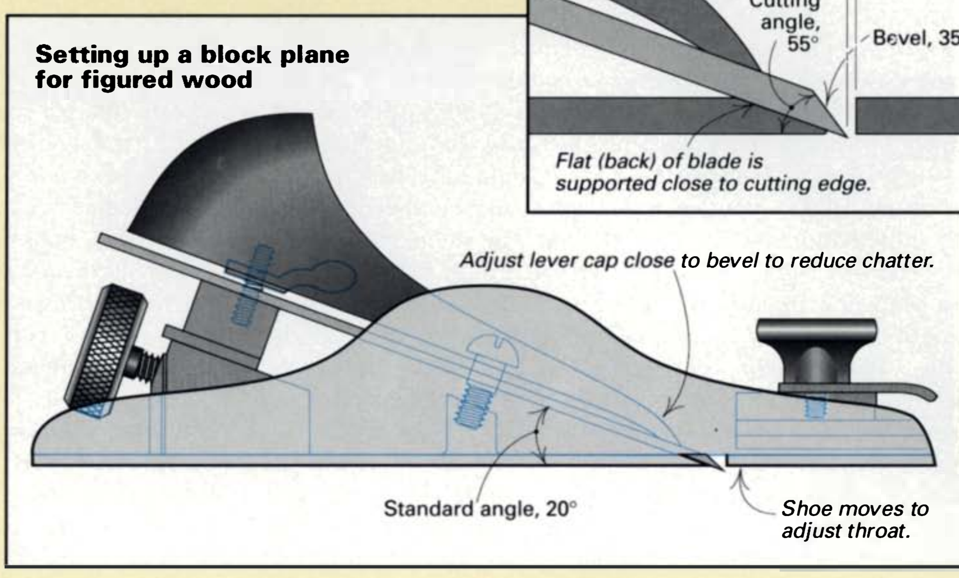
For general planing work, a bevel ground at 25° offers the best compromise between sharpness and edge durability. This gives a cutting angle of 45° for a standard-angle block plane. However, for smoothing figured wood, I like a 55° cutting angle. Once called the "middle" pitch, this is the angle found on many old molding planes specifically meant for hardwoods. To get this pitch, I grind the iron at a 35° bevel (a low-angle plane iron would have to be ground too bluntly). A 55° cutting angle shears off wood without causing tearout, and it works for the same reason that a cabinet scraper does—the edge is less likely to pry up the wood fibers.

Honing the iron at the same angle that I ground its bevel produces a nice edge. In other words, I don't add any secondary bevel. I begin with a 1,200-grit waterstone and then move to a 6,000-grit stone. If I'm using oilstones, I start with a soft Arkansas and then proceed to a hard Arkansas stone. As I'm honing, I ease the corners of the iron. The slightly crowned edge helps prevent the corners from digging in. I always sharpen several blades at the same time to keep handy.

Because highly figured woods exhibit frequent changes in grain direction, it's helpful to skew the plane, which reduces the shaving width. (For more on this, see *Fine Woodworking* #99, p. 67). Even more important, though, is to vary the approach angle. I get the best results on figured woods by planing in several directions. □

John Henry Harper attended North Bennet Street School and now works wood in Bowie, Md.





Drawing: Matthew Wells

Photo: Susan Kahn

Avoiding tearout in shaping—*The contrast of early and late wood (light and dark bands) form pleasing patterns in this walnut seat. Tischler glued up an odd number of boards, centering one for the pommel. To avoid tearout when shaping the seat, he used a power carving wheel followed by an auto grinder equipped with a coarse sanding disc. Next he removed high spots and tool scratches with a random-orbit sander. After he smoothed the contour with gouges and curved scrapers, he wet the wood for final hand-sanding.*

Jointing—*To minimize tearout, Tischler skewed the board on the left. For the board on the right, he honed a secondary bevel on his jointer knives to handle reversing grain. The tearout above the pencil point occurred before the knives were dressed.*

patterns on the face, edge and ends of a piece. I can also cut shapes into the wood and scrape and sand without fear of going through the veneer. And when I want thick veneer, I just resaw it from stock I have. I rely on several sawyers to get figured wood. Having flitch-cut stock gives me more options because I can select boards that are wider or have a natural edge. I've also learned to pay closer attention to lumber that the sawmills reject. To learn how to "read" the figure of a rough-sawn board, see *FWW* #99, p. 65.

Hand-tool methods

It's not uncommon to encounter highly figured lumber that won't machine well. I often turn to hand tools for flattening and final smoothing. Getting consistent results can simply mean becoming proficient with a tool you're already familiar with. For example, one cabinetmaker friend smooths figured wood using only a block plane (see the box on p. 45). I prefer hand tools when I'm smoothing a knot region (see the box on the facing page). Worked carefully, knot wood can yield highly figured, spectacular wood.

Planing and scraping—Sharp hand tools are essential for working high figure and changing grain. When I'm preparing a surface for a finish, I smooth in several stages, using three of my favorite tools (see the bottom photo on p. 44). First I flatten the board with a Stanley #4½ smoothing plane. To ease my effort, I keep the sole waxed, and I skew the plane. Next I take an old Stanley cabinet scraper (#80) and work in different directions, according to which way the grain runs. Because the face of a figured board can contain substantial end grain, heavy scraping may be needed, especially if the handplane didn't work well. The steep angle of the cabinet scraper blade almost always leaves a silky finish. Finally, I use a Sandvik card scraper to remove tool marks and scratches. I scrape at different approach angles, and I take both short and long strokes. Unlike working veneers where a light burr on the scraper is needed, scraping solid wood calls for a heavy burr. To get this, I use extra pressure when I'm turning the scraper's burr.

Sanding and hardening the wood—On hard, finely textured woods, scraping leaves the wood smooth—with maybe only light sanding required. However, a few figured woods will be fuzzy after scraping, particularly those with wood in tension like curly birch or quilted maple or those with high moisture content. I try aggressive sanding with the grain. I start with coarse paper and work my way up to fine to minimize the scratches.

Another way to deal with surface fuzziness is to chemically harden the problem area ahead of time. I've used everything from shellac and sanding sealers to cyanoacrylates and wood hardeners. Each time I was able to control fuzzy or otherwise difficult grain before scraping. If you use a hardener, first apply some on scrap, so you can check the substance for compatibility with the stain and finish you'll be applying to your project.

Machine methods

Much of the difficulty in machining highly figured wood comes from changes in grain directions. The amount of grain slope greatly affects how a figured board will machine. I always feed stock with the grain running "downhill" (see *FWW* #102, p. 48). But reading the edge grain can be confusing. Many boards want to be fed in two directions. Other boards that should plane well according to the edge grain will chip out severely. And when fed in what should be the wrong direction, the boards plane smoothly. This can happen when the pores of the wood are oriented opposite to the apparent grain.

Safety precautions are important when machining figured woods. Internal stresses in the wood can cause a board to plane roughly, or worse, bind and kick back at the saw or during shaping. Crotch wood will often machine surprisingly easily considering its degree of figure. This is because the grain slopes noticeably. Conversely, straight-grain quartersawn wood that has prominent fleck patterns (oak or sycamore, for example) can be difficult to machine. In this case, the rays are not parallel to the surface, which causes them to chip out easily. I've found it helpful to follow a few basic, but fundamental machining methods.

Use sharp, balanced knives, and take slow, light cuts—According to Ryszard Szymani, director of the Wood Machining Institute, there are several ways to minimize tearout while jointing and planing figured stock: First, make sure the knives are sharp. Sharpness is especially important because part of the cells may be cut against the grain. Second, keep knives properly set and the cutterhead balanced. (For more about this, see *FWW* #103, p. 86). Third, adjust the depth of cut and feed rate according to the wood you're working. In general, take light (not over 1/32 in. deep) passes, and move the stock slowly. A slow, light pass will keep up the cutterhead speed and lessen the chance of the fibers lifting.

Adding a secondary bevel and skewing the work—Another way to reduce jointer tearout is to increase the sharpness angle of the knives by grinding a secondary bevel on them (see *FWW* #102, p. 52). This will give the knives more of a scraping action and lessen their lifting tendency. The board in the photo at right on the facing page shows the improved edge that results. If you add a secondary bevel, remember that this will increase the jointer's feed resistance, and the knives may dull more quickly.

In woods with interlocked grain (elm is a prime example), skewing the work can reduce tearout by increasing the slicing action of the cut. Skewing can be done on both the planer and the jointer. This is effective on curly maple. But with woods whose curl runs diagonally to the edge of the board (curly birch and cherry come to mind), a skewed cut can actually be detrimental. You'll just have to try it on some scrapwood to see what will happen.

Wetting the wood and power-sanding—Another aid to machining difficult stock is wetting the surface between passes. This helps control tearout in bird's-eye figure. The moisture seems to hold the fibers and flecks in place better. This technique sometimes helps when I'm running a board against the direction its grain wants to be fed. I also dampen the wood to raise the grain between sanding stages (see the photo at left on the facing page). Wetting is time-consuming; I only do it when all else fails.

If, after trying all my machining tricks, I'm still getting excessive tearout, I turn to power-sanding—but only as a last resort. Even tiny sanding scratches reduce the wood's reflective properties and thus hide the figure. A belt sander can flatten a board, remove mill marks or do heavy surfacing when the wood doesn't handplane. Power sanding also works in certain shaping operations. If I'm contouring stock with difficult grain, I rely on an auto-body grinder fitted with a coarse (down to 36-grit) disc. I used this technique on the chair seat in the photo at left on the facing page. After working my way up through the grades of sanding grit, I finished with a sequence of random-orbit sanding, scraping and hand-sanding. □

Peter Tischler is a North Bennet Street School graduate who runs a chairmaking and cabinetmaking shop in Caldwell, N.J.

Smoothing knots and filling gaps

Defects in wood can add visual interest to furniture. The best examples I've seen are from the late George Nakashima, who liked to highlight the natural forms in wood by using wavy edges, checks and knots. A while back, I was fortunate to refinish a few of his pieces. Inspired by how he handled defects, particularly knots, I now use some special methods to make a seemingly worthless piece of wood usable.

One problem with knots and their associated reaction wood is the gaps or pithy areas that surround the center (see the bottom photo on p. 44). To stabilize these regions, I first clean out any loose material. Then I fill in the voids and scrape the surface smooth. If the process is done carefully, the repaired area will gain strength, contrast and workability.

Stabilizing gaps and pithy areas: I use the sequence of steps shown in the photos below to repair loose knots. The method also works on cracks and small (vacant) knot holes. First I pound in and glue custom shaped end-grain plugs and wedges into the voids. The wedges match the surrounding wood well because most reaction wood around knots has a high percentage of end grain showing. Next I mix up some sanding dust with five-minute epoxy, and I spread it into remaining gaps.

Once the glue and epoxy are hard, I saw off the wedges. To smooth the repair, I scrape in almost every direction, which addresses the changes in grain. As I'm scraping, I try to repeat the motions that produce the least amount of scratches.

Occasionally, I'll sand difficult spots with medium-grit paper, though this won't leave as nice a feel as scraping. Next I sand with fine paper and burnish with 0000 steel wool. I dust off the surface to see how I've done. Then using alcohol-soluble aniline dye, I touch up the blemishes in the filled areas until I'm happy with the color match. Once the project is completed, I wipe on some finish, usually Danish oil, which brings out the full colors.

I try to keep an open mind when I'm handling defects because I want them to retain an organic look. When I'm willing to put in the effort, I'm rewarded with a surface that shows enhanced figure. —P.T.

Step A: Filling the knot *involves spreading a mix of epoxy and sawdust into the cracks and then driving and gluing in shaped wedges into the gaps.*

Step B: Smoothing the surface *with a scraper blade at various angles all around the knot and its reaction wood shows that the surface is now solid.*

Step C: Oiling the wood *reveals the colors of the repaired areas. Darkening the fillers with dye will finish them to a near perfect match of the knot.*

Approaches for different figures

Wood is not homogeneous. Similarly, every board is unique. Surfaces with high figure and striking grain can be attributed to many factors, the most likely being growth and development of the tree, cellular orientation, color variation and external influences, such as fungi, insect or mechanical damage.

The descriptions here offer at least a partial explanation of how the colors and patterns got there. I've also offered suggestions for working surfaces, though they are not foolproof because each wood can have its own peculiarities. In fact, I'm always refining my approach to working high figure because even the most unusual methods are worth it when I can fully bring out a wood's potential. *—P.T.*

Samples are from the following sawmills: Rob Roth, Verona, N.J.; The Burl Tree, Eureka, Calif.; Randle Woods, Randle, Wash.

Burl (maple) is an irregular growth on a tree caused by mechanical or insect damage. Burls appear as bulges on the trunk. This example shows a burl's cross section. Burl grain is tightly compacted and resembles small bud-like knots. In lumber form, burls are difficult to work and are traditionally cut into veneers or saved for carvers, turners and instrumentmakers. When preparing a burl surface for a finish, use a razor-sharp scraper in many directions.

Quilted (bigleaf maple) figure is formed by crowded, elongated bulges of growth layers. Due to its varying reflectivity, I consider quilted figure to be the most three dimensional. Quilted is mostly found in bigleaf maple native to the Pacific Northwest and in tropical species like mahogany. It often machines poorly, leaving a fuzzy feel. The fuzziness usually does not scrape well. Wetting the wood and reducing the cutting angle are helpful, but sanding through finer levels of grit is generally the most effective. Blister figure, which appears as small, uneven bulges (mostly in maple), works similarly.

Worm wood (silver maple), caused by insect damage, produces striking markings. Species that are prone to burrowing insects, such as silver and red maple and paper and gray birch, exhibit dark streaks (insect tunnels) along the surface. Because the bore holes are usually small, the wood is still usable as long as the insects are exterminated early enough. Beetles, particularly the powder post variety that attack drying lumber, form maze-like patterns in the wood. Careful scraping, sanding and filling should give an acceptably stable and smooth surface.

Ribbon stripe (African mahogany) figure has alternating bands of light and dark fibers caused by spiral growth. Quartersawing is needed to fully bring out the figure. Mahogany, bubinga, sapele and zebrawood are common tropical species with ribbon stripe. Elm is a common domestic hardwood with this figure. Ribbon stripe is difficult to machine cleanly. But taking slow, light passes, reducing the cutting angle and skewing the work can all be beneficial. I often harden the wood with cyanoacrylate and then scrape in both directions. When ribbon stripe is combined with a wavy grain, a mottled figure occurs.

Ray flecks (quartersawn white oak) are caused by long tissue plates (called rays) oriented horizontally in a tree. Quartersawn, species with large rays, such as oak, sycamore, and beech, display highly decorative patterns. Because the ray cells are made up of weaker tissue and because they aren't always in the same plane as the surface, they tend to chip out. Keeping cutting edges, both for machines and hand tools, extra sharp is the best way to minimize chipping.

Photos these two pages: Robert Marsala

Knot and reaction wood (American elm) are caused by growth layers forming over the stem of a branch where it joins the trunk. The resulting changing grain can cause tearout on one side and not the other. But more importantly, there are hazards involved. Because reaction wood is unpredictable and because encased knots can dislodge, machining should only be done with sharp cutters and slow, light passes. This is why I prefer to work knot wood by hand. The knots tend to be hard and brittle, so I try scraping followed by sanding.

Curly (hard maple) figure is caused by the grain undulating at right angles to the length of a board. When light reflects off the surface, the wood appears wavy. Maple is the best known species to have curl, although pockets of curl, especially around knots, can be found in almost any hardwood. Common maple curl varieties include tiger stripe and fiddleback (shown here). Cherry and birch can exhibit broad diagonal curls, which are called flame. I smooth curl with coarse paper on a random-orbit sander or belt sander. I follow this with a scraper that has a heavy burr. If needed, I lightly sand with fine paper.

Spalted (beech) wood has a bold appearance, and it occurs in species that are prone to fungi attack, such as birch, maple, beech, poplar and red oak. In the initial stage of decay (before the wood becomes punky), dark stain lines form. Spalted wood works according to how much decay has taken place, and it must be surfaced before too much rot occurs. Areas surrounding the spalted area can be spongy, and they won't machine or finish evenly. Expect a large amount of waste to get enough usable, attractive wood. I work spalted wood much the same way I do worm wood.

Bird's eye (hard maple) figure is caused by localized indentations of the annual growth rings. I've seen bird's-eye figure in cherry, poplar, walnut and pecan, but the figure is most common in maple. Because the bird's eyes' dense, distorted fibers intersect perpendicularly to the boards face, they are prone to tearout. Wetting the wood between light, slow passes helps, as does reducing the cutting angle of the knives. Bird's eye usually scrapes well. To improve finishing, I use grain fillers or seal with shellac or lacquer. Applying several coats of finish and rubbing between coats is also helpful.

Crotch wood (black walnut)—Crotch wood occurs where two major branches of a tree meet and cause the cells to crowd and twist. The figure ranges from dramatic swirling patterns when sawn near the outside of the tree, as this V-shaped piece shows, to feather-shaped markings when cut through the center. Stump wood, sawn from the butt of a tree, will have figure similar to crotch when the outside of the stump is irregularly shaped due to the roots. Surprisingly, stump and crotch wood usually machine cleanly. Avoid using coarse sandpaper because the resulting scratches are difficult to remove.

***Clamping up a large carcase** is much easier with the author's carcase-press clamping system than with ordinary pipe or bar clamps. The press consists of two units, each of which is made of four veneer-press screws, a couple of lengths of heavy metal strapping, a few board feet of hardwood and a handful of nuts, bolts and washers.*

Dovetailing Large Carcases

Dedicated bench and clamping system simplify and square the work

by Charles Durham Jr.

I made my first dovetailed carcase with wide pine boards salvaged from the original kitchen in my first house. Dry, flat and wide, those boards became a wonderful blanket chest. Since then, much of the lumber I've used on large-carcase projects has been less than ideal. Wide, flat and dry are more the exceptions than the rule, whether you use naturally wide boards or glue narrower stock to width. When wide boards are cupped, twisted or both—even a little—making dovetails that fit well is tough. Yet accurately fitted and squared dovetail corners are crucial to the success of large projects like blanket chests, highboy tops and slant-front desks.

The other problem with large-carcase projects is the glue-up. Even if you've cut good, accurate dovetails, gluing and clamping big boards can be a real headache or, worse, result in a flawed project—especially if you work alone, as I usually do. Having the pipe clamp I just tightened fall off and dent the carcase as I tighten the next clamp is just one more hassle than I need.

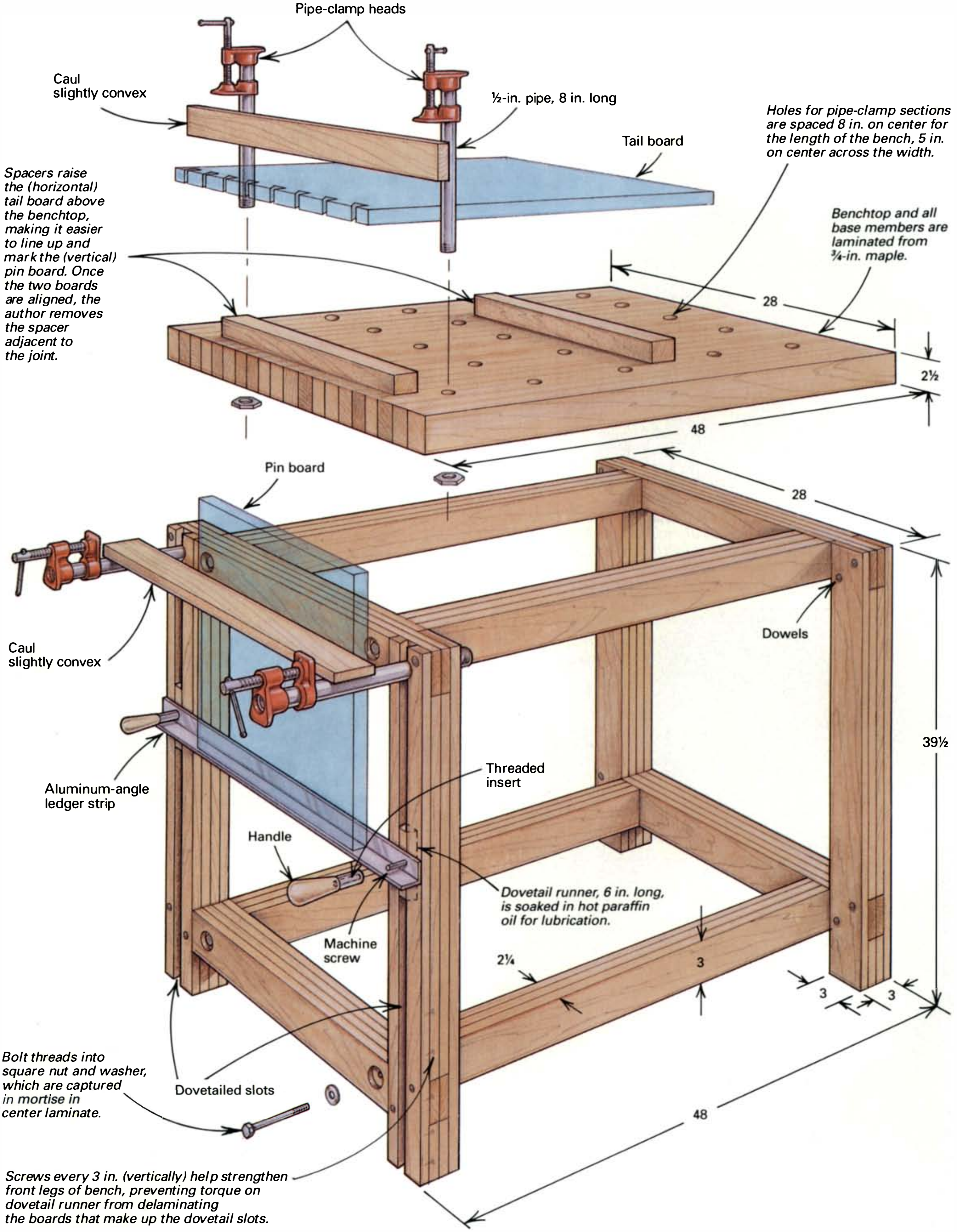
I solved both problems by building two assemblies: a dovetailer's bench to hold the boards flat, secure and indexed for accurate layout and cutting (see the drawing on the facing page and the photos on p. 52) and a carcase-press clamping system to help me close wide joints with uniform pressure, without having to wrestle an armload of clamps (see the photo above). Material for both is available at any good lumberyard, and you'll find all the hardware you need either at your local hardware store or through mail order. Total cost for materials was about $300, with lumber being the most expensive item. By substituting construction lumber for the hard maple I used, you could halve that amount.

Dovetailer's bench

The problem with laying out and cutting dovetails on a typical cabinetmaker's bench is that most benches are about 32 in. off the floor, which constrains you to narrower carcase work. To do bigger jobs on an ordinary bench, you have to jury-rig a support and clamp system to hold things flat and steady at the right height while you mark, saw and chop. My bench is a large, elevated clamping device that lets me overcome warp on wide boards, allowing me to dovetail the largest boards with ease and precision. The bench's working surface is at elbow height: 42 in. off the floor, which is long enough for the longest pin member I'm likely to encounter.

Photos: Vincent Laurence

Dovetailer's bench



Drawing: David Dann

The deepest carcase I would ever dovetail is about 25 in. So I added space for the clamp heads (see the drawing) to establish the benchtop's width of 28 in. A 72-in.-wide breakfront was the longest project on which I saw myself using the bench, so I decided to make it a bit more than half that length (48 in.) to keep that breakfront's top and bottom from falling off.

I use pipe-clamp heads to hold boards in place (see the top photo on this page) and cauls extending across the bench's width to take out any warp in either board. An aluminum angle that raises, lowers and locks with a twist of the wooden handles serves as a ledger strip for the pin member (see the drawing on p. 51).

I cut dovetails in a fairly conventional manner, but with a couple of twists. I lay out the tails first, using a sheet aluminum template I made for the purpose. Then I saw to the line with a Bosch barrel-grip jigsaw and chop the waste out on my dovetailer's bench. The jigsaw is so much faster and is at least as accurate (probably more so) as cutting with a backsaw. I mark the pins from the tails, aligning the tail board on the benchtop with the pin board on the aluminum ledger, using a chisel and mallet to transfer lines (see the bottom photo on this page). A light, clean rap ensures a sharp line with no chance of following the grain, which can happen when marking with a knife. Again, I use the jigsaw, this time with its base set at approximately 14° (from a bevel-square set on the tail board) to cut to the line and then chop out the waste on the bench. The fit I get with this system is nearly perfect.

***Marking tails**—The author uses an aluminum template to mark out the tails on the side board of what will be a mahogany blanket chest. The short sections of pipe clamp at the front of the dovetailer's bench ensure the board remains flat for an accurate layout.*

***Marking pins from tails** is more certain with a chisel than with a knife because there's no danger of the chisel following the grain. It's important, though, to make sure the chisel is absolutely perpendicular to the surface of the board you're dovetailing.*

Carcase press

My carcase press will close any size project I'll ever build and will do it in much less time than it takes with loose clamps. With the time saved, I can close the joints correctly before the glue grabs. The only fixed dimension is its internal working height—enough to take those 25-in. boards I produced on the bench. The carcase press consists of a pair of clamping frames made of maple laminations and pre-punched, galvanized steel strapping. The head member of each is fixed and has veneer-press screws mounted to it. (Veneer-press screws are available from Constantine, 2050 Eastchester Road, Bronx, N.Y. 10461; 800-223-8087.) A foot member moves along the galvanized strapping to accommodate carcases of various widths. The clamping frames can themselves be positioned as near or far from one another as need be (see the photo on p. 50).

At each end of the maple laminations, I made a sawcut precisely as deep as the strapping is wide and drilled holes for the bolts that connect the wooden end pieces to the metal strapping. The straps I use are 60 in. long, but they're available in virtually any length. Smaller wooden cauls ride on the strapping to transfer the clamping force from the press screws to the carcase. Ideally, the clamping force should bear directly on the corner of the carcase, but I find that placing the force just inside the joint, right on the baseline, works just as well. With the 8-in. press screws and this setup, there's a range of about 4 in., fully opened to fully closed.

The elimination of loose clamps is the major benefit provided by the carcase press. Instead of watching and worrying about clamps falling off, I can monitor the joint. But there's another advantage. Quite often, clamping a project together forces it out of square in one plane or another. With loose clamps, the unending adjustment required to restore squareness can be maddening. None of that has been necessary since I began using the carcase press.

Moreover, when using loose clamps, if a carcase winds (so that diagonal corners are high), there's nothing you can do with ordinary clamps. With the carcase press, I just wedge shims between press and carcase in the high corners, and it's flat again.

In using the carcase press, I work at table height on a sheet of laminate-covered particleboard. Because the bottoms of both clamping frames that make up the press are square, they stand upright on their own, making it easy to slide the carcase into the press. I get the joints just started outside the press and then place it inside and dry-assemble the carcase. Only after checking to see that everything's going to close up properly do I apply glue and clamp the carcase for good. □

Charles Durham is a professional woodworker in San Clemente, Calif.

Toolbox Tours de Force

Tool-storage solutions show style, ingenuity

by Vincent Laurence

***Convenient access to their tools** was a prime design consideration for Herbert Buchalter and his son Sanford of Freeland, Mich. Father and son share a shop and tools. The younger Buchalter, a professional furnituremaker, built the cabinet for his dad, though it's the son who gets the most use of it.*

To many woodworkers—even some of the best—a simple, unprepossessing plywood box, biscuit-joined together, is perfectly satisfactory for tool storage and organization. The materials and construction are in keeping with the function of the box—after all they're just tools, right?

Other woodworkers see things differently. To them, the toolbox, though still primarily functional, must also be beautiful, something that affirms why they do what they do, day in and day out. Many of these woodworkers also see their toolboxes as three-dimensional portfolios on view for prospective clients, testifying to the skill of the maker.

When we asked readers to send us photos of their toolboxes in "Editor's Notebook" (*FWW* #100), we weren't disappointed. From the more than 30 boxes, chests and wall cabinets readers sent photos of, we selected nine of the finest (including the one on the cover of this issue, which is described on p. 4). □

Vincent Laurence is an associate editor of Fine Woodworking.

Photo: Jonathan Binzen

This traditional 19th-century-style chest *(above) houses over 400 tools, weighs more than 300 lbs. loaded with tools, and took its owner, Tony Konovaloff of Bellingham, Wash., nearly 200 hours to make. Konovaloff, a professional furnituremaker, uses hand tools exclusively, so his entire shop is in this chest. The Latin phrase carved into the lower rail of the lid means "Art is long, life is short."*

"A place for everything and everything in its place," *one of the Shaker creeds, might just as well describe Konovaloff's attitude toward tool storage. Every tool has a specific location that it fits precisely, thus keeping the box neat and the tools accessible (inset).*

With the inside of its lid flipped down, *Konovaloff's box reveals its collection of saws and extra blades (right).*

Photos except where noted: Vincent Laurence

Photos left and right: Jonathan Binzen

Steve Johnson's mobile tool chest *was built to withstand the abuse of bouncing over cracked concrete as it is rolled around a factory (he's a professional tool-and-die maker). Built of solid walnut and designed much like the automotive tool chests he was used to, the drawers on his chest glide on full-extension, 100-lb. slides and are attached to an internal carcase of ¾-in. particleboard. Overall weight for the chest, without any tools in it, is about 215 lbs. (including a 60-lb. granite surface plate mortised into the top). The machinist's-style box on top of the chest doesn't travel with the larger chest, but is a good companion in the shop.*

Photo: Alec Waters

Case for an "artist"*—Tired of being told, "Hey buddy, use the freight elevator" every time he ventured into a high-rise apartment building for an installation, cabinetmaker Eric Sheffield traded in his old toolbox for the Gibson guitar case you see here. It holds an incredible number of tools—over 40 lbs. worth—and now, according to Sheffield, he's "accorded the respect a true artist deserves."*

***Being able to see his tools** and get to them easily was a priority for furnituremaker Greg Radley of Ventura, Calif., when he started designing this tool chest. Radley's solution was this chest-on-trestle with a utility cabinet tucked into the trestle below. The trestle and all frame components are solid ash, the panels are solid mahogany veneered with curly European ash and the interior partitions are all mahogany.*

Four-part portability—*"If I can't move it, I can't have it" is the imperative that guided the design of Harold Purcell's toolbox (right). His solution, a maple base and three stackable, cherry and mahogany boxes, provides Purcell with convenient access to his tools as well as a fair measure of visual and tactile satisfaction.*

Tim Kimack's veneered, inlaid and entirely handmade tool chest *(below) makes a fine home for his collection of antique and owner-built tools. Kimack, a finish carpenter and furnituremaker in Simi Valley, Calif., put over 400 hours into the chest, calling it "definitely a labor of love."*

Two for the road—*Like many an idealistic young woodworker, David Sellery of Santa Cruz, Calif., had visions of Krenovian masterpieces dancing in his head when he first started working wood. Years later, he found he had built a few more kitchen cabinets than he'd preferred just to pay the bills. But Sellery made the time to build this pair of carpenter-style toolboxes to remind him of why he first started working with wood. Though almost jewel-like in their detail, they're sturdy, functional and see daily use on the job site with no apparent ill effect.*

Plastics in the Woodshop

Choosing and using a versatile material for jigs and other applications

by Jeff Kurka

What's an article about cold, hard plastics doing in a woodworking publication? Plastics and wood may have very little in common, but it's the differences that complement each other. Primarily used for jigs and fixtures, as shown in the photos on these two pages, these materials enable woodworkers to develop more professional and more durable shop tools and apparatus. Plastics have a high strength-to-weight ratio, they are relatively hard and smooth, and they will far outlast wood when used as bearing or guide surfaces. Most plastics are extremely stable, being unaffected by moisture and only slightly affected by extreme temperature changes (about .0001 in. per degree C). Many plastics are easily worked on regular woodworking equipment and can be fastened chemically or mechanically. Some plastics even can be heated and reshaped around simple forms or patterns. And because plastics are available in a wide range of sizes (thicknesses, lengths and widths), shapes (round or square rods, sheets, blocks or tubes), colors and opacities, finding the right plastic is relatively easy.

There are five types of plastics that have found uses in my shop; acetals, acrylics, polycarbonates, polyethylenes and phenolics (see the photos on these two pages). Although the machinery and cutting tools to work these plastics may be familiar to you, the reaction of the plastics to machining may not be; therefore, it's important to understand the characteristics of each plastic to ensure quality parts and safe operating procedures.

Acetals

Acetals are part of the thermoplastic family (synthetic resins that soften or fuse when heated and harden again when cooled). Developed by Du Pont under the product name of Delrin, acetals are the toughest and most resilient of the thermoplastics.

High in tensile and compression strength, acetals are dimensionally stable and also slippery. Because they are almost impervious to solvents, they are impossible to glue together, but they take and hold screws much like metal.

Acetals' slippery nature and durability make them ideal for rollers, bearings, bushings or guide bars to ride in a tablesaw's miter slots.

Acrylics

Another kind of thermoplastic, acrylics are more familiar by their trade names, Plexiglas and Lucite. Although available in a variety of grades, I've found the standard grade to be sufficient for most shop applications. Acrylics are dimensionally stable and extremely rigid but brittle. They have

***A myriad of plastics helps woodworkers make better jigs**, fixtures and shop-built tools. From left: Slippery acetals make good bearing surfaces; rigid and clear acrylics are handy for templates; the impact resistance of polycarbonates protects you as machine guards; polyethylenes are tough and slick and great for sliding parts; and rigid and strong phenolics have no peer for table-mounting routers.*

Photos except where noted: Charley Robinson moderate-to-high impact strength, which can be increased by bending and forming them into curved shapes.

Acrylics have high optical clarity and transmit 3 to 5% more light than standard plate glass, but they scratch easily.

Acrylics can be chemically bonded by solvents or polymerized cements and mechanically fastened by a variety of means, but care must be taken when tapping or threading because the material is brittle.

Acrylics' optical clarity and rigidity make them well-suited for router baseplates, machine guards and parts templates.

Polycarbonates

Polycarbonates, such as Lexan, are often confused with acrylics and actually have some similarities; however, there are many notable differences. Polycarbonates are virtually unbreakable with an impact resistance 250 times greater than glass and 30 times greater than acrylic. Optical clarity is high, but dimensional stability is only fair due to their tendency to absorb moisture. Polycarbonates are approximately 20% more flexible than acrylics and may sag under a constant load (such as a table-mounted router).

Polycarbonates can be fastened chemically with solvents or mechanically with a variety of fasteners.

Shop applications are similar to those of acrylics, but the greater impact resistance of polycarbonates makes them particularly suited for machine guards.

Ultra-high molecular-weight plastic

Ultra-high molecular-weight (UHMW) plastic is a member of the polyethylene family and has superior physical and mechanical strength. UHMW is more resistant to abrasion and chemicals than stainless steel, it's slipperier than plate glass and it's relatively unaffected by moisture. Although UHMW can experience an expansion or contraction rate of almost ½ in. per 8 ft. at a 50° temperature swing, it's acceptably stable when mechanically fastened in place. UHMW also exhibits a moderate-to-high impact resistance. Although UHMW is a thermoplastic and will start to soften at around 170°F, it cannot be heated and reshaped.

UHMW can be machined with many traditional woodworking machines and tools and holds threads well for mechanical fastening. It cuts well on the tablesaw, but the shavings are fine and feathery and cling annoyingly to everything. UHMW can even be thickness-planed with excellent results.

UHMW also is available as tape in a wide

***Plastics in the shop**—Although this is a woodworking shop, plastics play a vital role, from holding workpieces in place, guarding cutting tools and guiding crosscut boxes to mounting routers and providing work surfaces. No shop would be complete without these handy materials that can make your shop-built tools more professional.*

range of thicknesses and widths. As solid stock or tape, UHMW is great for adding slippery, tough surfaces to sliding parts on jigs or fixtures, as drawer glides or as skid plates on cabinetry.

Phenolics

Phenolics, also known by the trade name Micarta, are of the thermosetting family and thus become permanently rigid when heated or cured. Phenolic resins, silicones, melamines and epoxy resins are formulated in various combinations and then reinforced with paper, canvas, linen and glass to create the various grades available. Applications of the grades (too numerous to mention here) are broken down into either electrical or mechanical. I've found a general paper/mechanical grade to be more than adequate for my woodworking applications, but you might consider a cloth/mechanical grade if your application requires close tolerances on small parts such as gears or pinions.

Phenolics are among the hardest of the plastics and rate high in impact and compressive strength and dimensional stability. They are extremely rigid and will bend or stretch very little before breaking; however, thickness tolerances can vary as much as .015 in. in a 36-in. span.

Phenolics can be fastened using two-part epoxies or many mechanical fasteners. They tap fairly well, and the threads will stand up to normal use. For repeated use, you should use brass inserts.

Phenolic's strength, stability and rigidity make it a good metal substitute in many applications and an excellent choice for table-mounting routers and router subbases.

Machining plastics

The plastics that I've been discussing can be machined on a variety of woodworking equipment: tablesaws, bandsaws, scrollsaws, drill presses, sanders, pin routers, router tables and, in a few cases, jointers and planers. Portable power tools and hand tools round out the list.

In general, tools should be operated at high speeds with moderate feed rates. The rpm of most power tools, such as tablesaws and routers, is acceptable for machining plastics. Drill press rpms can and should be varied to match their particular tooling or operation and will be dealt with when I discuss the drilling techniques.

Heat buildup is the biggest enemy to a good cut. Coolants, such as water or air jets, can be used to reduce heat, although for short runs, they are rarely necessary with sharp tools and proper feed rates.

Feed rates vary slightly depending on the material and the thickness of material being cut. A good starting point is 2 in. to 3 in. per second. Watch the point of the cut, and look at the resulting finish. Too slow and the plastic becomes gummy and sticks to the blade, especially with thermoplastics like acrylics and polycarbonates; too fast usually results in crazing and chipping of the plastic because the cutting tool loads up. With plastics such as acrylic, polycarbonate, acetals or polyethylene, the cutting tool tends to grab the material, and your edge finish will be poor. The cut will sound raspy rather than smooth and clean. On a hard material like phenolic, the plastic may actually climb the sawblade and kick back, especially with a tablesaw. Listen and look at what the tools are telling you, and with a little practice, you'll soon develop the proper feed rate for each type of plastic.

***Plastics for jigs and fixtures**—A shop full of accessories can be built with plastics. Clockwise from the bench vise: a mortise jig, a router subbase, a dovetail fixture, a featherboard, a hinge jig, a router-bit guard, hold-down clamps and a router-bit setting gauge.*

Safe working practices

Some of the acrylics, polycarbonates and a few phenolics can release mild concentrations of chemical vapors while being machined. Prolonged exposure can cause eye and respiratory irritation, headache and nausea. Because exposure is limited, this shouldn't be a problem, but there are precautions you can take.

Heat buildup when machining releases vapors, so air jets directed at the point of machining help cool the plastic and slow the release of vapors. Also, air jets help cool the cutting tool and blow away chips, shavings and vapors. Dust collection helps stop the plastic dust from becoming airborne. Finally, as is the case when cutting wood, adequate shop ventilation, suitable dust masks, machine guards and safety glasses will go a long way toward making your plastics experience a pleasant one.

Rough-cutting

I've found it best to rough-cut plastics slightly oversized and then machine to the finish size, usually with a template and router. I rough out straight cuts on the tablesaw and curved or irregularly shaped cuts on the bandsaw.

The ideal tablesaw blade for all plastics (except phenolics) is an 80-tooth, carbide, triple-chip design, which will give you the smoothest cut and the longest blade life. An 80-tooth, carbide, alternate top bevel (ATB) blade, either crosscut or plywood style, is a good alternative for the occasional user. I raise the blade about ½ in. above the plastic to help reduce the heat.

Phenolics present special problems because they are so hard. An 80-tooth, carbide, ATB crosscut blade is okay for occasional use, but repeated cuttings will quickly dull this blade. A better choice is an 80-tooth, carbide, triple-chip design with negative hook: It's not as aggressive as standard wooden blades. Raise the blade only about ⅛ in. above the material, and feed as rapidly as possible without forcing the phenolic through the blade.

Bandsawing acrylics, polycarbonates, acetals and polyethylene up to ½ in. thick is best done with a ⅛-in.- to ⅜-in.-wide blade with 10 to 14 teeth per inch (t.p.i.). I use the smallest blade that still gives a good cut because the wider the blade, the greater the heat buildup. Periodically, clean your bandsaw's wheels; plastic sawdust quickly builds up on the rubber wheels and can affect blade tracking. The same rules apply to bandsawing phenolics except you'll get a better cut from a blade with 4 to 7 t.p.i.

Sabersaws also can rough-cut plastics, but you must support the material as closely as possible to the cut to prevent cracking. A ¼-in.-wide, 10- to 14-t.p.i. blade should give good results.

Routing

Just as when routing wood, it's best to make your rough cut within 1/16 in. to ⅛ in. of the finish line, and then use the router either freehand or in a table for a final trimming cut. Although router bits can safely and effectively cut up to 25% of the diameter of the router bit, the less you trim, the smoother the finish will be.

I prefer a high-speed-steel spiral bit for edge-trimming acrylic, polycarbonate, acetals and polyethylene; its shearing cut yields the cleanest edge. Two-fluted, carbide-tipped bits, both straight and spiral, with and without bearings, also work well with these plastics. Spiral end mills can be used when cutting slots.

As a general rule, use the largest diameter bit that your work will allow. I try to use at least a ½-in.-dia. bit whenever possible to reduce chatter. For smaller bits, slow the feed rate to allow adequate chip clearance.

The hardness of phenolics restricts you to carbide-tipped bits. Be extra careful when using a carbide bit smaller than ⅜ in. dia. Small bits are commonly solid carbide, which is brittle and will snap easily.

When trimming phenolics, rough-cut as close to finished size as possible. A heavy cut in phenolic will cause the bit to grab with enough force to tear the workpiece from your hands. When template-routing, start your cut in the middle of a straight section, feed slowly with a good grip and you'll get good results.

For interior cutouts in any plastic, it's best to cut away the waste just as for an outside cut. I don't recommend plunge-cutting because the bit tends to grab the waste piece and throw it out violently. Slots can be cut by drilling a start and stop hole and then routing through the plastic in a series of passes.

I cut sliding dovetails or T-slots by first wasting as much material as possible with a straight bit or with the tablesaw. Then the dovetail or T-slot bit is making only a cleanup cut, which reduces heat buildup and bit loading and leaves a cleaner slot.

Drilling

When drilling, remember excess speed causes excess heat. Follow the recommended rpm for the type of drill bit you're using. As a general rule, thicker plastics will require slightly slower speeds.

High-speed-steel twist bits will work on all of the plastics in this article. Drill press speeds of 700 rpm to 1,000 rpm deliver good results when drilling acetals and polyethylenes, but 300 rpm is best for acrylics, polycarbonates and phenolics.

A bit with a 60° angled point (see the photo at left), produces better results on acrylics and polycarbonates, and you can bump the rpms to 1,500-2,000. Carbide-tipped bits work much better when drilling phenolic.

For clean holes with no chipping, use a wooden backing board. To protect your hands, always clamp the workpiece down. Use a slow, even feed rate, and back out of the hole often to reduce heat buildup and to clean the bit.

Photo: Vincent Laurence

***Drilling acrylics or polycarbonates—** A regular drill bit run at 300 rpm will work in acrylics and polycarbonates if you back it out frequently to clear chips (left hole). For higher speed production work, a special bit with a 60° point works best (right hole).*

Sources of supply

The following companies, most with branches throughout the United States, offer a wide variety of plastic products. Some of the branches may carry inventories of cutoffs for filling smaller orders. Also, acrylic and polycarbonate plastic are often available through glass dealers or large hardware stores.

AIN Plastics, Inc., PO Box 151, Mt. Vernon, NY 10550; (800) 431-2451

Cadillac Plastic and Chemical Co., 143 Indusco Court, P.O. Box 7035 Troy, MI 48007-7035; (800) 488-1200

Commercial Plastics and Supply Corp, 98-31 Jamaica Avenue, Richmond Hill, NY 11418; (718) 849-8100

Cope Plastics, Inc., 4441 Industrial Drive, PO Box 129, Godfrey, IL 62035-0129; (800) 851-5510

United States Plastics, 1390 Neubrecht Road, Lima, OH 45801; (800) 537-9724

Sanding

Machine sanding with 100-grit to 120-grit paper is okay for roughing plastics to size, but remember to use a light touch and back away from the abrasive often to avoid distorting the edge.

After machine-sanding, hand-sand, starting with 280-grit paper and ending with 600-grit to leave a smooth edge without any sanding marks. If desired, edges could be polished with rouge and buffed.

Gluing

Acrylics and polycarbonates are easily glued together with a methylene chloride-based solvent that breaks down the plastic and fuses the pieces together. If you're joints are tight-fitting and clean and you follow the manufacturer's instructions, you can get almost invisible joints.

Acetals, polyethylene and phenolics are not easily glued, and stronger bonds are possible mechanically.

Tapping and threading

All of the plastics can be successfully tapped and threaded, but take extra care when working with acrylics because they are a little brittle. Use a national coarse thread (it holds better than a finer thread). Wax lubricant on the taps and dies aids the cutting operation and leaves the threads cleaner and more transparent. Backing out of the cut often will clear the chips and improve the quality of the threads. Finally, if you are tapping a hole drilled into the edge of the plastic, clamp the edge in the jaws of a vise or hand-screw clamp to reduce the chance of cracking. □

Jeff Kurka designs and builds custom furniture and works plastic in Davenport, Ia.

***Symmetry and subtle shadow lines** give Patrick Warner's maple and yellow satinwood office credenza a dynamic visual rhythm. The same piece could serve as a buffet or as a case for audio and video equipment.*

A Stylish Credenza

Versatility and detailing make this chest attractive

by Patrick Warner

Credenza, the Italian word for sideboard, has come to mean a low, lateral piece of office furniture for storage. I designed the credenza shown in the photo above for my office at home, and its dimensions and organization reflect that. It's fairly shallow because I couldn't afford to lose much floor space in my small office and because I don't like deep shelves—you can never get to the stuff at the back. Its top is counter height: I wanted to be able to work at it standing up sometimes. I chose sliding doors for the piece because of the tight quarters and because I like to roam around on my castered chair and don't need more obstacles. But part of the piece's beauty is that all these elements are adaptable to your own situation and so is the overall function of the piece.

Options and adaptations

Though I built my piece as a credenza, you could just as easily call it a buffet, and use it in the dining room to store china and silverware. In that case, you might add a bank or two of drawers. And the doors, two or three as you wish, could be mounted on hinges or pocket-door hardware.

You could also easily move the piece into a living room, and use it to house audio and video equipment. The center section could have a swiveling television slide installed and a drawer or two could be added at the bottom of the side sections for tapes. In this arrangement, tambour doors would be an apt solution. They could be made as a pair that wrap laterally and meet in the middle or as three separate doors that track vertically.

If you wanted to use the cabinet as a display case, you could fit it with glazed doors, glass shelves and, possibly, a glass top. In this arrangement, you might want to make shallow, tray-like drawers, or simply install bottom-mount drawer slides on the shelving. And interior lighting might also be in order (for more on cabinet lighting strategies and hardware, see *Fine Woodworking* #101, p. 82).

Photos: Kevin Halle

Joinery decisions

Once I'd resolved the configuration and dimensions of my credenza, I set to work on the anatomy—what the parts would be and how they would be joined. Whenever I build a piece for myself, I view it as an opportunity to experiment, so I tested a number of ideas in this credenza that had been brewing as I made furniture for less indulgent clients.

I decided early on that the whole thing would be solid maple with a top and accents of yellow satinwood. I planned a fairly simple box carcase lifted off the ground by a separate and removable base. I hoped the base would lend the piece an airy feeling and avoid the impression of immovable weight that such office furniture often gives. I knew that the case inevitably would be dragged across a few floors, so I designed the base to be strong, though light, joining its legs and rails with dovetail tenons reinforced with machine-threaded knockdown fittings and hardwood corner braces, as shown in the drawing on p. 65.

For aesthetic reasons, I wanted the sliding doors in the same plane. So I left the center section of the case open to give the doors a space to slide into. I also decided to run the doors on a removable track. They would be installed with the track, avoiding the usual loose fit of sliding doors and the wide clearance required at the top to lift them out. The doors could be removed by unscrewing the track and sliding it out.

I chose a two-stage joinery method for the corners of the carcase. In the first stage, I joined the sides and subtop and bottom with tongue-and-groove joints across their full width. After the carcase was together, I routed out wedge-shaped recesses with a dovetail bit and filled them with yellow satinwood, as shown in the drawing on p. 65. I make the recesses and the loose wedges with mating router templates. These floating wedges have the appearance of dovetails, and the joint is nearly as strong. I used the technique in a spirit of adventure to explore the decorative advantages it offered, and I certainly didn't exhaust them. You could also use any carcase joinery you like on this piece, from true dovetails or finger joints in solid wood to the range of possible joints in plywood or medium-density fiberboard.

I wanted to leave the back of the case largely open but give the piece resistance to racking stress. So I made a frame at the back of 2½-in.-wide members joined to each other with half-lap joints and to the case with a tongue and groove (see the bottom photo).

For the vertical dividers, I chose tongue-and-groove joints for the subtop and bottom with the tongues stopped so they wouldn't show at the front. There's no real glue surface on this joint, so I screwed the dividers in place with #10 twin-thread screws driven through the subtop and bottom. These wonderful screws contradict the old saw about not screwing into end grain: They get great purchase in a hardwood like maple.

When it came to the subtop and the bottom of the carcase, I looked for a way to make them that would simplify the glue-up. Instead of edge-joining them into panels and proceeding in the usual way with an increasingly frantic case assembly, I chose to install them as slats. I machined tongues and grooves along their edges and tongues on their ends and dadoed them to accept the tongues of the vertical dividers. When it came time to assemble, I first joined the sides, the back frame and the rearmost slats of the subtop and bottom. Having only an open frame for a back greatly simplified the clamping. And once that initial assembly was clamped and squared up, I could then insert the rest of the slats at my leisure. A rare, tension-free glue-up.

The top went on when the case was finished. I made it of yellow satinwood and attached it with screws through the subtop.

***Angled forms play off straight lines**—Floating dovetail wedges, tapered muntins and recessed triangular handholds form a subtheme in Warner's rectilinear composition in lines and planes.*

***Around back**—A half-lapped open frame is all the back the cabinet needs. It is tongued around its perimeter and glued into a groove in the carcase. The back affords excellent clamp access during glue-up.*

Details, details

With all the decisions made regarding configuration, dimensions, materials and joinery, it might seem that the design process was at an end. But to me, one of the critical aspects of any piece of furniture is the detailing. Those subtle details are telling, particularly in a piece like this one that I had decided to leave unfinished (see the story on p. 64). In a piece that's been filled or stained and lacquered, the grain and color of the wood can leap out at you and carry a plain design. But when the wood is left unfinished, it mellows and recedes. I wasn't out to do anything startling, just to use what small devices I could to tie the piece together visually as well as structurally.

How thick is that? You could make this credenza using ¾-in. material for nearly all the parts. In a dim room, it would be hard to tell yours from mine. But when light hit the two credenzas, they'd look quite different. I constantly play with thicknesses of material. Variations of as little as 1/32 in. between adjacent boards can be perceived. I made the top and subtop each a shade under ¾ in. and did the same for the bottom and the door track. I made the sides 13/16 in., so they didn't seem too skinny by comparison with the doubled elements at the top and bottom. I used 5/8 stock for the dividers to show that their structural role is subordinate to the sides. There are no strict rules governing the thicknesses of different elements, but if you play around with the size of parts, you'll find the overall appearance of the work can be subtly controlled.

Proud of it—Varying thickness is also useful in parts that are viewed face-on rather than from the edge. On the sliding doors, I made the stiles 1/16 in. thicker than the rails, leaving them proud in the front. This slight variation in the plane of the door frames acknowledges the joint line and distinguishes the separate parts of the frame. I inset the panels 1/16 in. from the rails to create a third plane. And at the center of the panels, I used a false muntin of yellow satinwood as an accent, which stands proud of the panel by a bit less than 1/16 in. If these offsets were greater, the door might begin to seem fractured, but because they are only slight, they add visual nuance without attracting too much attention.

Shadow lines and shallow grooves—Shadows can be used like a pencil to vary the weight of the lines in a piece of furniture, to interrupt a featureless surface or to outline and highlight a part or detail. As with the varying of thicknesses, the use of shadows can be overdone and requires careful control.

I created a reveal around the floating panels in the sliding doors to underscore the distinctness of the panel and the frame. The reveal is 1/4 in. deep, and the shadows are dark. Shallower grooves cut to either side of the false muntins create a softer shadow and, therefore, mark the tapered shape with lighter emphasis. In the center section of the case, I created a shadow line with a chamfer at the back of the vertical divider where it meets the back frame. This balances the gap shadow between door and divider and picks out the divider as a discrete part (see the photo on p. 62).

The boldest shadow line in the credenza is the one between the bottom of the case and the front rail of the base. I dropped the rail to create this line, intending it to signify the functional separation between the carcase and the base. I've always liked the idea of making the base of a case piece look like a pedestal and tried to carry it out in this design. But I didn't want the two parts to be unrelated, and that led me to introduce several other details.

I had routed 1/8-in. grooves across the rails of the doors, and I echoed these on the base with the pair of grooves in the front rail. I hoped these grooves, with their lateral sweep across the length of the piece, would tie the three sections of the carcase together.

The leg design also was intended to relate the base to the carcase. I borrowed the tapered form from the false muntins and emphasized it (while breaking up the legs' blockiness) with grooves parallel to the tapered edges.

A curve or two for contrast—As I was finishing up, I saw that virtually all the lines in the credenza were rectilinear. Because the top was of contrasting material anyway, yellow satinwood to the maple of the base and carcase, I decided to express the distinction between them a little further by arcing the ends of the top and rounding over the edges. I cut the arc on an 8-ft. radius with a router and template and the roundover with a router and a 3/8-in. roundover bit. I used the same bit to round over the front edges of the shelves to give them a visual link to the top. □

Patrick Warner manufactures the Warner router base, reviewed in Fine Woodworking *#101 p. 34, and teaches woodworking at Palomar Community College in San Marcos, Calif.*

A case against the finish

Complete but unfinished*—Fed up with finishing, the author never flowed finish onto his credenza. Two years later, the maple and yellow satinwood have taken on the subtler tones time gives to bare wood.*

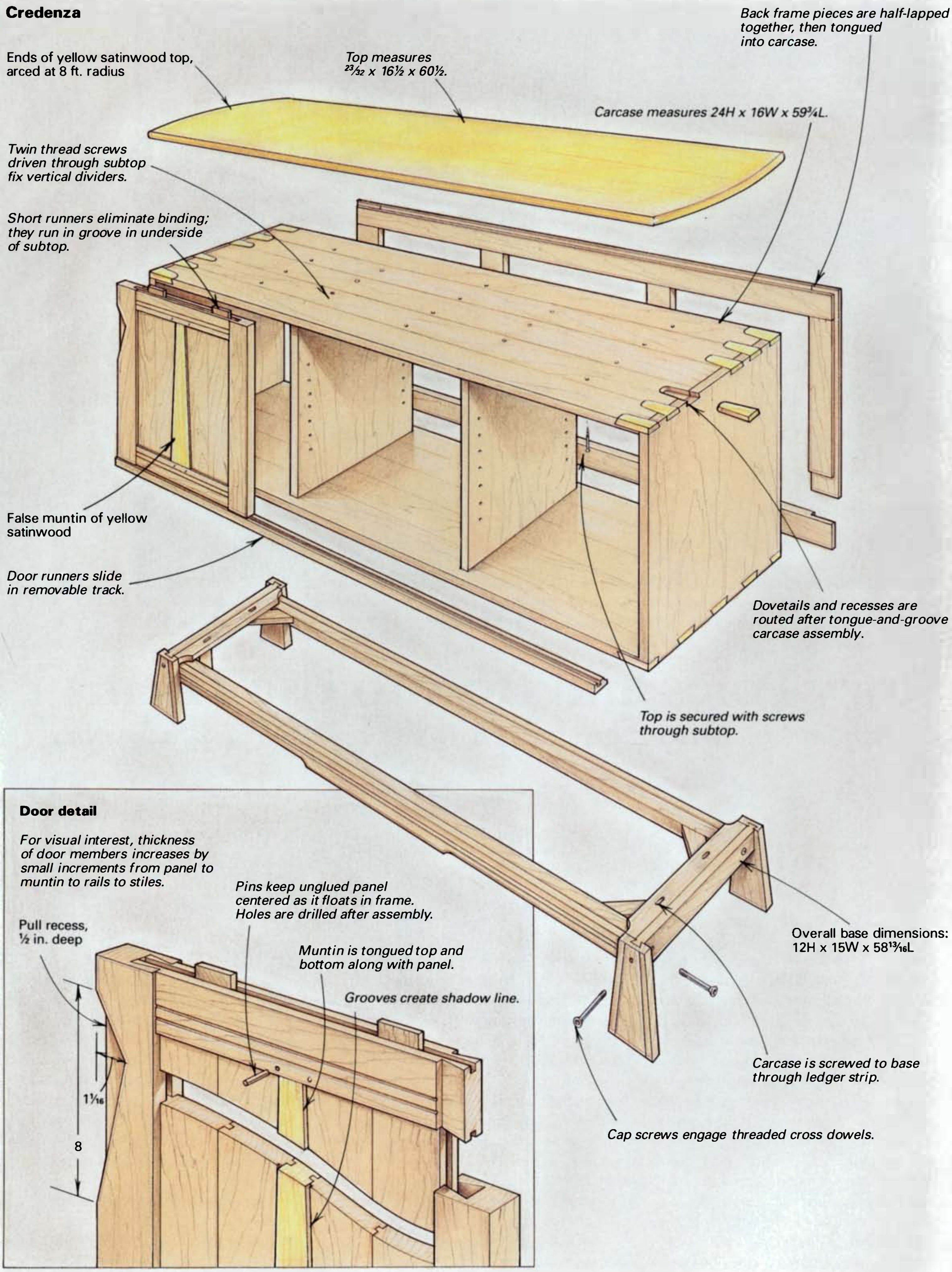
It always bothers me when I begin applying the finish on a piece of furniture and suddenly realize I'm only halfway to completing the job. I work like crazy to apply good design, milling and joinery to the furniture I make. That should be enough. Now just flood with Danish oil and deliver. Right? Well, perhaps. Danish oil is an easy, cheap and often acceptable finish, but for furniture that will take a beating or for high-end work, a hard finish and some filling and coloring is often required. To obtain such a finish takes special skills, techniques and equipment and often large amounts of time and money. This is not woodworking. It's chemistry, abrasives, coloring, compressors, spray guns, resins, solvents, clean rooms and rubber gloves. And I'd rather not get tangled up in all of that if I can avoid it.

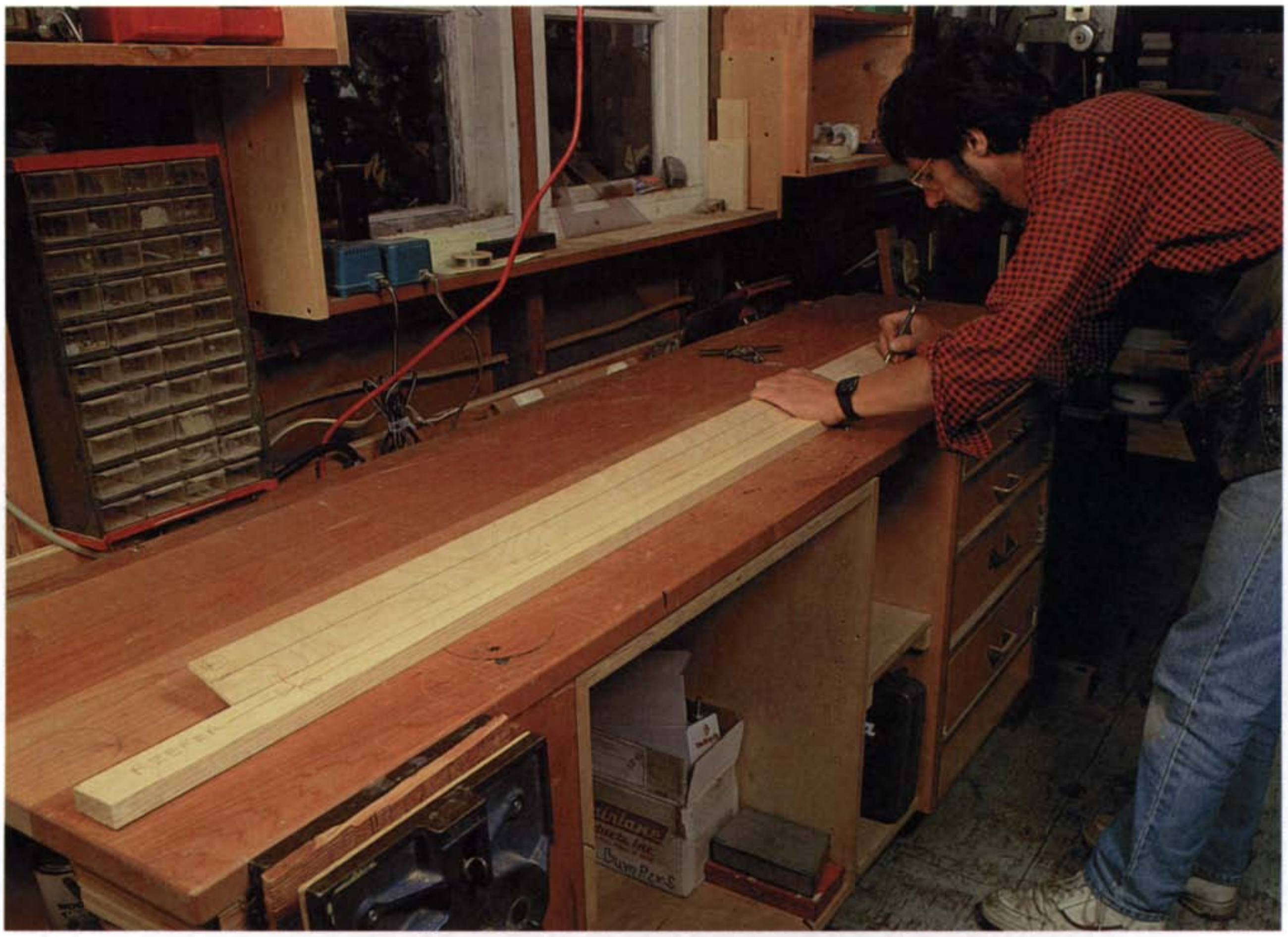
Finishes have their advantages, I admit. But when neither the environment nor the users are particularly threatening, a bare wood cabinet can be a refreshing change. Unfinished furniture is warmer both to the touch and the eye. It develops a nice patina and won't wear out a minute sooner than work that's French polished or sprayed with automotive acrylic urethane. If it does suffer an occasional insulting hand smear or wet glass mark, a simple sanding or steel wool buff-up will quickly restore the original look. Try *that* with a catalyzed lacquer or an acrylic.

When you finish wood, you emphasize the grain, color and figure, and this will limit its use in some applications. The soft, non-reflecting surfaces of unfinished wood, no matter the tree, play down the characteristics of the wood and put the material more in the service of the design.

A "no finish" finish is a natural with light woods like birch, beech or maple that will yellow badly under finish. These are beautiful woods that shouldn't be discarded for this idiosyncrasy. Left unfinished, these woods yellow a little, but with the advance of the patina, the color mellows, bringing up light tans and other tonal subtleties, as you can see in the photo of the sliding door of my credenza.

If you're hesitant about making an unfinished piece for the house or a client, make something for the shop: perhaps a jig, fixture or bench. Get some first-hand experience with bare stock, and see how it wears and ages. If you like it, think of how much more quality time you can invest in the next piece—time that would have been spent sanding, priming, sealing and rubbing out that finish. —P.W.


Credenza
Ends of yellow satinwood top, arced at 8 ft. radius
Top measures 23⁄32 x 16½ x 60½.
Back frame pieces are half-lapped together, then tongued into carcase.
Carcase measures 24H x 16W x 59¾L.
Twin thread screws driven through subtop fix vertical dividers.
Short runners eliminate binding; they run in groove in underside of subtop.
False muntin of yellow satinwood
Door runners slide in removable track.
Dovetails and recesses are routed after tongue-and-groove carcase assembly.
Top is secured with screws through subtop.
Overall base dimensions: 12H x 15W x 58 13⁄16L
Carcase is screwed to base through ledger strip.
Cap screws engage threaded cross dowels.
Door detail
For visual interest, thickness of door members increases by small increments from panel to muntin to rails to stiles.
Pins keep unglued panel centered as it floats in frame. Holes are drilled after assembly.
Pull recess, ½ in. deep
Muntin is tongued top and bottom along with panel.
Grooves create shadow line.
1 1⁄16
8



***Story poles are packed with information about the essentials of a project's construction.** The author uses two story poles, one for the site, the other for the shop. Here, he transfers information from a site pole onto a cabinet pole.*

Story Poles and How to Use Them

An ancient measurement tool ensures precise, fail-safe layouts

by Jim Tolpin

When I began working with wood over twenty years ago, one of the first tools I bought and taught myself to use was the steel-rule tape measure. I soon found it constantly in my hand, using it to make cutoff marks, to lay out assembly positions or to determine the dimensions of a space or the length of a piece of wood. I couldn't imagine woodworking without it—even though I was often frustrated by misread measurements and imprecise layouts. I assumed that these problems were due to my lack of experience, innate clumsiness and the early onset of senility. Unaware of any other way to take measurements or to make layout marks, I never thought to question the tool itself—until the day an elderly cabinetmaker nicknamed "Gentleman Jim" showed up on our job site.

Gentleman Jim had been hired to build a custom kitchen for the timber-frame house we were building, so he'd come to take measurements of the framing and utility rough-ins. I watched incredulously as he unpacked his "tools," which consisted in their entirety of a pencil and three long sticks. I was working on the roof, so I missed whatever magic he performed down in the kitchen, but I was able to catch up with him just as he was heading out the door. Noticing the sticks were now covered with lines and written notations, I asked him what they all meant. He breezily informed me that the kitchen was on the sticks, just like the great pyramid of Giza was on a cubit stick. I came to understand that Jim was going back to his shop to build a complete set of kitchen cabinets without having once pulled out a tape measure.

From pharaohs to foot rules

Having hooked my attention with that bait about the pyramid, the old cabinetmaker proceeded to explain to me about these

Photos: Vincent Laurence

Fig. 1: Recording site measurements on a story pole

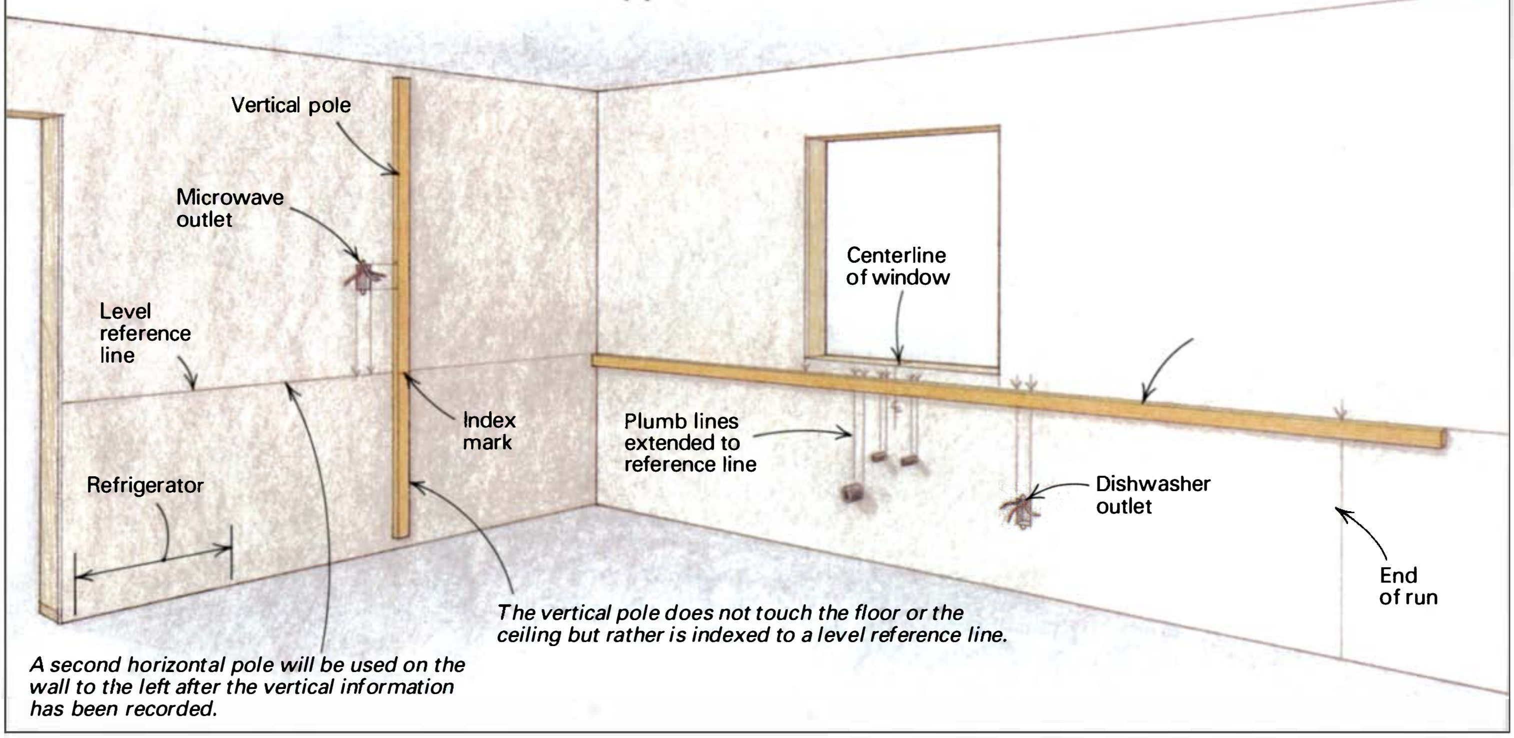
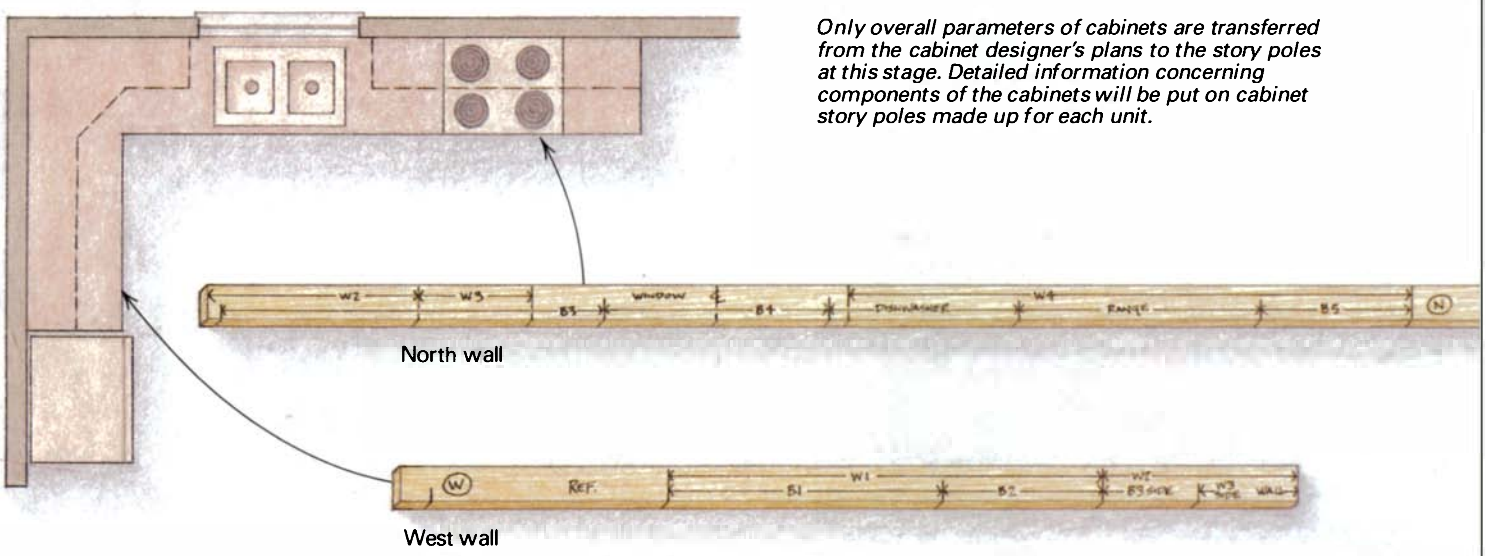


Fig. 2: Transferring cabinet layout to a story pole



"W" designates wall cabinets; "B" designates base cabinets.

marked sticks he called "story poles" and how he got away with not using a tape measure. Jim explained that the graduated rule was a relatively new phenomenon in the woodworking trade. The first rules as we know them—2-ft.-long folding sticks graduated with inch marks divided into sixteenths—didn't even exist until the beginning of the last century. Prior to then, all measurement and layout work was done by marking up straight sticks or rods.

Then Jim told me of his trip to Europe, where he was awed by the magnificent and astonishingly complex woodwork of the cathedrals built in the Middle Ages. He couldn't see where those craftsmen suffered from their lack of graduated rulers. Indeed, the layout of the great pyramids over 40 centuries earlier was done with a stick of a determined length (the renowned cubit). That massive layout job, executed with such a "crude" layout tool, was accurate to .05%. Jim figured if stick layouts were good enough for the popes and the pharaohs, they were good enough for him.

Eventually, I got off the roof and into the house, becoming a cabinetmaker and furnituremaker. When I did, I embraced Gentleman Jim's use of story poles. At first, I used them only to record on-site information concerning rough-framing and the positions of utilities that affected the design and construction of my cabinets. As I became more confident and more proficient with the sticks, I extended their use to all of my layout tasks. I now develop most dimensions of cabinet and other built-in components and mark all joint and assembly positions with story poles. Happily, misread or inaccurately marked measurements have all but disappeared from my work. Continuing to experiment with story poles, I have found a number of ways to make them easier to read and more versatile (see the box on p. 69).

Drawings: Vince Babak

***Cutting error is eliminated** when cutoff marks for cabinet components are transferred directly from the cabinet story pole to the wooden miter-gauge extension on the author's tablesaw (above). He transfers the cutoff mark, clamps a block to the extension and then cuts all like parts at one time, thus ensuring consistency from one part to another.*

***A cabinet story pole also works well as an alignment aid** for positioning internal partitions (right). The author tacks the cabinet story pole to the cabinet front, indexing it to the outside edges of the cabinet, positions the partition and then screws through the horizontal stretcher to fix the partition in place.*

Site story poles

When taking on the building of a set of kitchen cabinets or other built-in case work, the first thing I do is record site measurements on a few ¾-in. by 1½-in. straight lengths of a light-colored wood such as pine (see figure 1 on p. 67). I check the plans to be sure I have sticks long enough to span each run of cabinetry and at least one stick to run nearly floor to ceiling. If cabinets will run the full length of a wall, I use two sticks, each about 1 ft. longer than half the span. On site, I'll slide them by one another and tack them together with their ends butting into the corners, marking across both of them for later reference.

To avoid confusion, I resist the temptation of laying out more than one wall on a stick (such as putting a second wall on the back of the stick or on an adjacent side) or of squeezing another layout on an unused end. For the vertical measurements of a set of cabinets, however, I make up only one story pole because that vertical information is usually the same from wall to wall. If I do have to record certain measurements for a specific wall, I'll mark them on the edge or back side of the generic floor-to-ceiling stick, indicating clearly which wall these marks represent.

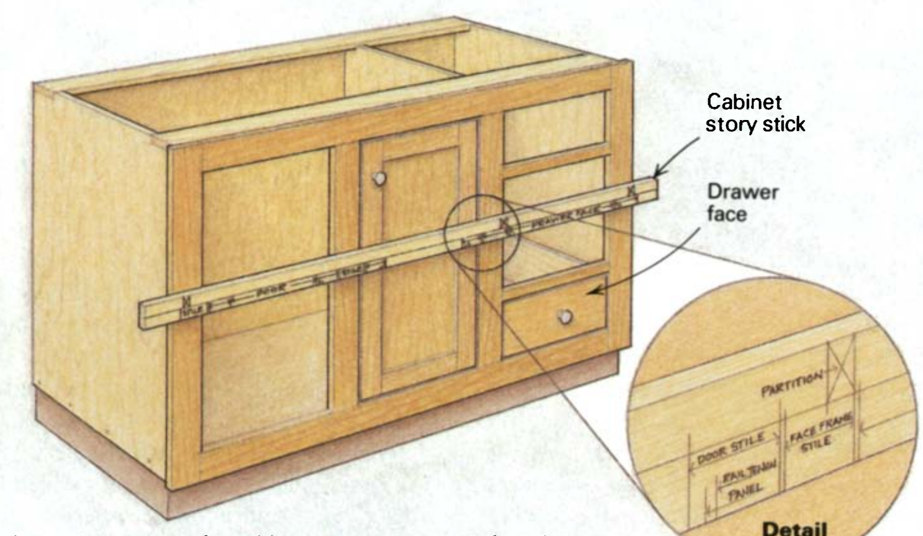
When building a set of kitchen cabinets or a built-in for a new house, an addition or a remodel, I wait to record the site measurements until all door, window, plumbing and electrical work has been roughed in and drywall has been hung. This way, anything that might affect cabinet layout has already been done.

First I strike a level reference line at a comfortable working height—about 40 in. for me—around the perimeter of the kitchen. A builder's sighting level or a reservoir-type water level makes short work of this task. I then draw plumb lines to the reference line from all the utilities and the edges of any rough openings. Working to an established level reference line and using plumb lines is far more accurate than marking out from the floor or corners, because you eliminate the possibility of errors due to varying floor heights or out-of-plumb walls.

My next step is to transfer the site measurements I've marked on the reference line to a story pole. I hold the stick firmly to the line with one end pressed tightly into a corner, and I make a tick mark at each marked point on the wall. I use a fine pen or sharp pencil, and I note what the mark indicates on the stick. I then use a small square to extend the mark across the face of the stick.

I also make a note near the end of the stick touching a wall to tell me how far out of plumb the wall is. I measure and record the maximum deviation by holding a 4-ft. level against a thin, straight section of plywood to extend the distance over which I'm taking the reading. A "+" by this number tells me that the wall leans away above the level of the reference line; a "-" indi-

Fig. 3: Cabinet story pole layout on base cabinet



Precise measurements for cabinet components are often the result of a synthesis of the information provided in the designer's drawings and the real, on-site measurements taken by the maker.

cates that the wall leans in. This information tells me how much vertical trim I'll need to add for scribing the cabinets to the wall. While I'm still on-site, I'll also sometimes indicate the centers of the wall studs on my story pole to help me locate nailers.

Having made a set of site-plan story poles, I've created a full-scale rendering of a room. All the information I need to develop the cabinets for this space either exists on or can be deduced from these few humble sticks. I need return to the site only to install the completed cabinets.

Once I'm back in my shop, I refer either to an architect's floor plan or to my own sketches, depending on whose design the cabinets are, and I lay out the cabinets for each wall face on the appropriate stick (see figure 2 on p. 67). I account for appliances and their clearance spaces by referring to the spec sheets. Once I have determined the overall length and width of each cabinet and marked their locations on the site-plan sticks, I'm ready to make up another set of story poles—one for each of the cabinets.

Cabinet story poles

Each of the new cabinet story poles will show the width and height of every component that makes up a cabinet. I make these story poles out of 1½-in. strips of light-colored ¼-in. plywood, cutting each a couple of inches longer than the overall dimension it must record.

To transfer the outside lines of the cabinet from the site pole to the cabinet story pole, I hold the strip firmly against the site pole, extending the strip past each end mark because the end of a stick makes a poor reference (see the photo on p. 66). I make tick marks indicating the outside parameters of the case and square the marks across the cabinet story pole. For accuracy, I always place the point of my pencil on the tick mark first and then slide the square up to the pencil.

Finally, I get to use my old friend, the steel-rule tape measure. Having established the outside dimension marks on the cabinet's story poles, I lay out the widths of the stock that make up the various components and account for clearances for hardware (see figure 3 on the facing page). In a sense, the lengths and widths of many of the case's components are arrived at by default. For example, the length of a cabinet door's rail may be the result of subtracting the width of the stiles at either end and then adding for the tenon length.

When it's time to cut the actual pieces for the cabinets, I could use my tape measure to transfer dimensional information from the cabinet story pole onto the stock, but there's a better way. I just go straight from the cabinet story pole to the tablesaw, pencil my cutoff marks onto the wood extension to my miter gauge, clamp a stop in place and make my cuts (see the photo at left on the facing page). By avoiding a measuring tape, I eliminate any chance of making a measuring error.

Cabinet story poles often become a tangle of lines. To make them a little more legible, I like to separate the layout of internal components (sides, partitions, stretchers and back panels) from that of face components (face frames, doors and drawer faces). To do this, I simply draw a line lengthwise down the middle of the stick, laying out the internal components on one side and the external on the other. In addition to reducing the number of lines in proximity to one another and leaving more room for notations, the split stick clearly shows how the various components relate to one another.

Sometimes, I use a story pole for a purpose besides laying out its components: I use it for an assembly aid to position those components for fastening. For example, when constructing a kitchen cabinet base unit, I attach a horizontal stretcher across the top of the partitions before installing the face frame (see the photo at right on the facing page). To position the free-floating inner partition at the required distance from the cabinet ends, I tack the cabinet story-pole strip temporarily across the front of the cabinet and line up the partition with the marks indicating its position on the story-pole strip. Then I just screw through the stretcher into the partition, fixing it in place. □

Jim Tolpin is a writer and a woodworker in Port Townsend, Wash.

Joinery and hardware story poles

When laying out certain joints to be hand-cut, I often use a miniature story pole to speed the process and ensure an accurate, consistent layout. For example, when cutting dovetails by hand, I find it easiest to figure my spacing, lay out the centerlines of the pins on masking tape stuck to a flat, accurate square and mark the top edges of all the pins. Then I just put tick marks at the ends of the boards I'm cutting pins on, strike a line from tick mark to baseline using my bevel square and I'm ready to go. I'm careful always to reference the same end of the square to the bottom edge of the box sides, so the pins and tails will line up all around the box. This way, I only have to measure once for the original layout, and the rest of the pin-marking is exactly the same and without any measurement mistakes or headaches. I lay out the tails directly from the pins.

Another good use of a mini-story pole is for laying out hardware, whether hinges, pulls, knockdown fittings or other types. I made a simple butt-hinge layout story pole by screwing a thin ebony offcut (about 3/32 in. thick) to a piece of pine and marking the hinge width across the piece of pine. The ebony offcut catches on the edge of the door, making the story pole slip-proof and also provides just the right amount of clearance above and below a flush-fit door to prevent it from binding. *—J.T.*

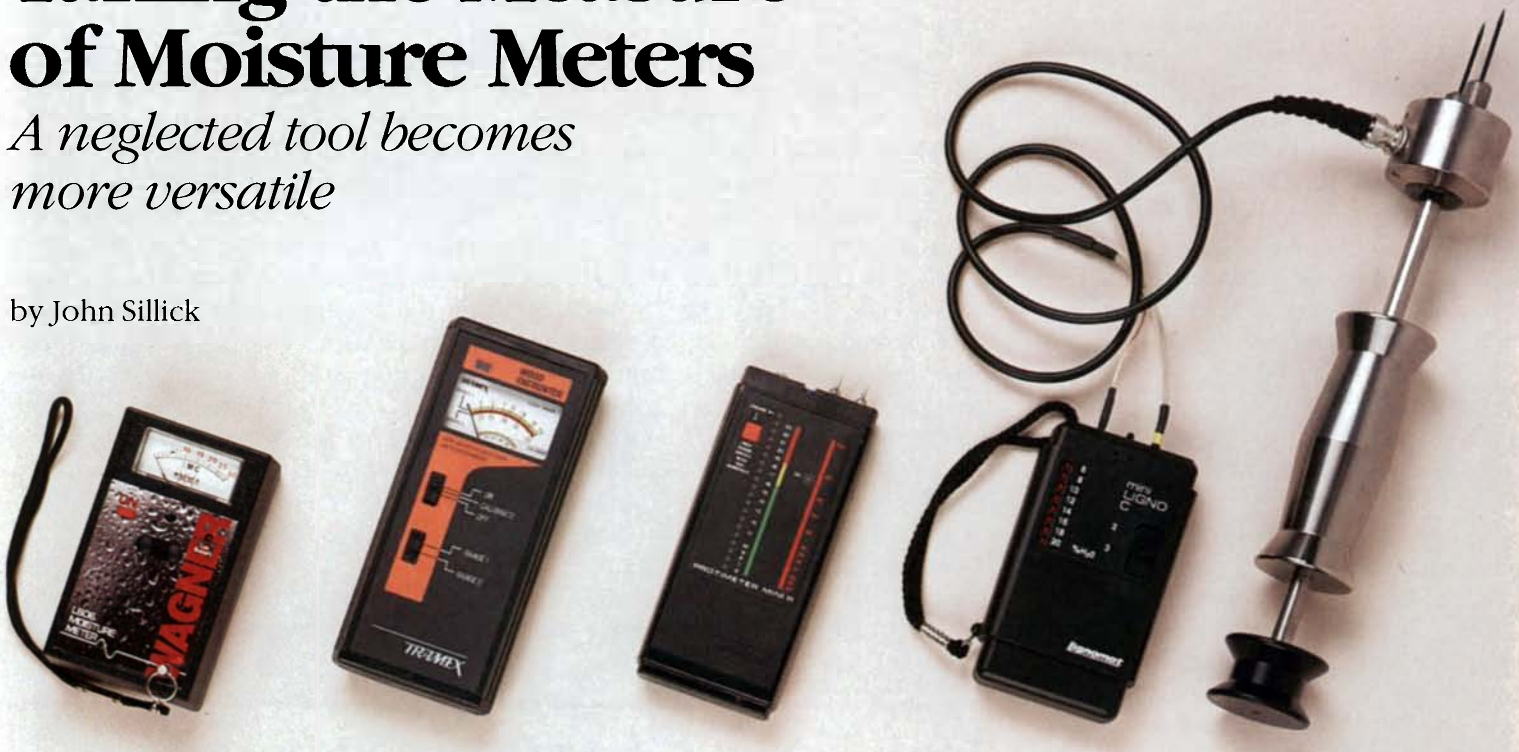
A quick story pole for dovetails*—Masking tape on a square is all it takes. The author chooses his spacing either by measuring or by eye, marks centerlines and pin widths at the edge of the board, and then strikes a line against his bevel square to the baseline.*

A hinge-layout story pole *consists of a thin piece of ebony and a short pine board. Together they index the hinge and provide door clearance.*

Taking the Measure of Moisture Meters

A neglected tool becomes more versatile

by John Sillick



***Meter types vary**—The author measured moisture with 18 meters from nine manufacturers for this article. Shown here from left are the Wagner L606 and the Tramex Wood Encounter, both pinless units that use an electromagnetic field to detect moisture; the Protimeter Mini III and the Lignomat Mini Ligno C, with an optional remote probe for deep measurements.*

I suffered my greatest woodworking embarrassment some 20 years ago. Friends of ours with a large family needed a big kitchen table that wouldn't cost too much. I decided I could oblige. I trucked over to the lumberyard and bought a half dozen spruce 2x8's, reassured by the "kiln dried" stamped all over them. The finished table looked all right, in a clunky, overbuilt way. That is, it did until two months later when each board in the top had shrunk away from its neighbor, and it compared unfavorably to a picnic table. In the years since, through making and restoring furniture and drying my own lumber, I've come to understand that learning to deal with moisture and shrinkage is the most important lesson a worker in solid wood has to learn.

Moisture leads to most of the failures in things made of wood. (The other cause, wild teenage parties, is a distant second.) Tenons on chair stretchers that have higher moisture content (MC) than the legs they join can shrink and sabotage the joint. Parts cut from thick sticks of wood that aren't thoroughly dried will stress anything they're built into because they'll shrink unevenly. A beautifully planed and sanded panel can wind up uneven if it's glued up with adjacent boards at different moisture contents: When the boards reach equilibrium in their new environment, some will have shrunk or expanded more than others. Drawers and doors that swell too much for their openings and stick can cause frustration, abuse and breakage. In many cases, you have to be able to anticipate not only that the wood is going to move with the exchange of moisture but also how much it's going to move.

Luckily, predicting wood movement has gotten a lot easier for the small-shop and the part-time woodworker in recent years. A moisture meter small enough to slip into your pocket can tell you what you need to know to anticipate what any given board will do in the future. With the profusion of moisture meters in the marketplace now at prices as low as $29, there's no excuse for overlooking moisture-content problems any longer.

To sort through the field of available moisture meters, I recently gathered 18 of them, from the most basic to the more sophisticated, and put them to work measuring the moisture content in some boards I'd been air-drying. I've put together a chart (see pp. 72-73) with the specifications of all the meters, the features I think are most important to weigh in deciding between them, and the results of my evaluation of the meters. To put the chart in context, I'll describe the different types of meters and how they work, the range of features and accessories available, and the time-honored oven-drying method I used for comparing their readings.

Two types of meters

All moisture meters function by measuring the way moisture affects the electrical properties of wood, but different meters measure different properties. There are two main types of meters, probed and probeless, as shown in the drawing on the facing page. The great majority are probed. They have two or more pins that are pushed into the wood, and they operate as sensitive ohmmeters. Direct current travels out one pin into the moist wood and is picked up by another pin. Dry wood allows little current to pass, damper wood permits more. The meter reads how much resistance there is to the current and correlates the resistance to moisture content.

A second group of meters can measure moisture content without piercing the wood with probes. These meters emit electrical waves through a sensor that is pressed against the wood. The waves create an electromagnetic field (EMF) the size of the sensor to a depth of up to ¾ in. The field behaves differently depending on how much moisture is in the wood. EMF meters can measure the capacity of the wood to store energy (capacitance), the amount of power the wood absorbs from the field (power loss), or the wood's resistance to the field (impedance). Some meters use one of these means; others use several in combination. Like their

Photos except where noted: Sloan Howard

Low tech and high-tech meters—Prices and features ranged widely among the meters, from $29 for the Sonin Rapitest pictured here at center, to $750 for the Delmhorst RDM 2S at right, which stores 3,000 readings and can be linked to a computer. The other meters in the photo are, from left, the Electrophysics MT 270, the Timber Check and the Moisture Register DC 2000.

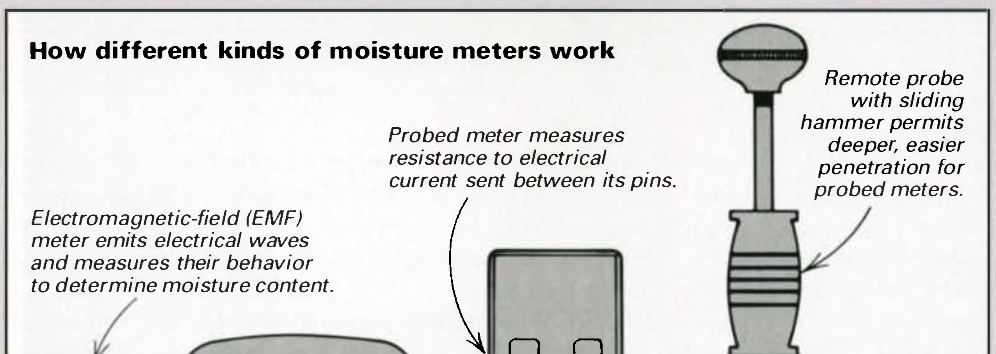
probed cousins, these meters then translate this electrical information to determine what percentage moisture is present.

Probing questions—Most probed meters have a pair of pins on one end of the unit. The consensus among manufacturers is that the pins should penetrate one-fifth to one-quarter of the thickness of the stock to get a legitimate reading of a board's moisture content. On a 4/4 board, the probes can read true if pushed in only ¼ in. On an 8/4 board, the probes should penetrate ½ in. Under the pounding they take, pins will sometimes bend or break, but most are easily and cheaply replaced.

To take readings on thick or dense stock, it's best to hook up your meter to an external probe. These come in several types. One style has a heavy weight that you slide along a steel shaft to help drive and extract the pins, as shown in the photo above. Another type can be hand-driven or tapped in with a mallet. Many meters have jacks for the leads to external probes. Others have caps that link the external probe leads to the pins on the case. A low-tech alternative for meters without an external probe is to drive a pair of nails into the board and connect them to the pins on the meter itself with wires and alligator clips (see the photo on p. 72). External probes and the depth of penetration they provide constitute one of the strongest advantages of probed meters. The major drawback of probed meters, of course, is that you have to pierce the stock to take a reading.

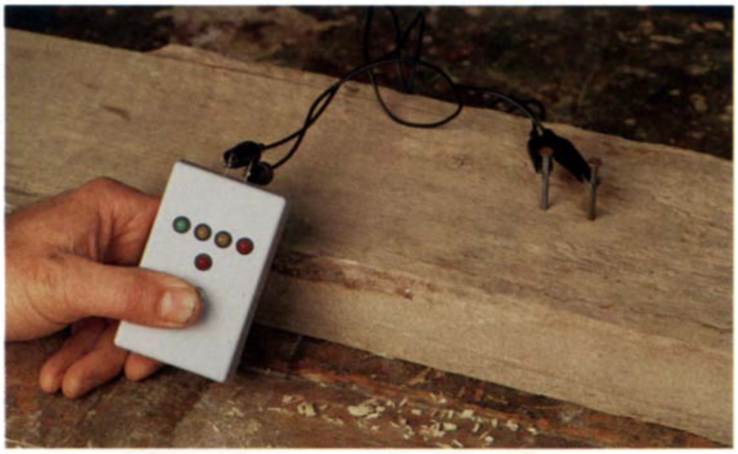
Look Ma, no pins—Electromagnetic-field meters don't require a lot of finesse to use. You press the meter's sensor against the surface of the board, and take a reading. The wood can be in the rough, milled flat or part of a finished piece of work. The meters do like to have complete contact between the sensor and the wood, so it's best to push firmly when checking rough-milled stock. To get a fair reading, the wood must be at least as wide as the sensor, which in most EMF units is 2 in. to 3 in. And when using EMF meters, you must remember they are capable of reading right through thin lumber and factoring in the moisture content of your benchtop.

Unlike probed meters, which read the wettest gradient their pins pass through, EMF meters average the moisture content in the area of their magnetic field. With an EMF meter, you can quickly get a picture of the moisture content of a board all



Drawing: Maria Meleschnig

Photo: Jonathan Binzen



Probing deep in the wood*—*A couple of nails, wires and alligator clips let you take deep readings with an ordinary meter. Electrophysics supplies this kit with its inexpensive meters.

along its length, without marring it in the slightest. But with thick stock, core readings will be out of reach, as the electromagnetic field's depth of penetration is fixed, usually at ¾ in. or less.

Features

Deciding which moisture meter to buy is largely a matter of sorting through the features: how they account for different species of wood and metering conditions, the range of moisture they're equipped to detect, how those readings are displayed and how well the manufacturer explains the product and its uses.

***Species correction*—**Just as different species of wood have different working properties, their characteristic structural and chemical qualities cause them to have different electrical properties. In dry wood (say, 7% MC), the difference between species is negligible. But for moister wood, in the 12% to 15% range that's normal for air-dried lumber, different species will display significant differences. The readings of both probed and EMF meters are affected by these differences. A piece of white pine may read as much as 4% different from a piece of white oak at the same moisture content. Each meter is equipped in some way to deal with these disparities. Most meters come with a table of corrections that lists common species of wood and gives you a number to add to or subtract from the meter reading to calculate the correct moisture content. Tables can be fairly cursory, with few species and simplistic corrections or extremely detailed, with a broad range of species and corrections tagged to specific readings. Some meters replace such tables with internal corrections for a wide range of species: You punch in the species and the microprocessor does the rest. Others have more general internal corrections, with a dial that is flipped between two or three classes of species.

Whichever way it is done, species correction adds accuracy. You'll have to decide whether you want to pay for the convenience of electronic corrections and whether the meter you want has corrections for the species you normally work with. Because the tables will be used for years, it behooves manufacturers to provide printed corrections in a conveniently portable format and with a durable cover and paper. As it is, many meters come with the corrections printed on stapled sheets of copier paper.

***Temperature correction*—**The temperature of the wood significantly affects moisture readings in probed meters. For every 10° above or below 70°, the reading on a probed meter can be off by 1%. If you check a stack of lumber outside on a 0° day, for example, you may wonder how your air-dried stock that read 13% last summer now reads 20% despite the dry winter air. The same boards at 200° in a kiln could read 6%. Correction figures for temperature are provided either internally or on paper with most of the probed meters. EMF meters are not affected by temperature changes.

***Zeroing and calibration*—**Some units, especially those with analog readouts, require a simple procedure to "zero" the meter. Others have indicators to show that the meter is in proper calibration. Some units come with resistor caps that, when in contact with the pins, tell you if the unit is in a truthful mood. If it isn't, there are often easily accessible adjustment screws. If you zero your meter and continue to get peculiar readings, you might check your batteries. As the batteries lose power, the readings will wander. Most

Moisture meter review

Model	Country of origin	Type of sensor	Reading range (% moisture content)
Delmhorst J-88 (800) 222-0638	USA	Probe, ½ in.	6-20%
Delmhorst J-3	USA	Probe, 5/16 in.	6-30%
Delmhorst RDM-2S	USA	External probe	4.5-60%
Electrophysics MT-80 (519) 668-2871	Canada	Probe, ½ in.	6-15%
Electrophysics MT-270	Canada	Probe, ½ in.	4-30%
Electrophysics CT-1000	Canada	EMF+	0-40%
Lignomat Mini Ligno C (800) 227-2105	USA	Probe, 3/16 in., 7/16 in.	6-20%
Lignomat Mini Master H	Germany	External probe	6-75%
Moisture Register DC 2000 (909) 392-5833	USA	Probe, 7/16 in.	5-62%
Moisture Register Model L	USA	EMF	0-25%
Protimeter Mini III (800) 321-4878	England	Probe, ½ in.	6-100%
Sonin Rapitest (800) 225-1153	Taiwan	External probe, 9/16 in.	10-28%
Timber Check B350 (800) 667-2986	Canada	Probe, ¾ in.	6-25%
Tramex Compact (303) 582-3538	Ireland	Probe, ⅜ in.	7-42%
Tramex Wood Encounter	Ireland	EMF	3-33%
Tramex Moisture Encounter	Ireland	EMF	10-20%
Wagner L606 (503) 582-0541	USA	EMF	5-30%
Wagner L601 DF	USA	EMF	5-30%

+ EMF = Electromagnetic field

Type of readout or display	Size (in.) and weight (oz.)	Compatible external probes	Species correction	Type of carrying case	List price	Averaged deviation from oven test MC %	Comments
Lights	4¾ x 2¾ x 1¾ 10 oz.	Yes	Extensive chart w/ variable corrections	Stiff leather pouch	$110	1.1%	Display is easy to read in low light
Analog	4¾ x 2¾ x 1¾ 12 oz.	Yes	Extensive chart w/ variable corrections	Stiff leather pouch	$165	1.5%	Built-in calibration check
Digital	7½ x 4 x 2¼ 3 lbs, 8 oz.*	External only	Inboard, 33 species	Hard shell attaché case	$750	1.0%	Interfaces with computer; temperature compensation; stores 3,000 readings
Lights	3½ x 2 x 1½ 5 oz.	Yes Alligator clips	Chart; divides wood in 7 groups	None	$49	0.8%	Informative owner's guide
Analog	4½ x 3 x 1½ 8 oz.	Yes	Chart; divides wood in 7 groups	None	$95	1.6%	Dial easy to read; informative owner's guide.
Analog	6 x 3 x 1 14 oz.	N/A	Chart; divides wood in 7 groups	None	$215	0.5%	Easily calibrated; excellent owner's guide
Lights	5 x 2½ x 1 5 oz.	Yes	2-position range selector	Vinyl pouch	$122	1.4%	Compensates for weakening battery
Digital	5 x 2½ x 1 14 oz.*	External only	Inboard, 20 species	Hard-shell case	$280	1.0%	Temperature-stable circuitry
Digital	6½ x 3 x 1 7 oz.	No$^{\Delta}$	3-position range selector; extensive chart	Nylon pouch	$168	1.2%	No battery-saving feature
Analog	8 x 4 x 3½ 2½ lbs.	N/A	Very extensive chart	Aluminum attaché case	$665	2.0%	Easy calibration and zeroing; heavy-duty construction; built-in battery charger
Lights	6½ x 2½ x 1 7 oz.	Yes	Very extensive chart	Nylon pouch	$211	0.7%	Auto-off; surface moisture accessory
Analog	4½ x 3 x 1½ 6 oz.*	Lightweight External only	None	None	$29	1.5%	Dial difficult to read; no battery-saving switch
Lights	5 x 1½ dia. 6 oz.	No	Limited chart	None	$80	2.2%	Cylindrical shape is easy to grip and push; useful owner's manual
Analog	6 x 3 x 1 10 oz.	Yes	Limited, general chart; Eurocentric	Vinyl cover	$159	1.6%	Sturdy aluminum casing
Analog	6 x 3 x 1 10 oz	N/A	Limited, general chart; Eurocentric	Vinyl cover	$295	2.1%	Easy calibration check; sturdy aluminum casing; no battery-saving switch
Analog	6 x 3 x 1 9 oz.	N/A	Limited, general chart; Eurocentric	Vinyl cover	$295	1.2%	Also tests plaster, masonry and roofing; no battery-saving switch
Analog	4½ x 2½ x 1½ 6 oz.	N/A	Very extensive chart w/ variable corrections	None	$197	1.0%	Easy calibration and zeroing. Excellent owner's manual. No corrections for imported species
Analog	7½ x 4 x 3 1 lb., 3 oz.	N/A	Extensive chart w/ variable corrections	None	$499	1.8%	Easy calibration and zeroing; easy-to-read dial

* Includes external probe

$^{\Delta}$ Version available with external probe only ($188 plus $105 for probe)

units have low-battery signals, and some can automatically compensate for a weakening battery.

Instruction manuals—When you buy a moisture meter, read the owner's manual. The manuals often invite meter owners to call with questions and comments, and when you do, instead of being stuck on hold, you talk immediately to someone knowledgeable, perhaps even the person who designed your meter.

Reading range—Is a moisture meter more useful if it has an expanded range of readings? Not necessarily. Wood above fiber saturation point (about 30% MC) is notoriously difficult to read for moisture content because it has water everywhere. And in any case, shrinkage does not really start until the water leaves the cells and starts to vacate the cell walls at approximately 27% MC (fiber saturation point). For someone who dries wood by kiln, though, the higher range of readings could be useful in a relative way to track and control the loss of moisture.

Readout on moisture meters is indicated via digital and analog displays, by computer printout or by a pattern of LED lights. What's the best? Personally, I appreciate my old LED meter: It is easily read in the half-darkness of my lumber sheds.

The case for a case—Most manufacturers make a strong plea for sensible care of their units. Unlike most woodworking tools, moisture meters have delicate components, which are sensitive to impact, extremes of temperature, dampness and dust. Probes have to be be kept clean. Oils and grime can have an insulating effect and distort readings. Left uncovered, the pins could take an inadvertent reading of your personal moisture content. All these factors make a protective case particularly valuable with these tools.

Oven-dry evaluation

To compare the accuracy of the meters I'd collected, I took readings on three samples of wood—hard maple, black walnut and white oak. I cut the samples from the middle of air-dried boards that had been kept under cover for at least three years. I took multiple readings with each meter and averaged them.

When I had used all the meters and recorded their readings, I determined the actual moisture content of the samples with the standard oven test: I cut two pieces from each sample (1 in. thick by about 3 in. by 4 in.) and put them in the oven at 200°. With a sensitive electronic scale, I measured the starting weight and kept checking and logging my findings until the samples quit losing weight. (It's helpful to marry someone who doesn't mind you tying up the oven for a few days.) I calculated the moisture content of the original sample by dividing the weight lost by the final dry weight. A piece of wood that weighed 6 oz. wet and 5 oz. oven dry is considered to have had a 20% moisture content when wet: $(6-5) \div 5 = .2$

Then I compared the meter readings (after the required species corrections) to the oven-derived moisture content. For each unit, I determined the variance from the oven-dried figures, and that's the figure I used in the chart. As a group, the meters did well, staying within 1.45% of the oven-dry result.

It would be a mistake to consider the figures I arrived at to be an absolute measure of the accuracy of the meters. What the process told me was that most of the meters are in the same ballpark; therefore, the features and accessories each one has to offer are the most important factors in choosing between them. I must say, though, I was pleased to discover that the Lignomat Mini-Ligno I have been using for the last 10 years has been accurate within 1.5%. I am not sure I have told the truth that much myself.

I found I liked something about nearly all the meters I surveyed. But if I were to go out and buy a meter right now, I'm pretty sure I'd go for the Wagner L 606. It has EMF technology at a reasonable price and wonderfully extensive correction tables. It's easy to use, and it's lightweight and compact. A real winner. If I were choosing at the low end of the price spectrum, I'd probably get the Electrophysics MT 80. You get good species corrections, good accuracy, and with their alligator clip setup, you can get deep readings when you need them. □

John Sillick is a teacher and woodworker in Lyndonville, N.Y.

Calculating wood movement

by Christian Becksvoort

My moisture meter is one of the most important tools I own. Whenever I fit a door, drawer or back, I have to know the moisture content (MC) of the wood. If I know the wood's moisture content and the total anticipated change in moisture content, from the driest January to the most humid August, I can accurately project the gap required above drawers of any given size.

I keep two cards (see the chart at right) with my moisture meter, which tell me the total wood movement for quartersawn and flatsawn cherry for an 8% change in moisture content, as well as a worst-case scenario (e.g., someone moving from Phoenix to Seattle) of 10% change in moisture content.

How did I come up with these magic figures? I sat down with my calculator and a simple formula and figured each change in dimension. The formula listed below can be found in *Understanding Wood* by R. Bruce Hoadley (The Taunton Press, 1980):

$\Delta D = D \times S\ (\Delta MC \div FSP)$ where:

ΔD = Change in dimension

D = Initial dimension

S = Total shrinkage percentage (from *Understanding Wood*, p. 74; use tangential shrinkage for flatsawn and radial shrinkage for quartersawn.)

ΔMC = Change in moisture content expressed as a decimal; must be less than the fiber saturation point (FSP) of 28%

FSP = Fiber saturation point, use 28%

Some examples: How much movement can be expected for a flatsawn cherry board 10 in. wide if the MC is expected to fluctuate from 14% to 4%?

$\Delta D = 10(.071)\ (.14\text{-}.04 \div .28)$

$\Delta D = (.71)\ (.36) = .2556$ in.

The dimension change will be just over ¼ in.

The same board exposed to an MC change from 12% to 6%:

$\Delta D = 10\ (.071)\ (.12\text{-}.06 \div .28)$

$\Delta D = (.71)\ (.21) = .1491$ or between 9⁄64 in. and 5⁄32 in.

For each species, S remains constant for flatsawn and constant for quartersawn. S is the percent of shrinkage from the green state (considered to be 28% MC) to oven dry (0% MC). These values (for domestic as well as imported species) can be found in *Understanding Wood* or in *The Wood Handbook: Wood as an Engineering Material*; Agricultural, Handbook #72, Forest Products Lab, 1976. This handbook is available from the Superintendent of Documents, United States Government Printing Office (Washington, D.C. 20402) or your local library. □

Christian Becksvoort is a contributing editor to FWW and a furnituremaker in Gloucester, Maine.

Movement of cherry

Width of board (in.)	8% change in MC* (from 6% to 14 %): Change in width of flatsawn board (.071)	8% change in MC* (from 6% to 14 %): Change in width of quartersawn board (.037)	10% change in MC (from 4% to 14%): Change in width of flatsawn board (.071)	10% change in MC (from 4% to 14%): Change in width of quartersawn board (.037)
1	.0203	.0106	.0253	.0132
2	.0406	.0211	.0507	.0264
3	.0608 1⁄16**	.0317 1⁄32	.0761 5⁄64	.0396 1⁄32
4	.0811	.0423	.1014	.0528
5	.1014	.0528	.1268	.0661
6	.1217 1⁄8	.0634 1⁄16	.1521 5⁄32	.0793 5⁄64
7	.1420	.0740	.1775	.0925
8	.1623	.0846	.2028	.1057
9	.1826 3⁄16	.0951 3⁄32	.2282 15⁄64	.1189 7⁄64
10	.2028	.1057	.2536	.1321
11	.2231	.1163	.2789	.1454
12	.2434 1⁄4	.1268 1⁄8	.3043 5⁄16	.1586 5⁄32

Notes: * MC = moisture content ** Approximate fractional equivalent

Build a Better Sawhorse

by Voicu Marian

Useful shop fixture offers good layout and joinery exercise

I made my first pair of these sawhorses a few years back while remodeling my house because it was uncomfortable working stooped down on the floor. With a hollow core door on top, I had a fairly sturdy workbench that could be moved easily from one room to the next. After finishing up in the house, I took them back to the shop, and that's where they've proven their value.

My workbench always seems to be cluttered with tools. Before I made these horses, I often used the tablesaw as an auxiliary bench. That worked well as long as I didn't need to cut anything.

Now I have a second workbench: A pair of these sawhorses provides a strong, stable base; a couple of thick, heavy planks atop them form a perfectly serviceable benchtop; and a plank across the stretchers makes a good shelf for bench planes and other larger tools that normally clutter a bench surface. I clamp horses and planks together for stability and use C-clamps and bar or pipe clamps in lieu of vises, dogs and bench stops. When I'm finished with the bench, it disassembles and stores easily.

What makes these horses different from most, though, is the joinery. I first saw this half-lap, half-dovetail joint (see the drawing) used by an old carpenter when I was growing up in Romania. It's a strong joint, not too finicky to cut—especially in softwood. The joint gives these horses greater strength and rigidity, a much longer life and, as a bonus, a nice look. Also, the practice you gain in laying out and cutting the joinery in construction lumber will transfer to the fine work you do in hardwoods.

Construction sequence

I dimension all my stock first and then bevel all the edges with a block plane. To ease assembly and ensure consistency, I nail together a quick, simple set-up jig, consisting of three pieces of scrapwood on a plywood base (see the photo).

I determine the angle of the legs by eye rather than by using any mathematical formula. I hold two legs upright and adjust their spread until it looks right. Checking with a protractor for future reference, I read 35°.

I cut the notches at the top of the legs for the saddle first, space the legs with a block the same size as the saddle and then lay out the short end stretchers. I lay out and cut the half-lap first, scribing from the insides and outsides of the legs. I mark out the dovetails on the top side of the stretcher at 8°, cut them and scribe around them with a sharp pencil onto the legs (see the photo). I cut and chisel out the leg to receive the stretcher. When the joint is assembled, leg and stretcher should be flush.

With all four end assemblies complete, I stand up a pair at a time and install the saddle, leaving a 4-in. overhang at each end. This provides a wider support for the boards I use as a benchtop as well as clearance for my feet. For now, one screw holds it together. Next I adjust the sawhorse so it's square to the surface it's standing on. Then I place the long stretcher across the short ones. I center it and mark it for length and for the shoulder of the half-lap.

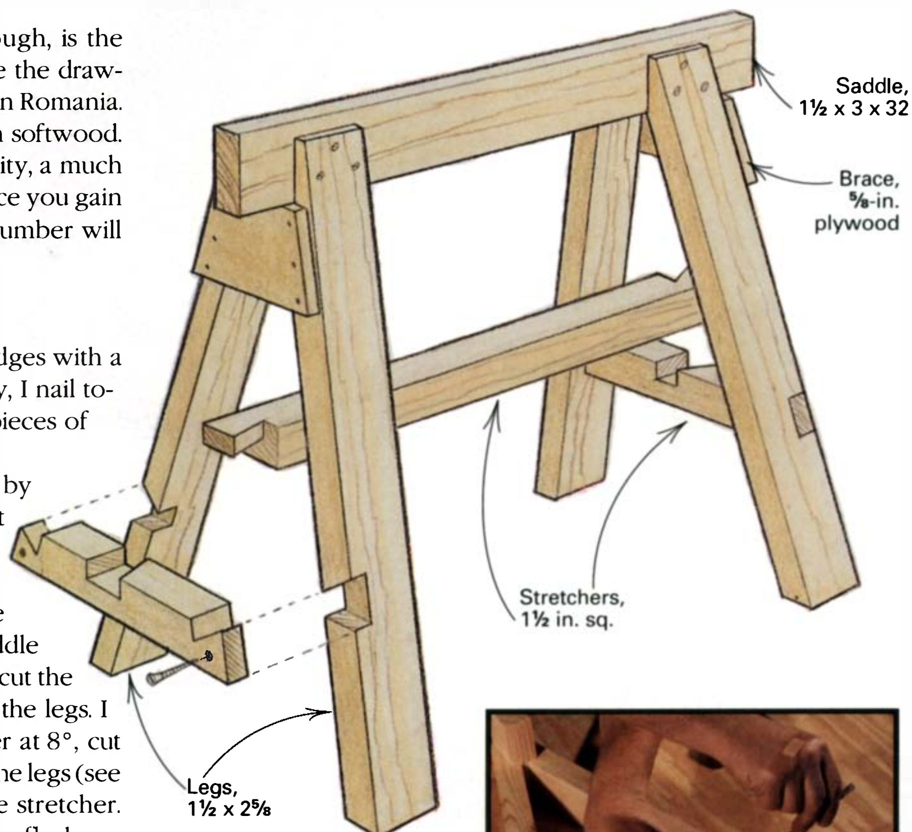
The rest of the process is the same as for the short stretchers, except I put the dovetails on opposite sides at each end. I do this more for aesthetics than for any structural reason. I glue the long stretcher in place and screw it from below. I then put two more screws on each side of the legs for a total of three screws into the saddle at the top of each leg.

The last thing I do is cut the tips of the feet, so they don't rock. To mark them, I lay the sole of my square flat on its side, scribe around each foot and then saw them off. □

Voicu Marian works wood in Alliance, Ohio.

The well-built sawhorse

Optimal dimensions for these horses depend on the function for which they're intended and on individual height and preference. For someone of average height, 32-in. horses make a good base for an auxiliary workbench, and 24 in. horses are about right for an assembly and finishing platform.



A simple, nailed-together jig speeds layout and ensures consistency from horse to horse. Here, the author scribes around the end stretcher dovetail to cut out its mortise in the leg.

Photo: author; drawing: Maria Meleschnig

Carpal Tunnel Syndrome and the Woodworker

Understanding and avoiding this insidious injury

by Dr. Kirk Kundtz

A healthy human hand and wrist

Woodworking is not a risk-free activity. While the most feared accidents threaten immediate injury, some woodworking injuries, collectively known as cumulative trauma disorders, can result from the repeated act of using tools and handling materials.

The best known and most infamous cumulative trauma disorder is carpal tunnel syndrome (CTS), and it is fast becoming an epidemic illness among American workers. The Occupational Safety and Health Administration (OSHA) reports that this affliction and related injuries comprise about 40% of all occupational illnesses reported in the United States every year. Groups at risk include typists, computer operators, meat packers, musicians, cashiers, carpenters, as well as furnituremakers and cabinetmakers.

Carpal tunnel syndrome is a problem that develops slowly. It may go unnoticed until its effects are extreme and debilitating. So we as woodworkers must learn to understand what an insidious problem it is, to recognize its symptoms and, most importantly, to adopt work habits that can prevent it from developing. And for those unfortunate enough to be afflicted already, there are some options for treating both early and advanced stages of CTS.

What is carpal tunnel syndrome?

To understand carpal tunnel syndrome, it's necessary to examine the anatomy and physiology of the wrist and hand. The drawing above shows a cross-sectional view of a normal, healthy wrist. The small oval-shaped compartment in the center of the drawing is the carpal tunnel, which is covered on one side by the carpal ligament (made of tough, fibrous tissue) and on the other side by the bones of the wrist. A number of important structures run through the carpal tunnel, including the tendons and the median nerve, one of the three major nerves of the arm. The tendons connect forearm muscles to bones in the hands and are like ropes, strong and mechanical. But nerves are like fiber-optic cables, delicate and complex.

While the carpal tunnel provides a protective conduit for these structures, there's a problem: The carpal tunnel itself is not at

Drawing: Bill Jurgens

all flexible and has no room for structures to expand within it. By encasing the delicate median nerve alongside a half-dozen slipping and sliding tendons, Mother Nature kind of goofed. If anything goes wrong in the tunnel and tissues begin to swell, the first structure to be affected will be the most sensitive one—the median nerve. Tendons that are constantly in movement—causing the hand to grasp objects and operate tools—are most vulnerable to inflammation and swelling.

CTS develops when tendons in the wrist become chronically swollen, and the median nerve is compressed to the point of damage. The median nerve, along with the radial and ulnar nerves, provides a pathway for information sent between the hand and the brain. But the ulnar and radial nerves lie outside the carpal tunnel, so they are not as subject to compression damage. Like a telephone cable, the median nerve is a trunk of millions of tiny nerves, each controlling its own muscle, hair follicle, sweat gland or blood vessel. And each of these fantastically delicate nerve fibers can be damaged easily. Without these nerves, our hands become nearly useless, which is why carpal tunnel syndrome is such a debilitating condition.

Causes of the affliction

Anything that causes inflammation and swelling in the carpal tunnel can lead to carpal tunnel syndrome. Any job that requires extensive use of the hands—such as woodworking—can lead to chronic inflammation and CTS. Some of the primary causes for woodworkers are discussed in the box below along with the appropriate preventive measures. There are also physical conditions that predispose some individuals (even those who don't use their hands extensively) to develop the affliction. These conditions include systemic diseases, such as rheumatoid arthritis, diabetes and thyroid disorders; metabolic conditions, such as pregnancy and obesity; and pathologic mechanical pressures, such as fractures and tumors. The unifying theme behind all these conditions is swelling, and in one way or another, they can all lead to swelling in the carpal tunnel. Woodworkers with any of these conditions are at an even higher than normal risk of developing CTS.

Symptoms

The earliest symptoms associated with median nerve damage and carpal tunnel syndrome are tingling sensations in the hands. These are usually localized to the thumb, the first finger and the middle finger. As median nerve damage continues, the symptoms worsen. Numbness, pain and cold intolerance develop. A frequent complaint at this stage is waking up at night or early in the morning with numbness or burning pain in the affected hand. Wristwatch bands and rubber gloves that previously were no problem to wear now tend to aggravate the symptoms. As the median nerve becomes more and more damaged, the problem worsens, and the hand becomes weak and clumsy. Eventually, if the problem goes untreated, the hand muscles will atrophy, and the hand will no longer be functional.

Treatment

If you feel you are already experiencing any of the symptoms of carpal tunnel syndrome, stop whatever activity is causing the problem. If the nerves are not damaged too seriously, the human body's enormous rejuvenative capacity may be able to heal the damage. However, there is a point beyond which the median nerve will not be able to heal. If your symptoms are mild, you may not need to seek medical help right away. First try taking an over-the-counter anti-inflammatory medication such as aspirin or ibuprofen, and rest the affected limb.

But if symptoms persist, get professional advice. Medical specialists who can help you include orthopedists, neurologists and occupational therapists. Experienced family doctors and internists can also help with initial management and evaluation of the problem. Treatment for mild to moderate cases of carpal tunnel syndrome involves splinting the wrists in a neutral position. There's also been some success with biofeedback techniques used in conjunction with splinting and medicines.

For some unlucky people, the swelling and inflammation from CTS become so bad the only way to save the median nerve is surgery. This involves slicing in half the fibrous tissue band that forms one wall of the carpal tunnel. This releases pressure in the tunnel and gives the median nerve a little more room. Unfortunately, this surgical procedure does not always guarantee full relief because the median nerve may have already been irreversibly damaged.

We as woodworkers need not only to protect our eyes and hands but also to pay attention to our wrists. In lieu of any miracle cures, prevention is the key to avoiding the discomfort and the debilitation that result from carpal tunnel syndrome. ☐

Dr. Kirk Kundtz is a physician in Cleveland, Ohio, and is an active woodworker.

Preventing CTS in the woodshop

Researchers have identified six primary factors known to contribute to carpal tunnel syndrome (CTS). Each factor is listed below, followed by preventive measures to help you steer clear of problems.

Repetition—Woodworkers who must perform jobs that take less than 30 seconds to do and are repeated for hours at a time are five times more likely to develop CTS. And when a repetitive job requires forceful hand and wrist exertion, such as clamping and unclamping panels, the risk jumps to 15 times greater than the norm. Some examples of repetitive tasks include planing,

***Keeping your wrist straight** will give you better control of a tool with less fatigue. Doing a repetitive job with a bent wrist puts undue strain on the wrist that can lead to CTS.*

Photos Sandor Nagyszalanczy

sanding and scraping by hand. The prolonged use of screwdrivers and wrenches can also cause problems.
Prevention: Avoid exerting your hands and wrists in a repetitive way over many hours. Consider swapping hand tools for power tools, such as power screwdrivers or power sanders (although these tools carry their own risk, which I will discuss later). You can minimize stress by keeping your tools sharp, taking breaks often and working on less hand-intensive tasks.

Poor wrist position—Whenever you grasp and use a tool with your wrist flexed up or down or side to side, the tendons in your carpal tunnel shift around radically. Improper wrist position during strenuous tasks, such as driving screws, many times each day can cause tendons to become inflamed and lead to carpal tunnel syndrome.
Prevention: Whenever possible, try to keep your wrist in a neutral position, as illustrated in the photo on p. 77. Switching to a tool with a bent handle instead of a straight one can correct wrist position, giving you better control with less fatigue. For bench work, such as sawing tenons or chopping mortises, secure the work at an appropriate height, so you're not twisting or flexing your wrists and hands excessively.

Put less stress on your tendons *by grasping tool handles with your whole hand (shown right) instead of pinching them (shown left). If you use the same tool for a long time, change your grasp occasionally, or wear gloves to act as padding.*

Padded gloves decrease the vibration *transferred from a power tool, such as a palm sander, to your hand. Excessive vibration can cause the wrist to become inflamed and, over time, develop carpal tunnel syndrome.*

Mechanical stress—When soft tissue, such as muscle, skin and blood vessels, is squeezed between bone and a hard object, such as a tool handle, the hands and fingers are strained. That can bring on tenosynovitis, a CTS-related disorder that leads to pain and swelling of the hand.
Prevention: Mechanical stress can be minimized by using tools with large handles or retrofitting existing tools with bigger grips. Try to select tools with well-padded handles (instead of bare metal) or that have rounded handles that do not dig into your palm. Also, never use the base of your palm to pound. Use a mallet or a hammer against a wood scrap instead.

Improper grasp—Holding a tool improperly stresses the underlying tenons. Holding a chisel or screwdriver with a pinching grasp places stress on the hand and wrist.
Prevention: Grasp tools with your whole hand instead of pinching them, as shown in the top photos at left, and change your grasp occasionally if you're using the same tool for a long stretch. Also, wear proper-fitting gloves to act as padding.

Vibration—Although it is not entirely clear how vibration affects the carpal tunnel, there is certainly no question that it does. Power hand tools introduce vibration directly to your hand and wrist, which can cause the wrist to become inflamed. The most notorious offenders are undoubtedly small orbital power sanders. Using them requires forceful exertion of the wrist, extremes of flexion, extension and deviation, repetitive movements, and they subject the user to excessive vibration.
Prevention: If you're not willing to switch to hand-sanding, wear padded gloves to decrease the amount of vibration transferred from the tool to your hand (see the photo at left). Anti-vibration gloves are available from Woodworker's Supply, 1108 N. Glenn Road, Casper, Wyo. 82601; (800) 645-9292. Also, try to limit the amount of time you use a vibrating power tool to short periods.

Cold temperatures—Working outdoors or in an unheated shop during winter contributes to carpal tunnel syndrome indirectly by numbing the hands and decreasing their ability to detect stresses.
Prevention: Try to work in a heated environment. If you must work outdoors, warm up your whole body before you go out, and take regular warm-up breaks. Wear mittens or well-fitting, insulated gloves. In lieu of these, at least wear a coat with knit cuffs to keep your wrists warm. *—K.K.*

Versatile Shop Storage Solutions

Wheels and wall cleats make for easy rearranging

by Joseph Beals

During the 10 years I worked in a cellar shop, I installed cabinets, drawers and open shelving wherever room allowed. The results were typical: I knew where to find everything, but there was little order to the method, and junk and dust were a chronic problem.

When I moved to a converted garage building, I left those built-ins behind. I packed tools, hardware and supplies into dozens of 5-gal. buckets, and I worked out of them for the next year until the new shop was at last functional. To avoid recreating the past, I designed a new storage system that remedies many of the usual irritations. I resolved to minimize any sort of generic storage that invites accretions of dust and junk. This meant little or no open shelving, no big drawers under the bench and no casual boxes or bins.

Finally, with the agony of moving so close behind me, I wanted a fully portable storage system. And I wanted a system that could be moved around easily.

***These movable cabinets** keep tools stored, on slide out shelves or in drawers, neat and dust-free. Casters make the base cabinets mobile while a cleat-mounting system allows the wall cabinets to be easily rearranged.*

Mobile cabinets

With these goals in mind, I built a set of floor and wall cabinets, as shown in the photo above, which offer exceptional utility in concert with a pleasing, traditional appearance; I also built special wall storage racks, as discussed in the box on p. 82. The floor cabinets are mounted on casters and incorporate a series of guide rails for shelves or drawers. The wall cabinets hang from simple wall-mounted cleats (see the photo at left on p. 83) and include integral dadoes to allow any combination of plain or purpose-built shelving. To cut costs, I built the cabinets from a variety of wood species using leftover stock and cutoffs, including quartersawn white oak, black walnut, mahogany, elm and cherry. All cabinets include paneled doors, ½-in.-thick birch plywood backs and straightforward joinery.

Building considerations

Many woodworkers rely upon detailed, measured drawings as the final design stage, but that's like committing a melody to manuscript without opening the piano for a trial run. Unless you have an extraordinary ability to assess light and shadow, mass, proportion and function on paper, you risk building a sterile, technocratic piece. Remember that a final measured drawing merely records the component dimensions of a functional, aesthetically pleasing prototype.

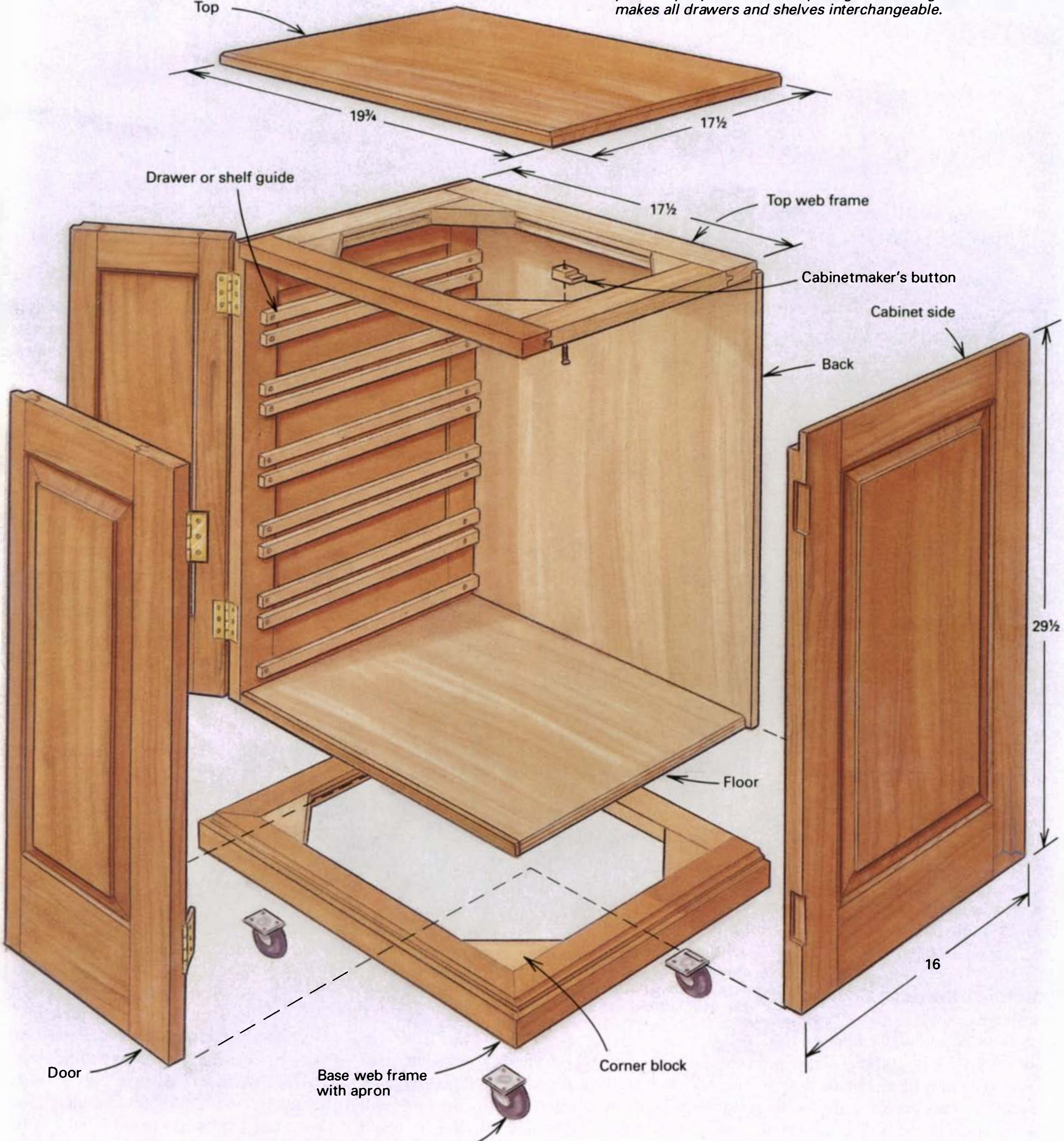
I used molded frames, raised panels and polished finish to create a display for clients visiting my shop, but there are many simpler options. Pine frames made on the tablesaw, router table or entirely by hand, together with ¼-in.-thick plywood panels and a paint finish are attractive and require no special tooling. A solid, flat panel, rabbeted around the perimeter to fit the frame grooves, is fully traditional and easy to make. If you are new to frame-and-panel work, these alternatives are a practical and satisfying introduction.

For a contemporary appearance, substitute plywood for frame-and-panel construction. Plywood cabinet sides can be grooved to house shelving or drawers, eliminating the guide rails required by a frame-and-panel carcase. Plywood has some drawbacks, however. A-C fir plywood is generally too crude for cabinetry, but ¾-in.-thick birch plywood, which is the least expensive alternative, will cost about $45 per sheet and is best suited for a paint finish. Also, exposed plywood edges must be banded for a good appearance, even under paint. Commercial banding veneers with a hot-melt adhesive are easy to apply, but shopmade solid edge-banding is more robust, and it looks better.

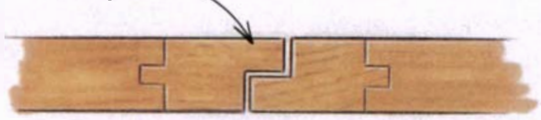
Photos: Charley Robinson

Fig. 1: Base storage cabinet

Mobile storage cabinets make it easy to rearrange your shop layout. Uniform spacing of drawer guides makes all drawers and shelves interchangeable.

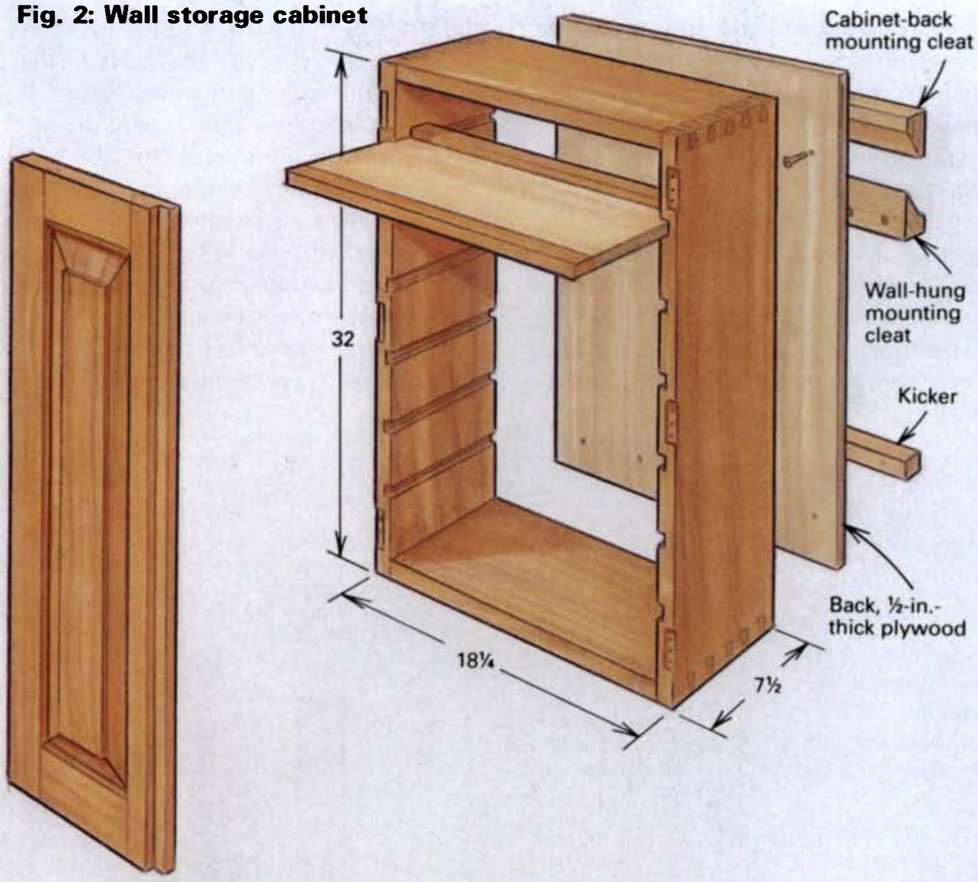


Door lap detail

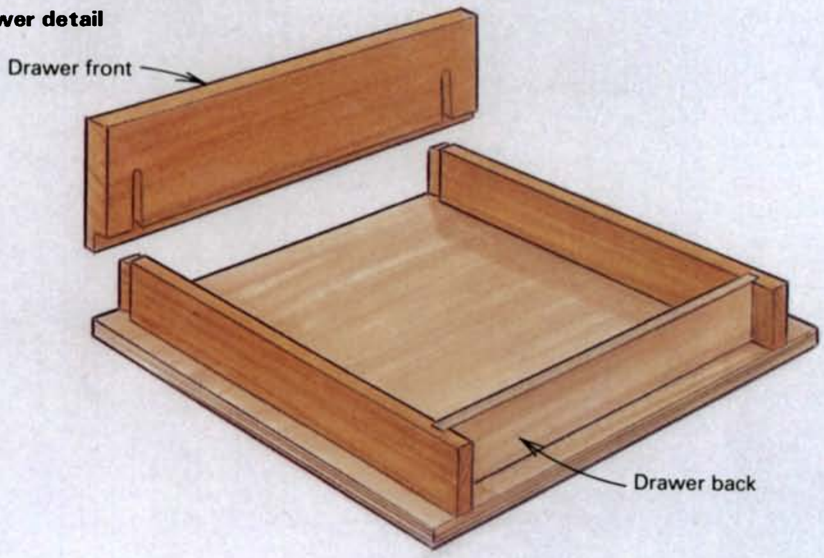


Drawings: Bob La Pointe

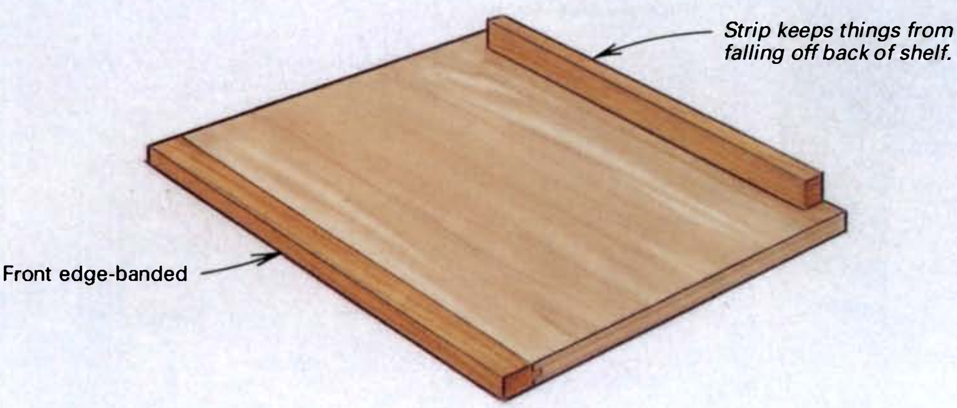
Fig. 2: Wall storage cabinet



Drawer detail



Shelf detail



Base cabinets

I built all the cabinets in multiples for maximum benefit of bench and machine time, but I'll describe the construction as if I were making only one of each, starting with a floor cabinet. I began with the frame-and-panel sides (see figure 1). The stiles are equal in length to the height of the frame, but stile and rail widths and the length of the rails, are determined according to personal preference and the method of joinery. Mortise-and-tenon joinery, for example, requires additional length on the rails for the tenons.

I used a matched set of cope-and-pattern cutters on the shaper to machine the frame, but there are many other equally suitable methods (see *FWW* #86, pp. 76-79). To ensure accuracy, I took panel dimensions off a dry-assembled frame. After preparing the stock, I wasted the bulk of the bevel on the tablesaw, then finished fielding the panel with a panel-raising cutter on the shaper. (For more on machining panels, see *FWW* #94, pp. 65-69.)

When the two sides were assembled and cleaned up, I used my shaper to cut a rabbet on the inside back edge to receive the plywood back and another across the inside top edge to house the upper web frame. Finally, I installed the maple drawer and shelf guides. The guide spacing is uniform, so any drawer will fit any space. And drawers and shelves are interchangeable, as shown in the bottom right photo on p. 83. To make this job accurate and quick, the guides are prepared in advance with counterbored screw holes and positioned with a series of spacers, as shown in the top right photo on p. 83. That ensures consistent, square placement. I load the screws into their holes, and run them in with production-line speed.

An upper web frame keeps the top of the carcase square, provides fastening for the solid top and an upper stop for the doors. Notice that the front member of the web is full length and is the only part that need be primary wood. For a run of several cabinets, using secondary wood for the sides, back and corner blocks can save an appreciable amount of stock. A lower web frame is the load-bearing part of the cabinet base. The lower web is exposed on the front and both sides with the two front joints mitered for a better appearance.

Both web frames are of traditional construction, as shown in figure 1. I used a shaper to machine the full-length grooves, and I cut the tongues on the tablesaw. I also splined the lower web miter joints for strength and convenience of positioning during assembly. To avoid juggling eight parts at once, the web frames are first glued without corner blocks. When the glue has set, the corner blocks are installed in a second operation.

A skirt on the front and sides of the lower web frame gives visual mass to the cabinet base and shrouds the casters. After the skirt is applied, I used a pair of cutters on the shaper to machine a simple reverse ogee (cyma reversa) molding detail on the front and sides, giving a graceful transition from the carcase to the base. Finally, a plywood shelf is affixed to the top of the lower web frame, with the front edge-banded with the cabinet's primary wood. The shelf provides a cabinet floor and positive positioning for the cabinet sides, and the front edge serves as a lower door stop.

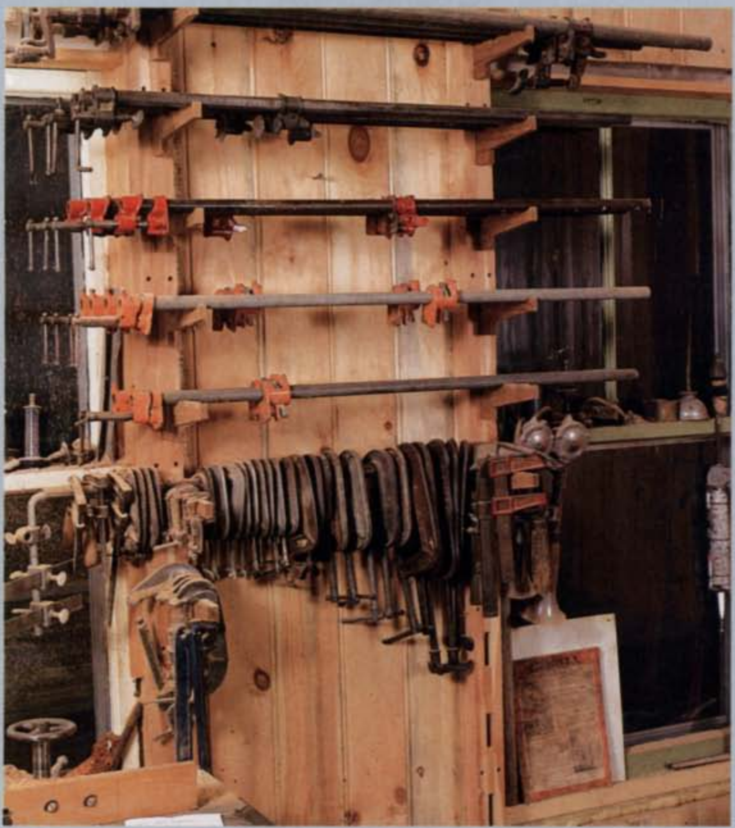
All the cabinet components are screwed together, so assembling the cabinet is quick and easy. The two sides are fastened to the lower web frame with screws driven up from below, just inside the skirt. The upper web frame is screwed down into the sides from the top and the plywood back is screwed into the rabbets that house it. I used no glue in the assembly, which makes it possible to take the carcase apart for any reason. I used shop-grade elm for a serviceable top on all floor cabinets. The tops are given a half-round profile on the front and sides, and they're fastened to the upper web frame with traditional buttons (see figure 1 on p. 80).

The cabinet shelves can be solid stock or sheet goods, as preference dictates. I used

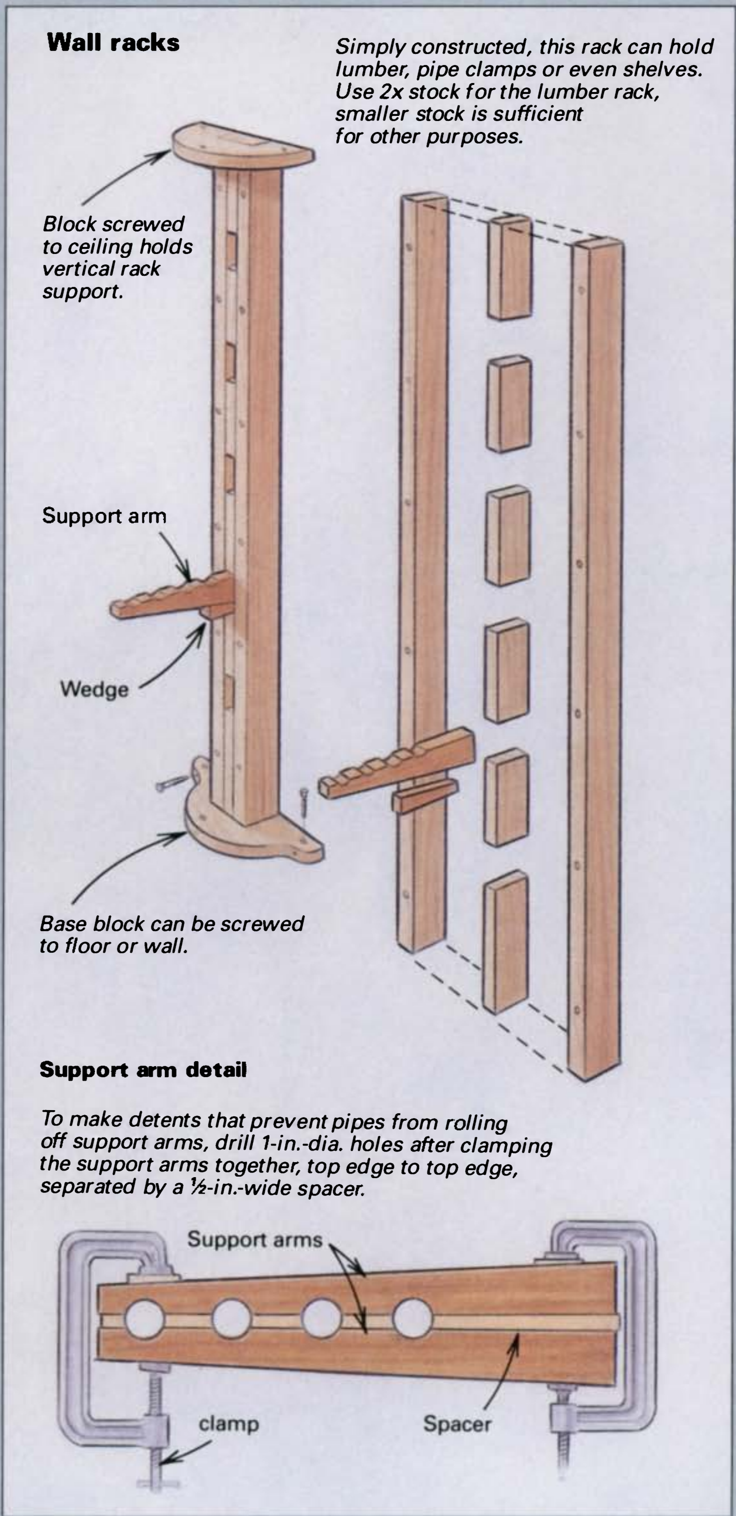
Wall racks for clamps, lumber or shelves

With tools and hardware stowed out of sight in the new cabinetry, I was still left with a pile of clamps along one wall and a stack of lumber on the floor. My solution to both these problems was the same, as shown in the photo below and the drawing at right. The lumber rack is of identical construction to the pipe-clamp rack but built with more substantial members.

The racks are easily built by sandwiching spacer blocks between two vertical pieces to create mortises that hold the support arms. The support arms are angled on their lower edges, and the wedges that hold the arms in place have a matching angle on their upper edges. To secure the support arm, slip it into the mortise, push the wedge into the mortise below the arm and tap the wedge into place with a hammer. The arms can hold clamps, lumber or even shelves for storing other small items.—*J.B.*



Wall racks for clamps *and lumber storage are easily made by sandwiching spacer blocks between a pair of vertical supports. Support arms slide into mortises and are secured with a wedge.*



Installing drawer guides (above) is done with production-line speed by drilling counterbored screw holes and positioning the guides with spacers.

Cleats allow cabinets to be moved—Strips ripped at 45°, one screwed to the wall and one to the cabinet back, (above) make it easy to rearrange cabinets. A kicker screwed to the cabinet back near the bottom makes the cabinet hang plumb.

Drawers and shelving are interchangeable because the guide spacing is uniform (right). Salvaged stock was used for the veneered drawer fronts.

½-in.-thick birch plywood, banded on the front to match the cabinet wood. The shelves pull out easily on the guides, and thin cleats glued to the back keep things from falling off the back edge.

To keep the design simple, I built the drawers as a box fastened to a shelf, as shown in the detail on p. 81. The two sides engage the front with sliding dovetail joints, and the front of the shelf fits in a rabbet on the drawer front. I screwed the sides and back to the bottom from below. The cabinet will hold six shallow drawers, but deeper drawers can be made by doubling or tripling the spacing module.

Building wall cabinets

Construction of the wall cabinets is simplicity itself (see figure 2 on p. 81). The solid carcase can be assembled in a variety of ways (see *FWW* #104, p. 75), but through-dovetails offer the strongest and best-looking joint. I cut all dovetails by hand, which took less than an hour for each cabinet. Before the carcase was assembled, I used a dado set on the radial-arm saw to cut six shelf dadoes in each side. Using steel shelf standards or a series of holes for shelf support-pins would provide a greater range of spacing options and a cleaner look, but my prior experience with these methods was unsatisfactory. A fully housed shelf never tips out nor does it require a store of mounting pins or brackets, which are typically missing at the moment of need.

Finally, I machined a rabbet on the inside back edges to house the plywood back. The rabbet is full length on top and bottom and is stopped a ¼ in. short of the ends on each side. I cut the rabbets on the shaper and cleaned the stopped ends with a chisel after the carcase was assembled. The back rabbet could also be routed with a bearing-guided bit or on a tablesaw. When the back is in place, a hanging cleat is fastened near the top (see the photo at left above), and a kicker is fitted near the bottom to keep the hung cabinet vertical.

Frame-and-panel doors

All cabinets are provided with a pair of narrow, paneled doors. A single-wide door might seem simpler, but the sweep can be awkward, especially on a floor cabinet in a restricted space. The doors are constructed like the floor cabinet sides and for appearance, have the same dimensional proportions of stiles and rails. Notice, however, that the two inside stiles are half width and give the appearance of a single, full-width stile when the doors are closed. The stiles are also half-lapped, as shown in the door-lap detail on p. 80, such that a single catch on the right-hand door keeps both doors closed. I cut the inside stiles wide to assemble the doors and machined the lap joint after assembly.

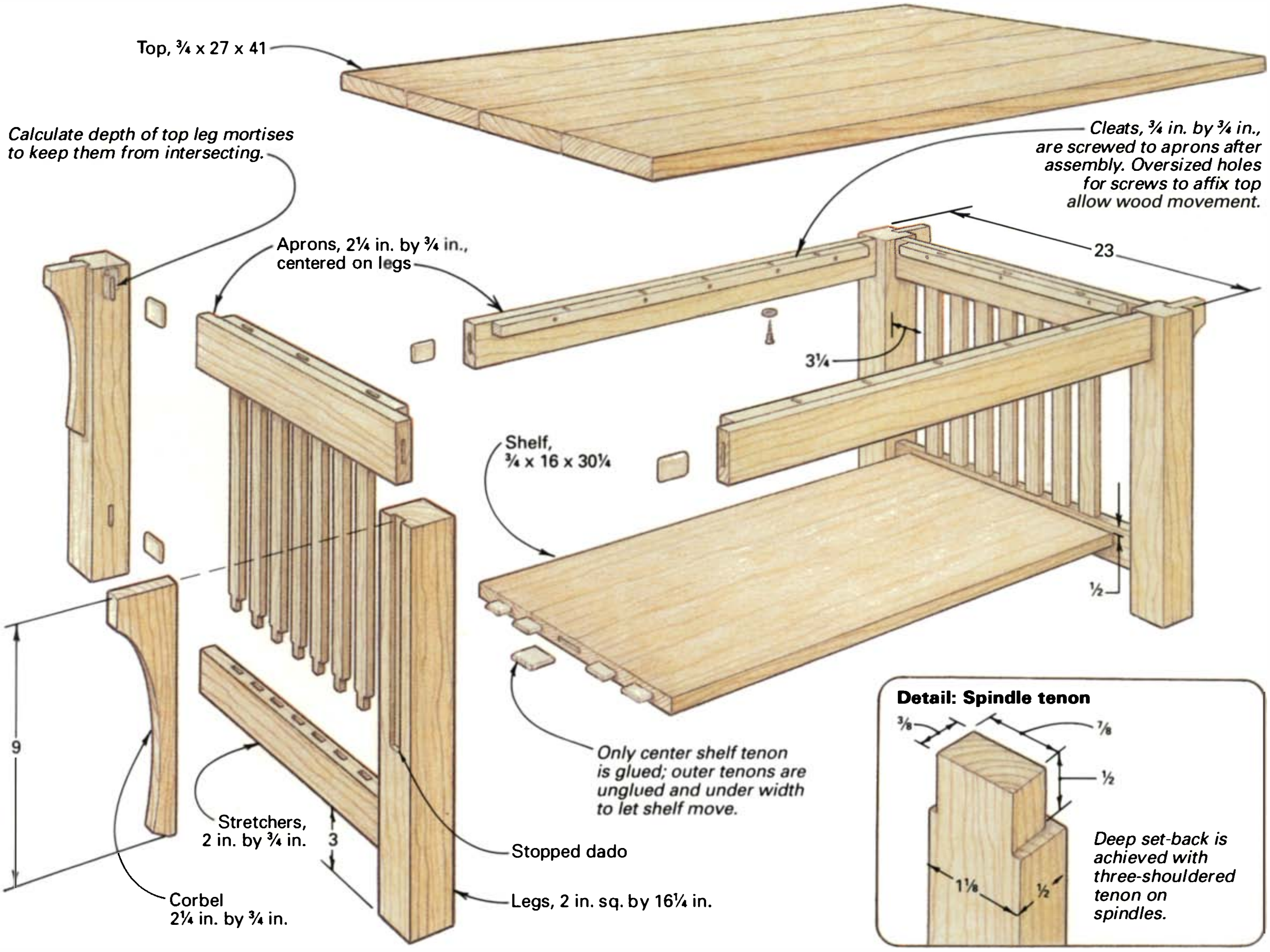
I used aniline dye to stain all but the cherry cabinet. Because cherry darkens so rapidly and dramatically, it is generally better not to color the wood under the finish. All cabinets received a half dozen coats of shellac, and after the last coat is well rubbed out, I applied a beeswax polish for a soft, lustrous finish. □

Joseph Beals is a builder and custom woodworker who lives in Marshfield, Mass.

Coffee Table Is Spare and Sturdy

Loose tenons simplify joinery

by Lars Mikkelsen



Ever since I started building furniture, I've taken pleasure in making the many different components in a piece and seeing them all fit together like pieces of a puzzle. As I progressed as a craftsman, the joints got better and more complex, and my enjoyment of the process increased. But making a lot of tight-fitting joints can be quite time-consuming and expensive, and most of my clients have tight budgets. They have come to me because they want something more than they can get in the department store, but they can't necessarily afford to have me spend a lot of time doing greatly detailed work. I often have to find ways to compromise while still aiming to produce beautiful furniture of sound construction. I look for ways to simplify, to use what tools and materials I can afford and to make limited resources grant handsome returns.

I recently had a challenge of this kind when a client approached me about making a coffee table. Together we settled on a basic table in the Craftsman vein (see the photo on the facing page) and a carefully trimmed budget for the job. Two hallmarks of Craftsman furniture are pinned through-mortises and legs coopered or veneered so quartersawn grain shows all around. But I decided to leave them out of my table, substituting the simplicity of loose-tenon joinery and solid-wood construction (see the drawing).

Drawing: Heather Lambert

Laying out lumber

I went looking for about 30 bd. ft. of quartersawn white oak. What I found was a few very rough boards that had turned quite black. After the first pass through my planer, I could see that the wood was not white oak. I was disappointed, but I kept on planing. What emerged was beautiful red oak of a variety I had never seen before. I decided it would suit my purpose well.

With the freshly planed boards arrayed on my outfeed table, I studied the grain and color to decide where the boards would be used to their best advantage. First I selected the boards for the top. These should be picked not only for their beauty but also with an eye toward having even color and straight grain along the edges, so they match well when joined together.

I needed four pieces for the top. I first crosscut them a few inches over length and arranged them as they would be joined. Next I marked a triangle across all four, so I could easily orient them. Then I arranged and marked the shelf boards and cut them to rough length.

I don't have a jointer, but with short boards like these, I can get good glue joints by ripping them a few times on the tablesaw, taking off about 1⁄16 in. with each pass and checking them for fit after each cut. For longer stock or waney-edged pieces, I clamp a straightedge to the board and joint it with a flush-trimming router bit.

***Simplicity simplified**—Lars Mikkelsen picked the functional Craftsman style for this low table and pared it down to its essence.*

Flat top

I glued up the top and shelf with pipe clamps, using ¾-in. dowels laid parallel to the boards as clamping blocks, as shown in the top left photo on p. 86. The dowels concentrate the pressure right in the center of the stock and minimize the clamps' tendency to tweak the boards up or down. I keep a stock of dowels of various diameters set aside for this purpose. I find it much easier to grab a pair of the correct size than to hunt down scrap or make up pressure blocks to the thickness of the workpiece each time.

After the glue had set, I beltsanded the slabs. I run my sander diagonally to flatten glued-up panels, feeling for the high spots and concentrating on them to attain a nice, flat surface. I start with a 100-grit belt, first sanding diagonally and then with the grain. Then I change to a 120-grit belt and sand with the grain only. People often complain that a belt sander is hard to control and easy to gouge with, but I have developed a good working relationship with my 3-in. by 21-in. Makita. With practice, you can gain the touch required to flatten a wide surface.

When the beltsanding is finished, I switch to a random-orbit sander and work through the grits, starting with 120 and moving on to 180 and 220. Then I hand-sand with a block and 220-grit paper to remove any slight swirl marks the random orbit may have left. On a relatively forgiving wood like oak, this step is my last, but with something hard and close-grained like cherry, I might finish up with 320-grit paper. Someone once asked me when you know you've sanded enough, and I told him, "You know you never have." There's always more you could do, but it's important to work methodically and take everything to the same level of finish. Instead of beltsanding, you could use handplanes to flatten the top and shelf or rent time on a big thickness sander.

Panels this wide cry out for a panel saw of some kind when it comes to crosscutting, but I don't have one. Instead, I clamp a crosscutting fixture square to the sides and cut one end with a hand-held trim saw, which is a small circular saw. When I had one end straight and square, I made the second cut on the tablesaw about ¼ in. longer than needed. Then I flipped the top around to make a finish cut on the trim-sawn end. I laid out the width so the two outside boards were roughly equal and ripped both sides. Using this method, I got good tablesaw cuts on all four sides with no tearout. A few strokes with a block plane were all that was needed to clean up the edges.

Building up leg stock

I glued up the blanks for the legs by sandwiching a piece of ½-in. stock between two ¾-in. pieces. I normally make legs from single sticks, but in this case, I couldn't obtain thick enough stock when I needed it. I took a lot of care with these laminations, matching the layers for color as well as grain orientation. When I was done, the joints were barely perceptible even under close examination. I ripped the twelve pieces for the leg blanks ¼ in. oversized in width and 5 in. oversized in length. The extra width gave me some leeway for slippage during the glue-up and for the final ripping to width. The extra length ensured that any snipe left by the planer in final thicknessing could be cut off.

I arranged the legs carefully, so matching grain would show on each side of the table. Then I held them together, and across the top end grain of the four pieces, I drew a single triangle. This quick marking method makes it easy to establish the orientation of a part at any point in the construction process.

Joinery

Loose tenoning is the method I use most often for making structural joints because it is strong and straightforward. Also called a splined mortise or floating tenon joint, the loose tenon joint is simply a pair of mating mortises with an independent tenon to span them. With a mortising fixture like mine, as shown in the bottom left photo on p. 86, the joints are easy to make. (For details on the construction and use of my jig, see *FWW* #92, p. 55.) Of course, you could also make the mortises by hand, on a router table or with a hollow-chisel mortising setup.

I make loose tenons from the same material as the table, so all seasonal movement will be the same. Just make sure the grain runs the length of the loose tenon. For this table, with 1-in.-wide mortises, I first ripped long strips 15⁄16 in. wide and 7⁄16 in. thick. Then I thickness-planed them to exact size, checking them every pass or two in a sample mortise until I got that wonderful feeler-gauge fit. If you have to use strength to pull the spline from the mortise, the fit's too tight; if there's no resistance, it's too loose. Making the tenons 1⁄16 in. undersized in width leaves room for ex-

Photos: Jonathan Binzen

***Dowels deliver clamping pressure** at the center of the board (right), and they keep the glue-up flat. The author keeps dowels of various diameters for gluing different thickness stock.*

***Offset tenons create a deep set-back.** For the gallery of spindles on narrow stock, the author offset the tenons, leaving out one shoulder (above).*

***Loose tenons need clean mortises**—Plunge-routing on a fixture like this shopmade one (left) produces crisp, uniform mortises for the loose tenons.*

cess glue and also gives you some welcome lateral adjustment in the glue-up. I rounded over the tenon edges on the router table and then cut them to length—⅛ in. shorter than the combined depth of the two mortises.

With all but the shelf and spindle joints cut, I dry-assembled the table. At this point, I measured between the stretchers to find the length of the shelf. This dimension could be calculated, but because even a slight misplacement of a mortise or variation in the thickness of the stretcher could throw everything off, I find it better to measure the length once everything else has been done.

I cut the shelf to size in the same way that I cut the top. It is attached to the stretchers with loose tenons, but only the center tenon is glued. The outer tenons, cut narrow by ⅛ in. and left loose, give the shelf room to move with changes in humidity while supporting it firmly.

The spindles are too small for loose tenons, so I tenoned their ends and cut mating square mortises in the stretchers and aprons. As I played around with the placement of the spindles, I decided that a ¼-in. set-back from the outside edge of the stretchers and aprons gave it the feeling I wanted. It's surprising what a difference ⅛ in. can make in places like this. If you pull the spindles up to the edge of the rails, you create a flat surface; if you push them in a bit, suddenly the spindles impart a feeling of structure and strength. Given the thickness of the stock I had, this decision meant cutting tenons with no shoulder on the outside face, as shown in the photo at right above. I could have used thicker material for the aprons and stretchers, but none was readily available. So to get the job done and to keep my expenses down, I worked with what I had. I cut the tenons with a dado set on the radial-arm saw.

I chopped mortises for the spindles on the drill press with a ⅜-in. mortising chisel. I wanted the mortises to be ¾ in. by ⅜ in., so I made a ⅜-in. spacer block, which I placed in front of a stop block on the fence. Once the stop block was clamped down at the right spot, I could make a mortise in two quick chops, one with the spacer block and one without. The sides of the mortises required a little cleanup with a chisel, but the ends, which are severed end grain and provide no glue surface, I left rough.

Corbels

With all the other parts milled and joints cut, I turned to the corbels. These curved supports, borrowed from architecture, are one of the elements that distinguish Craftsman furniture. In this case, they're not structurally significant, but like the deep set-back of the spindles, they lend the piece a sense of weight and solidity. Because I'd left out other decorative details, I wanted to get these right.

I started by making a template. I drew what I felt was a pleasing shape for the corbels on a ½-in. piece of plywood and cut it out with a jigsaw. To fair the curve and rid it of sawmarks, I used a technique I learned from a friend with boatbuilding experience. I folded sandpaper around a ⅟16-in.-thick sliver of wood, as shown in the top photo below. The sliver conforms to the curve, riding over low spots and cutting the high spots. If the initial cut is reasonably true, this quickly produces a perfectly fair curve. Then I used the piece of plywood as a template to shape the corbels. I first jigsawed the corbels a bit too large and then nailed the template to them with a couple of brads placed in the edge that would be let into the leg. By running the template against a flush-trimming bit in the router table (see the bottom photo below), I quickly produced identical copies.

The corbels fit into the leg with a stopped dado, which I cut on the tablesaw using a stacked dado blade. I set the fence to position the dado in the center of the leg and clamped a stop block to the fence so that the cut would stop exactly where the corbels end. When the leg hit the stop block, I turned the saw off, waited for the blade to stop and removed the leg. It is quite easy to finish the stopped dado with a chisel.

Assembly

The corbels were the last parts I made. When they were finished, my favorite moment had arrived—the time for dry-assembly. If all the joints are just right, dry-assembly is a joy to do as everything snaps together and holds tightly without clamps. In this case, I could lift the whole assembly by one leg without anything coming apart. This little act gave me a thrill and impressed my client, who happened to have stopped by my shop at just that moment.

Before final assembly, I block-sanded everything and eased all the edges. Some sanding will always be needed after glue-up, but it is easier to do the bulk of it beforehand when all the pieces lie flat and all their faces are easy to reach.

I did the assembly in stages, first gluing up each end and later linking them together. I started the glue-up by fitting one set of spindles into their stretcher and apron mortises. As soon as these joints were pulled tight, I glued the apron and stretcher to the legs. It's important to square this subassembly by measuring the diagonals with a tape. And I made sure the legs ended up in the same plane by sighting across them. By gluing all this in one operation, I prevented the possibility of having a skewed spindle assembly that would not fit neatly into the legs.

When the glue dried, I glued the two side aprons and the shelf between the end frames. I did this on a flat surface, checking the diagonals again to make sure the table ended up square and making certain all four legs were solidly on the surface. Sometimes a clamp or two must be skewed a bit to achieve this and to ensure the table will not rock later on.

I attached the top with cleats screwed solidly to the apron. To accommodate seasonal movement of the top, I drilled oversized holes up through the cleats and pulled the top tight with pan-head screws fitted with washers.

The finishing touch

For the finish, I applied three coats of Antique Minwax. I rubbed in the final coat with fine steel wool and immediately wiped it off, leaving a beautifully smooth finish that, with occasional reoiling, will only get more beautiful with time.

This table was my first effort in the Craftsman style. I had originally suggested this style to my client because I felt that it would fit the decor and because it stands up so well to heavy use. But while building the table, I came to appreciate the honesty with which design and construction are related in Craftsman work. There is no unnecessary ornamentation—sound structural components make the design. □

Lars Mikkelsen is a furnituremaker in Santa Margarita, Calif.

***Shaping corbels**—The author takes down the high spots on the corbel template's jigsawn curve with sandpaper backed by a flexible stick (above).*

***Corbel copies**—A plywood template on the router table (left) is used to flush-trim the corbels.*

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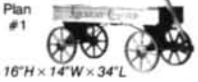
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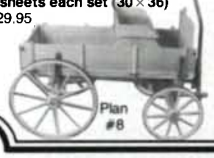
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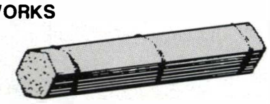

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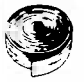


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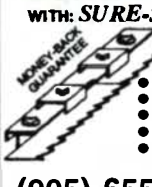

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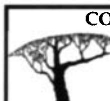

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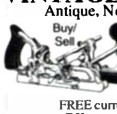

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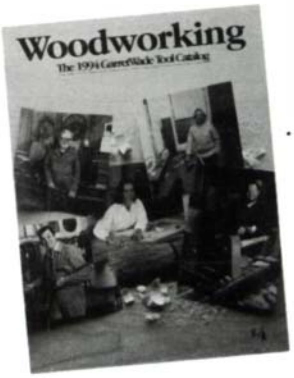

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11-950	8" Drill Press	199	144
28-160	10" Hobby Band Saw	210	145
31-050	1" Belt Sander 2.0 amp	104	78
31-460	4" Belt\6" Disc Sander	198	135
31-340	1" Belt/8" Disc Sander	268	204
31-080	1" Belt/5" Disc Sander	134	94
40-560	16" 2 speed Scroll Saw	266	178
11-990	12" Bench Drill Press	276	205
11-090	32" Radial Bench Drill Press	399	285
43-355	3/4" Shaper 1-1/2 HP	964	709
43-505	1/2" Bench Router/Shaper	399	275
22-540	12" Bench Top Planer	595	398
36-220	10" Compound Mitre Saw	350	235
14-650	Hollow Chisel Mortiser	668	289

NEW TOOLS BY DELTA

33-060	NEW "Side kick" Miter saw	510	365
14-070	NEW 14" Floor Drill Press	450	345
28-180	NEW Bench Band Saw	232	165
40-640	NEW 20" Bench Scroll Saw	466	305
28-190	NEW 12" Band Saw	465	375
50-075	NEW Dust Collector/Sweeper 3/4 HP	360	245
20-150	NEW 14" Cut-off Saw	375	219
36-090	NEW 10" Sidekick Miter Saw	293	214
37-070	NEW 6" var. speed Bench Jointer	337	248

DELTA STATIONARY

34-444	Table Saw complete with 1-1/2 HP motor & stand	812	615
22-661	13" Planer with 2 HP motor	1513	1168
	Planer has $75.00 rebate-price shown is before rebate		
28-245	14" Band Saw w/open stand 1/2 HP.	719	555
17-900	16-1/2" Floor Drill Press	462	389
40-601	18" Scroll Saw w/stand and blades.	1003	745
34-080	10" Mitre Box	Xtra Special	198
34-761	10" Unisaw 1-1/2 HP	1715	1359
33-990	10" Radial Arm Saw	818	615
37-280	6" Motorized Jointer	488	395
50-179	3/4 HP 2 stage Dust Collector	483	335
50-181	2 HP Dust Collector	885	618
70-200	20" Floor Drill Press	1049	815
46-700	12" Wood Lathe	548	439
33-055	8-1/4" Sawbuck comp with legs	865	595
34-330	8-1/4" Table Saw 13 amp	343	234
36-540	10" Table saw	210	168
34-670	10" Motorized Table Saw	511	395
32-100	Stationary Plate Jointer	645	249
36-040	8-1/4" Compound Mitre Saw	224	155
34-915	30" Unifence	385	239
34-897	50" Delta Unifence	525	285
36-755	10" TiltArbor Saw	1264	939
36-380	10" Table Saw	550	415
33-890	12" Radial Arm Saw	1829	1385
14-040	14" Bench Drill Press	382	335
28-560	16" Three Wheel Band Saw	457	410
37-154	DJ15 6" Jointer with 3/4 HP motor	1451	1089

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34-445	34-444 Saw with 30" unifence	1200	775
34-445B	34-444 w/Beis. 50" Comm saw fence	1300	889

NEW DEWALT TOOLS

DW944K	3/8" 9.6V cdls drill kit w/cse & 2 batt	283	149
DW945K	3/8" 12V cdls drill kit w/cse & 2 batt.	309	169
DW364	7-1/4" Circ. Saw w/brake, 13 amp	285	148
DW306K	8.0 amp Recip Saw w/case var. spd	291	155
DW610	1-1/2 HP 2 handle Router	274	148
DW411	1/4 sheet Palm Sander, 1.7 amp	97	58
DW705	12" Compound Mitre Saw	706	358
DW704	12" Mitre Saw	570	298
DW100	3/8" Drill, 4 amp. 0-2500 rpm, rev	118	68
DW250	4.5A Drywall Gun, 0-4000 rpm. rev.	169	88
DW254	4.5A Drywall Gun, 0-2500 rpm, rev.	169	88
DW402	4-1/2" Grinder 6 amp	158	94
DW682K	New Biscuit Joiner with case	429	225
DW614	NEW 1-1/4 HP Plunge Router	250	144
DW615	NEW 1-1/4 HP Elec. Plge Router	290	158
DW624	NEW 3 HP Plunge Router	441	245
DW625	NEW 3 HP Electronic Plge Router	511	269
DW675K	NEW 3-1/8" Planer with case	289	159
DW430	NEW 3 x 21 Belt Sander	291	165
DW431	NEW 3 x 21 var. speed Belt Sander	331	182

SKIL SIZZLERS

3810	10" Mitre Saw	359	205
77	7-1/4" Worm Drive Saw	257	144
5825	6-1/2" Worm Drive Saw	257	158
2735-04	12 volt cordless Drill Kit	249	132
2736-04	2735-04 with keyless chuck	269	135
1605-02	NEW Biscuit Jointer with case	221	129
5510	5-1/2" Circular Saw	166	110
5660	NEW 8-1/4" 60° Circular Saw	234	144
5860	NEW 8-1/4" 60° Worm Saw	282	169
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5657	NEW 7-1/4" Circ Saw - pivot foot	205	118
5525	NEW 6-1/2" Circ Saw - big capacity	173	98
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3330	16" Scroll Saw - Bench Top	205	135
3370	4" Belt/6" Disc Sander - Bench Top	205	135

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8030	New 3/8" variable speed Drill	250	139
8000	3/8"v/sp close quarter Drill 0-1300rpm	201	123
8005	Same as 8000 but is 0-2500rpm	200	134
690	5" Air Random Orbit Sander	139	132
690VV	690 w/venturi dust collection	281	175
658	5" Air Random Sander - dual action	261	155

JORGENSEN STYLE 35 ALUMINUM BAR CLAMPS

Model	Size	List	Sale	Lots of 6
3524	24"	31.38	17.45	99.45
3536	36"	33.66	18.65	106.25
3548	48"	36.97	20.59	117.35
3560	60"	41.19	22.99	129.95
3572	72"	44.52	24.95	142.00

JORGENSEN ADJUSTABLE HANDSCREW KITS

Model	for Jaw Length	List	Sale	Lots of 6
J-06	6"	9.05	5.55	32.15
J-08	8"	10.16	6.19	35.45
J-10	10"	11.89	8.95	50.99
J-12	12"	14.73	10.55	59.39

JORGENSEN ADJUSTABLE HANDSCREWS

Item#	Jaw Length	Opening Capacity	List	Sale	Box of6
#5/0	4"	2"	14.34	8.35	48.59
#4/0	5"	2-1/2"	15.40	8.95	51.99
#3/0	6"	3"	16.53	9.59	55.75
#2/0	7"	3-1/2"	17.75	10.35	58.95
#0	8"	4-1/2"	19.76	11.75	58.00
#1	10"	6"	22.63	12.50	68.00
#2	12"	8-1/2"	25.95	14.50	78.00
#3	14"	10"	32.88	18.00	99.00
#4	16"	12"	42.76	23.95	139.00

JORGENSEN STYLE 37 2-1/2"Throat 1/4"x3/4"

Item#	Jaw Length	List	Sale	Box of 6
3706	6"	10.67	6.05	32.50
3712	12"	11.82	6.50	35.10
3718	18"	13.04	6.99	37.75
3724	24"	14.25	7.99	42.50
3730	30"	15.88	8.85	47.75
3736	36"	17.36	9.99	53.95

STYLE 36 - STYLE 37 CLAMP W/E-Z HOLD

Item#	Bar Length	List	Sale	Box of 6
3606	6"	18.96	11.75	65.95
3612	12"	20.11	12.49	69.95
3618	18"	21.95	13.65	76.95
3624	24"	27.08	15.45	85.95
3630	30"	29.42	16.85	95.95
3636	36"	35.09	18.25	103.95

JORGENSEN STYLE 45 5" Throat 1-3/8" x 5/16"

Item	Jaw Length	List	Sale	Lots of 6
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4518	18"	34.97	20.45	116.99
4524	24"	37.02	21.75	123.99

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7236	36"	36.88	17.99	103.00
7248	48"	40.54	19.99	114.00
7272	72"	46.64	26.79	149.95

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3338	2-1/4 HP var. speed Plunge Router	501	249
3304	1 HP variable speed Plunge Router	307	164
3375	3-1/8" Univ. Planer 7.2 amp	329	155
3380	Biscuit Jointer with case	569	185
4024	3 x 21 variable speed Belt Sander	338	179
3339	NEW 3 HP var. spd Plunge Router	511	265

BLACK & DECKER

1166	3/8" Drill 0-2500 rpm 4 amp	118	65
2600	3/8" Drill 0-1200rpm 4.5 amp	167	92
1703-1	10" Mitre Saw with 73-770 blade	344	188
4011	1/4 sheet Palm Sander	86	59
79-034	Workmate 400	184	109
1349-09	1/2" Timberwolf Drill 2 speed	551	295
1180	3/8" Drill rev. 0-1200 rpm 5 amp	207	108
2037	Drywall Gun 0-4000 5.0 amp	184	98
2038	Drywall Gun 0-2500 rpm 5 amp	184	99
3157	Orbital var spd JigSaw 4.5 amp	263	145
2665K	NEW 3/8" cdls 12V Cyclone Drill	294	158
5045K	MACHO Rotary Hammer Drill	813	419
5071	3/8" Hammer Drill with case	259	139
5073	1/2" Hammer Drill with case	311	169
2054	Tek Gun 0-2500 5.0 amp	287	152
2660	Drywall Gun 0-4000 4.5 amp	149	78
1321	1/2" Spade hdle Drill 450 rpm 7 amp	320	182
2750	4-1/2" Grinder 10.000 rpm 6 amp	156	83

2694	7-1/4" Super Sawcat Circ Saw w/cse	285	152
2695	8-1/4" Super Sawcat Circ Saw w/cse	328	162

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73-756	6-1/2	36	29.80	16.85
73-717	7-1/4	18	14.60	7.99
73-737	7-1/4	24	18.06	9.29
73-707	7-1/4	35	28.02	15.85
73-757	7-1/4	40	32.87	16.89
73-718	8	22	20.95	10.95
73-758	8	40	42.70	24.25
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73-739	9	30	31.34	17.50
73-710	9	45	63.57	35.95
73-769	9	60	76.39	39.89
73-704	7-1/4	18	22.05	11.59
73-740	10	32	34.63	17.95
73-770	10	60	70.37	33.95
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D1220-2	20'	17'	27#	135.95
D1224-2	24'	21'	33#	159.95
D1228-2	28'	25'	42#	185.95
D1232-2	32'	29'	53#	209.95
D1236-2	36'	32'	62#	239.95
D1240-2	40'	35'	73#	298.95

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D1316-2	16'	13'	26#	127.95
D1320-2	20'	17'	32#	152.95
D1324-2	24'	21'	39#	169.95
D1328-2	28'	25'	50#	199.95
D1332-2	32'	29'	62#	229.95
D1336-2	36'	32'	77#	299.95
D1340-2	40'	35'	85#	329.95

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D1520-2	20'	17'	37#	169.95
D1524-2	24'	21'	45#	199.95
D1528-2	28'	25'	56#	219.95
D1532-2	32'	29'	66#	259.95
D1536-2	36'	32'(250# rating)	79#	309.95
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FIBERGLASS FLAT STEP TYPE 1A- 300# RATING EXTENSION

D6116-2	16'	13'	34#	179.95
D6120-2	20'	17'	40#	199.95
D6124-2	24'	21'	53#	239.95
D6128-2	28'	25'	60#	269.95
D6132-2	32'	29'	74#	309.95

FIBERGLASS FLAT STEP TYPE 1A- 300# XTRA HEAVY DUTY EXTENSION

D7116-2	16'	13'	37#	209.95
D7120-2	20'	17'	43#	245.95
D7124-2	24'	21'	58#	279.95
D7128-2	28'	25'	66#	309.95
D7132-2	32'	29'	79#	369.95

Buy any 3 ladders(can be asst) deduct additional 5% Prepaid Freight and best prices too!

AEG POWER TOOLS

Model	Description	List	Sale
HBSE75S	3 x 21 variable speed Belt Sander	309	168
ABSE15S1	1/2" cdls 12 volt Drill complete w/cs	403	174
FSPE100X	NEW Barrel Grip v/spd Jig Saw	274	165
BSPE100	NEW Top Hdle v/sp Jig Saw w/cs.	286	165
TXE150	New 6" var/spd Rand Orb Sander	304	139
SKS300	NEW 10" Compound Mitre Saw	1019	499

HITACHI TOOLS

C7SB	7-1/4" Circular Saw	233	125
C7BD	7-1/4" Circular Saw with brake	258	135
M12V	NEW 3 HP variable speed Router	476	239
TR12	Plunge Router 3 HP	389	188
F1000A	12" Planer/6" Jointer	2970	1549
P12R	12-9/32" Planer	1470	759
P12RA	Planer/Joiner	1940	979
C12FA	12" Mitre Saw	625	315
C8FB	8-1/2" Slide Compound Saw	1400	599
P20SB	3-1/4" Planer 3.4 amp	179	95
G12SA	4-1/2" Grinder 6.9 amp	160	89
DS10DVAK	12 volt Cordless Drill Kit w/2 batt	393	199
NR83A	Framing Nailer 2 - 3-1/2 Full Head	700	385
NR83AA	Framing Nailer 2 - 3-1/2 Clip Head	750	409
NT65A	16 ga. Brad Nailer 1 - 2-1/2	610	318
NT45A	18 ga. Brad Nailer 13/16 - 1-3/4	490	269
NV45AB	Coil Roofing Nailer 7/8 - 1-3/4	750	395
NV83A	Coil Nailer 2 - 3-1/4	750	409
NV50A1	Coil Nailer 1-1/4 - 2	564	305
N5008AA	7/16" Stapler - 16 ga. 1 - 2 lgth	580	315
N3824A	1" Stapler 16 ga. 1/2 - 1-1/2	630	345

WAGNER PAINT & SPRAYER PRODUCTS

120	Power Sprayer	70	57
CP	Cordless Painter	100	79
230HD	Power Painter/Sprayer	100	84
959	Power Roller	140	105
255	Airless Kit	180	130
375E	Airless System	195	155
404	Airless Painter & Roller	320	249
505	High performance Airless Painter	440	369
550	Professional Airless Painting System	769	685
HVLP	Fine coat finishing HVLP System	195	155
CS2000	Professional fine finsih HVLP System	339	269

DREMEL TOOLS

3950	Moto Tool Kit with bits & case	134	79
3952	Super Moto Tool Kit with accessories	152	95
1671	16" Scroll Saw - 2 speed "Best buy"	302	174
1695	NEW 16" var. speed Scroll Saw	408	224
290	Electric Engraver with point	25	16
8508	Cordless Moto Tool Kit with case	109	64
1731	5" Disc\1" x 30" Belt Sander	189	114

DAVID WHITE INSTRUMENTS

LP6-20	Sight Level package - 20x	310	198
LP6-20XL	LP6-20 w/9056 tripod & 7620 rod	375	259
L6-20	Meridian Level - 20x	290	185
LT8-300	Level Transit - 26x	695	445
LT8-300P	above Level with optical plum	821	518
LT6-900	Level Transit - 20x	389	249
LTP6-900	Above Level with tripod & rod	601	369
ALT6-900	Automatic Level - Transit - 18x	638	389
ALTP6-900	above Level with tripod & rod	708	459
AL6-18	Automatic Level - 18x	449	315
ALP6-18HD	above Level with tripod and rod	570	375
ALP8-20	NEW Automatic level 20x with tripod & rod	710	539

QUAL-CRAFT JACKS

2200	Pump Jack	79	58
2201	Pump Jack Brace	30	20
2203	Pump Jack guard rail holder	31	21
2204	Work Bench & rail holder combo	53	39
	Buy any 6 (can be assorted) deduct additional 10%		
2601	Wall Jack	167	108
	Lots of 4 deduct additional 10%		

PASLODE IMPULSE GUNS

Model	Description	List	Sale
IM250	Trimpulse Finish Nailer Kit complete drives 3/4" - 2-1/2" brads	849	595
IM325	Impulse Framing Nailer Kit complete drives 2" - 3-1/4" nails	849	595
IM-200-S16	impulse Siding Stapler	849	629
402500	Extra battery		Sale 38.95

Paslode Nailers not available in MN, WI, IA

SENCO AIR NAILERS

SFN1	Finishing Nailer 1" - 2"	448	269
SFN2	Finish. Nailer 1-1/2" - 2-1/2"	571	375
SN325	Nailer 1-7/8" - 3-1/4"	665	425
SLP20	NEW Pinner w/case 5/8" - 1-5/8"	399	269
SKS	Stapler 5/8" - 1-1/2"	390	245
M2	Stapler 1/16" wide - 1-3/8" - 2" length	535	345
SN70	NEW HD Framing Nailer 2" - 3-1/2"	690	475

Not available in all states

EXCALIBUR Fences & Tables

Model	Description	List	Sale
TT45R24L9	24" Fence	369	299
TT45R50L12	50" Fence	399	318
EXSLT30	Sliding Table	599	475
EXSLT60	Sliding Table	745	585

RECORD WOODWORKING VISES

Model	Jaw Width\Opening		List	Sale
53E	10-1/2"\15"	Quick release	199	125
52D	7"\8"	Quick release w/dog	137	85
52-1/2D	9"\13"	Quick release w/dog	186	125

REMINGTON POWER FASTENING TOOLS

Model	Description	List	Sale
75707	476 Power Hammer with case	35	28
77550	480 Power Driver with case	169	104
78480	482 Multi Driver with case	369	235

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READER SERVICE NO. 63


Photo: Kate Morris

Three sanders in one—Delta's Sanding Center puts stationary belt, disc and pneumatic drum sanders in one station. A heavy-duty 1½-hp motor powers the unit.

Delta Sanding Center

Most woodworkers—myself included—consider sanding a necessary evil. I try to do as much with my power saws, jointer, planer and sharp hand tools as I can. Then I slog through the sanding, wishing there were a better way.

Much of my dislike for sanding is really a distaste for inferior or inadequate sanding equipment. I've often thought that the ideal machine for a small shop would be a belt/disc sander with provision for arbor-mounted accessories. It would include a pneumatic drum that inflates to sand compound curves and irregularly shaped pieces. My labor-saving, drudgery-eliminating dream machine would also have a slower motor, so the wood would not burn. And it would cost less than big industrial machines.

Now I can stop dreaming and start sanding. Last fall, at the Woodworking Machinery & Furniture Supply Fair in Anaheim, Calif., Delta introduced the Sanding Center (Model 31-280), as shown in the photo above. It's a U.S.-made belt/disc sander with cast-iron tables (and platen, for the belt sander); a stamped-steel stand; and a 1½-hp induction motor that turns the disc at 2,500 rpm, nearly a third slower than most of the imports. Belt size is 6 in. by 48 in., and the machined and balanced disc is 12 in. across.

A power take-off spindle opposite the disc accepts either of two optional adapters (½-in. or 1-in. arbor) on which you can mount an inflatable sanding drum, abrasive flap, mop, flutter or buffing wheels, as well as a flexible shaft. Other options include a fence for the belt sander; an extension table and three pivot pins for sanding circles; a dust-collection tray, which surrounds the bottom half of the pneumatic drum; and a mobile base. An integral dust hood under the table has a 4-in. connector for hooking up to a dust-collection system. The hood catches virtually all of the dust coming off the belt and the disc.

The price of the Sanding Center starts at around $750 to $800, but if you add in all of the options, you're up over $1,600 (assuming a 25% discount off list). That's a lot of money, and this is not as heavy-duty as the industrial machines. But for a home shop or for a small professional furniture-making operation, it will do quality work, and its array of accessories make it much more versatile than even the best of the standard belt/disc sanders. The Sanding Center may not take you to sanding nirvana, but it could make you more efficient, cutting your sanding time considerably. And that's no mean feat. The Sanding Center is available through Delta's dealers and through many of the larger mail-order companies. *—Mark Duginske*

Tilting router table

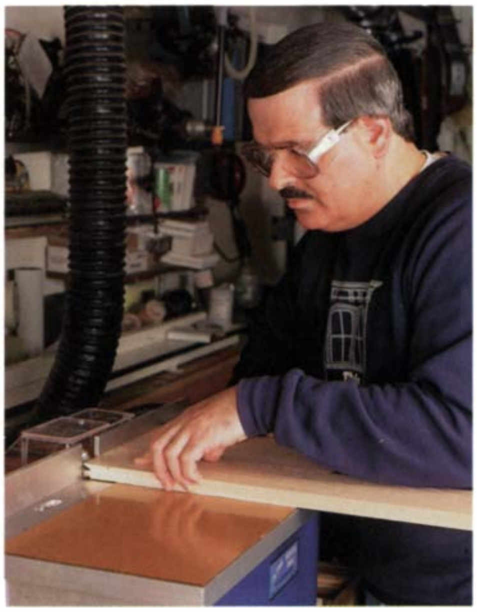
A recently introduced router table, CFW Engineering's T-090, puts a new slant on routing. The rear portion of the table, to which you mount the router, pivots from 0° to 90°. What's so great about that? Well, what it means is you can use a vertical panel-raising bit positioned horizontally (90° to the tabletop) and run your panel over the bit on the flat. You don't need any special jigs or high fences to get the panel to ride evenly over the bit. Increased safety and accuracy are the result.

More significantly, it's possible to achieve a virtually limitless number of profiles from a single bit because you can tilt the router to any setting between 0° and 90°. Adjusting the crossfeed (crossfeed travel is 3 in.) to vary bit depth adds to the possibilities. If you like a particular profile, you can accurately duplicate it later by recording the angle on the protractor scale and the depth reading on the crossfeed. Using this router table with a router that features a micro-adjuster will allow you to fine-tune tricky router operations such as matching cope-and-stick joinery and achieving perfect rule joints quickly and easily (see the photo at right).

The router table's top is made of phenolic-laminated medium-density fiberboard surrounded by an aluminum-angle frame. It sits atop a sheet-metal base with a baked-on enamel coating. The unit comes with a combination clear plastic guard and dust-collection fitting, which accepts a 3-ft. length of 2½-in. hose (included). The hose hooks up to a standard shop vacuum. An extruded aluminum fence adjusts laterally to vary the opening from 1 in. to 3¼ in., depending on the size of the bit you're using.

I had the opportunity to use this router table in my shop for several weeks. The table did everything the manufacturer said it would and did it well. Its only drawbacks are minor, but worth mentioning.

There is no on/off switch on the machine, so you have to reach around back, up and inside the table to turn your router on. A foot switch is a viable option, but a



Versatile router table—CFW Engineering's new tilt-top router table allows you to create different molding profiles by varying bit angle and depth. The table also permits horizontal router mounting.

Photos except where noted: Vincent Laurence

MICRO FENCE

TM PATENT PENDING

The micrometer-adjusted router edge guide that affords .001" readout accuracy with handheld routers. Minimizes set-up time. Eliminates the need to purchase odd-sized or seldom used bits. "Lifetime Tool" construction of stainless steel, brass and anodized aluminum. Easy to read, laser-etched micrometer dial. Light-weight. Fully warranted. Now available to fit most Porter-Cable, Bosch, Makita, Hitachi, Milwaukee, DeWalt, B'& D and Elu routers and laminate trimmers. For free brochure and ordering information, write Micro-Fence, 11100 Cumpston St. #35, North Hollywood, CA 91601 or call 818-766-4322.

*See more about MICRO FENCE on page 110, FWW, #105.

MICRO FENCE

READER SERVICE NO. 92

ULTIMATE SAW FENCES

Vega's new Utility Model Saw Fence upgrades your saw with all the great features of the Professional Model at a more affordable price. You will be amazed at the accuracy, ease of installation, and useful accessories available for these fences.

- Exclusive Micro Adjust-allows setting to .001"
- Precision alloy head-glides on a massive hard chrome tube.
- Precision Fence Bar-black anodized aluminum for extreme hardness and durability.
- Optional accessories include Finger Saver, Stock Feed System, Laminate Cutting Guide and Leg Sets.

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READER SERVICE NO. 16

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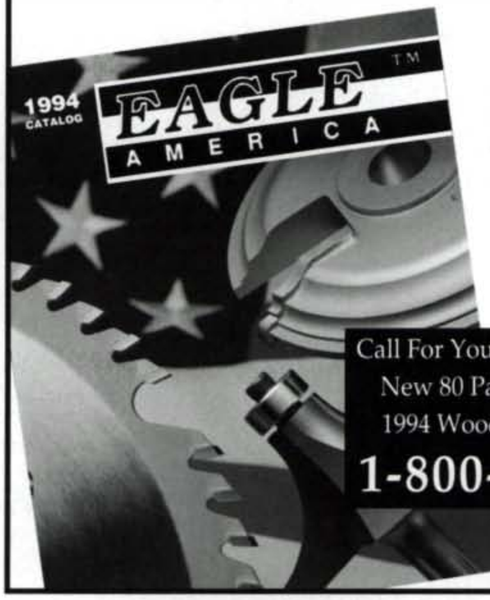
At **Eagle America** our first commitment is to bring you high quality American Made cutting tools and accessories at affordable prices. Whether it's our American crafted router bits, shaper cutters or saw blades everything we sell is backed by our 100% Satisfaction Guarantee.



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"NO GEN. PURPOSE BLADE PRODUCED BETTER RESULTS than the FORREST 40 tooth Woodworker II. Install and leave it for plys & woods to 1 ½". W. Krier. Outperformed 36 other PREMIUM blades in WOOD Mag. test P. 45, Sept. 93. **Save $15**

Get 3 - $5 sharpening discount coupons on FORREST or other make carbide blades or dados if ordering before Feb. 28, 1994. Mention FWW for another EXTRA BONUS.

WOODWORKER II - TABLE-SLIDE & CHOP MITERS (gen. prps.) & small PORTABLES (Skil, etc.)

Things you asked us for:

With this ONE ALL PURPOSE blade (40 Teeth) youcan SMOOTH RIP & CROSSCUT 1"-2" ROCKHARDS and SOFTWOODS with **smooth-as-sanded surface.** PLY-VENEERS (oak/birch) crosscut with NO BOTTOM SPLINTER.

- Mostly 1/8 kerf 15°, ATB and 20° face hook (easyfeed).
- DOUBLE HARDER and 40% STRONGER CARBIDE.
- Ends **blade changing** (does rip, combo and crosscut).
- Ends **scratchy saw cuts** (for the rest of your life).
- Ends **second step finishing** (jointing or sanding).
- Ends **cutting 1/16" oversize** to allow for RESURFACING.
- Buy and **sharpen ONE** blade instead of 3 (24T rip, 50T Combination, 80T Crosscut).
- *Strongly* recommend our *.001* flat **large stiffener-dampener** against out side of blade for smoothest, quietest cuts by this and any other blade.
- Use 30T if ripping mostly 2" - 3" hardwoods.
- Side wobble held *.001* - others .004/.010 is common! RAISE for THICK woods, LOWER for THIN woods and *perfect cut everything!* All 5/8" holes, unless otherwise noted.

	List	SALE		List	SALE
14" x 40T x 1" BORE	$215	$149	9" x 40T	$146	$109
14" x 30T x 1" *	195	139	30T	125	99
12" x 40T x 1" *	183	129	*8-1/4" x 40T 3/32	136	99
12" x 30T x 1" *	162	119	8" x 40T 3/32	136	99
10" x 40T 1/8 & 3/32	156	119	30T 3/32	115	89
30T 1/8 & 3/32	135	99	7-1/4" x 30T 3/32	112	69
			New 6" x 40T 3/32	139	89

5/8" holesstd. Boring up to 1-1/4" $7.50 extra - Shipping $4.50

Saw Boss
* NEW For Sears & Makita Table Saws

Also help all your other blades to cut better.
Use our 1/8" DAMPENER STIFFENERS, against one side

4" - $21
5" - $24
6" - $25

Tryable and RETURNABLE.
Stops vibration, flutter, cutting noise and blade ring.
Parallel and flat to .001 • 7" and la ger available.

5/8" holes std. Boring up to 1-1/4" $7.50 extra.
Others available. Add $2.50 Shipping.

WE RECOMMEND OUR FACTORY SHARPENING as some local sharpening creates problems with Micro-chipped edges reducing blade life & cutting quality.
2-4 DAYS ON THESE AND ALL MAKES OF FLAT FACE & CONCAVE CARBIDE TIP SAWS.
SHIP VIA UPS. Typical 10 x 40T $15.00, 60T $17.75. Add return UPS $4.50 or 2nd Day Air $8.

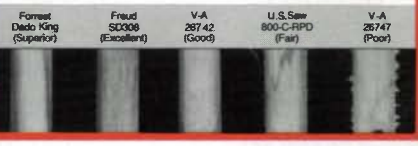
SATISFACTION GUARANTEED OR FULL CASH REFUND.
47 years of fine American saw making & sharpening.

NEW DADO KING DELUXE DADO SET cuts *ALL* 1/8 - 29/32 **flat bottom** grooves WITH or CROSSGRAIN all woods. OAK, BIRCH, VENEER PLYS, and MELAMINE. NO SPINTERING due to unique 4T Neg. Face fillers and 24T outside saws.
***OUT PERFORMS 29 + 32 OTHER DADO SETS-WOOD Mag.**, Oct. 91 "Best Value"*

"No tearout on all five woods tested." -*Fine Woodworking July/Aug, 1991*

Boring up to 1-1/4" $25 per set
SALE! 10% OFF $5.50 Per Set Shipping
NEW 3/32 Chipper & Shims incl.

8 - 5/8" Bore List **$321/SALE $289** • 10 - 5/8" & 1" Bore List **$389/SALE $349**



WOODWORKER I - For TABLE and RADIAL SAW

this trim and crosscut ALL PURPOSE blade gives scratch free POLISHED cuts on all materials RIP or CROSSCUT up to 2".

- All 60T and 3/32" *THIN* kerf 30° ATB and 5° face hook on 10" dia and under. 12" and 14" are 20° ATB 1/8" K.
- DOUBLE HARDER and 40% STRONGER carbide.
- THIN KERF:
  Saves 1/3 wood loss on each cut, radial or table. Feeds easy when used for moderate rip and crosscut on table saw. **Reduces "JUMP IN"** greatly for better "PULL CONTROL". Practically **eliminates bottom splinter** on RADIAL-CROSS CU .
- Totally stops ALL bottom and top splinter on ply veneers in push-cut mode on RADIAL.
- Our STIFFENER STRONGLY RECOMMENDED AGAINST outside of blade only for best cuts.

Made and serviced in USA for your benefit.

	List	SALE
14" x 60T x 1" 1/8"	$224	$159
12" x 60T x 1" or 5/8" 1/8" K	198	139
10" x 60T x 5/8" 3/32" K	162	129
9" x 60T x 5/8" 3/32" K	156	119
8" x 60T x 5/8" 3/32" K	150	109
New 8-1/4" x 60T x 5/8" 3/32" K	150	109

RYOBI RA200 TS200 SEARS HITACHI PSM8 **MAKITA 500B NBA PORTER CABLE 368-1**

CHOPMASTER for SLIDING COMPOUNDS & MITER SAWS

New specs, 5° Neg. Pts. & flat, dial .001/.002 for perfect, tight, smooth, splinter-free miter joints.

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		List	SALE
Delta Sidekick 6-1/2"	6-1/2" x 40T x /8"	$149	$ 89
Sears 8-1/4" & Delta	8-1/4" x 60T x 5/8"	170	99
Hitachi 8-1/2" DeWalt 8-1/2" & Ryobi	8-1/2" x 60T x 5/8"	179	109
Delta	9" x 80T x 5/8"	204	119
Ryobi-Makita & all	10" x 80T x 5/8"	207	129
Hitachi & B&D & DeWalt	12" x 80T x 1"	229	139
Ryobi-Makita	14" x 100T x 1"	266	179
Hitachi	15" x 100T x 1"	277	189

For good gen. prps. cuts use Woodworker II 30T & 40T or Woodworker I. Use small stiffener where possible

DURALINE HI-A/T FOR TABLE & RADIAL SAWS

ALL FLAT FACE
5/8" HOLES. Boring up to 1-1/4" $7.50 extra
Larger holes - time basis. Shipping $4.50

	List	SALE		List	SALE
7-1/4" x 60T 3/32"k	$149	$129	12" x 80T x 1" 1/8"k	$212	$181
8" x 80T 1/8 & 3/32"k	202	169	12" x 100T x 1" 1/8"k	253	215
9" x 80T 1/8 & 3/32"k	207	179	14" x 80T x 1"	232	197
10" x 80T 1/8 & 3/32"k	207	159	14" x 100T x 1"	266	226
			16" x 80T x 1"	262	223
Special sale price 10" diameter only		$159	16" x 100T x 1"	294	243

Above 1" bore std.

CARBIDE is THE HARDEST OF THE C-4 grades and 40% STRONGER, NOT WEAKER!! For 50% to 300% longer life!

NEW DOUBLE FACED LAMINATE B ADES- TABLE & SLIDING PANEL SAWS

ALL CONCAVE FACE

For Single or Stacked Melamine, Micas & Vinyls

10x48Tx5/8 List $234 **SALE $159**
12" or 303mm x 60T x 30mm or 1" List $238 **SALE $179**
14" or 350mm x 60T x 30mm or 1" List $279 **SALE $249**

These CONCAVE (HOLLOW) FACE blades cut chipless 2 to 5 times longer & faster than our FLAT FACE Duraline HI-A/T. Varyblade 1" to max. height above Melamine for best life. Can stack Melamine 2-5 sheets high. All makes of CONCAVE blades can be precision sharpened by our trained technicians to achieve factory new performance.

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For HOLZ-HER VERTICAL PANEL SAW, 220mm x 30mm Bore:
- 50 Teeth **CONCAVE FACE** — Melamine & 2 Sided Micas — List $162 **SALE $139** (use with or without 2 knife scorer)
- 80 Teeth **FLAT FACE** — Vinyl, Melamine & Oak-Birch Plys — List $204 **SALE $159**

For STRIEBIG + HOLZ HER PANEL SAW, 300mm x 3 mm Bore:
- 60 Teeth **CONCAVE FACE** — Melamine Solids & Plys — List $238 **SALE $179**
- 100 Teeth **FLAT FACE** — Vinyl Plys: Oak & Birch — List $263 **SALE $179**

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READER SERVICE NO. 77

manufacturer-installed safety switch on the front of the table would have been appreciated. Also, dust collection would be much improved if there were some provision for collecting from below.

Mounting flanges on this table are on the inside of the table, making it necessary to screw the base to a piece of plywood and then to clamp the plywood to your bench. It would have been more convenient to have the flanges facing out. Finally, a miter slot would have been quite useful. As it is, the fence is your only means of guiding the workpiece.

The unit was packed well for shipping, sustaining no damage whatsoever, and it arrived 90% assembled. It took me just over half an hour to mount my router and get the table ready for action. The router table sells for $399.95. To purchase one or for more information, contact CFW Engineering (2112 N. Dragoon, Suite 9, Tucson, Ariz. 85745; 602-882-6255). *—Fred M. Farkas*

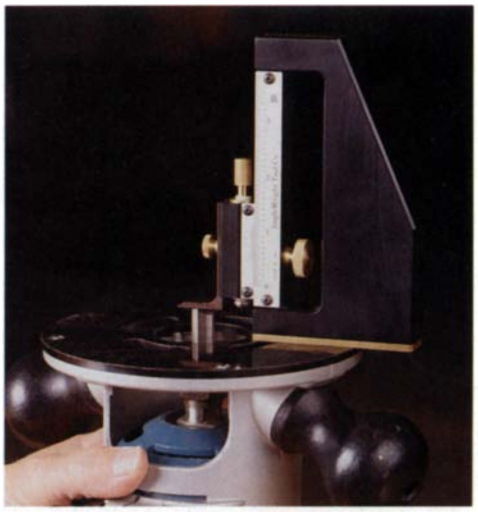
Precision height gauge

AngleWright Tool's new height gauge is a black anodized-aluminum extrusion with an attached, permanently etched scale (available in decimal or fractional graduations) and a hardened steel pointer/blade (see the photo at right).

The tool is designed primarily for setting router-bit and shaper-cutter heights, but has enough range ($3\frac{1}{4}$ in.) to handle a 10-in. sawblade. The tool can also be used on its side to set fine-width cuts on shapers, router tables and tablesaws.

The gauge only takes a moment to calibrate and can be reset as necessary (if you sharpen the blade, for example, or switch from fractional to decimal scale). It's a well-made gauge, not cheap ($119, plus $6 shipping and handling), but a pleasure to use. For more information or to purchase, call AngleWright at (310) 471-7432.

—Vincent Laurence



Gauge helps set bits and blades—The AngleWright height gauge is a precise instrument for setting the height of router bits and shaper cutters. But it's also useful for setting the height of tablesaw blades and depths of cut on shapers and router tables.

Micro-Fence

Micro-adjusters, or, precisely, threaded lead screws, have been used as standard equipment on metalworking machines for many years. But it has only been in the last few years that woodworking equipment has begun to take advantage of these devices, which are capable of adjusting to within .001 in., in many cases. This level of adjustability is doubly advantageous. Not only can you adjust a tool with exacting precision but also you can repeat the setting later. Just make a test-cut, measure the difference between it and the cut you desire (with a dial or vernier caliper), and then dial in the difference with your micro-adjuster.

It's for these reasons that I was so excited when I discovered the Micro-Fence, a micro-adjustable fence for routers. The Micro-Fence was designed by Richard Wedler, a professional woodworker from Southern California, and his father, Jack, who is a mechanical engineer. The Wedlers designed the fence for use in Richard's shop, but then they realized what they had on their hands and decided to market it.

Standard router fences generally consist of a solid fence and two rods that slide into the base of the router. The Micro-Fence is based on this design but replaces the solid fence with a movable aluminum subfence that slides on a pair of rolled stainless-steel rods. It is through the subfence that the micro-adjuster lead screw moves (see the photo below left). Coarsely knurled brass lock screws on the subfence provide a good grip, allowing you to set the subfence's gross position securely against the stainless rods. The lead screw then fine-tunes the position of the actual fence, which is an L-shaped (in profile) aluminum extrusion attached to the end of the lead screw. The lead screw turns a laser-etched micrometer dial, which is graduated in increments of .001 in., so that you can easily see how much you are moving the fence.

The Micro-Fence can be used for general edge-routing, rabbeting, dadoing and the like, but where it really excels is in doing precision work, such as routing for inlay (see the photo at left), matching a previous cut or hinge-mortising. It's also useful for dadoing to accommodate undersized plywood: Two passes with a $\frac{5}{8}$-in. bit will take care of a $\frac{21}{32}$-in.-thick dado quickly and efficiently. Also, the fence's shallow profile makes it possible to use it on your bench without bottoming out when routing $\frac{3}{4}$-in.-thick stock.

A number of options are available, including subbase assemblies for use with laminate trimmers (these don't have any provision for mounting a router fence), longer (12 in.) bars for deeper routing and a pair of half-round Delrin inserts, which can be attached to the end of the standard fence for routing circular or curved work, as shown in the photo.

A high-quality tool, the Micro-Fence is precise, with no slop. Its price is $98, which includes a 30-day satisfaction guarantee and a one-year warranty. It also includes a chart for converting decimal readings to fractional or metric equivalents. For more information or to purchase one, contact Micro-Fence (11100 Cumpston Street, #35, North Hollywood, Calif. 91601; 818-766-4322). *—M.D.*

Photo: Mark Duginske

A precisely adjustable router fence, the Micro-Fence allows for accurate routing of odd-sized rabbets, dadoes and other precision cuts. It's a great accessory for dealing with undersized plywood, routing grooves for inlay, as shown here, or for fine-tuning the depth of a hinge mortise.

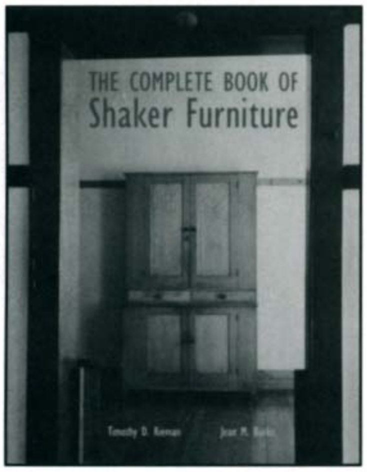
Follow-up

Booklet for Robo-Sander owners

Woodworker and inventor Ken Picou has written a manual called "Robo Tips for the Small Shop." Anyone owning a Robo-Sander, regardless of where or when it was purchased, can get a free copy of this manual by sending a stamped, self-addressed envelope to Ken Picou Design, 5508 Montview, Austin, Texas 78756. *—V.L.*

Mark Duginske is a contributing editor to Fine Woodworking *and is a woodworker, teacher and author in Wausau, Wis. Fred Farkas is a woodworker in Stony Point, N.Y. Vincent Laurence is an associate editor of* Fine Woodworking.

The Complete Book of Shaker Furniture by Timothy D. Rieman and Jean M. Burks. *Harry N. Abrams, Inc., 100 Fifth Avenue, New York, N.Y. 10011; 1993. $75.00, hardback; 400 pp.*



I bought this book as a reference. I expected to look at the pictures whenever I was in need of inspiration, as I do with many other books on furniture. Little did I realize I would spend the better part of the next week engrossed by its sense of discovery and its exceedingly informative and readable prose.

The book begins with a concisely written introduction to the Shakers, outlining their history and describing their working environment. Though there is a short chapter included on the tools used to build Shaker furniture, it is intended to provide historical perspective rather than information directly useful to the modern craftsman.

After introducing the reader to the Shakers, the authors present a comprehensive examination of Shaker furniture. The overall Shaker community was organized into regional divisions called bishoprics, and Rieman and Burks divide their book along the same lines. They carefully present and explain the details of design or construction and any other evidence that led them to attribute a particular piece to a particular bishopric. They also isolate work by particular individuals. By showing where each piece of information was obtained and how each deduction was made, the authors demonstrate an authority rooted in fact and observation rather than opinion.

The book's 400 photos (117 in color) are each described in detail, emphasizing design specifics and distinctions. Progressing through these one at a time and making close comparisons between similar pieces of furniture gave me a much better understanding of furniture design; it conveyed more than most books attempting to teach design ever could.

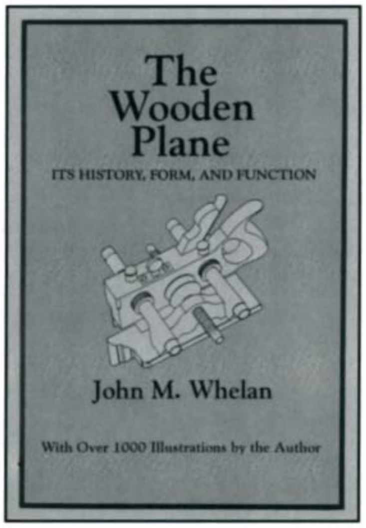
Two minor mistakes (plates 238 and 241 were transposed as were plates 275 and 276) do not dissuade me from thinking this one of the best edited and most carefully assembled references I have seen in the realm of furniture. It is beautiful to look at, easy to read and constructed to last several lifetimes.

One especially interesting aspect of the book was its complete time frame and its inclusion of work from all the bishoprics. While most books on the subject tend to show only furniture from a classic period, and mostly from New England and New York, this one covers the whole range of furniture made in Shaker communities from Indiana to Maine. It also includes quite a bit of work with hardware and decoration that don't jibe with the popular conception of Shaker furniture.

This book does not show how to build Shaker furniture. In fact, it does not even show specifically how to design it. Rather, it is an investigation of individual pieces and the people who made them. The authors included a quote from Sister Mildred Barker (1898-1990) of Sabbathday Lake, Maine: "I would like to be remembered as one who pledged myself to the service of God and had fulfilled that pledge as perfectly as I can—not as a piece of furniture." *—Clifford R. Johns*

Editor's note: Another fine book on Shaker furniture, also coauthored by Timothy D. Rieman, has recently been reissued. *The Shaker Chair*, by Charles R. Muller and Timothy D. Rieman, with drawings by Stephen Metzger ($24.95), originally published in 1984 by Canal Press, has been handsomely reprinted in paperback by the University of Massachusetts Press. It is a scrupulous and illuminating work rich with primary source material and well-documented with black and white photos and superb line drawings. The comparative regional approach employed in *The Complete Book of Shaker Furniture* is evident here as well and is exemplified in a gray-tone poster that comes with the book. The poster features line drawings and photos of 12 similar Shaker rocking chairs, isolating the differences in details that mark them as belonging to a particular time or region.

The Wooden Plane: Its History, Form, and Function by John M. Whelan. *The Astragal Press, P.O. Box 239, Mendham, N.J. 07945-0239; 1993. $37.50, hardback; 513 pp.*



Lately, the popularity of tool collecting, and particularly wooden-plane collecting, has exploded. Tool collectors passionately bid to win their prizes at auctions, and the rest of us scour yard sales to find discarded gems. This fever to acquire planes has created a thirst for information on the history, design and function of these tools.

Thankfully, there are a few people out there who can provide that information. These experts have been collecting for years, slowly acquiring rare planes, culling valuable information from old tool catalogs, poking around musty barns and attending countless auctions. And in some cases, *using* wooden planes.

John M. Whelan, author of *The Wooden Plane*, is one of these experts. Now he has written an extraordinary book: an encyclopedia on the wooden plane. It is organized into chapters covering the history of planes, types of planes by design and function, and the operation of planes. There are sections on bench planes, simple and complex molding planes, planes for curved and angled surfaces, and specialty planes. Planes are also listed by the trades that used them. Also, there are over 50 pages of molding-plane profiles with brief descriptions, glossaries of English, French and German terms, and a detailed system for identifying and naming molding profiles. This last section is important because it establishes a common language for collectors to use to explain what they have or what they're seeking.

This volume was exhaustively researched, but it lacks the narrative quality and historical perspective, for example, of Ken Roberts' two-volume *Wooden Planes in 19th Century America*. Whelan's presentation of the material is also somewhat fragmented, isolating sections from one another. The author states in the forward that this was his intention, making it unnecessary to read the whole book to obtain a piece of information.

This book has over 1,000 illustrations prepared by the author. They are expertly drawn, but they give it a monotonous, bland look. Photos would help convey important information on materials and surfaces beginning collectors would find useful.

Despite my caveats, if Whelan's intention was to provide novice collectors with an exhaustive single-volume reference on wooden planes, he has succeeded. This is a book you'd be happy to have along on "hunting trips." *—Mario Rodriguez*

Clifford Johns is an amateur woodworker in Wheaton, Ill. Mario Rodriguez is a contributing editor to Fine Woodworking.

Listings of gallery shows, major craft fairs, lectures, workshops and exhibitions are free, but restricted to happenings of direct interest to woodworkers. We list events (including entry deadlines for future juried shows) that are current with the time period indicated on the cover of the magazine, with overlap when space permits. We go to press three months before the issue date of the magazine and must be notified well in advance. For example, the deadline for events to be held in March or April is January 1; for July and August, it's May 1, and so on.

ARIZONA: **Show**-Grand Canyon State Woodcarvers Desert Woodcarving Show, March 11-13. Phoenix Civic Plaza, Phoenix. For info, call Frank Gacnik (602) 345-9020.
Show-Arizona Woodworking Show, April 8-10. Youth Center, 1826 W. McDowell Road, Phoenix. For more information, contact The Woodworking Shows, 1516 S. Pontius Ave., Los Angeles, CA 90025. (310) 477-8521.

ARKANSAS: **Meetings**-Woodworker's Association of Arkansas meets the first Monday of each month at 7:00 p.m. at Woodworkers Supply Center, 6110 Carnegie, Sherwood, 72117. For more information, call (501) 835-7339.
Classes-Wood strip canoe making, split bamboo fly rod making, toolmaking, March thru April. Contact the White River Artisan School. (501) 435-2600; (501) 430-5437 (evenings).

CALIFORNIA: **Workshops**-Woodworking for women. Furnituremaking with hand tools using traditional joinery, weekends. San Francisco. Contact: Debey Zito (415) 648-6861.
Workshops-Various workshops including Japanese woodworking, joinery and sharpening. For info, contact Hida Tool Co., 1333 San Pablo, Berkeley, 94702. (415) 524-3700.
Workshops-Building the Norwegian Sailing Pram with Simon Watts. Six days, March 28 thru April 2. The Blue Ox Millworks Historical Park, Eureka, 95501. (800) 248-4259.
Exhibition-Fifth annual Bungalow Heaven Home Tour, April 24. Pasadena. Features furnituremaking by Mark Tudor. For more information, call (818) 585-2172.
Lecture-Frame Design in America: 1820-1840, May 10. American Decorative Arts Forum. M.H. de Young Memorial Museum, Golden Gate Park, San Francisco, 94118. (415) 456-8177.
Exhibition-Turned Wood: Small Treasures, thru March 31. Del Mano Gallery, Los Angeles. For info, call (310) 476-8508.

COLORADO: **Classes**-Woodworking and related classes, year-round. For info, write Red Rocks Community College, 13300 W. 6th Ave., Lakewood, 80401, or call (303) 988-6160.
Seminars-Woodworking seminars, Sept. thru April. For more information, contact Schlosser Tool and Manufacturing Co., 301 Bryant St., Denver, 80219. (303) 922-8244.

CONNECTICUT: **Workshops**- Adirondack Chairs, March 5-6; Innovative Furniture Designs, March 19-20. Brookfield Craft Center, PO Box 122, Brookfield, 06804. (203) 775-4526.

DISTRICT OF COLUMBIA: **Show**-The 25th Annual Smithsonian Craft Show, April 14-17, Andrew W. Mellon Auditorium, 1301 Constitution Ave., N.W. Washington, D.C. For more information and application, call (202) 357-4000.

FLORIDA: **Meetings**-Central Florida Woodworkers Guild meets the second Thursday of each month, Winter Park. For more info, call (407) 862-3338.
Meetings-South Florida Woodworking Guild meets every second Monday, 7 p.m. Constantines, 1040 East Oakland Park Blvd., Ft. Lauderdale. For more information, contact Woody McLane (305) 565-2729.
Exhibition-Global Carving Challenge: Aquatic Life 1994, March 25-27, Holiday Inn Airport Marina, Sarasota. For more information, call Wood Carvers Supply, Inc. (813) 698-0123.
Show-25th Annual Santa Fe Community College Spring Arts Festival, April 9-10. N.E. 1st Street between 2nd and 8th Ave., Gainesville. For more information, call (904) 372-1976.

GEORGIA: **Workshops**-Japanese woodworking by Toshihiro Sahara. One Saturday each month. Sahara Japanese Architectural Woodworks. (404) 355-1976.
Classes-Woodworkers Guild of Georgia, PO Box 8006, Atlanta. For info, contact John Gorrell (404) 460-1224.
Show-Prater's Mill Country Fair, May 7-8, Dalton. For more info, call Judy Alderman or Jane Harrell (706)275-6455.
Exhibition and seminar-Third Annual Custom Woodworking Business Conference, March 25-26. Woodfield Hilton & Tower, Arlington Heights. (800) 343-2016.

INDIANA: **Classes**-Various woodworking classes and workshops. For info, contact Woodworking Unlimited, 6038 E. 82nd St., Indianapolis, 46250, or call (317) 849-0193.
Show-St. Duneland Woodcarvers 18th annual woodcarving show, April 9-10, Porter County Fairgrounds & Expo Center, Valparaiso. For more information, contact Frank Kik, 7425 Arizona Ave., Hammond, 46323. (219) 845-2695.

KANSAS: **Auction**-26th annual Mennonite Relief Sale, April 8-9. State Fairgrounds, Hutchinson. Antiques, furniture, tools and woodwork. For information, call (316) 283-0518.

KENTUCKY: **Workshops**-Woodturning and joinery instruction. For further information, write Jim Hall, Adventures in Wood, 415 Center St., Berea, 40403, or call (606) 986-8083.
Meetings-Kyana Woodcrafters Inc. meets the first Thursday of each month. Bethel United Church of Christ, 4004 Shelbyville Road, Louisville, 40207. For info, call (502) 426-2991.
Workshops-Traditional Windsor chairmaking instruction. One-week courses. Contact David Wright (606) 986-7962.

LOUISIANA: **Show**-LFIA Fine Furnishings and Art Showcase, March 16-20. New Orleans Superdome. (504) 386-0471.

MARYLAND: **Festivals**-Sugarloaf Craft Festival, April 15-17. Montgomery County Fairgrounds, Gaithersburg; April 29-30. Maryland State Fairgrounds, Timonium. Contact Deann Verdier, Sugarloaf Mountain Works (301) 990-1400.

MASSACHUSETTS: **Instruction**-Full-time program in fine furniture construction. Complete facilities. Wm. B. Sayre, Inc., One Cottage St., Easthampton, 01027. (413) 527-0202.
Classes-Woodworking classes, throughout most of the year. For information, contact Boston Center for Adult Education, 5 Commonwealth Ave., Boston, 02116. (617) 267-4430.
Fair-24th Annual Craft Fair, May 20-22. Worcester Center for Crafts, 25 Sagamore Road, Worcester, 01605. (508) 753-8183.
Classes-Woodworking classes, April thru June. School of Fine Woodworking, One Cottage Street, Easthampton. Contact UMass Division of Continuing Education (413) 545-3653.

MINNESOTA: **Classes**-Woodcarving classes year-round. For information, contact the Wood Carving School, 3056 Excelsior Blvd., Minneapolis, 55416. (612) 927-7491.

MISSISSIPPI: **Classes**-Various woodworking classes. For more info, contact Allison Wells School of Arts & Crafts, Inc. Canton. (800) 489-2787.

MISSOURI: **Show**-The Kansas City Woodworker's Guild 9th annual show, Treasures in Wood, March 19 thru April 3, Crown Center Exhibition Hall, 2450 Grand Ave., Kansas City. For more information call Crown Center Shops at 274-8444.

NEBRASKA: **Meetings**-Omaha Woodworkers Guild meets at 7 p.m. the third Tuesday of every month. Westside Community Center, Omaha. Contact John Cahill, 334-5550.

NEW HAMPSHIRE: **Classes**-Fine arts and studio arts. Manchester Institute of Arts and Sciences, 114 Concord St., Manchester, 03104.
Classes-Various woodworking classes. For information, contact The Hand & I, PO Box 264, Route 25, Moultonboro, 03254. (603) 476-5121.
Auctions-Antique and craftsman's tool auctions, year-round. Contact: Richard A. Crane, Your Country Auctioneer, 63 Poor Farm Road, Hillsboro, 03244. (603) 478-5723.
Workshops-Week-long Shaker-style furniture and chairmaking workshops, year-round. For more info, contact Mary Sweet, Dana Robes, Wood Craftsmen, Lower Shaker Village, Enfield, 03748. (603) 632-5385.

NEW JERSEY: **Call for entries**-Sugarloaf Craft Festival, May 13-15, Garden State Exhibit Center, Somerset. Contact Deann Verdier, Sugarloaf Mountain Works, 200 Orchard Ridge Drive, # 215, Gaithersburg, MD 10878. (301) 990-1400.
Assistantships-Peters Valley Craft Center offers summer studio assistantships in woodworking, June thru August. Deadline: April 1. Peters Valley Craft Center, Assistantship Program, 19 Kuhn Road, Layton 07851. (201) 948- 5200.

NEW MEXICO: **Classes**-Woodworking classes. North New Mexico Community College, El Rito, 87520. (505) 581-4501.
Classes-Fine woodworking classes. For info, write Santa Fe Community College, Santa Fe 87502, or call (505) 438-1361.

NEW YORK: **Classes**-Various beginning and advanced woodworking classes. Constantine's, 2050 Eastchester Road, Bronx, 10461. (718) 792-1600.
Classes-Traditional 18th-century woodworking techniques with Mario Rodriguez. Contact Warwick Country Workshops, PO Box 665, Warwick, 10990. (914)-986-6636.
Meetings and classes-New York Woodturners Association meets bi-monthly. YWCA, 610 Lexington Ave. (53rd. St.) New York City. Contact Howard Alalouf (914) 337-0226.
Classes-Various gilding classes for fine furniture, antiques, frames, carvings, restoration. Center for the Gilding Arts, 381 Park Ave. South, New York City. For more information, call (212) 683-4822.
Classes-Intermediate woodworking and furniture design, thru May 10. Div. of Continuing Education, SUNY Purchase, 735 Anderson Hill Road, Purchase, 10577. (914) 251-6514.
Exposition-Northeastern Woodworkers Association annual woodworking exposition, March 19-20. Shenendehowa High School, Clifton Park. For info contact the association at PO Box 94, Rexford, 12148-0094. (518) 393-8804.
Exhibition-Northeast fine crafts exhibit, March 6-May 1. Designer Crafts Council of the Schenectady Museum and Planetarium, Nott Terrace Heights, Schenectady. (518) 382-7890.
Fair-4th annual Snug Harbor craft fair, Sept. 30-Oct. 2. Snug Harbor Cultural Center, Staten Island. Deadline: April 16. Contact Sara Cogswell Wells, Snug Harbor Cultural Center, 1000 Richmond Terrace, Staten Island, 10301. (718) 448-2500.
Exhibition-Arts & Crafts Designer Charles Rohlfs, thru April 10. Burchfield Art Center, Buffalo State College, 1300 Elmwood Ave., Buffalo, 14222-1095. For more information, call Eileen Sullivan at (716) 878-4529.

NORTH CAROLINA: **Meetings**-North Carolina Woodturners, second Saturday of each month. For more information, contact PO Box 2968, Hickory, 28603. (704) 324-5960.

OHIO: **Workshops**-Hand-tool joinery and bandsaw and tablesaw techniques, March 7-11; Machine Tool Joinery and Wood Finishing & Restoration, March 14-18. For more information, contact Conover Workshops, 18125 Madison Road, Parkman, 44080. (216) 548-3491.

OREGON: **Meetings**-Cascade Woodturner's Association meets every third Thursday. For information, contact Cascade Woodturners, PO Box 91486, Portland 97291.
Classes-Oregon School of Arts and Crafts, 8245 S.W. Barnes Road, Portland, 97225 (503) 297-5544.

PENNSYLVANIA: **Classes**-Windsor chairmaking, weekly and weekends. Contact Jim Rendi, Philadelphia Windsor Chair Shop, PO Box 67, Earlville, 19519. (215) 689-4717.
Exhibition-Pennsylvania Delaware Valley Wood Carvers Assoc. Mid-Atlantic Woodcarving Show, April 8-9. Penn. State Abington gym, Woodland Road, Abington. (215) 757-2152.
Exhibition-International Lathe-turned Objects, thru April 4. Berman Museum of Art, Collegeville. (215) 489-4111.

RHODE ISLAND: **Call for entries**-Chair Fair, June 4, the South County Center for the Arts, West Kingston. Deadline: March 18. For info, call David Goss (401) 789-6626.

SOUTH CAROLINA: **Call for entries**-First Southeastern Art & Craft Exposition, September 30-October 2. The University of South Carolina, Columbia. For more information, contact Rolfe Godshalk,, The Columbia Museum of Art, 1112 Bull Street, Columbia, 29201. (803) 383-0003.

TENNESSEE: **Workshops**-Turned lidded vessels, woodturning, design in turning, coopering, March thru April. Arrowmont School of Arts and Crafts, (615) 436-5860.
Call for entries-Artist-in-residence program and summer work study program. Deadlines are May 15 and April 1, respectively. For more information and applications contact The Arrowmont School of Arts and Crafts, P.O. Box 567, 556 Parkway, Gatlinburg, 37736. (615) 436-5860.
Workshops-Refining a Bowl, March 26-27, Green Wood Turning April 16-17 Turning Hollow Vessels July 11-15. Contact Tennessee Technological University, Appalachian Center for Crafts, Box 430, Route 3, Smithville, 37166. (615) 665-0502.

TEXAS: **Meetings**-North Texas Woodworker's Association meets the third Tuesday of each month. Contact Bruce May. NTWA, PO Box 831567, Richardson, 75083. (214) 271-0125.
Exhibition-The 19th Texas Crafts Exhibition, April 9-10. The University of Texas at Austin, Winedale Historical Center, PO Box 11, Round Top, 78954. For info, call (409) 278-3530.

VERMONT: **Courses**-Yestermorrow Design and Building School, Route 1 Box 97-5, Warren 05674. (802) 496-5545.
Workshops-Craftsmanship, design and shop math, machine setup and use, Japanese hand tools, sharpening. April 2 & 3. Contact Trillium School of Woodworking, Route 2, Box 4015, Middlebury, 05753. (802) 545-2266.

VIRGINIA: **Exhibition**-Tools exhibition, thru June. Colonial Williamsburg, PO Box 1776, Williamsburg, 23187-1776. For more information, call 1-800-HISTORY.
Exhibition-Masterworks: Alex Dunton Retrospective, April 1-May 27. Hand Workshop, 1812 West Main St., Richmond, 23220. (804) 353-0094.

WASHINGTON: **Juried Show**-The Kitsap County Woodcarvers Club 8th annual show at the Kitsap Mall in Silverdale, April 16-17. For more information, contact Joseph W. Finden 11108 SE Bean Road, Port Orchard, 98366. (206) 871-3638.

WISCONSIN: **Juried Show**-22nd annual Festival of the Arts, April 17. For info, contact Festival of the Arts, PO Box 872, Stevens Point, 54481

AUSTRALIA: **Call for entries**-The National Woodturning 1994 Exhibition, May 28-June 12. Melbourne. Deadline: May 13. For more information, contact Peter Robson, 12 Gidgee Court, Forest Hill, VIC 3131 (03) 878-7211.

CANADA **Meetings**-West Island Woodturners Club (Montreal, Que.) meet every Tuesday, Sept. thru May. For more information, contact Dennis Brown, 8817 Cure Legault, Lasalle, Que. H8R 2V9. (514) 366-6071.
Exhibition-Re-visions: Emerging Forms in Furniture, March 3 -April 3, by the graduating class of furniture design student sat Sheridan College School of Crafts and Design. Arts on King, 169 King St., E. Toronto, Ont., M5A 1J4. (905) 844- 9430.
Workshops-Five days of intensive hands-on Ultra-Lite-Sawmilling in a rain forest on a small N.W. Pacific Island with Will Malloff. The North Island College, Box 320 Sointula, B.C. V0N 3E0. (604) 974-5429.
Call for entries-The Wood Show, Aug. 5-7. Deadline: June 1. Five categories: chairs, birds, bird houses, turning and miniatures. For application, contact The Wood Show, Box 920, Durham, Ont. N0G 1R0. (519) 369-6902.
Show-Chatham Wood Show, March 22-24, Kinsmen Auditorium and Memorial Arena, Chatham, Ont. For more information, contact Cryderman Productions, Inc., 136 Thames St., Chatham, Ont. N7L 2Y8. (519) 351-8344.
Workshop-Traditional Windsor chairmaking. Weekly courses. For info or brochure, contact David Goodwin, The Village Chairmaker, Sparta, Ont., N0L 2H0. (519) 775-2751.
Workshop-Birchbark Canoe Building, July thru 17 or July 23-August 7. Course on Lake Superior, (Wisconsin). For info, contact David Gidmark, Box 26, Maniwaki, Que. J9E 3B3.

Cabinet of lesser-known woods—When Oregon cabinetmaker John Shipstad built this wine cabinet, he used lesser-known woods. Because of their lack of figure, he relied on the color of woods like kamarere, bayo and chakte koc to accent the frame, inlays and pulls. The panels are sucupira veneer over apple plywood.

Symbolic of environmental interconnectedness, Our Mother Hangs in the Balance *was sculpted by Michael Brolly, who says, "Remove the bat from the flower, and the tree falls down." Brolly used walnut, holly and mahogany for the piece.*

Turning dictates wood choice—David Ellsworth said he chose white oak for his multiple-axis turned and carved vessel, Mo's Delight, *because he wanted a less figured wood to let the design stand out.*

Conservation by Design

When I hear the word *conservation*, two meanings come to mind: preservation of a precious commodity and painstaking museum work. Both definitions fit the Conservation by Design exhibition held at the Rhode Island School of Design (RISD) art museum in Providence.

The show, which concluded Jan. 16, was a collaboration between RISD and the Woodworker's Alliance for Rainforest Protection (WARP). It grew out of the need of today's artists to express their view of conservation as an element of design, according to Rosanne Somerson, acting head of RISD's graduate furniture program. The show also highlighted uses of recycled wood and alternative species in furniture, sculpture and turnings.

As I was guided by curators Thomas Michie and Jayne Stokes, I was impressed by the scope of the show (see the photos at left). More than 70 examples from an international selection of artists and designers were part of the juried exhibition. Each piece conveyed a novel and refined design, and the diversity ranged from traditional chairs and chests to the whimsical (a cabinet made from yardsticks and a stool with baseball bat legs, for examples). Many pieces used composite and salvaged woods, like pallets, while others used ecologically certified hardwoods, including both overlooked and sustainably grown species. An array of lesser-known woods prepared by EcoTimber, an import lumber firm from San Francisco, graced the museum's entrance wall.

The breadth and spirit of the show are captured in a color catalog edited by WARP president Scott Landis. Sponsored by associations like the World Wildlife Fund, the U.S. Forest Service and the Peter Joseph Gallery in New York City, the book contains a wealth of information and rich images. It includes essays on design by Edward Cooke Sr., John Makepeace and Silas Kopf, as well as essays on forest stewardship by Ray Keene, Timothy Synott, Laura Snook and Scott Landis. In addition, Seth Stem discusses what efforts four companies (The Martin Guitar Co., Portico Door Co., Bridge City Tool Works and The Knoll Group, producers of Frank Gehry designed bent maple chairs) are making toward responsible wood use.

As in the exhibit, the catalog features artists' statements that offer insight into what Conservation by Design means. To order the catalog ($30 U.S., $40 Canada, not including shipping and handling), write to WARP, 1 Cottage St., Easthampton, Mass. 01027, or call the RISD museum of art shop at (401) 454-6540.

—Alec Waters, assistant editor

Photos: Dean Powell

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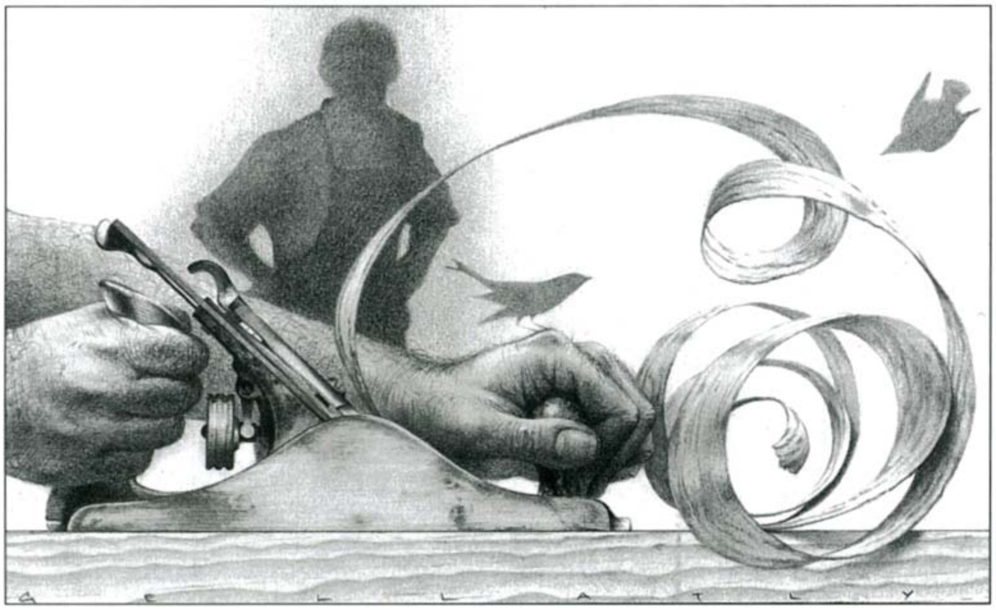

The ghosts of the birds: a lesson in sharpness

When I was a student of fine craftsmanship and design at a small college in the heart of the Oxfordshire countryside, I found it to be the perfect setting in which to learn the craft of woodworking at a leisurely pace, to be free and easy and to be with like-minded people. I was not aware of it then, but a fellow student was to become one of the most influential people to my way of life and thinking. His name was Kiyo.

Kiyo was a Japanese master craftsman of awesome abilities. The people he worked for in Japan had sent him to England to learn the European methods of woodwork, with the intention of combining the two very different disciplines. Kiyo was fascinating to watch at work, never did I see him struggle nor expend more energy than was required. He never rushed, and yet he was quick. He could saw and plane down to the line with deadly accuracy, without even looking.

At the end of a day's work, Kiyo would sort through the long, wide and fine shavings from his plane. He'd look at each one carefully and occasionally nod to himself with satisfaction. He would then pack his tools away, clean the bench and working space and cycle off home with a few of the best shavings in his basket. The following morning, Kiyo would arrive at the workshop with his lunch tucked under his arm, his strange food immaculately wrapped in the shaving from the previous day's work.

My feeling that something was not quite right in my methods of working lay in the form of shavings around Kiyo's bench. To be able to create such shavings requires a level of sharpness that surpasses even the finest of razors. By extension, the sharper the blade, the easier the work becomes. Kiyo didn't sweat. I did.

Kiyo gave me one of his plane blades to compare with my own. At first sight, they appeared to be identical. On closer inspection, however, they were poles apart. The back of his blade was so flat and highly polished that the reflection it gave was as perfect as a mirror. The grinding angle was the same, but Kiyo used the small bench grinder, which gave a "hollow" angle as opposed to the flat angle we achieved on the large horizontal grinder.

The way in which the actual cutting edge was constructed was different, too. We had been taught to place the blade on the oilstone, pivot the blade until it rests on the grinding angle and then lift up one more degree. This is the honing angle, or secondary bevel. The Japanese method is to rest the blade on the grinding angle and hone in that position. After several honings, the hollow ground disappears and becomes a flat angle. Then you know that your blade needs regrinding.

After much practice and thought concerning honing, my blades did indeed become very sharp, but still not sharp enough. I decided to look at the way I moved while honing and discovered that my whole body moved in a to-and-fro motion as I pushed the blade back and forth along the stone. That meant there was room for error. I concluded that the only parts of my body that should move were my arms and that a shorter stroke was more desirable than a long one.

The final discovery came a few days later: For centuries we have honed our blades in an uncontrolled manner, with long strokes, back and forth. The oblong shape of our stones dictates that movement. If our stones were disc-shaped and we honed in a circular movement, the resulting sharpness would be far superior.

I practiced circular movements on the oblong stones and found it awkward, but it became easier, day by day. More practice.

Halfway through making a chair in cherry wood, I reached the stage of thicknessing its four seat rails. I sharpened my precious #7 plane blade without a second thought, placed the blade in the plane, adjusted it just so, dabbed some candle wax on the sole and began planing. The resulting shavings were as long as the timber, as wide as the blade and as fine as a hair. There was a high-pitched whistle with each forward stroke, which put me in mind of the ghosts of the birds who visited that cherry tree several summers ago. Out of the corner of my eye, I saw Kiyo standing watching with the faintest glimmer of a smile and a gentle nodding of his head.

Next morning, Kiyo's lunch was wrapped in my shavings. I was honored, humbled and satisfied. Nothing was said. It didn't require words of praise; after all, we were only workmen.

—Simon Forrest, Leeds, Yorkshire, England

Alastair A. Stair, 1913-1993

Alastair A. Stair, a noted English antique furniture dealer and one of the original contributing editors to *Fine Woodworking*, died Dec. 13, 1993, at the age of 80 at his home in Manhattan.

Born in London, Stair worked for the firm his father founded, Stair & Company. He came to the United States in 1935 to work in the company's New York office. After retiring from the company in 1983, Stair became a consultant for Sotheby's auction house in New York.

Stair's involvement with *Fine Woodworking* began with an article on library ladders in *FWW* #1. He was later featured covering topics such as hidden drawers (FWW #3), treen (*FWW* #5), claw-and-ball feet (FWW #10) and rolltop desks (FWW #13).

—William Sampson, editor

Notes and Comment
Do you know something we don't about the woodworking scene in your area? Please take a moment to fill us in. Notes and Comment pays for stories, tidbits, commentary and reports on exhibits and events. Send manuscripts and color slides (or, black-and-white photos—preferably with negatives) to Notes and Comment, Fine Woodworking, *PO Box 5506, Newtown, Conn. 06470-5506.*

Drawing: Michael Gellatly

LABOR OF LOVE

In his early days as a professional woodworker, David Kuznitz of Mammoth Lakes, Calif., found himself with more time than money. In need of a wide-belt sander, an item far beyond his means, he decided to build one. Six months of part-time effort and $2,000 later, he'd created the technical wonder you see here.

The body of the sander consists of a half-lapped oak frame sheathed with two layers of $\frac{3}{4}$-in. medium-density fiberboard and covered with a skin of teal-colored plastic laminate. At the machine's core is a 300-lb. cast-iron surface plate. Power for the abrasive belt comes from a $7\frac{1}{2}$-hp motor; a $\frac{1}{4}$-hp motor drives the conveyor belt, and a $\frac{1}{6}$-hp motor raises and lowers the surface plate on Acme threaded rod.

A dial indicator shows how much stock is being removed per pass, and a digital measuring device indicates the overall thickness of the stock exiting the sander. Boards can be sanded to as thin as .030 in. and to a tolerance of .002 in. Solenoid-controlled air cylinders tension the belt, electric eyes ensure belt tracking and microswitches are positioned to automatically shut down all motors, which are linked in a safety interlock system in case the belt should mistrack.

Photo: Vincent Laurence