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Installing knife hinges, p. 48



Choosing a detail sander, p. 52



Rating joinery for doors, p. 58

On the Cover: Small sheets of veneer can form dramatic patterns, like this sunburst in crotch mahogany. Frank Pollaro describes several techniques on p. 40. Photo: Susan Kahn

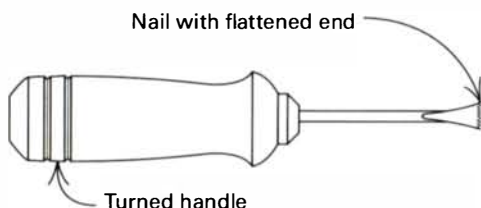
More on cleaning files—Associate editor Charley Robinson gave some good advice on cleaning files when he answered the question from Sands Figures (see *FWW*# 109, p. 32).

I've used another simple method for many years and think it works better for overly clogged files. Start with a piece of 1/8-in.-thick brass, 1/2 in. wide and 5 in. long. Lay the file down on a bench or flat surface, and run the brass across the file. The file will cut grooves in the brass to match the cut of the file, and the brass then cleans anything caught in the grooves of the file. You simply start at one end and work toward the other. I can clean a 6-in. file in less than two minutes.

—John M. Johnson, Church Hill, Tenn.

When it comes to cleaning files, here is something my dad used to do that seems to work better for me than anything else I've tried. It's just a nail flattened on one end and inserted in a handle (see the drawing below).

File-cleaning tool



I make my handles on the lathe using scraps. Once you introduce it to the file, it cuts its own grooves and does a nice job. It gets the job done, and that's the bottom line.

—Rich Dumler, Russell, Kan.

File cards are excellent tools, but they don't always clean double-cut or finely cut files due to the diameter of the wires in the card. Most automotive supply houses sell tire and battery brushes that contain longer and thinner wires. The wires are formed in a manner that cleans files thoroughly, including bits of soft metals. The brush nor-

mally sells for about \$2 to \$3.

Instead of hot water to soften residue in a file, I prefer to use WD-40 or kerosene. Both are mild solvents and, when dry, leave a thin coating that resists the formation of rust. Lamp oil purchased at craft stores is a scented and inoffensive form of kerosene. My personal observations indicate that files dragged backward across the abraded surface tend to clog more frequently than files that are lifted clear during the return stroke.

—Gale W. Hodgkin, Longmont, Colo.

Tools I wish they'd make—Like all of us, I constantly need something that I don't have in my shop. So I conjure up jigs, fixtures and tools, most of them very specific to the task at hand. Some, however, are more universal in nature, and I'd like to see someone make them.

How about sandpaper color-coded to grit size? That would make it a lot easier to identify sandpaper when it's been cut into small pieces. The back of 80-grit paper, for example, could be red, yellow for 120-grit, green for 150-grit, etc. The same color should be used for all abrasive types.

Another item is a double-ended carpet-style tack to prevent two pieces of wood from sliding around when you're trying to glue and clamp them up. The tacks would be small and insertable with a simple tool and could remain permanently buried in the assembly. I'm sure that many such thoughts are hovering out there.

—Leonard Feldberg, Chestnut Ridge, N.Y.

Paint containers: an invention of the devil—I hope paint manufacturers read this. About latex paints—the metal cans today, with their dumb grooved lips, deserve to be in the hall of shame. After spending hours and days making a wood project comes the final, dreaded finish. I open the can and find rust particles! My knees buckle. I gulp hard and mix furiously to hide these suckers. They'll show up later.

About oil paints—no matter how well I clean the grooves, turn the can upside down or add a little thinner on top, the paint will scum up later. Why can't someone make plastic quart and gallon containers with strong female plastic lids? I guess we'll have to wait for a Japanese, Chinese or European solution.

—Walt Gaus, Medford Lakes, N.J.

Take care with polyurethane glue—Gorilla Glue has been advertised in *FWW* and appears to be an excellent glue for woodworking. But one word of warning, especially to the weekend woodworker. The glue is similar to Crazy Glue in that it adheres to the skin. It changes color with time, and the brown stain is difficult, if not impossible, to remove. It has taken me

Fine Woodworking

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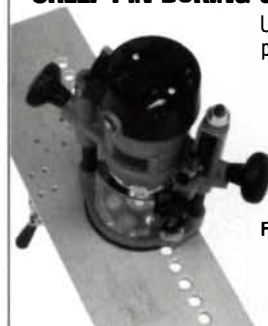
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about one week to clean my hands after using the glue. I've had to wait for the superficial layer of skin to slough off naturally.

I would suggest keeping a container of alcohol close at hand and removing any glue from the hand as one proceeds. This will save hours and days of scrubbing later on. Patients just do not like to be examined by surgeons with what appear to be dirty hands.—*Dr. William M.P. McKinnon, New Orleans, La.*

Selling combination jointer-planers short

Robert Vaughan's review of jointer-planers (see *FWW* #109, pp. 76-81) did a disservice to many fine machines, and I object especially to his superficial appraisal of the Inca 570. As an Inca owner for many years, I'd like to clarify a few details Vaughan overlooked or plain got wrong.

It is the jointer's outfeed table that detaches, and it can stay on the machine for both jointing and planing operations unless you want to mount the chip deflector (that's really unnecessary because raising the jointer guard accomplishes the same thing). Second, Vaughan mentions the lack of "height-adjustable feed rollers," a misleading criticism. Within the machine's depth-of-cut range of 0-1/8 in., the Inca's spring-loaded feed rollers are self-adjusting. No manual adjustment is provided because none is necessary.

Finally, I think Vaughan fails to appreciate the convenience, accuracy and surface quality offered by the Tera cutterhead, which provides 130 cuts per inch, not 86 as stated in Vaughan's chart. Changing all three knives takes less than two minutes, and their self-aligning feature is as accurate as any woodworker will get after laboring with conventional knives and adjustments on another machine.

It's true that the Inca, like most of these machines, is better suited to handling stock under 6 ft. in length, even with its available extension tables. By their nature, though, these tools are a trade-off—you accept some limitations in exchange for saving space and a lower cost. Given that the stated intent of the review was to aim at "the needs of the small shop," it was nar-

row-minded of Vaughan to close by dismissing the tools out of his bias for larger, single-purpose equipment, especially when many woodworkers might be better served by a combination machine.

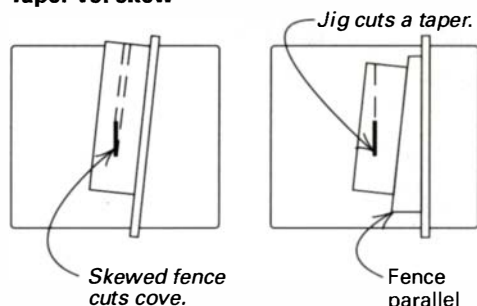
—*William LaHay, Colchester, Conn.*

A stiff rip fence works better—I'm writing about the article on shopmade rip fences (*FWW* #109, pp. 88-90). The article is well-organized and clearly written and presented. Worth Barton has described very nicely how he went about doing what he set out to do. But I think tablesaw rip fences should be clamped at the rear because they will be much stiffer, that is, much more resistant to deflection.

All mechanical structures deflect when pushed. Deflection translates into inaccuracy, and we need all the accuracy we can get. A rip fence clamped at the rear, as well as the front, deflects only about 20% as much as a cantilevered fence, such as the one Mr. Barton made, when pushed laterally near its midsection. Deflection resistance should be absolutely the top consideration in a rip fence.

A couple of other points. He says the "auxiliary fence can be placed right or left" and later says, "mine skews 0.020 in. over its length" to provide clearance. I think this is a potentially dangerous thing to do. Sawteeth provide clearance because of their set. If the fence is purposely skewed, then moving it to the other side of the blade is asking for trouble.

Taper vs. skew



Barton also says that the slots in the auxiliary fence "allow the fence to be adjustable and skewed for 2° or 3° tapers." Am I missing something? As the drawing

shows, skewing the fence is how you cut coves on the tablesaw. If you want tapers, you have to skew the work but still have the fence parallel to the blade.

—*Abijah Reed, Putney, Vt.*

Franchising does have advantages—I

disagree with the opinions made by Sam Meek (*FWW* #109, p. 10) pertaining to franchising. As a franchisee of Furniture Medic, a mobile network of furniture restoration and repair franchises, I have been pleased both from my own efforts and from the corporate level.

By investing in a franchise, others in my field are available to share ideas and assistance. I agree that when I attended Furniture Medic's training course, it was very elementary for seasoned woodworkers. But for those who have no experience, the course is designed to give a comprehensive study of furniture repair and restoration.

Franchise systems are not perfect, and not all franchisees are happy. But if a person has the desire to own his or her own business and is willing to work hard, franchising can be very rewarding and profitable. I have been pleased with the results of my efforts and would do it all over again in a heartbeat.—*Bill Parsons, Norridge, Ill.*

Erratum—An item in "Editor's Notebook" in *FWW* #110 misspelled the name of a reader who offered advice on using the Internet. He is Fred Garlock.

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 are in the shop.

—*James P. Chiavelli, publisher*

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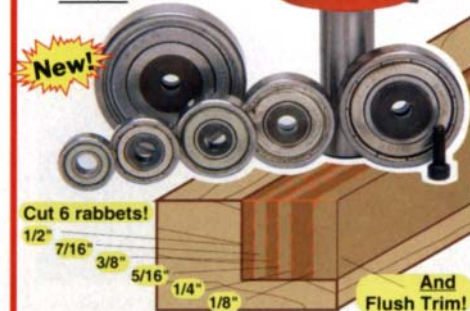
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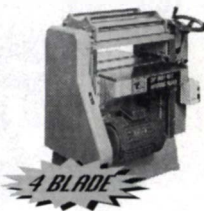
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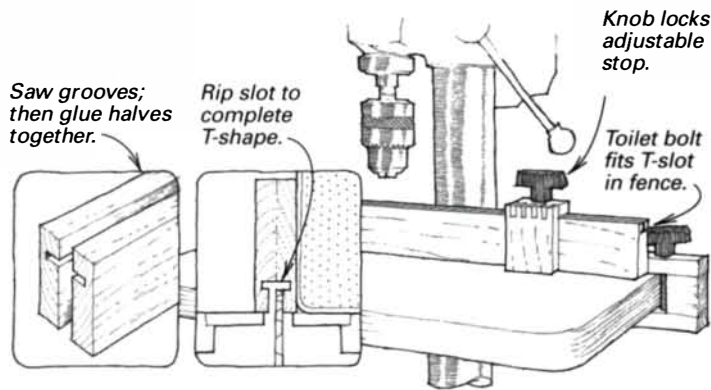
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Adjustable stop uses a T-slot

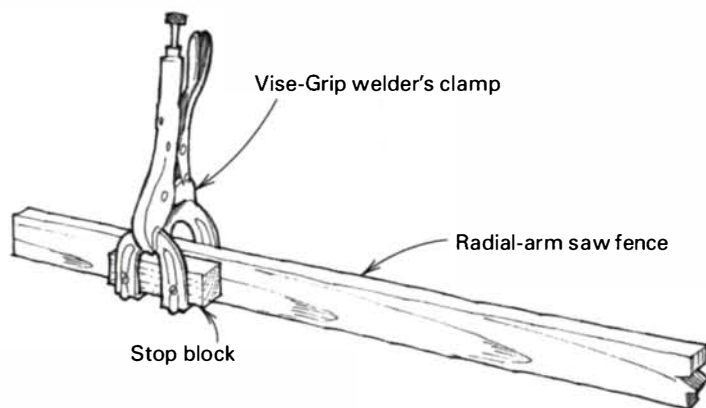


I use this fence stop on a drill press, but it could be adapted easily for another application. The stop is a finger-joined, L-shaped block. It locks to the fence by a knob and a toilet bolt that rides in a T-shaped slot in the top of the fence.

To make the slot, cut kerf-sized grooves into the faces of two fence halves using the tablesaw (see the drawing above). These grooves should be about 1/2 in. from the edge and deep enough to hold half the toilet-bolt head. Glue the two fence halves together, face to face, with a waxed spline in the slot to ensure perfect registration. Now saw into the edge of the fence to complete the T-slot. Center the slot, and size it to fit the shank of the toilet bolt.

—Arthur W. Griggs, Glencoe, Ill.

Vise-Grip stop block is quick and simple



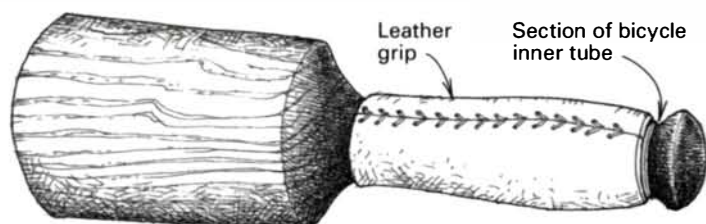
The stop block I use on my radial-arm saw fence is a Vise-Grip welder's clamp. Glue or screw a hardwood block to the L-shaped arms of the clamp. Then adjust the jaw gap until the cam action locks the device to the fence.

—K.O. Brown, Bessemer, Mich.

Quick tip: When storing nails or screws in sealed containers, add some rice to absorb moisture.

—Gary Gene Gautier, Surbiton, Surrey, England

Padded grip improves mallet-handle comfort



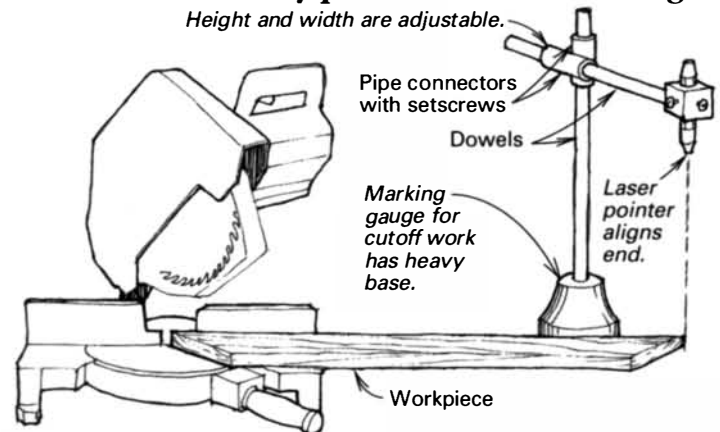
To improve the comfort of a wooden mallet, pad the handle with rubber, and cover it with leather. Cut a section of bicycle inner tube, and stretch it over the handle. Then cut the leather

covering to shape by trial and error. Leave a 1/4-in. gap where the edges meet. Punch rows of matching holes down each side of the joint, dampen the leather and, using waxed cord, lace the leather onto the padded handle like a boot.

—Tom Riley, Baltimore, Md.

Saw fence accurately positions crown molding

Height and width are adjustable.



Making tight-fitting, precise joints on crown molding is a time-consuming and fussy task at best. The tall profile of the moldings combined with the low fence height on most chop saws make it nearly impossible to hold the molding in the correct cutting position. To solve this problem, I first added a taller fence to my saw, which helped considerably but did not eliminate the need for strong finger pressure to hold the alignment. Then I cut the fence's height to match the molding's height. This helped some more. But the last step, the addition of a little lip to the top of the fence, made the real difference. Now, light finger pressure suffices because the force from cutting pushes the molding securely into the fixture. I get accurate joints every time.

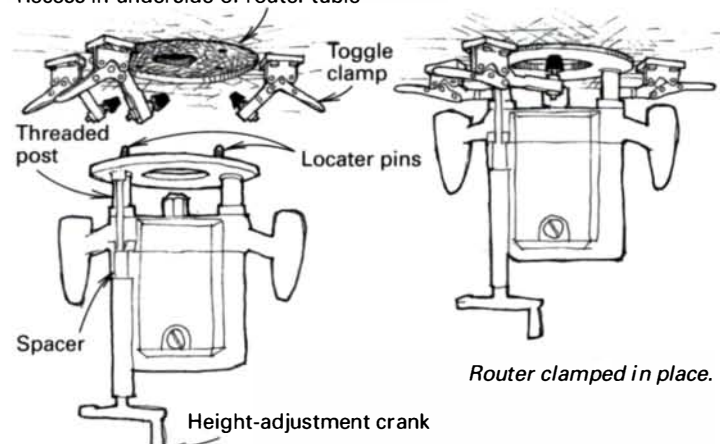
—Klaus W. Nielsen, Dunwoody, Ga.

Quick tip: Your lathe's tool rest deserves as much attention as your gouges. File the rest smooth and flat every so often, so your tools don't follow the dips and dents and transfer them to your turning. Rub a piece of paraffin wax along the rest occasionally. It makes the turning tools glide easily.

—Geordie Smith, Ruddell, Sask., Canada

Router-table uses easy toggle-clamp mount

Recess in underside of router table



If you've used a router table, you know firsthand the annoyances that go with mounting, dismounting and adjusting the router under the table. So when I redesigned my router table, I wanted a mounting method that was quick, secure and convenient, not only for installing router bits but also for adjusting their cutting depth. The approach I settled on uses three toggle clamps to

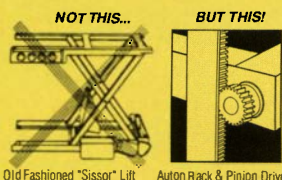
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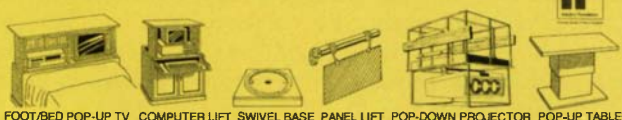


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hold the router under the table. The setup cost about \$30.

To use this approach, first remove the router subbase and all the miscellaneous hardware attached to the base—wing nuts, stop turret and so on. If you are using a plunge router, buy and install a crank handle to the end of the threaded adjustment column. Now recess the underside of the router table $\frac{1}{4}$ in. deep, and cut a $1\frac{1}{2}$ -in. hole in the center of the recess for the router bit.

Using the subbase mounting-screw locations, install locator pins in the base of the router, and drill mating guide holes in the router table. Make the pins by grinding the heads off machine screws. Screw three or four toggle clamps at convenient, equally spaced locations around the base of the router, and adjust their clamping action to hold the router firmly in place. Toggle clamps are available in several varieties and holding strengths, from 60 lbs. to 1,000 lbs. I'd advise some over-engineering here: for example, 200-lb. clamps with anti-vibration locks and horizontal handles.

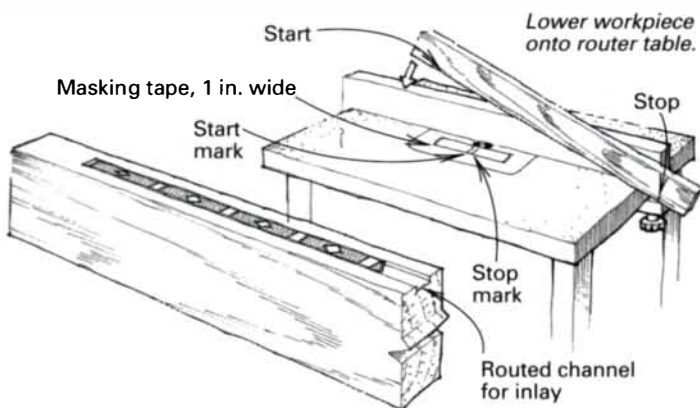
Now I can dismount the router and have it on the tabletop ready for a bit change in about 10 seconds, and I don't have a mounting plate to work around. Mounting takes approximately 20 seconds.

—Arthur Margolese, Santa Rosa, Calif.

Quick tip: Try dipping a flat magnet into your drawer of brads. It's much easier to pluck a single brad from the resulting metal sculpture than from the drawer bottom. When you're through with a project, brush the brads off the magnet and back into the drawer.

—Byron J. Thomas, Tulsa, Okla.

Routing stopped grooves for inlay strips



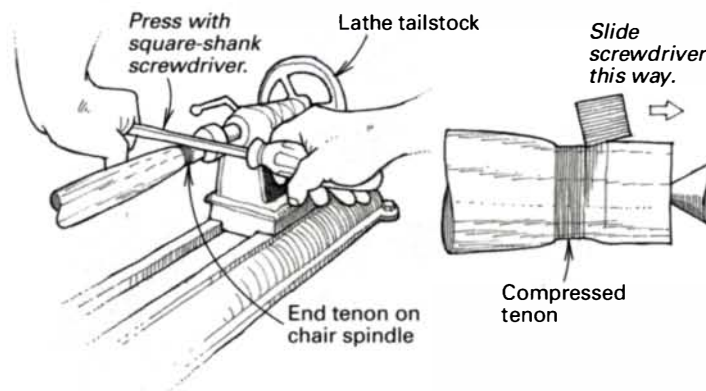
While I was pregnant with our first child, my husband, Marty Jack, and I made a crib. In addition to using the wood of our choice (maple), we wanted to personalize the crib with inlay strips. But we needed to find a place where the inlay would survive a baby's inquisitive fingers and teeth. For safety, we centered the inlays in the top of each drop-side rail under plastic teething protectors.

Choosing the inlay pattern from The Woodworkers' Store (21801 Industrial Blvd., Rogers, Minn. 55374-9514; 800-279-4441), we bought strips for the two rails, each $\frac{1}{4}$ in. wide by 36 in. long, plus extra length so the pattern would match at the ends. To create stopped grooves for the inlay strips, Marty used his router table, setting the depth of cut to 0.075 in., half again the $\frac{1}{20}$ in. thickness of the inlay. The extra depth kept the strips (with glue) below the top of the rail, which let us buff out the finish without damaging the inlays.

To show where to start and stop each cut, he laid a strip of masking tape on the table in front of the router bit. Setting a square against the fence and against the edge of the router bit, he marked off both sides of the $\frac{1}{4}$ -in. straight-cutting bit. Then he made corresponding start and stop marks on the side of the two top rails (see the drawing). The marks allowed him to see where the bit's edges were while the work was covering them.

To start each cut, Marty plunged the rail onto the router bit with the workpiece start mark in line with the tape's leading bit mark. He guided the work along the fence and then ended the cut by lifting the piece off when the tape's trailing mark and the rail's stop mark aligned. —Barbara Bazemore, Merrimack, N.H.

Compressed tenon fits tighter in socket

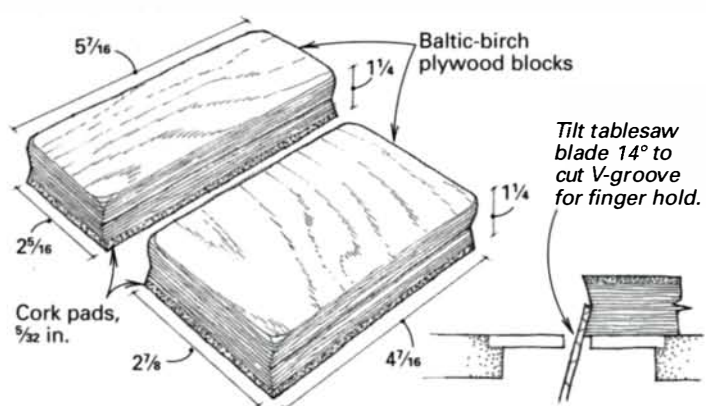


With the technique shown in the drawing above, I can get a tight-fitting socket joint without having to drive in a wedge. The secret is to compress the tenon while it's still on the lathe. Start by turning the tenon about $\frac{1}{32}$ in. oversize. Then, with the leg still turning in the lathe, use a large square-shank screwdriver or similar tool to compress the fibers of the tenon. Push down hard on both ends of the tool while slowly moving it along the length of the tenon. This will compress the tenon so that it can slip easily into the socket.

When assembling the joint, spread glue in the hole, put glue on the compressed tenon and immediately insert it into the hole. Within 15 seconds, the wood will expand and lock the joint tighter than if you had wedged it.

—Tim Hanson, Tomahawk, Wis.

User-friendly sanding blocks



To make hand-sanding less tiring, our class at Anderson Ranch Arts Center analyzed and redesigned the common sanding block. After experimenting with a variety of materials and thicknesses, the consensus was that a relatively thick (1 in. to $1\frac{1}{4}$ in.) block laminated from hefty Finply or Baltic-birch plywood, is the most comfortable. We glued $\frac{5}{32}$ -in.-thick sheet cork, available from any building-supply store, to one side of slightly oversized blanks. Then we trimmed the blocks with the cork-side up to reduce tearout.

Opinion was split on whether the blocks should be narrow or wide. So to satisfy everyone's ergonomic needs, we came up with the two sizes shown in the drawing above. Each one uses a one-quarter sheet of sandpaper. After the blocks were cut to size, we sliced shallow V-grooves (finger holds) in both long edges of the blocks on the table saw. Finally, we rounded

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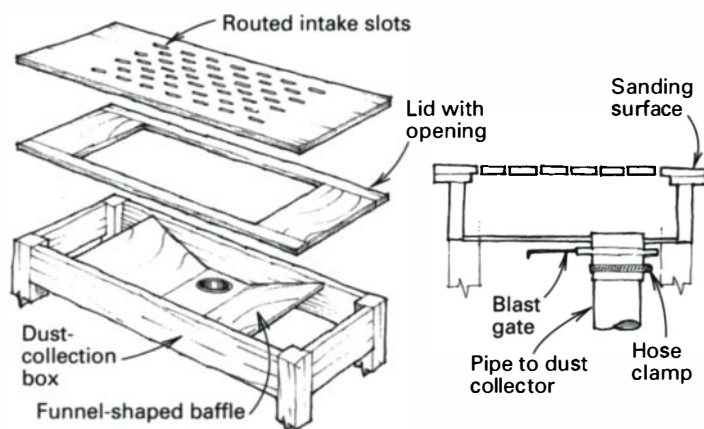
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the corners and then lightly sanded all the surfaces.

Our prototypes were reviewed by Nicole Vavuris, a safety engineer for the city of San Francisco. He said that the stress in the wrists caused by hand-sanding would be lessened by using these blocks, which encourage you to sand with the heel of your hand in a "power grip." Always avoid a fingertip grip.

—John and Carolyn Grew-Sheridan, San Francisco, Calif.
(and the class at Anderson Ranch, Colorado)

Dust-collecting sanding station



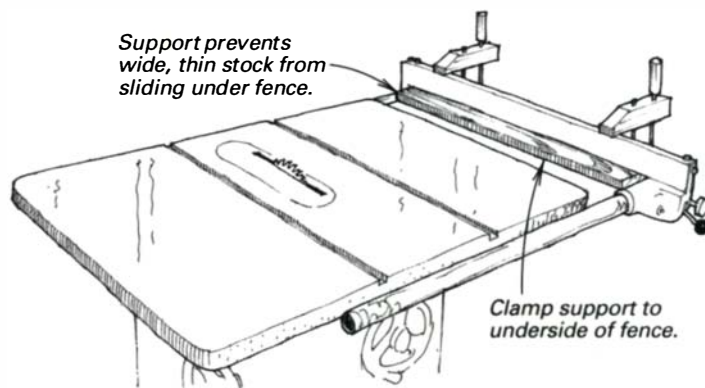
This sanding station, which I installed as an extension to my bench, has proved useful for sanding, routing and biscuiting. It pulls in most of the fine dust created by these operations. I brush any dust that remains over the slots and watch it disappear.

To build the sanding station, rout a number of short slots in 3/4-in. material. Then build up the underside of the top by lami-

nating in an extra 3/4-in. lid, leaving open the area where the collection box fits in. Attach a scrap-plywood collection box to the bottom, and add a blast gate and pipe to your dust-collection system.

—John Weidner, San Francisco, Calif.

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When ripping wide panels from thin sheet stock or plastic laminate, the edge next to the fence has a tendency to slip under the fence, which can be dangerous. To remedy this situation, clamp a piece of scrap under the fence, as shown.

—Edmond Valade, Goffstown, N.H.

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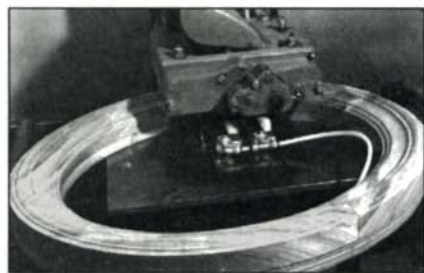


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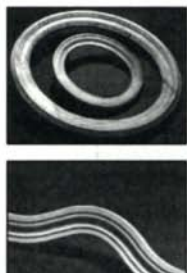


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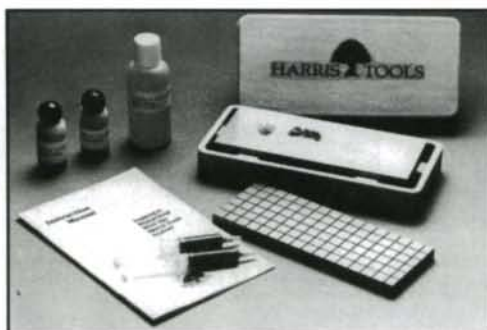
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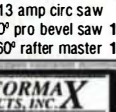
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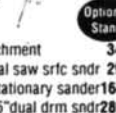
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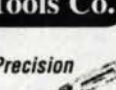
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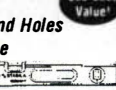
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3283DVS
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Accenting curly maple's figure

I've recently purchased some highly figured tiger maple for a five-drawer chest of drawers. I'd like to finish this piece to match the gentle golden tone of Colonial maple furniture. Could you give me some advice on achieving this color?

—Dan Campbell, Meyersville, N.J.

Garrett Hack replies: There is nothing like the golden amber color that figured maple takes on after many years of exposure to light and the oils of the human hand. In contrast to cherry, which oxidizes rather rapidly, maple achieves this color slowly. Trying to hasten the darkening by using stains can be frustrating. The irregular grain takes stain unevenly and too often ends up looking stained. It is natural that it does stain unevenly, considering the wildly varied orientation of the grain to the surface. The trick, then, is to color the wood, highlight the grain and have it look like natural oxidation.

The process I go through is quite simple, but it takes a bit of practice and some trial and error. I apply several coats of tinted varnish instead of staining and then finishing over the stain. This process eliminates the splotchiness of staining and allows a lot of control over the color. Although most of my experience is with rock or sugar maple, these techniques will work equally well with figured red maple and many other woods.

For maximum finish clarity, the wood must be properly prepared, which for me means the polished surface left by a sharp plane. Planing figured maple is a difficult task, and I frequently rely on some help from a scraper. But when done right, the surface shines.

Getting the right color to suit your taste, the wood and the overall design of the piece is the trial-and-error part of the job. I use a combination of spar varnish (synthetic varnish, such as polyurethane, seems to work equally well), boiled linseed oil and turpentine in equal parts, to which I add the color. My favorite colorant is Minwax Golden Oak stain. For the first coat or two, I add about four tablespoons of color to a pint of the above mixture. Artist's oil pigments also work well and can be combined for subtle shadings or to get many new colors. The varnish and oil add to the pigment's golden color. For the initial coat or two, it is better to keep the color light to avoid the splotchy look from uneven absorption. Add more color as needed to subsequent coats.

I brush on the finish, let it sit until it feels tacky and then rub the surface thoroughly to remove any excess. Although some of the color comes off, the rubbing develops a smooth finish that needs very little steel-wooling later. I build up several thin, colored layers, altering the color of the varnish as necessary. Three or four coats are usually sufficient. For extra protection, such as on a tabletop, I'll add a few coats of clear finish once the color is right. For a final coat, I apply a combination of beeswax and boiled linseed oil with a 0000 steel wool pad.

[Garrett Hack is a furniture designer, maker and one-horse farmer in Thetford Center, Vt.]

Are petroleum distillates necessary in finishes?

Because I have developed a severe sensitivity to the petroleum distillates used as solvents in many finishes, I'm having trouble finding a finish I can use without becoming extremely ill. My solution has been to use pure tung oil because the label claims the oil contains no petroleum distillates. It rubs on beautifully, but it is recommended that the first coat be diluted with mineral spirits to a 50/50 mix. Instead, I have been using Di-Citrusol, a 100% plant-derived solvent made by Sutherland Welles (available from Garrett Wade, 161 Avenue of the Americas, New York, N.Y. 10013; 800-221-2942). The results seem beautiful, and I've been using these materials with no protection, either gloves or respirator, and have had no adverse reaction. But I still have questions about these products:

Is it okay to use Di-Citrusol to thin tung oil? Is it necessary to use petroleum distillates or some other additive as a drier for tung oil? And what is tung oil anyway?

—David Carse, Hinesburg, Vt.

Nancy Lindquist replies: Di-Citrusol can be used to thin 100% tung oil. The proof is that you are getting good results. The key to solubility is that the tung oil has enough chemical similarity to the mixed terpene hydrocarbons that make up Di-Citrusol. You also could use turpentine, which has a similar chemical structure as tung oil. Mineral spirits is usually recommended because it's compatible and inexpensive. The choice is whether you like a pine smell, the slight odor of "odorless mineral" spirits or the gasoline-type odor of regular mineral spirits.

In general, the health hazards listed for all these solvents are the same. If you are irritated specifically by mineral spirits, Di-Citrusol or turpentine are good alternatives. But remember, all these solvents are irritants to the skin, eyes and respiratory system. I recommend using gloves and working in a well-ventilated area or wearing a charcoal-filter respirator when using these solvents. All three solvents are flammable. Be sure to let your oily rags dry in single layers to keep them from igniting. If you are concerned about the safe handling of solvents and other coating materials, ask the supplier for a Material Safety Data Sheet (MSDS) on these products.

None of these solvents are driers. A drier is a metallic salt (cobalt, manganese and zirconium are common; lead has been discontinued due to health risks) added to oils to speed up what naturally occurs in the curing process. The solvent is related to drying only in that it must evaporate away so the oil can cure properly. The oils dry by reacting with the oxygen in the air. The solvent reduces the viscosity (resistance to flow), so you can apply the material more easily. The first coat of oil or varnish is thinned to help the finish go into the pores for better mechanical adhesion. A thicker material might bridge the pores and not stick to the wood as well.

There are a variety of oils used in wood finishes. They are classified as non-drying, semi-drying and drying oils based on their chemical structures. Almost all the oils for finishing are from plants. Linseed oil comes from the flax plant, which also is used to make linen clothing. Tung oil comes from a tree in China. Both linseed and tung oil are drying oils. But tung oil dries faster than linseed oil.

People have been using oils for wood finishes a lot longer than chemists have been studying them. You knew the answers to your basic questions without all these details. If it makes you feel sick, don't use it. If it works now and suits the appearance and use requirements of the piece, it will serve you well. The added questions come from our knowledge of chemistry and the newer field of toxicology. Always ask for the MSDS, and read the hazard labels to find out what protective gear you need before you start working with new materials. If you haven't read the MSDS on familiar materials, now is the time. Then you can do your best work without all the worry.

[Nancy Lindquist is a woodworker, designer and finishing specialist in Chicago, Ill.]

Chopping block benchtops

Now that I'm retired, I have time to upgrade my workbench. I want to put on a maple, butcher-block top, complete with front vise, end vise, dog slots—in short, the whole works. But today's butcher blocks are strips of hardwood and usually are glued up side by side. The tops that I remember in my manual training class of 60 years ago were end-grain hardwood, 2 in. by 2 in. Granted, more care must be taken in jointing and gluing up these pieces, but wouldn't the top be superior with end grain showing? —Roland A. Wedig, Grand Junction, Colo.

Mario Rodriguez replies: You're right about end-grain

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butcher block being superior to long-grain butcher block for surface wear, but the problem for a benchtop is in stabilizing the lamination and maintaining a flat work surface. Usually, professional butcher blocks are 2-in.- by 2-in.-sq. maple strips, about 18 in. long with the end grain as the work surface. The length of the strips gives considerable strength and stability to the lamination. For your workbench top, the commonly available butcher block made up of strips glued side by side is strong enough and will serve you well.

[Mario Rodriguez is a contributing editor to *FWW* and a woodworker in Warwick, N.Y.]

Cutting and polishing marble with woodworking tools

Recently, I was given a large, 1-in.-thick slab of marble from a men's room remodel. I was thinking of having the slab cut to size and repolished at a stone yard to make a coffee-table top. I mentioned this to my local tool dealer who claims anyone can cut a marble slab and rout a profile on the edge with the same old router and carbide cutter bits you'd use on wood, only taking less meat with each pass. Can ordinary routers really cut and shape marble? Is there any way to polish the top?

—Scott Onishuk, Goleta, Calif.

Joseph Beals replies: I cut marble with a bonded abrasive masonry wheel in a circular saw, using a wood fence clamped to the marble to guide the saw and a felt pad under the shoe to protect the surface finish. For 1-in. material, three or four passes seem to best suit both the saw and blade. The marble should be cut on a dead flat surface to guard against the waste piece breaking off prematurely. A wet cutting diamond saw would be better for small jobs, but the stock I use for table and countertops typ-

ically runs 6 ft. to 8 ft. long and 3 ft. to 4 ft. wide, which rules out the use of ordinary wet saws.

Dry cutting produces a large volume of very fine dust. I work outside, wear a respirator and protect the saw. The dust could burn out the motor. A cloth tied around the motor housing to cover the air inlets works adequately, but blow out the saw with compressed air when the job is done.

The cut edges can be dressed with a belt sander fitted with an 80-grit or 100-grit belt, and the sharp corners given a radius if desired. The edge is wet sanded, starting with a 240-grit waterproof paper, followed by 320-grit and 400-grit. Rinse the sanding block frequently in a water pail, and keep the marble well flooded. Use the same wet sanding protocol to clean up scratches and weathering on the polished face, but be aware that deep scratches or stains may exceed the capacity of hand-powered repair.

I polish the top surface with a proprietary buffing compound from the Multi-Seal Pacific Corporation (P.O. Box 3457, Alhambra, Calif. 91803; 800-222-6915), but other products may be available. The compound I use is a marble refinisher composed of a liquid vehicle and an acidic powder. The two parts are applied separately to the marble and mixed to form a slurry. The slurry is worked with a nylon buffing pad on a machine for large surfaces or with a nylon or burlap pad on a hand block for small surfaces and edges. For most marbles, this compound will take a 400-grit wet-sanded surface to a high-gloss polish with little effort.

Marble is relatively soft, but it is nonetheless stone, which means it is a hard, abrasive crystalline material that chips and fractures easily. It is suited to the use of edge tools such as a sculptor's chisel, that spall large chips at hand speed. But

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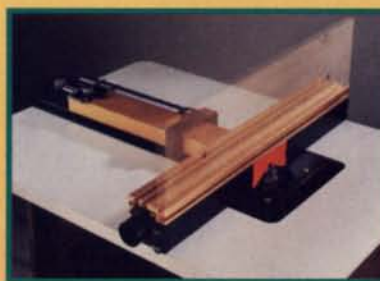


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a router will work adequately for edge-shaping. The hardness of the material will self-limit the rate of stock removal. There is no particular danger of throwing large chips, but the nature of the cut will tend to break or chip any sharp details in the profile, and the tool itself probably will be unsuited for wood-working afterward.

I cut ovolo, ogee and other profiles by wasting the bulk of material with the circular saw, dressing the rough cut with 60-grit or 100-grit floor paper and then following the previous directions. A similar method can be used to cut rounds or other curved work, as in lamp bases or small tabletops, but in all cases, the work is very labor intensive. For anything other than a one-off project, a stone shop with a diamond profiling wheel will do a better, faster job.

[Joe Beals is a designer, builder and custom woodworker in Marshfield, Mass.]

Fox-wedged tenon chair repairs

I am trying to restore an old Windsor chair that has some really shoddy repairs done on it—1/4-in. dowels, plastic wood and glue to fill gaps. The holes for the legs in the bottom of the seat are worn and too large. I plan to drill out the holes in the seat bottom, turn plugs to fill the holes so the grain in the plug and the seat run in the same direction, and then redrill for the legs.

Somewhere, I have seen a wedge used in the end of a round tenon that is not a through-joint. Could this be used in the leg assembly of a Windsor chair? The trick to me would be sizing the cut in the tenon and the wedge because you might have one chance. Would this blind-wedged tenon be better than gluing, and how do you do it? —William Schubart, Palmyra, Va.

Jeff Jewitt replies: The problem you describe is common to

many Windsors, and you seem to be on the right track in your restoration procedure. As you have found out, most repair work to furniture involves undoing bad repairs done previously. I would like to suggest the following to give you an idea of what constitutes proper repair procedure.

Wood's shrinkage across the grain was well-known to early chairmakers, and original Windsor construction used this ingeniously. Makers used green wood for the seat, and when the seat dried to its final width, it formed a mechanical lock around the tenons on the ends of the legs. If the legs also were turned green, the tenon ends were kerfed with a saw and then wedged with a small piece of hardwood, usually maple. This ensured a tight fit when the wood dried. On most chairs, the tenons went through to the top of the seat, which is known as a wedged tenon. On commercially produced chairs, the leg frequently did not extend through and was simply tenoned into the bottom of the seat, as yours is. This tenon was glued, and over time, invariably loosened, due to seasonal expansion and contraction of the seat. In some instances, the tenon was kerfed and wedged; this is known as a fox-wedged tenon.

If you're repairing an old chair of possible value, it's best to duplicate the original construction as closely as possible. Piecing in new wood in the seat and redrilling the mortise for the old tenon is probably the best way to fix this chair. I also recommend this procedure if you are making a new leg or splicing on a new piece to make a new tenon. Because the joint is hidden, you can get away with a fox-wedged tenon, but remember, you're altering the original construction.

To make a fox-wedged tenon, I drill a 1/8-in.-dia. hole through the tenon. The hole should be perpendicular to the grain and about 1/4 in. above the tenon shoulder. Saw a kerf down the mid-

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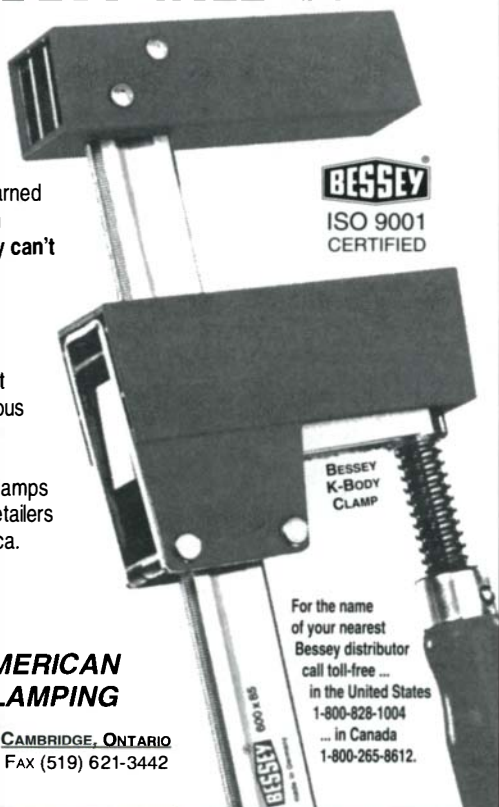
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dle of the tenon, also perpendicular to the grain, to meet the hole. The hole relieves the pressure from the wedge, which could cause a split to run down the leg. Make a small wedge from hard maple with the top of the wedge twice the thickness of the sawblade kerf. The wedge should be as long as the kerf. Fit the wedge into the top of the tenon, and place it into the seat socket. You can use glue, if you wish, on the tenon and in the seat mortise. Drive the leg into the mortise with a wooden mallet. But before you drive it home, turn the chair over and check for wobble. If all looks okay, drive the leg home.

[Jeff Jewitt specializes in the conservation and restoration of antique furniture in North Royalton, Ohio.]

Stripping and refinishing kitchen work surfaces

I just refinished two pieces for use in the kitchen: a butcher-block top for a dishwasher and a butcher-block tabletop. I had the table stripped professionally with methylene chloride. I sanded down the dishwasher top myself. After stripping off the old finish, I used two coats of tung oil, and then I used finishing wax.

I suppose this finish is all right for living room pieces, but I know now that it is wrong for high-traffic use. It seems that gray spots developed on both pieces. The customer said that it happened when she placed wet tin cans on the top of the dishwasher. I had to use steel wool and mineral spirits on the stains and all the wax, and recoat with satin polyurethane—a finish I had been trying to avoid using.

I've since heard that mineral oil would have worked fine for the dishwasher top. For the table, I wonder if Watco or tung oil would have been sufficient? And are the gray marks a reaction of the wax to water? —Dave Seroy, New York, N.Y.

Pat O'Daly replies: I wish you had said more about your stripping and refinishing process and what kind of wood the butcher block is made of. My assumption is that part of your problem is in the stripping. If these surfaces were actually used for food preparation and stacking up dirty, greasy dishes, then there was probably a lot of contamination in the grain, especially in the end grain.

I'm not sure what the old finish was that you stripped off. However, commercial strippers generally have wax in them to help them stay on the surface long enough to do their job. I strip off the finish and then strip off the stripper. The first coat or two of stripper removes the finish. Then I put on a light third coat to reactivate the residual stripper and scrub that off with a regular-strength solution of trisodium phosphate (TSP). TSP is readily available in hardware stores and paint stores. I scrub this off immediately with fresh, clean water and steel wool or a nylon scrubber. Obviously, you wouldn't want to do this on a veneered piece. In this case, use acetone instead. At this point, the piece should be reasonably free of contamination.

I have oiled and waxed a few butcher blocks in my day and have not had the problem you describe. It isn't out of the realm of possibility, though. Wet tin cans sitting on the surface for a while may react with tannins in the wood or old grease leaching to the surface. You had the right idea, though. Traditionally, finishes such as melted beeswax in turpentine were scrubbed into kitchen surfaces or melted paraffin was brushed on, allowed to cool and the excess scraped off. The idea was to have a renewable, nontoxic, flexible finish that wouldn't chip or flake off in the food. I think tung oil (several coats allowed to cure for several days each) or Watco (allowed to cure 30 days before exposing to food stuffs) would be fine. Watco reformulated its

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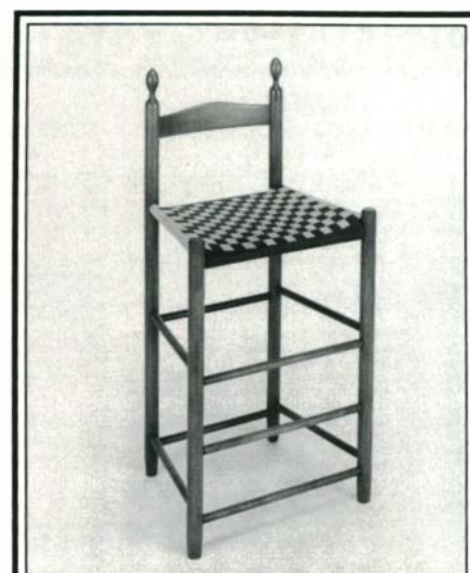
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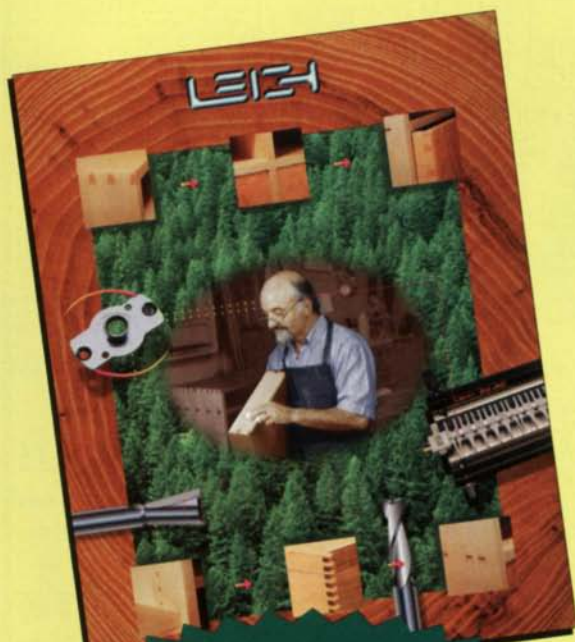
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product line last year to be less toxic. The mineral oil is okay but has no driers, so the oil remains sticky for a long period, attracting dirt until it breaks down.

[Pat O'Daly is a professional finisher. She operates a furniture and antique restoration business in Sonoma, Calif.]

Searching for greenheart and other laurels

When I was in Panama, I had a lovely cocktail table made of greenheart, which has a striking dark, deep green color. I've been looking for some locally, but the best I've found is just a light-colored, nondescript wood. Can you tell me more about this beautiful wood?

—Steve Mahaffy, Danville, Calif.

Jon Arno replies: Finding a source for greenheart is one thing, but finding vividly green greenheart is a totally separate matter. Greenheart belongs to the laurel family, Lauraceae. Its tropical genus, *Ocotea*, includes about 250 species, many of them native to northern South America, Central America and the West Indies. Another genus in this family, *Ectandra*, also produces important cabinetwoods. There is mass confusion in the trade as to what's what by the time these timbers clear U.S. customs.

If these species were similar in terms of their physical properties, it probably wouldn't matter, but this is definitely not the case. Some are relatively open-grained and coarse-textured, and others are nearly as fine-textured as maple. Although they are all relatively hard woods, their specific gravities range from about that of our native white oaks (0.60) to blade-burning densities well in excess of rosewood (0.90). Also, their color ranges from reddish-brown through various shades of green to olive drab. Sometimes the wood will have jet black streaks that are so dominant they give it mostly a black hue reminiscent of a somewhat sickly green Macassar ebony. Greenheart is extremely strong

and durable and is used extensively in heavy construction and marine applications as well as cabinetry. And there is as much demand for the ugly but functional timbers as there is for greenheart with furniture-quality color and figure.

True greenheart, *O. rodiaei*, is especially common in the Guianas and neighboring southeastern Venezuela. As a result, knowing the geographic source of the timber has some vague predictive value with respect to what it might be like. But when it comes to greenheart, there is no such thing as a sure thing. For this reason, even though it is available from many mail-order sources, I would strongly advise against buying the wood sight unseen.

One other important factor to consider is that most timbers in the laurel family tend to be pungent, and some are rather toxic. The *Ocotea* genus is known to produce some alkaloids that one authority cites as being "curare-like" in their action. Numerous cases of skin rash and bronchial problems have been reported among woodworkers in Europe, where this wood has been used in substantial quantities since the mid-18th century. With this in mind, if you are able to locate some greenheart that suits your taste, it might be a good idea to limit your first-time exposure to the sawdust, and then wait a few days to see if you have an unusually high sensitivity to it. There are a number of woods with a worse reputation for toxicity, but greenheart is certainly no saint.

[Jon Arno is a wood technologist and consultant in Troy, Mich.]

Send queries, comments, and sources of supply to Q&A, Fine Woodworking, PO Box 5506, Newtown, Conn. 06470-5506. We attempt to answer all questions, but due to the great number of requests received, the process can take several months.

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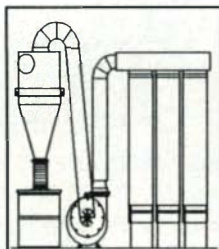
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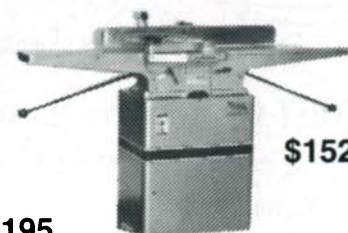
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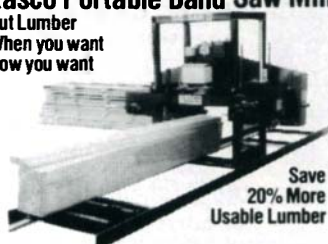
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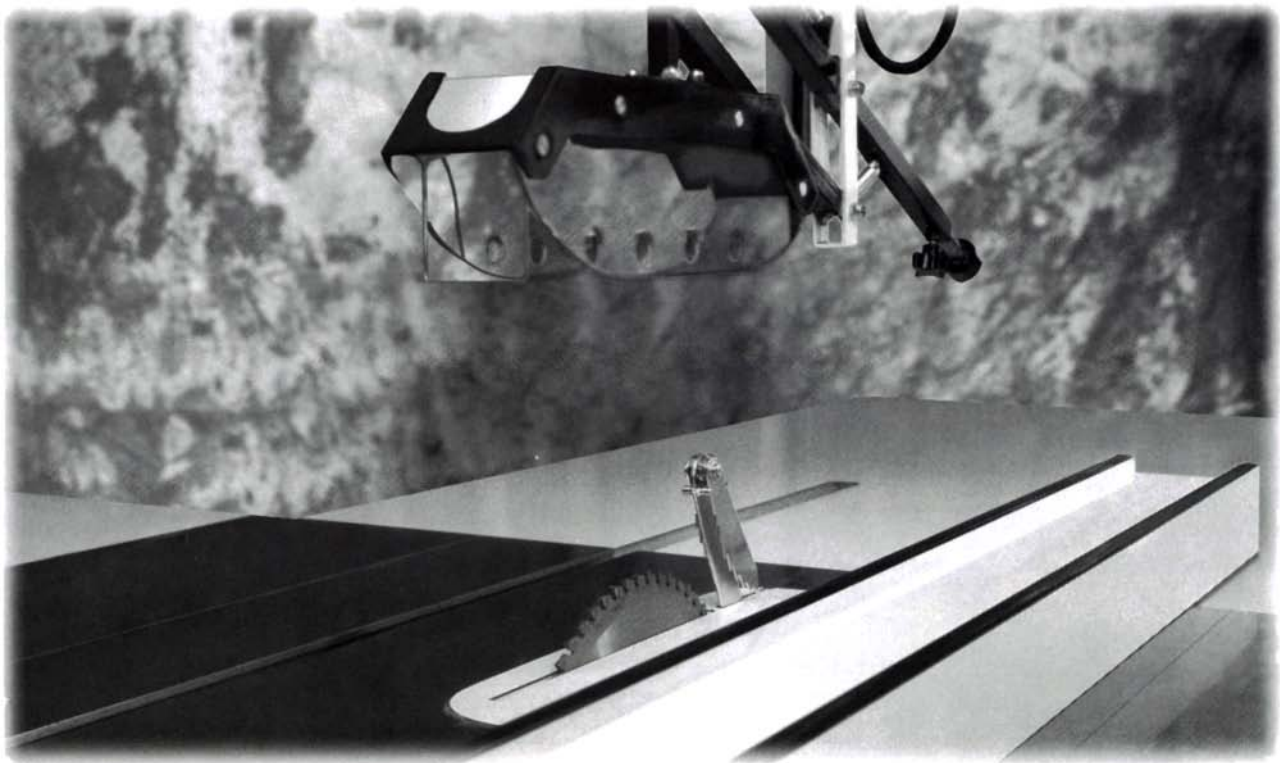
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332	QUICKSAND 5" RNDM ORB W STIKIT PAD	36
332K	332 W CASE & 100 SHEETS PAPER	92
333	QUICKSAND W HOOK & LOOP, DUSTLS	73
333K	333 W CASE & 50 SHEETS PAPER	99
334	QUICKSAND W STIKIT, DUSTLESS	73
334K	334 W CASE & 100 SHEETS PAPER	99
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340K	340 WITH CASE & 10 SHEETS PAPER	72
345	SAW BOSS 6" CIRCULAR SAW	104
347	7 1/4" FRAMERS SAW 15 AMP, 10.25 LBS	127
351	3" X 21" BELT SANDER	148
351K	351 W 10 ASST BELTS & BELT CLNR	158
352	3" X 21" BELT SANDER W DUST BAG	151
352K	352 W 10 ASST BELTS & BELT CLEANER	161
9352VS	3" X 21" VS DUSTLS BELT SANDR W CSE	165
9352VSK	9352VS W 10 ASST BELTS & BELT CLNR	175
360	3" X 24" BELT SANDER W DUST BAG	169
360K	360 W 10 ASSORTED BELTS & BELT CLNR	200
361	3" X 24" BELT SANDER	182
361K	361 W 10 ASST BELTS & BELT CLEANER	193
362	4" X 24" BELT SANDER W DUST BAG	195
362K	362 W 10 ASST BELTS & BELT CLEANER	208
363	4" X 24" BELT SANDER	191
363K	363 W 10 ASST BELTS & BELT CLEANER	204
410	UNDERSCRIBE LAMINATE TRIMMER	148
411	MITER FOLD LAMINATE TRIMMER	165
447	7 1/4" FRAMERS SAW W BRAKE 15 AMP	137
505	1 1/2 SHT FIN SANDER	123
505K	505 W CASE & 2-10 YD ROLLS PAPER	159
511	CYLINDRICAL LOCK INSTALLATION KIT	139
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556	BISC JOINER W CASE & TILT FENCE	168
556K	SAME AS ABOVE W 1000 BISCUITS	190
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690K	690 W CS, EDGE GUIDE, & TEMP GD KIT	179
9690	1 1/2 HP ROUTER W CASE	144
691	1 1/2 HP "D" HANDLE ROUTER	148
691K	691 W CASE, EDGE GD & TEMP GD KIT	204
693	PLUNGE BASE ROUTER, 1 1/2 HP	169
695	SHAPER TABLE W 1 1/2 HP ROUTER	216
696	SHAPER TABLE	128
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7335K	7335 W CS, DUST EX SYS, 100 SHTS PPR	165
9733K	6" RANDOM ORBIT SANDER, VS W CSE	137
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7519	3 1/4 HP FIXED BASE ROUTER-1 SP	233
7536	2 1/2 HP FIXED BASE ROUTER	202
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7538	3 1/4 HP PLUNGE ROUTER-1 SPEED	235
7539	3 1/4 HP PLUNGE ROUTER-5 SPEED	269
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7549K	7549 W CASE & 10 BLADES	152
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9833S	12V CRDLS KIT W 2 BAT, CASE	169
97310	LAMINATE TRIMMER KIT W 4 BASES & CS	194

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TXE150	6" VS DUSTLS RANDOM ORBIT SANDER	138
BSPE100	BAREL GRIP JIG SAW, VS W CASE	155
FSPE100	TOPHANDLE JIGSAW, VS W CASE	155
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31-080	1" BELT 5" DISC SANDER	90
31-460	4" BELT 6" DISC SANDER	134
34-182	TENONING JIG	84
36-090	10" SIDEKICK MITER SAW	219
37-070	NEW 6" VS BENCH JOINTER	258
40-560	16" SCROLL SAW, 2 SPEED	184

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0407-1	12V KYLS CDLS DRILL KIT W 2 BAT, CS	173
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6494	10" COMPNDR MITERSAW W CARB BLD	309
6507	VAR SPEED SAWZALL W BLADES & CSE	144
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6527	SUPER SAWZALL W BLADES & CASE	172

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1273D	4" X 24" DUSTLESS BELT SANDER	208
1273DVS	4" X 24" VS DUSTLESS BELT SANDER	219
1370DEVS	6" VS DUSTLS RNDM ORB SNDR	224
1584VS	CLIC BARREL HANDLE JIG SAW, VS	148
1584VSA	1584VS JIG SAW W CASE	168
1584VSB	1584VS JIG SAW W CASE & 20 BLADES	182
1584DVS	BARREL HANDLE JIG SAW, DUSTLS	193
1587VS	TOP HANDLE JIG SAW, VARSP	148
1587VSB	1587VS JIG SAW W CASE	168
1587DVS	1587VS JIG SAW W CS & 20 BLADES	182
1604	TOP HANDLE JIG SAW, DUSTLESS	193
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1608KX	LAMINATE TRIMMER	94
1613EVS	DELUXE INSTALLERS KIT W 4 BASES	229
1613EVS	2 HP VAR SP PLUNGE ROUTER	194
1613EVS	1613EVS 2W RA1051 EDGE GUIDE	216
1614EVS	1 1/4 HP VAR SP PLUNGE ROUTER	159
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Model CM614 Sign Carver



Model T-110 Dupli-Carver

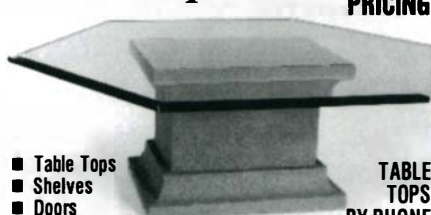


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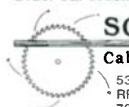
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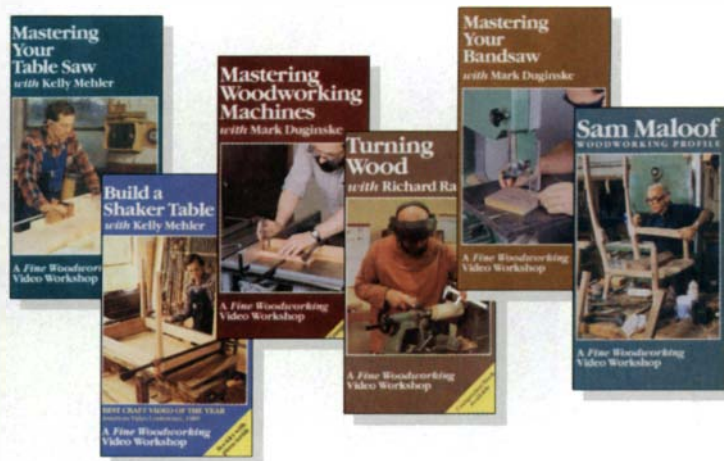
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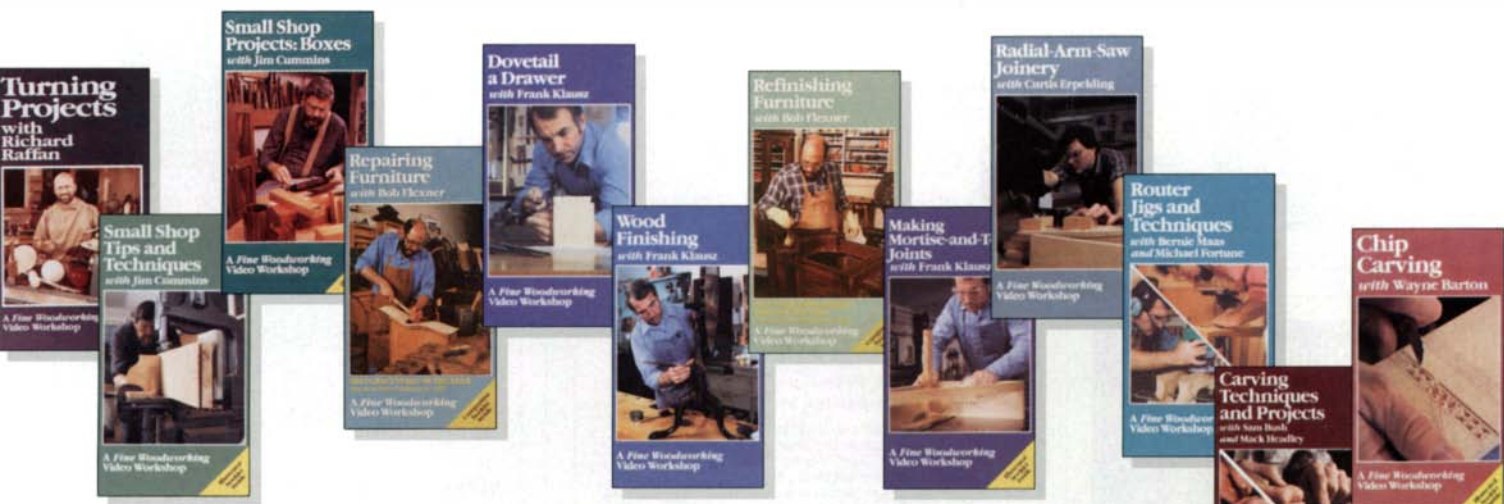
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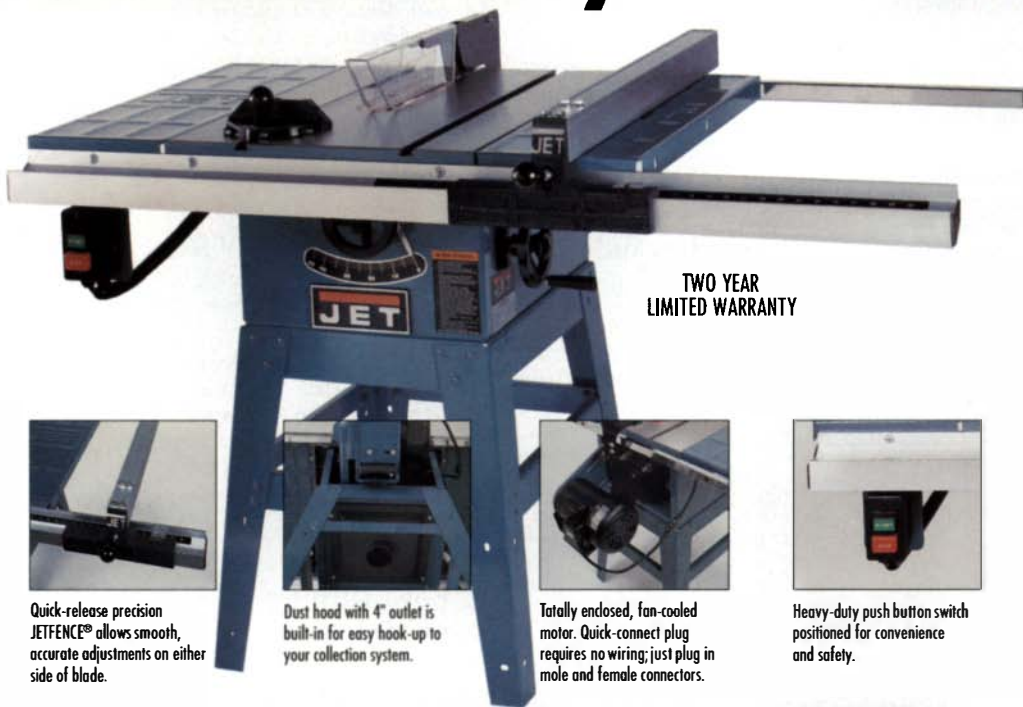
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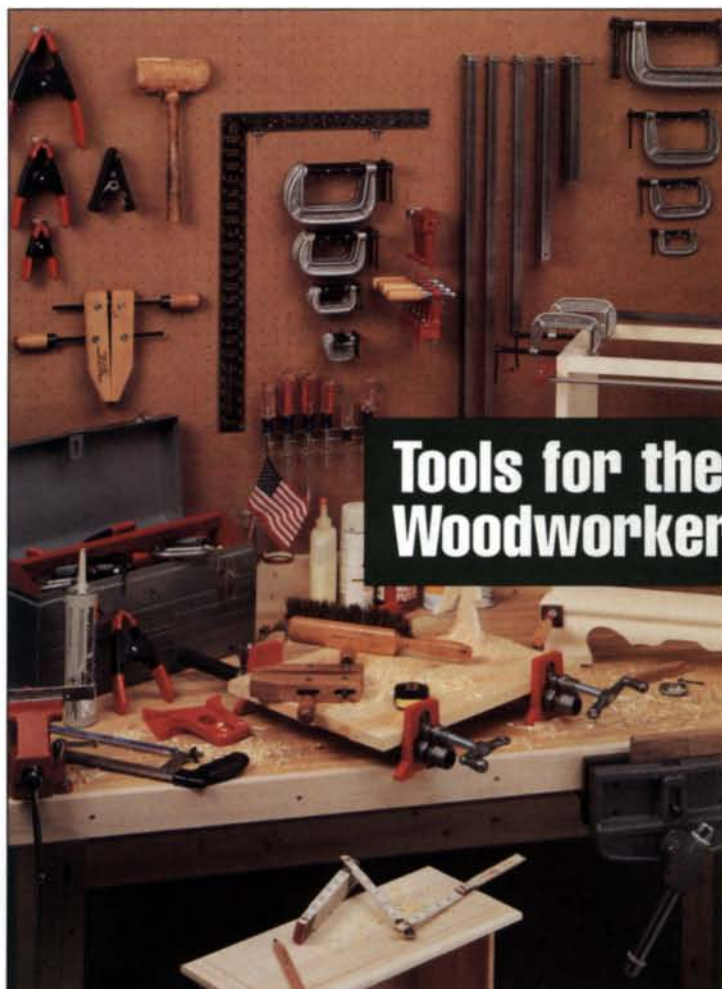
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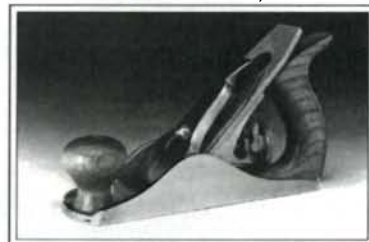
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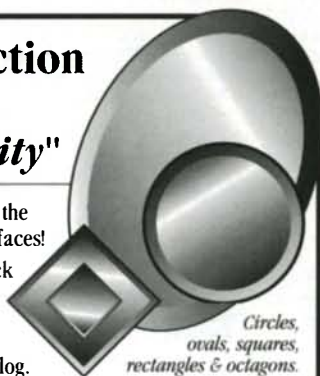
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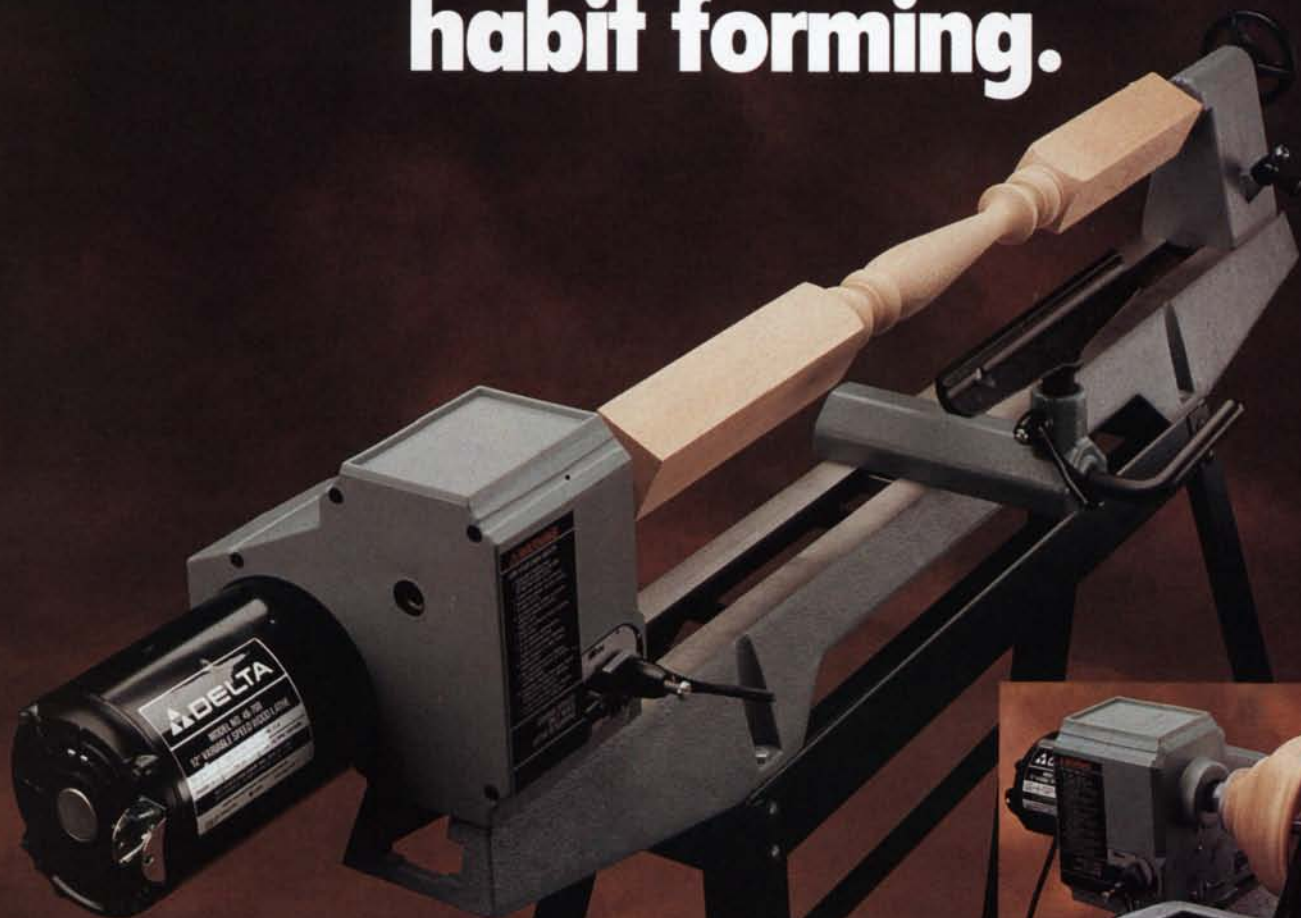
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Practice pays off. The author so admired a sunburst veneer match he ordered from a local supplier that he taught himself how to make his own. It took some practice, but now he can make patterns like this tabletop in crotch mahogany.

Veneer Matching: From Small Sheets, Great Patterns

How to make the best possible use of extraordinary veneers

by Frank Pollaro

There was a time when I couldn't imagine using veneer for anything more than covering the raw edges on plywood. Then a special table came along. I thought it might be nice to do something besides my usual solid-wood glue-up with an occasional inlay.

I had a local veneer supplier make an ebony sunburst for the tabletop. When the top arrived, I felt such admiration for the craftsman who had so perfectly arranged those 20 pieces of ebony veneer into a brilliant star. But besides admiration, I was determined to do the veneer work myself next time.

After ordering some veneer and reading up on veneering, I began cutting, arranging and pressing some basic veneer matches. Two years and several hundred square feet of veneer later, I cut my first 16-piece sunburst match for a tabletop. It turned out beautifully, but it did take some time.

Since then, I've worked increasingly with veneers and done many sunburst matches as well as plenty of simpler matches. I've learned a few things in the course of this work that make veneer matching easier and the results more consistently successful. You don't have to tackle anything complicated to enjoy veneering. The figure, color and diversity of the veneers that are now available is breathtaking. Here are some techniques that have helped me.

The basic principle

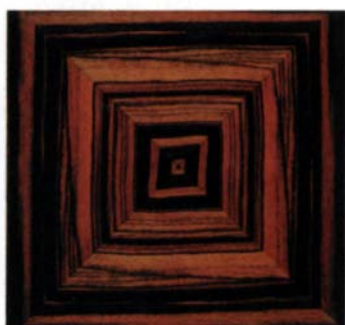
The eye doesn't notice the precise width of a sheet, or leaf, of veneer, but the eye will notice sloppy asymmetry or poorly matched grain lines. That's why it's more important to make sure the grain lines in a pattern meet cleanly or are aligned in an attractive manner than it is to have all of the pieces of a pattern exactly the same size. This is the secret to a successful veneer match.



BOOK-MATCH



FOUR-PIECE MATCH



DIAMOND MATCH



REVERSE-DIAMOND MATCH

Four simple matches make the most of smaller leaves of veneer. A book-match works best with veneers that have asymmetrical grain or figure patterns because the match creates symmetry. For the same reason, a four-piece match is best-suited for burls and other similarly wild-figured veneers. Diamond and reverse-diamond matches are most impressive with straight-grained veneers.

I usually pick an obvious mark, like a swirl, pin knot or area of particularly remarkable grain, and keep this mark the same distance from the edge of each leaf of veneer. That way, a pattern looks balanced or symmetrical throughout a match, regardless of whether it's a simple book-match or the most complex sunburst.

Book-matches and four-piece matches

A book-match is when two leaves of veneer are opened from a common edge, as you would open a book (see the top left photo). Book-matching is best done with veneers that are obviously asymmetrical: Two veneer leaves opened so they look like mirror images of each other form a symmetrical, balanced whole.

When four leaves of veneer are book-matched and then book-matched again, perpendicular to the first seam, the result is called a four-piece

match (see the top right photo above). Burls and odd patterns commonly are used for a book- or four-piece match.

Diamond and reverse-diamond matches

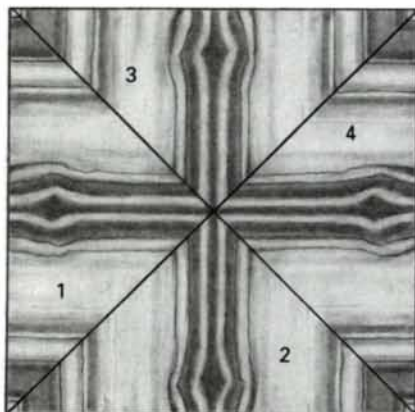
The most sophisticated matches commonly used for square shapes are the diamond and reverse diamond. These are best-suited for straight-grained or striped woods. For a diamond match, the grain is positioned parallel to the four outside edges of the square (see the bottom left photo). For a reverse diamond, the grain is perpendicular to the outside edges (see the bottom right photo).

Creating a diamond or reverse diamond match is not an obvious process like a book- or four-piece match. For either the diamond or reverse diamond, I begin by cutting the four component pieces, each slightly longer than a finished side of the match and slightly wider than half of the match. I cut angles at 45° to the grain on two

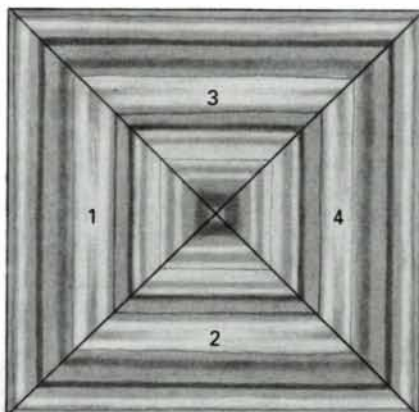
Fig. 1: Creating a diamond or reverse-diamond

The cutting and taping sequence is the same for diamond and reverse-diamond matches. The only difference is that the grain is oriented perpendicularly to the outside edges for a reverse diamond (below left) and parallel to the outside edges for a diamond (below right). Mark individual leaves as shown.

Reverse-diamond match

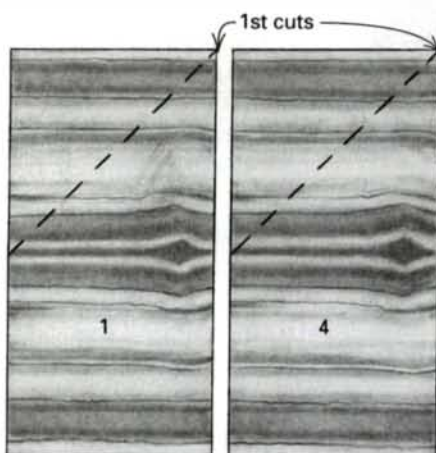


Diamond match



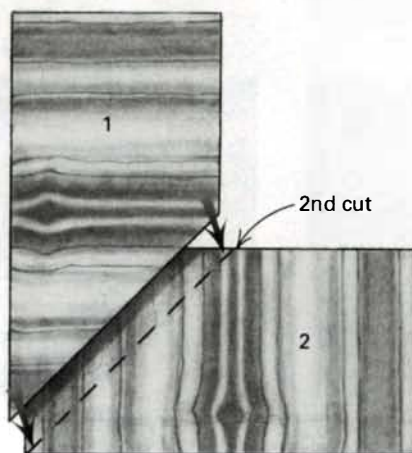
Step 1

First cut opposing leaves from their midpoints to the opposite corners.



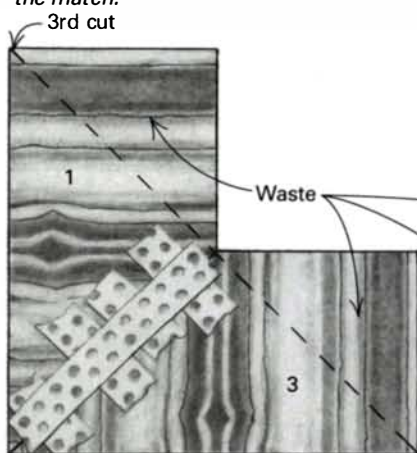
Step 2

Now lay the cut half of #1 over #2. Align grain as well as you can, and then mark and cut #2. Tape these two pieces together. Repeat steps 1 and 2 with pieces #3 and #4.



Step 3

Cut diagonally across L-shaped piece to create a right triangle. This is one-half of the match.



Step 4

Lay section #1-2 over section #3-4. Mark and cut as in step 3. Tape the two halves together, and you're done.

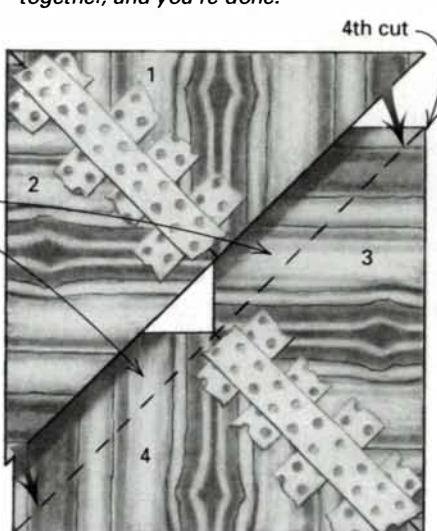
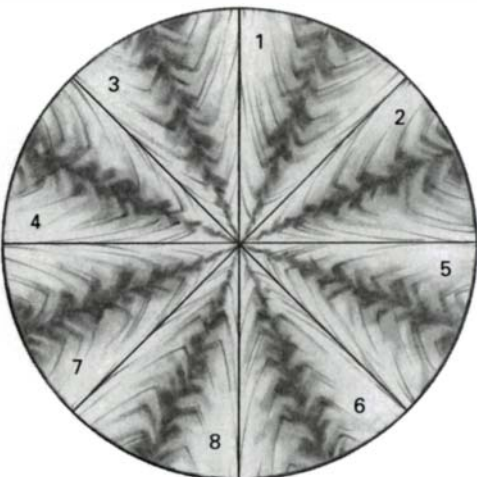
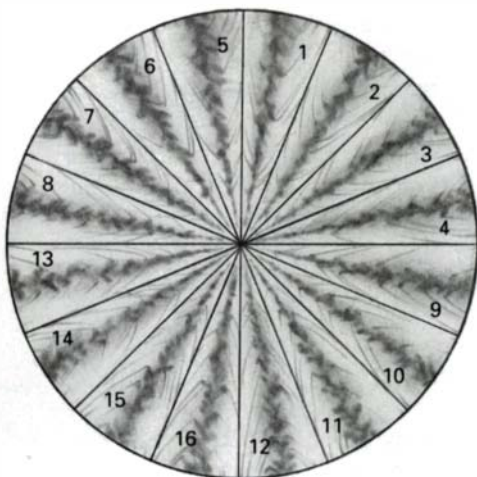
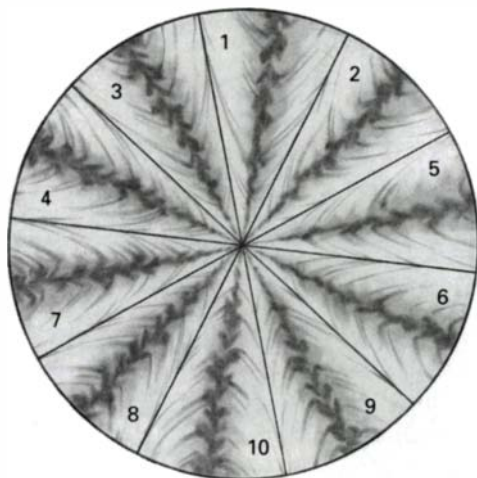


Fig. 2: Laying out a sunburst

By positioning veneer leaves as shown, you can eliminate any abrupt changes in figure between leaves. This will keep the pattern looking more balanced throughout.



of the four pieces from the center of a long side to an opposite corner (see step 1 in figure 1).

Then I place one of the cut quarters over another uncut piece of veneer (this will be the quarter adjacent to it), carefully aligning the two pieces to get a 90° corner (step 2). I mark the second piece with a sharp pencil, cut it using a veneer saw and a good straightedge and then tape the two pieces together with veneer tape. I repeat the process with the other two pieces.

What I have now are two L-shaped pieces. I draw a line diagonally across the corners and then cut along that line, leaving a right triangle that is half of the match (step 3). This half is then laid over the other, grain lines are aligned and the bottom piece is marked and cut to form the second half of the square. Finally, the two halves are taped together to complete the match (step 4).

The sunburst match

By far, the most beautiful of all matches is the sunburst (see the photo on p. 40). It is most often used for round tables. But it also works well for squares, ovals, quarter- and half-rounds and arcs, which make beautiful headboards for beds.

Laying out, cutting and arranging the wedges—To make a sunburst match, I determine how many leaves of veneer I need. For the best results, they must be sequential leaves. That is, the leaves must be in the same order as they were sliced off the log, so grain variations are subtle and occur only gradually with each successive leaf in a stack, or book, as it's called. I usually make sunbursts using eight, 10, 16, 20 or 32 leaves (see figure 2).

I decide how many leaves I need by multiplying the diameter of the desired circle by π (3.14 is close enough) and then dividing this number by the width of my veneers. For example, for a round table, 30 in. dia., I'd multiply 30 in. by 3.14 and divide that number by the width of my veneers (say, 7 in.). In this case, the number of leaves I'd need to complete the circle is about 13½. I can't round the number down; therefore, I aim for 16 leaves because I have made 16-piece matches before, so I have a template to speed layout.

The templates are simple to make: For eight-, 16- and 32-piece matches, I halve a circle, halve the half and so on. I make the template just slightly wider (¼ in. is about right) than the exact angle of each piece so that when half of the circle is assembled, I'll have slightly more than half of a sunburst. That way, I can tape up the two halves separately, and then trim each half with a straightedge. The two halves can be joined to form a complete circle. But I'm getting ahead of myself.

After I've established the number of leaves in my sunburst and made a template, I number each leaf in sequence. I preview what the finished sunburst will look like when it's assembled, so I know where to cut the individual sheets of veneer. I do this by taping

LAYING OUT THE TOP



Preview a whole sunburst on one leaf of veneer. By using a pair of hinged mirrors (duct tape will hold them together), the author can see how a sunburst will look before the first leaf has been cut.



A razor-sharp saw is essential for cutting heavily figured veneers like this crotch mahogany. A heavy straightedge with a fairly high side guides the saw and keeps it perpendicular to the veneer.



A template reduces layout time while improving accuracy. Even if you're only planning to do one sunburst, the time spent making a template will be well worth the effort.

two pieces of mirror together to create an adjustable angle, which I set on edge on one leaf in the match. By adjusting the angle to match the template and then moving the mirrors around, I can see the whole match before I make the first cut (see the top photo). I can be sure to get exactly the effect I'm looking for.

When I like what I see, I double-check that the space between the mirrors corresponds to the template, and then I trace along the inside edges of both mirrors. The next step is to cut one edge of this piece, using a reliable straightedge and a freshly sharpened veneer saw (see the center photo on this page). I now have a leaf of veneer with only one side of the wedge-shaped section cut. I lay this leaf on each of the remaining leaves and mark along the cut edge. This ensures that each section will be taken from the

CUTTING, TAPING A SUNBURST MATCH



Tape across the seams every 5 to 6 in. and then all the way along the seams. Stop just shy of the center, so you can see where all the points come together. Paper veneer tape scrapes off easily after the veneer is bonded to the substrate. And it won't tear the veneer fibers like other kinds of tape.

Careful trimming with a veneer saw yields a perfect half-circle. The author sizes his templates, so half the match is slightly larger than a half-circle. This allows him to trim thin wedges off each side and not have to worry about the two halves of the match falling short of making a full circle.

Rolling the tape with a veneer roller helps achieve a flat pressing. Make sure the edge of one leaf doesn't overlap an adjacent leaf. This prevents edges from breaking off in the press or a veneer leaf not adhering because it wasn't touching the substrate.



same place in each leaf, so I get the same effect I saw in the mirror. When all the leaves are marked, I cut along the marked lines. Now I take the template, mark the second side of the angle onto each of the pieces and cut them.

The next step is crucial, but not at all intuitive. If the leaves are laid out in sequence (one to 16, for example), then number one would be right next to number 16. With that layout, changes in the figure from leaf one to leaf 16 could be subtle or glaringly obvious. A knot might pierce a stack of veneer leaves at an angle, and the resulting sunburst would look as though it spiraled, an asymmetrical, not very pleasing effect.

To make the sunburst appear more balanced, I take the leaves out of chronological order and then assemble them in a sequence that eliminates any huge jump between leaves (see figure 2 on

p. 42). The improvement may be subtle, but it's worth doing.

With the sequence established, the last decision I need to make is whether I want a pinwheel or a book-matched sunburst. In a pinwheel sunburst, the leaves are arranged with all the same faces up, and the resulting pattern looks like, well, a pinwheel. In a book-match sunburst, alternate leaves are flipped to create a running book-match. I lay out a sunburst both ways before I decide.

Taping and preparing the sunburst for the press—I tape the wedge-shaped sections across the seams every 5 to 6 in. and then

over most of the length of the seam. To align the sections, I stop taping just shy of the center so that I can see where all the points come together (see the top two photos at left).

I assemble the two halves of the match separately. Then I lay a straightedge across the edge of the first half so that the straightedge just touches where the points of veneer converge, and there's an even wedge of veneer to cut off to the left and right of center. There should be about $\frac{1}{4}$ in. on both sides at the perimeter of the half-circle. I trim carefully (see the photo at left) because thin strips are prone to tearout. Then I repeat for the other half. I tape the two halves together, being particularly careful to line up the centers of the two halves. The match is complete (see the bottom photo).

The sunburst should be pressed to the substrate as quickly as possible, particularly when using figured veneers such as crotch mahogany. These figured veneers tend to dry out unevenly, causing them to lift in places and making them difficult to press. If you can't get the match in the press the same day that you assemble it, make sure you cover the match with plastic

(garbage bags work great for this), and weight it heavily.

If the sunburst is lifting off the table in the middle when it's uncovered, spray a light mist of water with a little glycerin (I dilute the glycerin 10 to one) near the outside edge. Allow the match to flatten for a few minutes before pressing. If the sunburst is lifting around the edges, spray the middle area, which will help prevent it from cracking once in the press. When I do press the sunburst, I make sure I also press a piece of backing veneer on the opposite side of the substrate. This equalizes the forces of wood movement and ensures the tabletop will stay flat. The backing veneer need not be the same highly figured wood. □

Frank Pollaro teaches workshops on veneering and is a designer and builder of fine furniture in East Orange, N.J.

Weaving a Cane Seat

More comfortable than wood, less expensive than upholstery

by Judy Warner



Tools and technique are simple. Caning doesn't require many tools, and this octagonal pattern is easy to reproduce.

Caned seats are versatile. Though this traditional pattern is at least 300 years old, it goes well even with contemporary furniture styles.



I had two reasons for wanting cane seats on the breakfast-nook stools that my husband had made. First, I love the light, airy pattern of traditionally woven cane, a pattern that's been around for more than 300 years. Second, I was tired of sitting on the hard wooden seats of the old stools. We've been very pleased with the results; the pattern blends well with the contemporary stools (see the photo at left), and the firm yet flexible cane is more comfortable than wood and less expensive than upholstery.

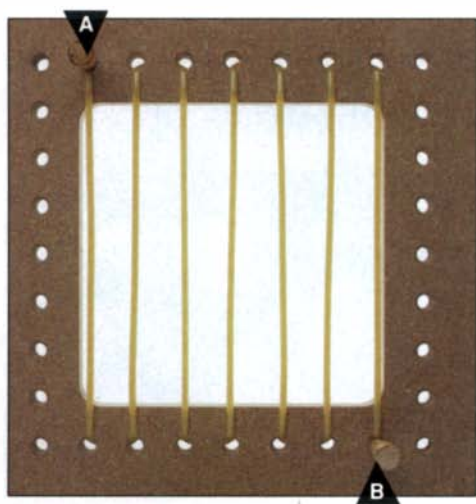
Cane and equipment

Cane for chair seating comes from rattan, a vine-like plant that grows up to 300 ft. in the jungles of Indonesia, China and India. The foliage and outer bark are cut away

from the 1-in.-dia. main stem, which is cut into strips to make the cane.

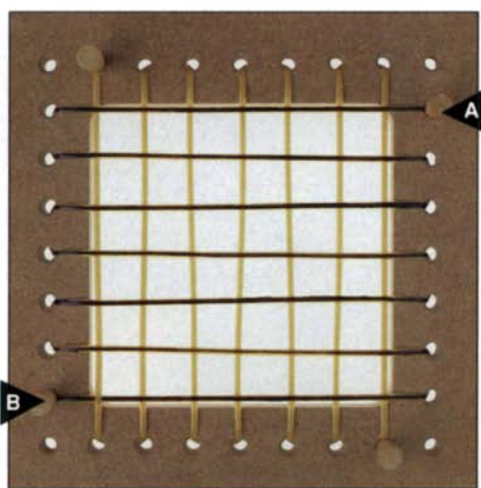
Cane is readily available from several weaving supply stores and is usually sold in metric widths (see the sources of supply box on p. 47). Cane is supplied in hanks of 500 ft. and 1,000 ft. or in a coil of 250 ft., which is enough for one 12-in.-sq. seat. If this is your first seat, I suggest ordering at least 500 ft. of cane and weaving a practice seat. An easy way to make a practice frame that requires no joinery is to cut it from $\frac{3}{4}$ -in.-thick plywood.

Tools needed for the caning job are minimal, and they usually can be obtained from the same source as the cane. You'll need caning pegs (golf tees also work), an awl, scissors, clothespins and a dish pan to soak and soften the cane. If you're a begin-



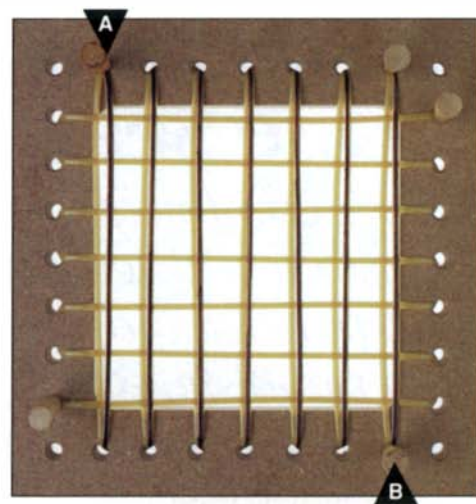
Step 1: First vertical layer

Starting at hole A, peg the cane, pull it across the seat and then weave it down through one hole and back up through the adjacent hole. Keep the glossy side up. Peg the last hole at B, leaving about 5 in. extra for tying off. The cane should be slightly slack because the grid tightens with continued weaving.



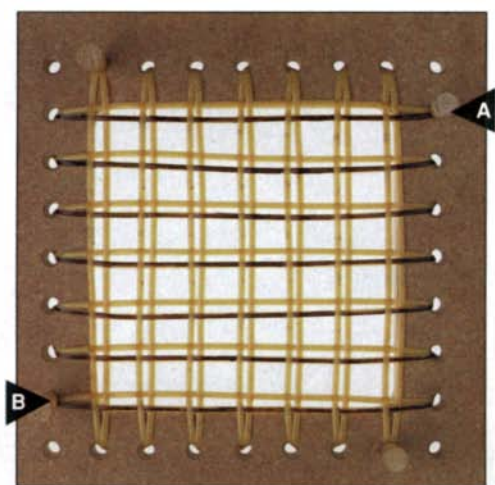
Step 2: First horizontal layer

This is a repeat of the first layer, except this layer fills in from side to side. Start at hole A, leaving about 5 in. of extra cane, and tap in a peg. This layer also should be slightly slack and lay on top of the first layer. Continue from side to side to the finish point at hole B. Peg the cane, leaving an extra 5 in.



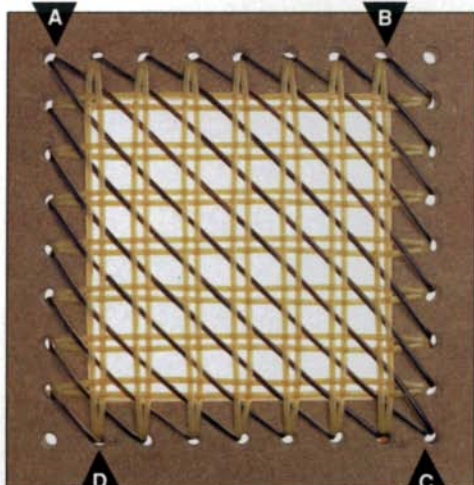
Step 3: Second vertical layer

Begin another layer in the same manner as Step 1, using the same holes, starting at A and ending at B, as in Step 1. This layer sits on top of Step 2's horizontal layer, with the cane slightly to the right of the cane in the first vertical layer. Again, leave about 5 in. at each end, and peg the ends in place. The cane still should be slightly slack.



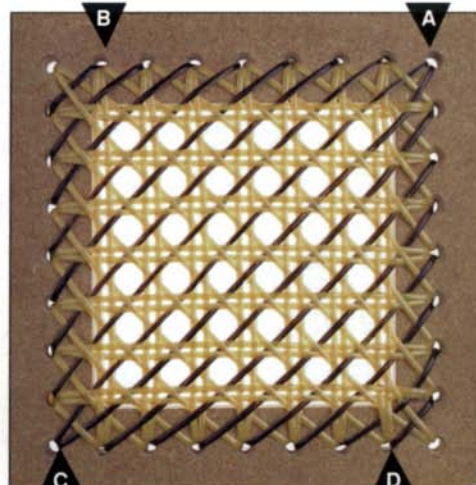
Step 4: Second horizontal layer

Work from right to left, starting at hole A, but this time, the cane is woven under strands in layer 1, over strands in layer 3 and in front of strands in layer 2. I weave about one-third of the way across the seat and pull the strand taut before weaving the next third. The cane pulls through more easily if you keep it moist.



Step 5: First diagonal layer

The diagonals are woven with two separate strands. The first strand starts at hole A and ends at hole B. The second starts at hole C and ends at hole D. Weave under vertical and over horizontal pairs of strands as you go. Leave an extra 5 in. of cane at the ends, and then peg the loose ends as you go.



Step 6: Second diagonal layer

This layer, which runs perpendicular to the first diagonal layer, will complete the pattern. This time, the cane is woven over the vertical pairs of strands and under the horizontal strand pairs. Complete as in Step 5. To tie off loose cane on the underside of the seat, make an overhand knot as shown in the drawing at right.

ner, you might want to consider plastic cane. Plastic cane is easier to weave, doesn't require soaking and holds up to heavy use. Another option is to use pre-woven cane panels held in a groove around the seat opening with a reed spline.

Preparing the seat

For a new seat, I lay out and drill holes for the cane based on the look I want. For example, for a light, delicate look, I'll use narrower, 2mm- to 2.5mm-wide cane (roughly $\frac{3}{32}$ in. wide) and size and space

holes according to the chart on the facing page. I chamfer the top and bottom of each hole to ease the stress on the cane as it wraps around the frame. I also lightly chamfer the top inside edge of the seat frame, so the cane doesn't wear at that point. A rabbet routed around the bottom side of the seat frame helps hide the knots that hold the cane in place, as shown in the photo on the facing page.

To prepare an old seat that I'm repairing, I cut the caning away just inside the frame and save this piece for a pattern reference

when weaving the new seat. After cleaning out all the old cane and any other residue left in the holes, I make any necessary repairs to the chair. Now's the time to clean up and refinish the chair, if necessary. It's much harder later.

Caning a seat

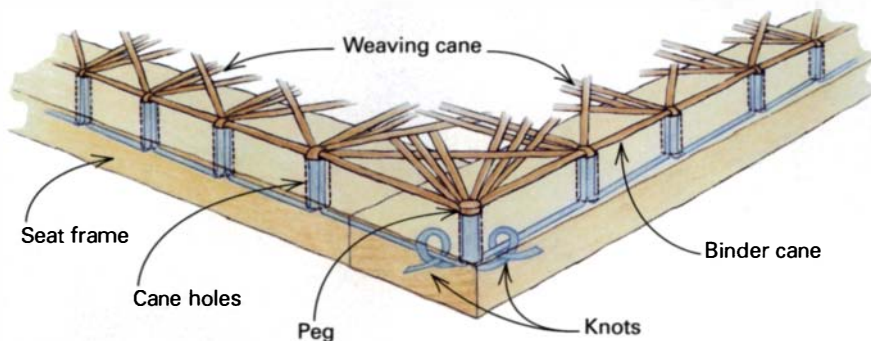
I use the seven-step approach, a standard caning technique, as shown in the photos above and in the top drawing on the facing page. This method is suited to the simple, square seats that my husband makes for

Selecting cane

Hole diameter	Space between holes	Size	Width of cane
1/8 in.	3/8 in.	Superfine	1.75mm
3/16 in.	1/2 in.	Fine-fine	2mm-2.5mm
7/32 in.	5/8 in.	Fine	2.5mm
1/4 in.	3/4 in.	Medium	3mm
5/16 in.	7/8 in.	Common	3.5mm
		Binder	4mm-6mm

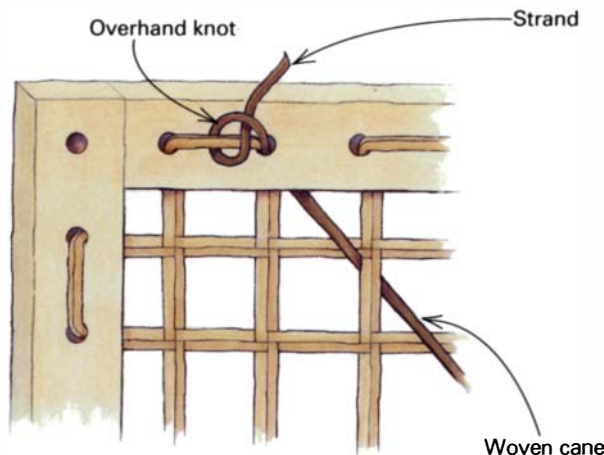
Step 7: Binder cane

For a finished look, install a binder cane. Cut a length of binder to fit one side of the seat, leaving about 5 in. extra on each end for tying off. Pull the binder through corners and peg in place. Secure the binder with regular cane by pulling the cane up through the first hole, over the binder and down through the same hole, continuing to the next corner.



Tying off loose ends

(Bottom view of seat frame)



Sources of supply

The following companies manufacture or supply caning equipment and materials.

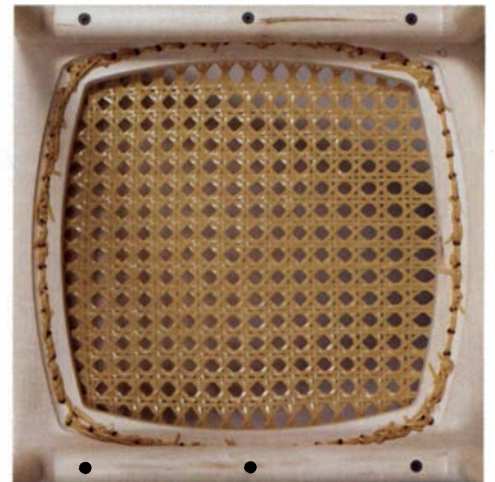
Cane & Basket Supply Co.,
1283 S. Cochran Ave., Los Angeles,
CA 90019; (800) 468-3966

Constantine, 2050 Eastchester
Road, Bronx, NY 10461; (800)
223-8087

Earth Guild, 33 Haywood St.,
Asheville, NC 28801; (800)
327-8448

H.H. Perkins Co. Inc.,
10 S. Bradley Road,
Woodbridge, CT 06525; (800)
462-6660

The Woodworkers' Store, 21801
Industrial Blvd., Rogers, MN
55374-9514; (800) 279-4441



Keeping the knots neat—A rabbet routed into the underside of the seat frame helps hide the mass of knots and cane endings. Chamfering the top and bottom of each hole and the top, inside edge of the frame helps prevent undue wear on the cane.

his stools (see the bottom photo on p. 45). It's a technique that has been around for more than 300 years and is a good starting point for learning more advanced designs later. Whether weaving a new seat or replacing the broken cane in an existing seat, the first step is to determine the appropriate cane size from the chart above. I used medium cane (about 1/8 in. wide) in 10-ft. to 15-ft. lengths on this seat.

Before weaving, the cane must be soaked in water for at least 10 minutes to make it pliable. If the cane dries out while

weaving, a quick dab with a damp sponge will help the cane slide a little more smoothly. Another thing to keep in mind while weaving is that the top side of the cane is smooth and shiny and somewhat convex, and the bottom is flat and rough. Be sure to keep the shiny side up. Use a continuous pattern of down through one hole and up through the adjacent hole. Hands should be positioned one above, one below, as shown in the top photo on p. 45. Note that no actual weaving takes place until the fourth step.

Finish the seat by tying off all the loose ends with overhand knots, as shown in the bottom drawing above, cutting away any extra fringe and trimming the ends to leave about 1 in. Try to keep the knots equally spaced around the underside of the seat frame.

I like the natural, glossy look of cane, but it can be stained or finished with shellac or varnish if you prefer. □

Judy Warner is a weaver in Escondido, Calif.



Good installation starts with a good fit. The author uses plastic laminate shims to set a narrow reveal between the door and the carcass. Then he marks how much to trim off the door.



Knife hinges aren't created equal. The hinges on the left and right are stamped steel with a riveted pivot pin, making them nearly impossible to install accurately. In the center is a Brusso hinge, well-machined and much easier to install.

Installing Knife Hinges

*Careful layout and mortising
are keys to success*

by Gary Rogowski

Knife hinges are a sweet finale to a piece of cabinetry. They have a simple, subtle beauty. Just a small semicircle of brass is all that shows with the door closed, letting the lines of the furniture and the figure of the wood take center stage. Knife hinges also are tremendously strong and almost totally resistant to sagging, making them the hinges of choice wherever a narrow, consistent reveal around a door is important.

Knife hinges are strong because of the orientation of their leaves. Their leaves are mortised flush to the horizontal surfaces of the door and the carcass. The forces of gravity and leverage acting on the hinge put shearing forces on the screws. In other words, for the door to fall off its hinges, or even sag, the screws would have to shear, or the door frame or carcass would have to be destroyed. Not so with butt hinges, where gravity and leverage exert forces of tension on the screws. Over time, this causes the door to sag and tends to pull the screws out of their holes.

Despite their advantages, knife hinges have gotten a bad rap for being notoriously difficult to install. They are less forgiving of sloppiness, but with a little extra care in layout and mortising, knife hinges are no more difficult to install than butt hinges.

Don't buy inexpensive hinges

A number of different types and brands of knife hinges are available, but only one brand I know of is really worth considering. Avoid hinges that are made from stamped steel, have riveted pins (making them inseparable and, therefore, next to impossible to install accurately) or are finished poorly. The good ones are made by Larry and Faye Brusso and are available through many woodworking catalogs or directly from Larry and Faye Brusso Co. Inc. (4865 Highland Road, Suite J, Waterford, Mich. 48328; 810-674-8458).

Brusso hinges consist of two machined and polished brass leaves, each about 1/8 in. thick, countersunk for screws (see the bottom photo on the facing page). The leaves, which come apart, pivot on a short pin and are separated by a single washer. They come in many sizes, but there are just two basic types of knife hinges: straight and L-shaped.

The straight knife hinge is used in situations where the top and bottom of the carcass extend over the door frame, and the door frame covers the carcass sides.

The L-shaped knife hinge is used on full inset doors. The short leg of the hinge, into which the pivot pin is set, moves the pivot point away from the carcass so that



For a consistent reveal around a door, use shims the same thickness as the hinge washer. Many varieties of plastic laminate are the right thickness, but cardboard and other materials will often work as well.



To lay out the hinge mortise, start with a pencil. With a laminate shim between the carcass wall and the hinge, the author marks the end of the hinge leaf and the edge of the short leg of the "L." These reference lines set limits for a marking gauge, which is used next.



Marking-gauge line establishes front edge of mortise. Scratch a marking-gauge line from pencil mark to pencil mark. The marking gauge should be set for the distance from the center of the pivot pin to the outside edge of the hinge leaf's long leg. Try not to let the gauge wander along any sloping grain.



Use a knife to mark edge and end of mortise. Position the hinge leaf on the marking-gauge line, mark the end of the hinge leaf and the inside edge of the "L" with a knife, and then erase the pencil lines.

Now pencil in the back edge of mortise. This line is just a rough approximation to keep you safely within bounds when routing the hinge mortise. You'll mark the actual back edge of the hinge later with a knife.



Router removes most of mortise quickly. The author uses a 3/16-in. bit set for the thickness of the hinge leaf. He stays well away from the pencil mark and knife marks that define the mortise.



Paring chisel cleans up front edge of mortise. Be sure to take the mortise no farther than the knife mark.



Clean up roughness left by router along back edge. With a chisel, the author removes most of the waste remaining in the mortise. But take care to stay well away from the pencil line—the back edge still needs to be marked with a knife.



the door can swing clear of the carcass side without binding. Brusso also offers an L-shaped hinge (L-39) with an extra long short leg for use in cabinets where the door must clear a protruding corner post to open fully.

Accurate placement is key to success

Laying out the mortises for either type of knife hinge involves essentially the same steps. Layout is the most critical part of setting them. Installed correctly, knife hinges will hold a door true to the face of the carcass and establish a consistent reveal between the door and the carcass sides all the way around. The key to achieving both of these goals is accurate placement of the hinge leaves. This comes down to a precise hinge setback in both the carcass and door and shimming the door hinge against the carcass wall to set the reveal. The photos accompanying this article show how to do this and how to hang a cabinet door using a set of L-shaped knife hinges, the more commonly used type of knife hinges.

Hanging a door using knife hinges begins with making sure the dry-assembled carcass's face is flat and square. Before gluing up the carcass, lay out the two carcass hinge mortises, disassemble the carcass and then rout and pare the hinge mortises (see the photos at left and the top right photo on the facing page). Glue-up the carcass, and then let the glue dry, checking again to make sure the carcass is square across its opening. Plane or sand the face of the carcass flat.

Doors should fit snugly

The door should be built to fit snugly in the carcass opening. Trim the door, so it just fits in the opening with shims along the bottom rail and the hinge stile. The shims should be the same thickness as the washer that separates the two leaves of the hinge (leave the handle stile and top rail tight for now). At this point, I have mortises in the carcass and can cut the mortise in the bottom of the door. I lay it out and cut it in much the same way as I did in the carcass (see the second photo from the top on the facing page).

The next step is to put hinge leaves into their mortises. A friction fit should keep them in, but you can tape them in if you like. Put the door into the carcass opening with the bottom hinge connected. Check and mark the reveal again on the bottom, hinge-stile side and on the top, as necessary. Plane or sand the door's edge to get the reveal right on these three sides. Then lay out and mortise for the top door hinge.

Screw the carcass hinge leaves and the bottom door-hinge leaf into place, but be sure to drill and cut the threads first by screwing steel screws of the same size into the screw holes. This keeps the brass heads of the screws that come with the hinges from marring or stripping.

The final fitting of the door will be done with both hinges in place but left unscrewed. Hold the top door-hinge leaf on its mating leaf in the carcass while you set the door into the lower hinge pin. Slide the top of the door onto the door-hinge leaf (see the bottom photo on this page). Close the door, and check and mark the handle-stile reveal (see the top photo on p. 48). Open the door, slide it off, plane or sand the door's edge to get an even reveal all the way around and reinstall the door. The door-handle stile can be trimmed back at a slight angle to provide clearance for the door as it swings past the case.

What if it's not perfect?

All is not necessarily lost if the fit is less than perfect. Hinges that are too deep can be shimmed in the mortises. If the leaves aren't deep enough, then you can rout or pare the door mortises a little deeper. Case mortises are tougher to get to, but with a router plane or a swan-neck chisel, you can remove material from them as well.

If it's just a little bit off, a door that's not flush with its carcass can be planed or sanded to match the case. For more serious adjustments, you can shift a hinge mortise's location by gluing in carefully matched pieces of scrap and remortising. If it's just a screw that's out of place, you can usually drill out the holes, fill them with sections of dowel and redrill. □

Gary Rogowski designs and builds custom furniture and teaches woodworking at the Oregon School of Arts and Crafts in Portland, Ore.

Video: Installing knife hinges



Gary Rogowski takes you step by step through the installation of a set of knife hinges in this 27-minute video tape (VHS only) companion to "Installing Knife Hinges." To order the tape, contact The Taunton Press, Order #011044, P.O. Box 5506, Newtown, Conn. 06470, or you can call (203) 426-8171.



Mark back side with a knife. Tilt the hinge leaf into the mortise, and hold it tightly against the front wall of the mortise to mark the back edge. Then pare carefully to this knife line, checking frequently to see if the hinge leaf will fit. Once it fits, that mortise is done. The procedure is the same for all four mortises.



Cutting mortises in the door. A board clamped to door gives router a steady platform. Otherwise, routing the mortise in the bottom edge of the cabinet door would be a tippy proposition. Be sure to use clamp pads (here held in place with spring clamps) to avoid damage to the door.



Drill suited to a tight spot. A Yankee drill lets the author drill screw holes against the carcass's side. This would be impossible with a power drill or a corner brace. A piece of cardboard prevents the side of the carcass from being marred by the drill.



Now try the fit. For a final fit of the door, set the door in place. With the bottom hinge connected, slide the door onto the top hinge. Friction should hold the top carcass hinge leaf in place, but tape adds a measure of security.



Detail sanders do the work other sanders can't. These machines excel in tight quarters, like the corner of a drawer. By oscillating within a tight range, the sanding pads move just enough to smooth wood but not enough to damage adjacent surfaces.

Picking a Detail Sander

Priced from \$40 to \$185, these lightweight sanders tackle tight corners

by Sven Hanson

Of all the dull but essential jobs in woodworking, sanding tops my list. Until recently, I thought I owned two of every type of sanding machine available, none of which was particularly great in close-quarter combat with belligerent wood. Then Fein, Ryobi and Bosch introduced detail sanders, also called triangle sanders (for the shape of the pad) or corner sanders (for the job they do best).

When I started shopping for a detail sander, I was slowed down by the wide differences in price. I kept asking myself, "How can one sander cost \$40 and another \$200 when they both claim to do the same job?" Some thorough investigation, and the need to sand a large set of panel doors, helped me make up my mind. Before I tell you which machine I bought, let me share what I learned about detail sanders.

For a long time, Fein was the only kid on the block. Its detail

sander sold for nearly \$300. It was largely regarded as a specialty tool, kind of an oddity that probably didn't belong in the normal tool kit of any home-shop woodworker or, when you get down to it, most professional woodworkers. It was just too expensive to justify the limited use it would see in most shops.

Ryobi's introduction of the DS1000 in 1992, with a price tag of about \$40, changed all that, making detail sanders more accessible. Fein, in turn, dropped the price of its detail sander to about \$200. Since then, Bosch has come out with two detail sanders, the B7000 and B7001 (single- and variable-speed versions of the same unit). Ryobi has a vastly improved model, the DS2000, and the price of the Fein continues to drop, now down to \$185 through some discount mail-order tool dealers.

Unavailable at the time of this review but scheduled to be on the market by the time this magazine is in your hands, is Skil's model

7200. It's a two-speed detail sander with dust hookup and is supposed to be available for about \$40. Sears also is selling a detail sander, model 11600. The sander, which is made for Sears by Ryobi, is just a cosmetically altered version of Ryobi's DS1000. All internal components are identical. And Wolfcraft, which manufactures woodworking accessories, sells a corner sanding attachment for an angle grinder for \$29 (see sources on p. 55). All this competition really benefits the woodworker because the quality of these relatively new sanders is going up, and prices are coming down.

How do they work?

At first glance, all the machines appear to do the same thing: oscillate over a short distance to sand wood in tight spots. That's true. But each manufacturer uses a different mechanism to convert the spinning motion in the shaft of an electric motor into orbital or arc-shaped oscillations. (The industry measures the output of these sanders in strokes per minute, or spm.) The mechanical wizardry is different from model to model, but I found the net effect is not drastically different. All the oscillating patterns are within $\frac{1}{8}$ in. of each other.

Whether the pivot point is centered or farther back on the pad doesn't affect how these sanders handle the kinds of tight-corner tasks they are designed for. I did find, however, that each of the sanders seems to work better when some part of its sanding pad touches an adjacent surface, like the sidewall of a drawer.

All of the detail sanders I worked with (except for the Ryobi DS2000) generated around 90 decibels (dB) of noise in a typical work situation. The Occupational Safety and Health Administration (OSHA) limits exposure at 90 dB to eight hours, but I make a practice of using hearing protection with any tool that generates more than 80 dB or so. Cautions on hearing protection go double if you're working in a small environment where sound can resonate.

Ryobi offers two sanders

The Ryobi DS1000, with its \$40 price tag, .24-amp motor and top speed of 7,600 strokes per minute, slows more easily under load and bounces around more than any of the other sanders. Also, it delivers hand-numbing vibration, which feels equivalent to running a chainsaw. And because you turn it on with the same hand you hold it with, you have to contort your pinky finger to depress the power switch. It's located inconveniently at the bottom rear portion of the tool, just above the power cord. But I was amazed to find that of all the sanders I tried, the little \$40 Ryobi left the

smoothest surface and sanded fairly aggressively.

The DS1000 tracks smoothest against a sidewall when either the toe or the heel of the sanding pad touches the adjacent surface. The toe seems to sand slightly more aggressively than the heel. I took advantage of the Ryobi's front-end aggressiveness by spray mounting an oversized piece of sandpaper to the rubber pad and, wearing a golf glove to protect my index finger, sanding the curved contour of a raised panel (see the top photo on this page).

To create the \$70 DS2000, Ryobi's newer and much-improved offering, the engineers kept the ergonomic housing shape of the DS1000, moved the switch to the top center of the machine and added a dust-collection port. They also upped the power a bit, went from a single speed to a two-speed unit (9,000 and 11,500 spm) and lengthened the cord to 10 ft.—all of that with a street price of about \$70.

The biggest changes, however, are in the dampening of vibrations and noise. The vibration seems halved, at least, and the noise level I measured was down to 70 dB under load, the lowest of any of the detail sanders. The result is a sander that's much more pleasant to work with. It provides greater operator control, smoother sanding and less vibration and bounce.

Though the improved Ryobi is less likely to fatigue the user, the trade-off is it sands more slowly than its less expensive precursor, making it the slowest of the bunch. The Ryobi DS2000 tracks similarly to the DS1000, heel or toe against an edge, with the toe being somewhat more aggressive.

Both Ryobis have hard rubber-faced sanding pads designed for pressure-sensitive adhesive (PSA) papers. PSA

papers are cheaper than hook and loop but not easily removed and restuck. If you prefer the convenience of hook and loop, though, it's easy enough to convert the Ryobi by buying a piece of adhesive-backed, hook-and-loop fabric, cutting it to size and applying it to the pad.

The DS1000 doesn't come with any dust-collection capability or hookup, nor is it offered as an option. With the possible exception of the Fein, detail sanders don't really make enough dust to concern anyone but a spouse. A dust-collection system can improve sanding efficiency, however, by removing dust that would otherwise remain suspended between the sandpaper and wood, slowing down your sanding. An optional dust (vacuum) attachment is offered for the DS2000.

To increase the utility of the detail sanders, manufacturers offer various accessories. For the DS1000, Ryobi offers a number of pa-



To sand a contoured surface against an edge, the author had to improvise. He attached an oversized piece of sandpaper to the pad with photo spray mount, extending the paper so it could reach the ogee profile of this raised panel. The golf glove keeps his fingers from burning.



Bosch's pad extender allows sanding into very thin spaces, like the space between the slats of this shutter (below). A dust hose is available to connect the dust port at the rear of the machine to a vacuum.



Street price	Weight (lbs.)	Power (amps)	Strokes per minute (spm)	Stroke size	Pad Type	Cord length	Switch location
\$40	1½	.24	7,600	⅛ in.	Rubber for PSA-backed papers	7 ft.	Bottom rear
\$70	1¾	.3	Two-speed: 9,000 and 12,000	⅛ in.	Rubber for PSA-backed papers	10 ft.	Top forward
\$70-\$80	2	1.1	13,000	⅛ in.	Hook and loop	10 ft.	Top forward
\$185-\$200	3	1.4	20,000	⅝ in.	Either rubber or hook and loop	10 ft.	Left center

Fein sands aggressively with very little vibration. It sands best with the center of one of its three sides against a perpendicular edge.



(for looped sandpaper) that snap into place. The hook-and-loop material makes it easy to rotate paper to either of the two alternate positions, extending the useful life of the paper. And removing the whole sanding pad makes it easy to switch grits and still have the previous-grit paper mounted and ready to go for another part of your project.

A dust-collection port is molded into the plastic body of the Bosch sander, and a hose attachment is available as an option. Besides the hose for

pers (40-150-grit); pads for metal finishing, rust removal, finish stripping, abrading between coats of finish and buffing out wax; and a scraper head and scraper blades for removing paint, putty or adhesives. For the DS2000, pads and blades are available, as well as a vacuum attachment for dust removal.

Bosch: Midpriced, average performance

At roughly \$70-\$80, the Bosch B7000's price is about in the middle of the range. So is its performance, with average sanding speed, average finish and average vibration for this single-speed, 13,000 spm unit. The B7001 (\$80-\$95) is identical in all respects to the B7000 except that the B7001 is a variable-speed model, adjustable from 6,500 spm to 13,000 spm by turning the speed selection switch at the back of the tool. Both units are rated at 1.1 amps. Like the other machines, the Bosch sands best against a raised edge with one of its pad points against the edge.

Both of the Bosch sanders come with hook-faced sanding pads

dust collection, Bosch also offers sanding sheets and an extension pad that's useful for sanding into narrow spaces, such as between slats on a shutter (see the bottom photo on p. 53).

Fein: most expensive, effective and versatile

The Fein MSX 636-1 (about \$185) is the leader in every category, including power (1.4 amps), speed, quality, accessories and cost. It's far and away the fastest of the detail sanders, with the least vibration and the best operator control. The Fein requires one additional step up in grit to get as smooth a surface as the other sanders do, perhaps because it's actually doing more sanding. But the surface it leaves is more consistent overall, with fewer scratches or swirls. Even with the additional step, the job gets done faster. The Fein runs smoothest against a perpendicular edge when the midpoint of one of the three curved sides of the triangle is against that edge (see the bottom photo).

The basic Fein sander is available with either rubber pads for

	Dust hookup port	Noise level (dB)*	Smoothness of sanded surface	Sanding speed	Operator control	Vibration	Corner sanding ability	Warranty
	No	87	Very good	Very good	Fair	Extreme	Fair	2-year home use
	Yes	70	Good	Fair	Very good	Minimal	Good	2-year home use
	Yes	88	Good	Fair to good	Good	Moderate	Good	1 year
	Optional accessory	91	Good	Excellent	Excellent	Minimal	Excellent	1 year

Notes:

*As measured by the author at approximately 3 ft.

Bosch #B7001 is identical to model B7000 except for a variable-speed feature (6,500 to 13,000 spm).

Sears has introduced a detail sander, model 11600, which is mechanically identical to the Ryobi DS1000

PSA papers or a hooked pad for loop-backed papers. Most dealers sell the unit with the rubber pad for the less-expensive PSA papers, but you can buy the hook-and-loop conversion pad as an accessory.

The Fein creates enough dust so that it ought to come with a standard pickup kit. One is available as an option, but it costs an extra \$45. That's a fair chunk of change, but the kit includes a vacuum adapter and a hook-and-loop pad with dust pickup holes.

Other accessories, besides the dust pickup kit, include a pad extender (which is called a "sanding finger") similar to the Bosch's but narrower and, therefore, more versatile. Other accessories are sandpapers (both PSA and loop backed) ranging from 36-500-grit, scraper blades and two sawblades (and depth stops for these blades) suitable for cutting wood, fiberglass and sheet metal.

Also available as accessories are hard and soft backing pads, extra-thin pads for narrow spaces, plastic pads to prevent marring of sidewalls, felt polishing pads and non-woven abrasive pads.

I bought the Fein

The durability of these sanders is hard to measure, but manufacturers provide some clues in the owners' manuals. Bosch, for example, suggests checking the brushes in the motor every two to six months and changing the bearings after 300 to 400 hours. Fein suggests cleaning and inspecting the sander after 900 hours.

If you're not going to ask a lot of a detail sander and you don't

Sources of supply

Fein Power Tools Inc., 3019 W. Carson St., Pittsburgh, PA 15204; (800) 441-9878

Ryobi America Corp., P.O. Box 1207, Anderson, SC 29622; (800) 323-4615

Bosch and Skil models: S-B Power Tool Co., 4300 W. Peterson Ave., Chicago, IL 60646; (312) 286-7330

Wolfcraft corner sanding attachment

Wolfcraft, Inc., 1222 W. Ardmore Ave., Itasca, IL 60143; (708) 773-4777

Woodworker's Supply Inc., 1108 N. Glenn Road, Casper, WY 82601; (800) 645-9292

mind its "strong vibes" or the placement of the power switch, then the Ryobi DS1000 might be the tool for you. It's a fair shake for \$40, but it's definitely not for heavy or long-term use.

The DS2000 is better in every way than its predecessor, except that it's slower. It's on a par with the Bosch with its smooth handling and surfacing, its greatly reduced vibration and the lowest level of noise of any detail sander. And the DS2000 is not a bad deal at \$70 or so.

On all accounts, I put the two Bosch units (single- and variable-speed versions of the same unit) in the second tier, alongside the DS2000, for both price and quality. They'll do the job but won't jar your bones in the process. You may not need the B7001's variable speed (if things are going too fast for you, use a finer-grit paper), but at only \$10, this feature may be worth getting anyway.

If commercial use fits anywhere in your equation, you need the Fein. It's the one I bought. It looks, feels, sounds and acts like a professional machine. It has the widest range of accessories and more than enough power to take advantage of them. The price (\$185) of this machine may seem exorbitant to the hobbyist who will only need a detail sander from time to time. But for a professional, the cost of a \$40 or \$80 unit can quickly multiply if the sander breaks down in the middle of the job. □

Sven Hanson is a woodworker and professional carpenter in Albuquerque, N.M.

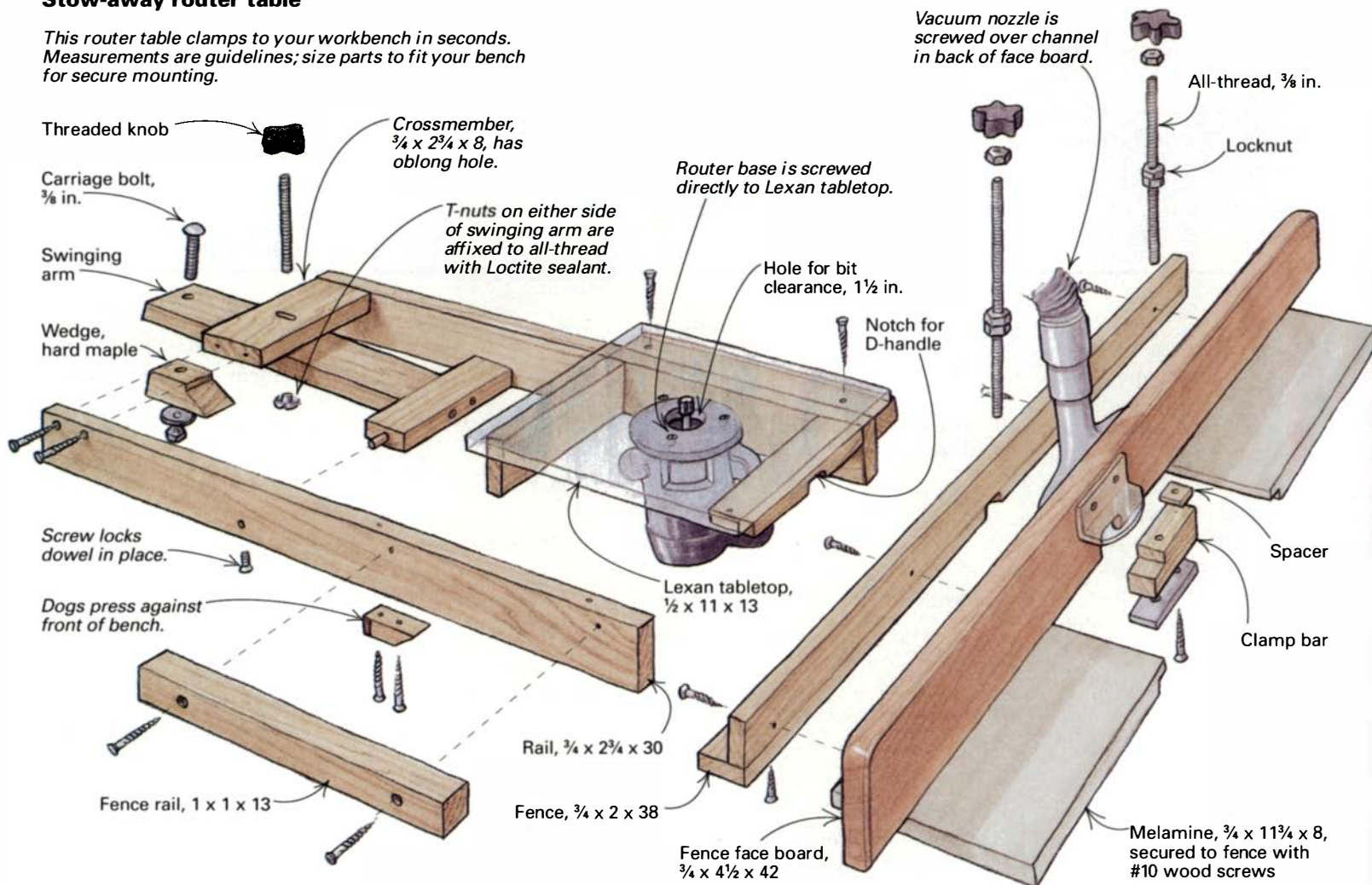
Stow-Away Router Table

Cantilevered frame clamps to bench quickly, stores in seconds

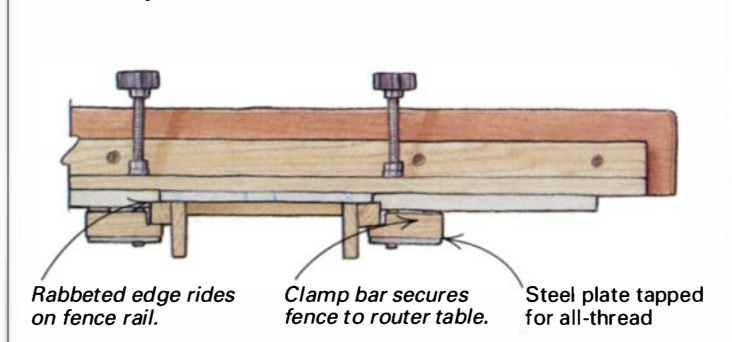
by Jim Wright

Stow-away router table

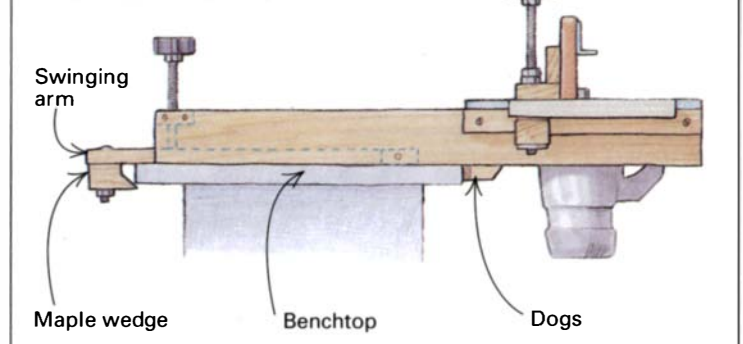
This router table clamps to your workbench in seconds. Measurements are guidelines; size parts to fit your bench for secure mounting.



Detail: Adjustable fence



Detail: Bench-frame connection



I'm afraid my early attempts at making a router table were nothing to write home about. The first three designs—a table with legs, a cabinet base and a table attached to my tablesaw—all ended up on the scrap heap. They were just too bulky, a fatal flaw when it came to my small shop and lack of storage space.

It finally occurred to me all I really needed was a simple router table that could be clamped to my workbench. Here's how it works: I attach my router to a plastic insert and drop it into the frame of the table; the router hangs over the front edge of my bench. A sliding fence rides on top of the frame and adjusts easily. The mass of the bench kept the router table from vibrating, but best of all, the whole assembly is compact and easy to store (see the drawing).

The key was in finding a way to clamp the assembly to my bench, so it wouldn't move. I did that by sizing the frame of the router table, so it spanned my bench exactly. Then I held the frame in place with a simple clamp made of a wooden wedge and a length of all-thread.

Building the frame for your bench and router

The first step is to decide how large a tabletop you need for your miter. Allow enough room for the knobs and handles on your router, and give yourself room to adjust the router when it's attached to the table. Just how much is enough depends on your router. I have a D-handle on my router, so I had to cut a relief in the framing to accommodate it. I made the frame for my router table of hard maple. The corners are fastened with #10 wood screws, so assembly is easy.

The router table stays in place because it grabs both the front and the back edge of my workbench. Attached to the rear of the router-table frame is a maple wedge that hooks over the back edge of my bench. Screwed into the bottom of the frame near the front of the table are two dogs that press against the front edge of the bench. I added 80-grit sandpaper on the inside faces of these pieces to give them a better bite. When I tighten the knob at the back of the frame, the wedge pulls up against the bottom of the bench and locks the frame into place. Because the dogs on the front of the frame are tight against the front of the bench, my router table really can't go anywhere.

The assembly should hold securely even with the clamp knob a little loose—that's important. If the fit between the router table and your bench is sloppy and the clamping mechanism were to fail, the

table would fall on the floor. Not a nice picture: router, work and fingers all mixed together and heading for the deck.

Making the tabletop

The thick table is a piece of ½-in. Lexan from a dealer's scrap pile. The 11-in. by 13-in. piece cost me \$10, but expect to pay more if you have a piece cut to size from stock. Lexan, a polycarbonate, cuts easily with a tablesaw, and trimming it to size is no problem. Other plastics may shatter or melt, but Lexan is lovely to work with. Phenolics also work well and are more

Big router-table performance in a benchtop package—This shop-built router table sets up in seconds and stores easily when not in use. Securely clamped to your benchtop, it can do most anything more conventional router tables can.



rigid than Lexan. (For more on plastics in the woodshop, see *FWW* 105 p. 58.)

The base of the router dictates the layout for the mounting holes. Use a drill press with a spade bit turning at low speed (clamp the work) and light pressure to cut a 1½-in. hole in the center of the base (a piece of scrapwood beneath the work when drilling will keep the bit from jumping when it breaks through). The mounting holes are made with a twist bit, then countersunk. The Lexan is attached to the frame with four #10 wood screws.

Fabricating the fence

The fence is made to slide on the frame. Two clamps lock it in place. Attached to

the right and the left sides of the fence are two pieces of melamine, which support the work as it's fed past the bit. The fence slides on or off in seconds. Once the router is mounted to the table, the table itself can be mounted or removed from the bench in 15 seconds—without changing the position of the fence.

The fence has a face board screwed to it with a channel in the back to create a duct for dust collection, as shown in the drawing. I added a plastic finger guard for safety. As a bonus, I find that the guard helps control the dust. □

Jim Wright is an amateur woodworker in Berkeley, Mass.

Choosing the Strongest Joinery for Doors

Mortise-and-tenon options may be best overall performers

by John D. Wagner



Biscuits make a strong joint. Among the strongest joints tested were those made with a plate joiner and #20 biscuits. How the joint would fare after repeated freeze-thaw cycles is another matter.



Taking door joints to the breaking point—Ben Brungraber, left, applies hydraulic pressure to a mocked-up door frame joint.

Put a couple of cabinetmakers together, and it probably won't be long before they're arguing over what kind of joinery they like best. Woodworkers who make a lot of doors may be the worst of all. At least that's the way it seemed to Grant Taylor, the owner of a custom door shop in South Acworth, N.H. Taylor was used to hearing the my-joinery-is-stronger-than-yours debate among members of the Guild of New Hampshire Woodworkers. He had his own opinions on which joinery was strongest, but so did everyone else.

There's certainly no shortage of options when it comes to joining the rails and stiles that make up a wooden door frame. The traditional choice is mortise and tenon. But there are plenty of alternatives. Big plunge routers have helped introduce loose-tenon joinery in which a mortise is cut in both the rail and the stile and a separate

tenon, cut from stock run off on the table-saw, joins the two. Dowel construction is much faster than mortise and tenon but is generally considered weaker. Biscuit joiners, which cut football-shaped slots in rail and stile for pressed-wood splines, may be the fastest method of all. Each method had something to offer. Some were faster and less labor-intensive; others appealed to traditionalists. But reliable information on just how strong these joints actually were and how well they'd stand up over time, seemed to be in short supply.

Eventually, Taylor had heard enough. He decided to find out which joint really does make the strongest door. He got in touch with Ben Brungraber, the resident engineer at Benson Woodworking in Alstead, N.H., for help. Brungraber had been interested in the question ever since writing his doctoral dissertation on timber joint strength, and together, the two devised a

testing procedure they hoped would settle the argument for good.

The result? Biscuited joints were the strongest, but mortise-and-tenon construction still may be the best choice. To know why, you'll have to know more about how the tests were run.

Building the joints and a test bed

It would be a stretch to call these tests a rigorous scientific examination. Sure, the samples were well-made and the tests run carefully. But a truly definitive study was far beyond the facilities and time that Taylor and Brungraber had to work with. Even with its limits, though, their work may help settle an argument or two.

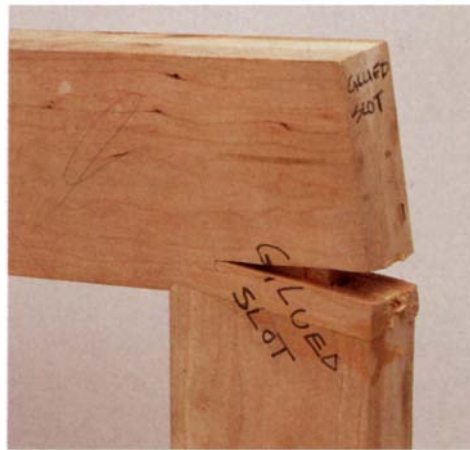
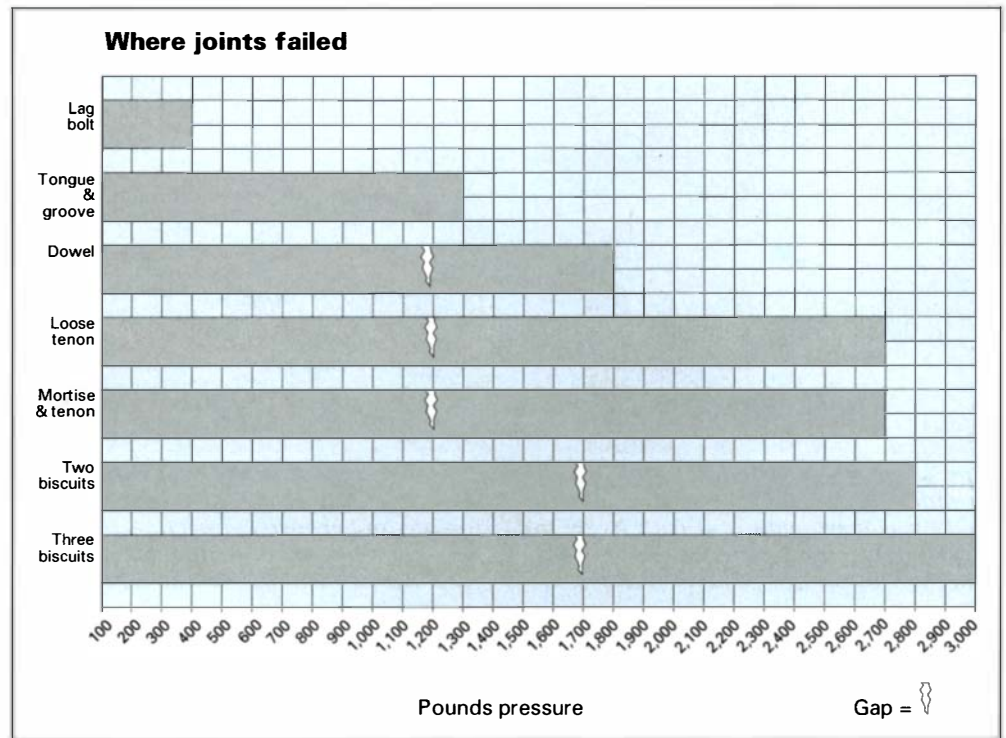
Taylor and Brungraber had a pretty simple idea: Make up a number of different kinds of joints; then bend them until they broke. The instrument of torture was a 1-in. hydraulic ram hooked up to a device showing how much pressure was being applied. Brungraber had used the same device to break apart massive timber joints in strength tests. The pair devised a floor-mounted jig that would hold the mocked-up door frame joints between two hefty timber posts (see the bottom photo on the facing page).

Setting up the joint tests

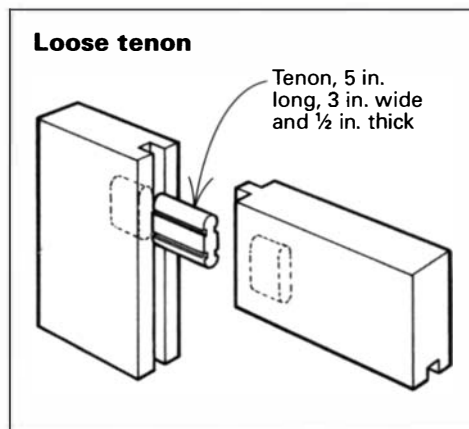
Taylor built seven different types of joints, each one imitating where the rail and stile of a door frame meets above a hinge. Each joint consisted of a stile section 12 in. long and a rail section 7½ in. long. Taylor routed ½-in.-wide by ⅝-in.-deep grooves in the inside edges of both rail-and-stile sections where a panel would normally go.

A tongue was cut in each rail section to mate with the groove in the stile, as shown in the drawings that accompany this article. Each of these basic joints was then modified with the addition of other joinery, such as dowels, a loose tenon, lag bolts or a traditional mortise and tenon. All the wood used was clear cherry (two pieces of cherry were face-glued together to make the 1⅞ in. thickness of rail-and-stile sections). All the joints were glued up with Elmer's yellow glue and then allowed to dry for two weeks.

Taylor also made calculations to ensure that the glued surface area of the dowels used in one joint was the same surface area as the loose tenon or mortise and tenon used in another. His intent was to make the test as even as he could. In all, the joints included a mortise and tenon, a loose tenon, a dowel joint, a joint lag bolted together with no glue, a ½-in. by ⅝-in. tongue and groove and two biscuited



Loose tenon proves to be good joinery—*It took 2,700 lbs. of pressure to force the loose-tenon joint to fail, making it one of the top performers in the test.*



joints, one with two #20 biscuits, the other with three biscuits.

Doors sag toward the lock side, so Taylor decided to test each joint in compression. Once mounted in the testing jig, the joint would be compressed by Brungraber's hy-

draulic ram to simulate the strain that a sagging door would impose on the joint.

Taylor used a dial indicator sensitive to .001-in. movement to track the joint's deflection under pressure. As Brungraber applied pressure in 100-lb. increments with a hydraulic pump, Taylor recorded the correlation between the joint's movement and the pressure.

Tests measured three things: the joint's overall resistance to deflection, how much pressure it took to open up a gap in the joint and when the joint failed. By plotting the deflection and hydraulic pressure information on a graph, Taylor and Brungraber could track each joint's performance against the others (see the chart).

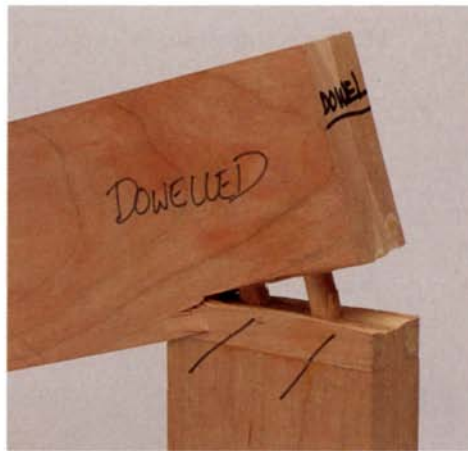
Testing the joints

With curious woodworkers hovering nearby, Taylor and Brungraber loaded the first joint into the jig and brought the hydraulic jack to tension. Because no one was sure how the joint would react or how it would fail, nerves ran a bit high until the first test showed that most failures were incremental, not violent (there were three exceptions, which I'll tell you about later). Here's a summary of what they discovered.

Loose tenon—The loose tenon measured 5 in. long, 3 in. wide and ½ in. thick, with two glue grooves cut on each side. The joint deflected just over ⅞ in. before it showed a slight gap at 1,200 lbs. pressure. The joint failed outright at 2,700 lbs. But upon examining the failure, Taylor and Brungraber found that the tenon didn't



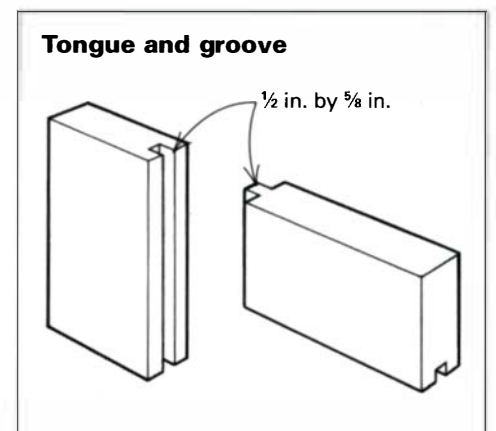
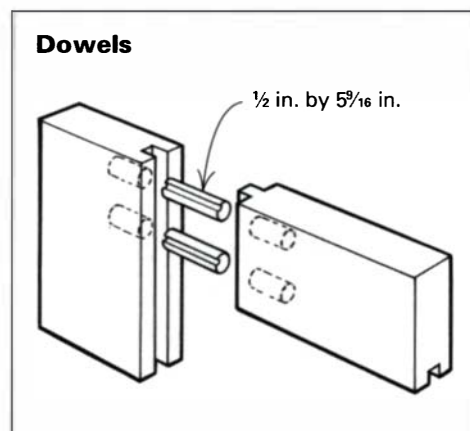
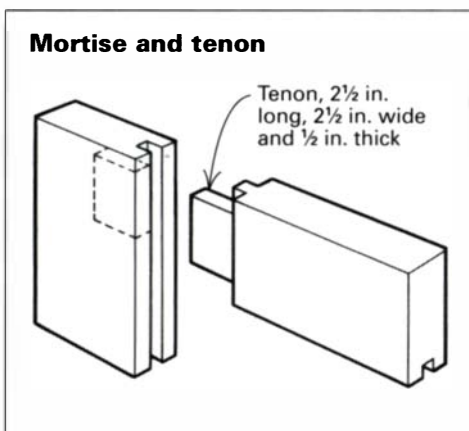
High strength in a traditional joint—The mortise-and-tenon connection showed good overall strength and isn't likely to fail completely or suddenly, making the joint the first choice of timber framers.



Dowels may not be the best choice—The doweled joint may have relied on the tongue-and-groove connection for much of its strength. Once the stile split, the dowels pulled out without much resistance.



Tongue-and-groove joint shows surprising strength—Even without extra reinforcement, the simple tongue-and-groove joint took 1,300 lbs. of pressure before it shattered into two pieces.



fail. Instead, the stile itself split, allowing the loose tenon (not starved of glue, it turned out) to be pulled out slowly (see the photo on p. 59).

Mortise and tenon—The traditional, square-cornered mortise-and-tenon joint showed above-average resistance to deflection and good resistance to gapping. Like the loose tenon, the joint didn't gap until 1,200 lbs. of pressure had been applied. It failed outright at 2,700 lbs. (see the photo at left above). But it deflected $\frac{7}{16}$ in. more than the loose tenon at the same point of failure.

Dowel—The two $\frac{1}{2}$ -in. dowels each measured $5\frac{1}{16}$ in. long. The joint failed at 1,800-lbs. pressure, with a gap forming at about 1,200 lbs. (see the center photo above). Taylor had grooved the dowels to promote glue distribution. Even so, the dowels appeared a bit glue-starved and probably would have performed better had the glue been spread over mating surfaces more evenly.

Taylor and Brungraber were interested to see that the $\frac{5}{8}$ -in. tongue and groove in this joint never failed. The joint broke when the

stile split along the grain. Once the grain began ripping apart, the dowels simply pulled out without much resistance.

Tongue and groove—Just for the heck of it, Taylor and Brungraber decided to test the $\frac{5}{8}$ -in. tongue-and-groove joint by itself. It was a lot stronger than people thought it would be. There was no gapping until the joint shattered outright at 1,300 lbs. of pressure (see the photo at right). Here, too, the joint itself didn't fail; it forced a failure along the stile's grain and broke the wood.

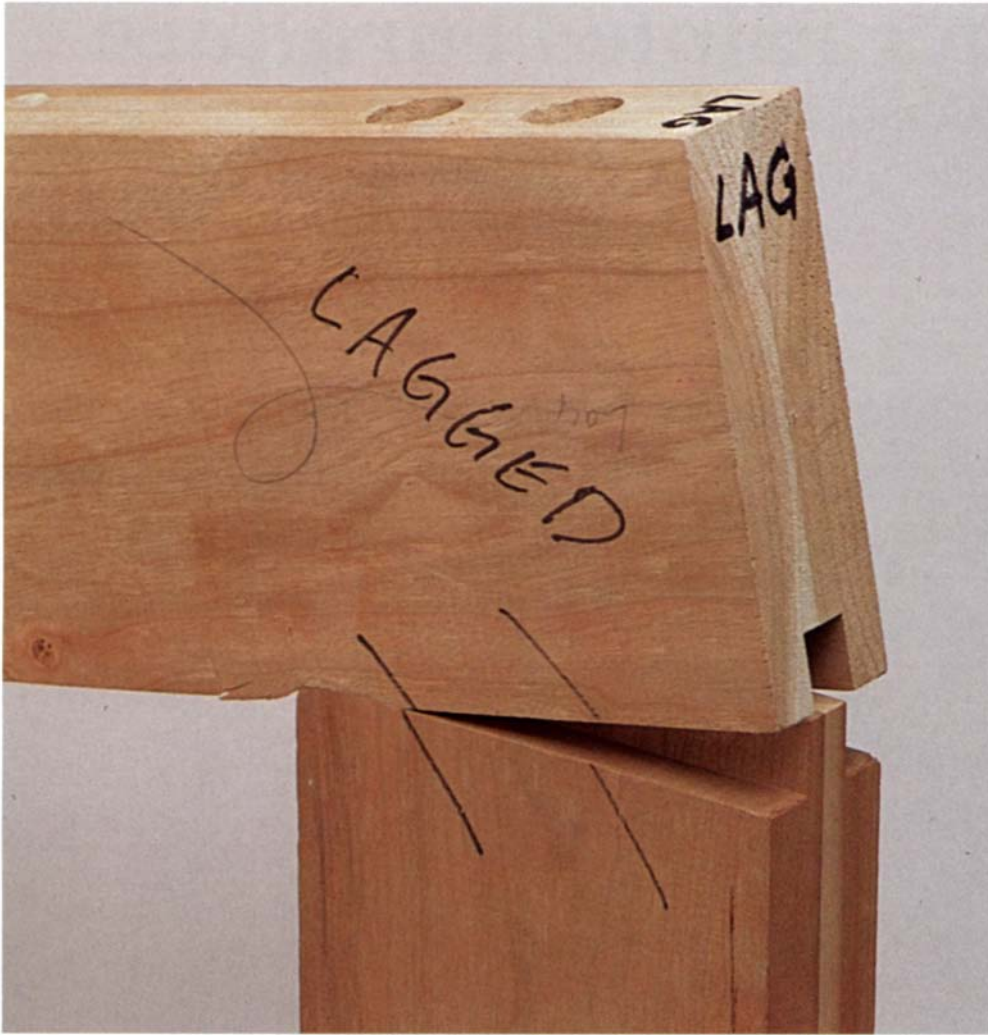
Lag bolts—The two $\frac{1}{4}$ -in. lags extended $1\frac{3}{4}$ in. into the stile. This joint was the worst performer by far (see the photo at left on the facing page). A gap opened in the joint at 400 lbs. with each stroke of the jack producing more and more deflection. It was a dramatic illustration of how little holding power threads have in end grain.

Biscuits—The two biscuit joints were a little different from the others in that they didn't have the $\frac{5}{8}$ -in. tongue and groove—just a butt joint. The first biscuit joint had two #20 biscuits, each one inserted $\frac{1}{2}$ in. from each face of the frame. The second

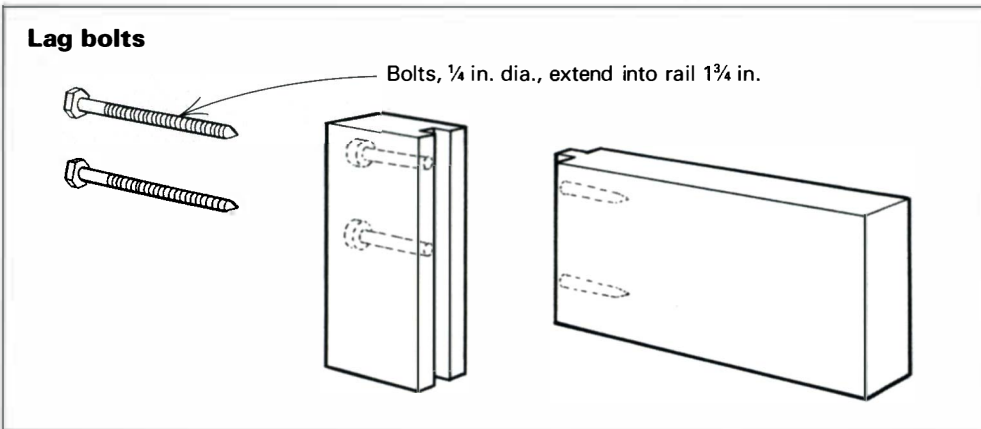
joint included a third biscuit, inserted between the original two. Both joints behaved almost identically. Both gapped at 1,700 lbs. (the two-biscuit joint deflected .032 in. before it gapped, and the three-biscuit joint deflected .029 in. before it gapped). The two-biscuit joint failed with a dramatic explosion at 2,800 lbs. pressure (see the top photo on p. 58), and the three-biscuit joint failed at 3,000 lbs. pressure with nearly identical deflection (see the photo at right on the facing page).

In the three-biscuit joint, the biscuits didn't fail. Rather, they forced a failure along the grain of the stile. In other words, the joint was stronger than the wood itself. In the two-biscuit joint, one of the biscuits split, causing a shear failure in the second biscuit. After that, the glued butt joint quickly separated where it was in tension at the top of the joint.

Taylor and Brungraber think that the biscuits themselves in the two-biscuit joint failed around 1,700 lbs., with the glued butt joint giving the holding power until outright failure at 2,800-3,000 lbs. Brungraber said the biscuit joints showed wonderful overall strength and resistance to deflection. But in wet-dry or freeze-thaw cycles,



Lag bolts and no glue make for the weakest joint—The lag-bolt joint clearly demonstrated the failure of screw threads to hold in end grain. The bolts began losing their grip when the joint gapped at a mere 400 lbs. of pressure.



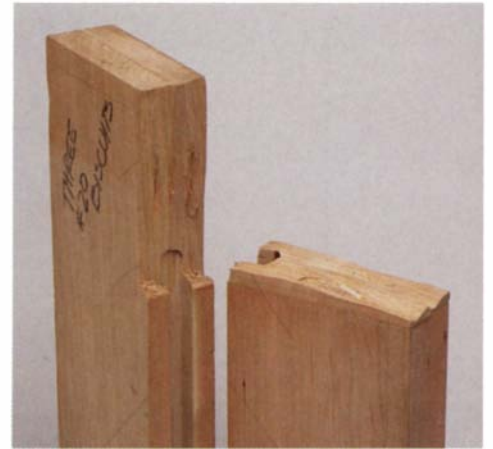
the part of the joint without biscuits would eventually fail, and the joint's strength would be compromised as it became solely dependent on the biscuits themselves.

Overall appraisal

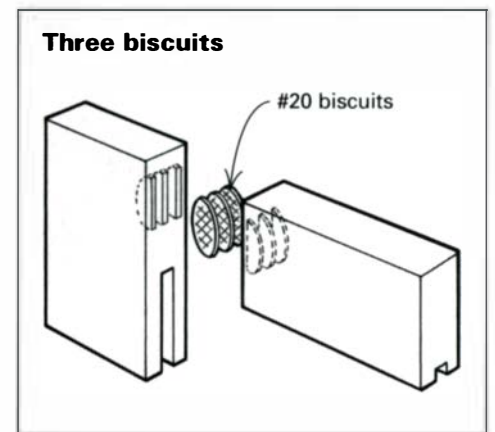
So what should you use in your doors? Doors won't take the kind of abuse these tests delivered, but the choice for Brungraber and Taylor is a loose-tenon or traditional mortise-and-tenon joint.

Though the failure of the biscuit joints

occurred at nearly the same overall pressure, the biscuit joints failed completely, snapping suddenly into two pieces. Comparatively, the loose tenon and the mortise and tenon first gapped, and then they failed, but the joint stayed physically intact, with the rail and stile still attached to each other. Brungraber says that this is why mortise-and-tenon joints are the joints used in timber framing. Even while the joints fail, they fight every step of the way. The failure in a mortise-and-tenon



Third biscuit adds little strength—Adding a third biscuit to the joint made no significant improvement in the joint's performance. Close examination reveals the wood failed before the biscuits.



joint is rarely as complete and sudden as what they saw in the biscuit-joint failures or the failure of the $\frac{3}{8}$ -in. tongue-and-groove joint.

The overall best joint, the one that Taylor suspected was the strongest and the one he uses in his custom doors, is the loose tenon. The joint began to open up at the same point as the dowel joint and the mortise and tenon, but the loose-tenon connection showed continued resistance to deflection and good overall strength.

The other graphic lesson found in these joint failures was the essential importance straight-grained wood played in all the joints' strength. Most of the joints proved to be stronger than the wood itself (this is shown by how many of the joints were tenacious enough to force a failure along the stile or rail's grain). Using straight-grained wood will invariably strengthen any joint's overall performance, as does careful, thorough gluing. □

John D. Wagner is the author of Building Adirondack Furniture (Williamson Publishing Co., 1994). He lives in Montpelier, Vt., where he writes frequently on building-technology issues.

Better Painted Furniture

Use automotive filler and primer to level the wood, aerosol cans to paint and clear coat it

by Chris A. Minick



Automotive aerosol paint makes for a flawless finish. Wearing an organic-vapor respirator and rubber gloves, Chris Minick sprays a cabriole leg in a number of light coats. By hanging the leg from a chain, he can rotate the leg as he fills in missed areas. The spray booth is a U-shaped drape of 4-mil polyethylene hung from his garage rafters. Minick leaves the doors open for ventilation.

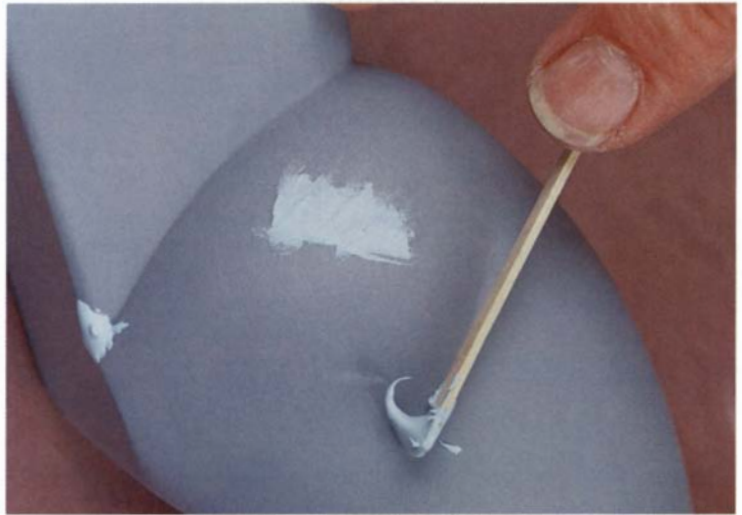


Paint showcases furniture's wood and form—Painted maple legs emphasize the lines of the author's highly polished coffee table. The black tabletop edges, bottom apron bead and corner legs make an attractive frame around the ribbon-striped-mahogany veneer top and quilted-mahogany veneer apron. The underside of the table is also painted.

Two-part auto-body filler won't shrink, so it's great for leveling defects in wood. Using plastic-covered graph paper to measure the proper amount of filler and catalyst, Minick mixes the filler. After he packs the filler, he uses a knife to strike the repair flush with the surface, which will reduce sanding later. Areas of the leg that will be glued have been masked off. The filler cures quickly.



Glazing putty smooths out blemishes in primer—After Minick primes a leg, he sands it out to reveal tiny surface dents and nicks, which he fills with blue glazing putty. When that's dry, he'll sand, re-prime and then lightly sand again in preparation for paint.



“If it works, don't mess with it,” sums up the attitude that many woodworkers have toward finishing. Learning about a new finishing technique can be complicated and confusing. So it seems easier to stick with an old standby like tung oil, or stain followed by varnish, even though it may be merely adequate. If that's your habit, you may have overlooked an important class of finishes—paint.

Paint is a versatile medium because it can be used as a design accent to emphasize the lines of a piece, or it can be used to draw attention to handsome woods in furniture (see the bottom photo on the facing page). A painted finish also lets you use up those too-good-to-burn pieces of scrapwood. But don't be mistaken. Paint cannot cover up poor workmanship or shoddy surfaces. A painted finish requires better preparation than a clear finish. Fortunately, there are some products that make the whole process relatively painless.

If I have to paint a fairly large project or one that needs a special color, I use a good latex paint and an airless sprayer. But for most items, especially the ones that require a professional-looking paint job (such as the coffee-table leg in the top photo on the facing page), I use ordinary aerosol spray cans for priming, painting and clear coating. Auto-parts stores have a marvelous variety of colors and types to choose from. And automotive fillers and putties are superb too.

Learning from automotive finishers

Folks working in the automotive industry are constantly refining paint finishes, due to the meticulous demands of car finishes (see the box at right). That's the main reason I buy many of my furniture-finishing products, including fillers, primers and paints, from my auto-parts store. And given the fact that paint is more easily scratched and more difficult to repair than most clear finishes, I borrow another technique from automobile finishers: I clear coat my painted finishes. Before I buy anything for a project, though, I think through my whole painting strategy.

Planning your paint job

Painting, like any finishing technique, can be frustrating when some unexpected problem arises halfway through the process. The best way to eliminate surprises is to test all your materials and practice new techniques on scrapwood. After all, you wouldn't cut dovetails the first time using prized wood for your project. So you should treat paint-finishing the same way. Paint decisions for a piece of furniture must be made before the first board is cut.

Because my furniture pieces often combine painted elements as well as stained and clear-coated portions, it's easier to finish each component separately, then assemble them. Though this requires careful planning of the construction and care in final assembly, it eliminates complicated masking and leads to better finish results.

When choosing stock for your project, think about which com-

Why new car finishes work on wood

Furnituremakers may question the wisdom of using automotive finishes on wood. After all, aren't car finishes brittle—meant for relatively immobile surfaces like metal instead of dimensionally unstable substrates like wood? Although that argument was true in the past, it is no longer accurate. Automotive primers, aerosol paints, clear-coat finishes and touch-up paints have changed because car components have changed. The latest materials, such as high-impact plastics and composites, are used to manufacture car bumpers, trim and door panels. So paint makers have had to reformulate their coatings to accommodate increasing flexibility. This flexibility allows woodworkers to use car-finishing products on wood, which is notoriously unstable. If you don't care to use finishes from the auto-parts store, you can use most general-purpose aerosol primers, paints and clear coatings to get equally stunning results.

—C.M.

Simple tools improve the quality of a paint job—To prime the spackled MDF edges of an end table, Minick places it on a lazy Susan mounted to his bench. This allows him to spin the work as he sprays. Because the push buttons on aerosol cans are awkward, he uses an inexpensive plastic trigger handle.



Use spackle to fill voids in edges



Spackle fills voids in medium-density fiberboard—After masking off the veneered top of his table with paper and acrylic adhesive tape, the author rubs wallboard spackling compound onto the MDF edges. The spackle adheres well, dries quickly and sands beautifully.

The medium-density fiberboard (MDF) edges of my coffee-table top posed a unique finishing problem for me. Because the top was veneered, I needed a way to hide the MDF core. Edge-banding with solid wood was an option, but that didn't fit my design. I ruled out veneer as well because of the shaped edge that I wanted. So I decided to paint the edges black, like the legs. But first I had to prepare the surface of the MDF for primer.

MDF absorbs finish like a sponge, and the small pits in the core must be filled or they will show through the paint. A few finishers tackle this problem by using glazing coats; this technique requires real skill. Large furniture manufacturers solve

the problem by spraying on two-part edge filler/surfacer, but it is expensive, hard to find and requires specialized spray equipment. I avoided all this by wiping a coat of wallboard spackling compound (made by DAP) on the exposed MDF edges (see the photo above). The spackle sands easily, fills the pits and provides a good base for the primer. To save yourself some work, mask off the top and bottom of the tabletop before you start spackling the edges. —C.M.

ponents will require special needs. For example, if you decide that certain parts must be real smooth, then maple, poplar and birch are good wood choices. However, if you want to show a bit of wood texture through the paint, then open-grained woods, such as oak and ash, are more appropriate. I wanted smooth, glossy black legs on my coffee table that would enhance the figured-mahogany veneer top and apron. In addition, I wanted the legs to be hard to guard against knocks. For these reasons, maple was the logical wood choice. But as far as the painting goes, the wood used is irrelevant, really, as long as you are careful with the under-paint treatments.

Preparing surfaces and equipment

The key to getting flawless painted furniture is meticulous surface preparation. The monochromatic nature of paint dramatically magnifies minor flaws that would otherwise go unnoticed under a clear finish. Small tearouts, hairline cracks in knots, stray sanding scratches and other seemingly minor defects must be filled and smoothed before painting. This may sound like lots of dismal work, but if you follow car surface-preparation steps, you can reduce the drudgery.

Sanding and filling—All parts should be thoroughly sanded to at least 180-grit and inspected under a strong light; then use auto-body fillers to level off any voids. These polyester fillers (familiar brands include Bondo and White Knight) work exceptionally well at repair because they tenaciously stick to raw wood, cure quickly, sand easily and accept most kinds of oil-based and latex primers and paint. Best of all, they don't shrink. On the down side, they smell bad and have a short working life once mixed, usually less than 15 minutes.

For the coffee-table legs, I filled dents and nicks with two-part auto-body filler (3M's 2K Lightweight putty). I even built out an edge that had been clipped off on the bandsaw (see the top photo on p. 63). I also filled in the knots. No matter how sound they look, knots always have cracks that show through the paint. Knots often contain resins, too, especially in softwoods. So once the filler in the knots had cured (about 30 minutes), I sanded them flush and spot-sealed the knots with shellac just to be safe. Finally, to make the edges of the medium-density fiberboard (MDF) top perfectly smooth, I used some spackle (see the story at left).

Setting up a makeshift spray booth—I don't have a paint booth in my home shop, so before I prime or paint, I set up a crude but effective painting area in my garage (see the top photo on p. 62). Ventilation for my plastic spray booth is provided by a box fan that draws outside air through an open rear door and exhausts it through a partially opened garage door. I also use a good organic-vapor respirator to protect myself when I'm using aerosol cans to spray primer and high-solvent lacquers.

Priming and puttying—Primers serve the same functions for painted finishes as sealers do under clear coats. Primers seal in resins and extractives that may discolor the paint, provide a uni-



For a high-gloss finish, rub out the clear coats with liquid automotive polishing compound. As a finishing touch, Minick buffs out the clear-lacquer topcoat (one of five) on a coffee-table leg.

finer than 320-grit. While you're sanding, be careful not to cut through to the wood, or you will have to re-prime. The object of this final sanding is to level and smooth the surface but still leave some tiny scratches in the primer. This slight texture, called tooth, makes a better bond between the primer and topcoat.

Painting, clear coating and rubbing out

Aerosol paint cans are available in different colors, gloss levels and brands. I have had good luck using both Plasti-kote and Krylon on furniture. Aerosol paints that are low-gloss sand easier than high-gloss ones, but I prefer the high-gloss variety because their higher resin content adds to the durability of the finish. You shouldn't be overly concerned about the actual glossiness, however, because the final sheen of the project will be controlled by the clear coat.

To start painting, I mist a tack coat of paint over all the primed area. Then I spray several light coats to fill in the blanks until the entire surface is covered with a level wet coat. Continued painting at this point will result in runs or sags. Let the solvent evaporate for five minutes or so, and then lay on another coat the same way. Two or three coats are usually enough to provide sufficient color build on a well-primed substrate.

For the tabletop's edge, I overcoated the spackled and sanded edge with the same automotive primer and paint that I used for the legs. The only differences were that I masked off the top and then used a lazy Susan to hold the work (see the top photo on the facing page).

The clear coat is the final touch that sets apart an average paint job from a real showstopper. Clear coats not only protect the paint from occasional dings but also add depth to the finish, which is more suitable for fine furniture. In addition, clear coats unify components by providing a consistent sheen over the entire piece. And clear coats are easier to rub out and repair than paint.

For peace of mind, I usually choose my clear finish from the same resin family as the paint. I used an aerosol automotive clear acrylic on my table project, but any good clear lacquer will work. For the tabletop edges, I clear coated the paint with Pratt & Lambert #38, which is the same varnish I used on the mahogany-veneered top and apron. Four or more clear coats may be needed to achieve a good film thickness (3-4 mils). Remember, some film will be lost when rubbing out, so compensate for this. Make sure that your paint is completely dry before you clear coat. I like to wait several days.

For rubbing out clear coats to a high luster, I like to use liquid automotive buffing compounds (not paste compounds). I've found that car buffing compounds are easier to use than those carried by most wood-finishing-supply places. Both 3M and Meguiar's offer good compounds for polishing. Meguiar's has several formulas with different abrasive levels for hand-rubbing or power buffing. Let the clear coats dry a day or so, and then buff out to whatever sheen you desire (see the photo above). □

Chris Minick is a finishing chemist and a woodworker in Stillwater, Minn. He is a regular contributor to Fine Woodworking.

form non-porous base for the color coat and highlight any defects that were missed in the filling process. Aerosol primers are sensible to use if you're painting relatively small areas. I often use automotive high-build, scratch-filling primers under pigmented-lacquer paints. High-build primers are easy to apply, sand like a dream and fill in tiny nicks and pits in wood. Adhesion tests in my shop show that automotive primers are completely compatible with high-solvent lacquers, but marginally compatible with oil paints and not at all with latex. When I buy primer at the store, I pick up several different brands of cans and shake each until I hear the little agitator ball dislodge. I pick the can that takes the longest for the ball to loosen because, generally, this means the primer contains a higher percentage of solids. Primers with more solids do a better job and are easier to sand.

Allow the primer to dry thoroughly (it should powder easily when sanded), and then inspect the piece carefully. You'll be surprised at the number of imperfections that will appear on your supposedly smooth wood. You must fill the tiny defects, or they'll show through the paint. Don't use the two-part auto filler this time, though, because it won't stick to the prime coat. Instead, use an automotive glazing putty, which is designed for application over primer (see the bottom photo on p. 63). 3M's Acryl-Blue Glazing putty suits my needs, but any non-shrinking brand should work.

Sand the primer and dried putty smooth. Next apply a final coat of primer. Then sand again—this time to at least 220-grit but not

Models Help Projects Succeed

Prototypes of cardboard, foam or paper help solve design and construction problems

by Jan Zaitlin



Big or small, models help refine design—The author uses three kinds of models to help her visualize furniture projects before they are built. Full-size mock-ups can be assembled quickly with cardboard and straight pins, as she does here.

I'm a big fan of making models and mock-ups before I move on to a finished piece of furniture. Whether the prototypes are cardboard or foam, full size or one-eighth scale, they help solve a long list of furnituremaking problems. Models are good for demonstrating knockdown features and can help me decide what construction techniques to use. Clients love models because visualizing the real thing from drawings can be difficult; models can show clients how finished pieces will look in their intended room settings. Even if I'm building a project for myself, a quick model can prevent disappointments later.

I use several types of models, and the applications and the materials for each vary. I have three favorites: the quick, full-scale mock-up, what I call the scale appearance model, and the full-size detail mock-up like the one in the photo above.

A quick, full-scale mock-up

A mock-up is a quick, inexpensive, full-scale, approximation of the completed piece. The purpose is to catch any obvious mistakes in proportion. I usually build one right after I have my design concept drawn, dimensioned and approved. The mock-up shouldn't take more than an hour to construct and should be taken to the site. There, I can tell if the finished piece will be the right size for the intended space, if it blocks too much light or if its position or dimensions will cause some other unexpected problem, such as limiting the swing of a door. If the project is a dining table, I can place chairs around the mock-up to see if it makes the room seem too crowded, allows room for serving platters and seats the required number of people comfortably.

I use inexpensive materials that can be worked quickly. Mock-

ups need not be pretty. For most projects, I use corrugated cardboard, which can be used for curved as well as angular projects because I can bend it with the “grain.” And I can draw on it with a pencil or marker to suggest details.

Sometimes the appropriate mock-up material is foam board, polystyrene foam sandwiched between smooth paper. Foam board looks cleaner than cardboard, and it doesn’t have the strong grain that corrugated cardboard has. It is available at art and architectural supply stores and comes in a range of thicknesses ($\frac{1}{8}$ in., $\frac{3}{16}$ in., $\frac{1}{2}$ in.) and in sheet sizes up to 4 ft. by 8 ft.

Both foam board and cardboard are easily cut with a utility knife. I use a cordless hot-melt glue gun for quick assembly. On those occasions where hot-melt glue is not appropriate (it can be messy and thick), I have used a quick-drying white glue called Elmer’s Tacky Glue. I also use a variety of tapes including repositionable tape, which is good for changing things around. Check the adhesives section in art or graphic supply stores.

A handy fastener for butt joining is an ordinary straight pin, the kind used by tailors to hold fabric together. These are available at fabric stores and often at grocery and drug stores. Straight pins are great for making a knockdown mock-up (see the photo on the facing page).

For more sculptural applications, such as a chair or lamp base, or wherever it is important to show mass, I use rigid blue foam (extruded polystyrene). It is used in construction as insulation and comes in 2-ft. by 8-ft. sheets, 1 in. and 2 in. thick. Avoid the white foam. It breaks up into little pellets and doesn’t sand well. 3M makes a spray adhesive especially for foam that bonds almost instantly, so you can stack up layers of foam to get a mass of material very quickly.

Blue foam can be worked quickly with most woodworking machinery and hand tools. The board can cut cleanly with both a bandsaw and a tablesaw, sanded quickly with a disc sander (be sure to use a dust mask) or sculpted with a Surform tool or a file (see the photo above).

Other materials are also useful for mock-ups: scrap wood for those times when cardboard just isn’t strong enough, aluminum foil to simulate a mirror or metal parts and construction paper or poster board bent, cut or used like a veneer. Be creative.

When you build your mock-up, it’s a good idea to make it easy to alter, so you can make changes without too much trouble. After all, you’re really trying to see how the shape and proportion work, so a mock-up that’s easy to adjust will be a lot more helpful than one with permanent joints. Be sure it is easy to disassemble, so the mock-up can be moved to a site or stored until completion of the real piece. Don’t be tempted to toss the mock-up before the piece is completed. It will come in handy when you need to try out design changes that occur in mid-project.

A scale appearance model

After the mock-up, I consider making an appearance model—a scale model that looks like the real piece only smaller. I make appearance models when I am designing a piece for production or if a one-of-a-kind piece is particularly sculptural, uses unusual

construction techniques or if the concept cannot be conveyed adequately with a drawing. A model gives a more realistic sense of the finished piece, especially if your drawing skills are weak; it makes a great presentation tool, and it can be used to create photos of a room setting when the job site isn’t available for a mock-up. A nice appearance model takes a day or two to build.

I make appearance models of furniture at one-eighth or one-quarter scale, according to the size of the project. It’s best not to go overboard on detail, or the model begins to look too cute, like doll furniture. Small details also take time to do well and often don’t tell you much. If they are really important, do the third type of model, a full-scale detail mock-up. More on that later.

Wood is the primary material on most of my appearance models. I used to mill my own small stock, but I found that it was time-consuming to cut the very thin stock that is necessary. And quite often, the quality was not as good as the store-bought model-making material. It can be tricky to mill small stock without having it explode in the planer or chip badly. Many hobby shops and architectural supply stores carry a good selection of basswood, cherry and walnut. I avoid balsa because it doesn’t cut cleanly.



Cushion that’s really foam—High-density, white polyurethane foam shapes easily and is perfect to mimic upholstery in scale models.

Many of the places that carry model-making supplies also sell ultra-thin plywood. I have seen three-layer sheets (1 ft. by 2 ft.) of ply as thin as $\frac{1}{64}$ in.

When the project calls for a substance other than wood, I use a variety of materials. The blue foam mentioned earlier is good for simulating the pleats, folds and soft look of upholstery. There is a better quality, white, high-density polyurethane foam available in sheets $\frac{1}{4}$ in. to 2 in. thick that is more expensive but holds details better and is more uniform (see the photo above). You can paint it with acrylic paint.

Acrylic sheet or rod can be used to simulate metal or glass. It can be bent with heat from a heat gun, torch or in an oven and painted with a metallic paint. I have used pieces of acrylic sheet to simulate glass tabletops by painting the edges green (a light green marker is even easier).

Painted wood used to offend the woodworking purist in me. But now I see that it can be used to simulate other materials. For example, there are faux marble paint kits available in paint stores or art supply stores, so you can machine a tabletop in wood and then make it look like marble or granite. To make the patterns look right on scale models, you may have to alter your technique slightly. For instance, to get a smaller pattern that looks right, a tight-pored sponge, like a sea sponge, works best for marbling.

Don’t overlook paper as a model-making material. When used like a veneer, it is quicker than paint and can simulate laminates

and stone. Art or graphic supply stores carry paper in glossy or matte finishes, and the number of colors will surprise you. Ask for Pantone paper. While you are in the graphics department, get a can of instant spray adhesive made just for paper.

And don't leave until you check out some markers, pencils and press-on stripes and patterns. Architects and designers use these to simulate details; you can too. You can draw on inlays or drawer and door lines. A dot can simulate a knob, a horizontal line can suggest a wire pull and markers can simulate aniline dyes. There are wood-colored markers, but you need to test the color to see if it approximates the real wood color.

Special tools help model making—Though the construction of scale models can be relatively quick, it requires some special tools

Simple fixture makes cutting small model parts safer—The author made a small crosscut fixture for her radial-arm saw to reduce the danger of small parts getting pushed through the big gap in a standard saw fence.



Detail mock-ups test alternatives—The author used white foam to make a full-size detail mock-up of a cabinet handle. Several options can be made as detail mock-ups and then tried out on the quick, full-size mock-up.



and fixtures to make the machining of small parts safe and accurate. For example, I made a small-parts crosscut jig for my radial-arm saw (see the top photo). The jig helps block off the big gap in the fence that could swallow up small parts as they are being cut to length.

To deal with this gap problem on the tablesaw, I made a wooden throat plate with a narrow slot. I also can rip thin material on the tablesaw without having it slip under the bottom edge of the fence by using an easily installed facing for the fence that goes all the way down to the table surface. I always use push sticks; sometimes I use two, one in each hand. Featherboards are also good for keeping your fingers away from the cutting edges.

Joinery for models—I often simplify the joinery on appearance models. I use butt joints when I can get away with it, but I also use thin dowels or wooden toothpicks for through-dowel joints when necessary. Dado joints are pretty easy with a router table and $\frac{1}{16}$ -in. and $\frac{1}{8}$ -in. straight bits. Make certain that the hole in the table

is not so large that it creates a safety hazard when machining small parts. I use little De-Sta-Co clamps to make quick jigs to hold the small parts when I machine them on the router table.

Mortise-and-tenon joinery may seem a bit extreme, but occasionally, I find that it provides detailing important to the look of the finished piece. And it may help hold the model together. I drill out holes and clean out corners just like I do in full-scale mortise joints, but I use a shopmade $\frac{1}{16}$ -in. chisel. I made the chisel by grinding the tang end of an old, dull file. The steel is hard enough to keep an edge.

One store-bought model-making tool that I find useful is the tiny brass bar clamp. I got a pair of them as a gift and thought I would never use them, but the bar clamps are handy because they fit in small places. Other good clamping tools are clothespins, paper clips, tape and rubber bands.

Scaled construction hints at real problems

Although the tools are smaller, scale model making provides a good opportunity to think through the whole construction process on full-scale pieces. As I build the model, I imagine that I am doing everything in full scale, and based on that experience, I choose the best construction technique for the real piece. It is important to remember, however, that if a construction operation or detail is easy in scale, it may not be when it is full size and vice versa. For example, once I neglected to account for how difficult it

would be to lift a glass top in and out of a frame repeatedly to get a perfect fit; on the model, it was easy to fit because the small piece of acrylic was so light. Conversely, some things can be awkward on a scale model because the access is tight or the parts are so small that clamping is difficult, but on the real thing, access may be a simple matter of reaching your arm inside of a cabinet or using a bar clamp.

Full-scale detail mock-up

Mies van der Rohe, the famous architect, once said, "God is in the details." So when I am working on a piece that has unusual edge or surface treatment, a unique pull, connection or foot, I mock up just the detail. The full-scale detail mock-up lets you see your design in three dimensions. If you have already made a full-scale mock-up of the entire piece, then it's a good idea to attach this detail mock-up to it (see the bottom photo on this page). Work precisely on the detail mock-up so that you can work from it to build the real thing.

My material of choice is foam, both the blue and white types discussed earlier, because foam is so easy to work. When I use wood, I prefer something that can be worked easily, such as pine. Wood is the obvious choice if the detail is turned on the lathe or if it requires a texture that cannot be expressed in some other quickly worked material. □

Jan Zaillin is an industrial designer and a furnituremaker in Albany, Calif.

Photos make models look real



Models let you look at the result in advance. This scale model of a conference table comes to life when photographed with a few props and an appropriate background. Cardboard or clear acrylic human figures add scale.

Scale models that are made with care can be photographed to look like full-size pieces, as shown above. This is a great design and presentation tool.

Determine the background:

The easiest background is a sheet of paper large enough to fill the picture frame. Use any color paper as long as it isn't glossy. Bend the paper, don't crease it, so it sits on a tabletop and runs up a wall behind the table. For a more dramatic effect, use a roll of background paper, available in a variety of colors from professional photo supply stores. Tack one end to the wall, and put a table about 3 ft. away from the wall. Roll the paper onto the table, and set the roll on the floor. Place the model on the paper near the front of the table, and focus light there. The background fades into darkness, which contrasts with the lighted model.

Photos of the piece on site:

To see what the piece will look like on site, I use three pieces of foam board taped together on the back side to form two walls and a floor large enough to

house the model and fill the picture frame (see the bottom photo). To give a sense of scale, I use a few props. This can be as simple to do as drawing an outline of a door with a circle for a knob at the right height. When I was photographing a model of an audio-visual storage system, I drew a screen on a cardboard television set, which was just a rectangle of gray cardboard propped up from behind with a little cardboard triangle.

Figures add human dimension:

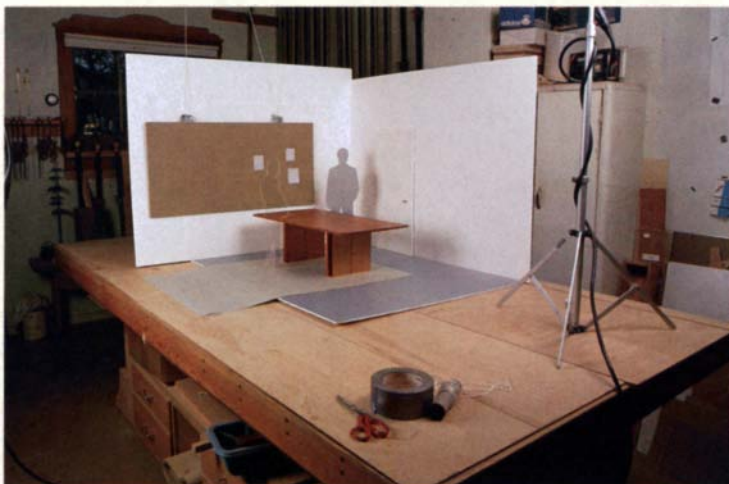
I find scale figures help-

ful, too. You can make a quick one by photocopying a figure from an architectural graphics book or a department store advertisement. Enlarge or reduce the figure until it is the right size. Use spray mount to fix the figure as a cutting guide to any rigid, thin material, like 1/8-in. acrylic. Then glue a small triangle to the back of the figure to make it stand on its own.

Photo tips: In addition to a 35mm camera, I would suggest that you use a macro lens or a set of magnifying lenses, called

close-up filters, which screw onto a lens to allow you to focus at much closer distances than standard lenses. A tripod and a cable shutter release allow you to snap a shot without wiggling the camera. Light stands can be fashioned with clamp-on shop lights and a chair for a stand. But daylight shooting is often quicker and can be just as effective. Just be sure that your film is matched to whatever lighting you choose. Any good photo supply store can give you advice on choosing the correct film.

—J.Z.



Three pieces of foam board can make a room—With the camera pulled back, the illusion is revealed. The backdrop is held up by string and tape. Simple shop-style clamp lights can substitute for the electronic flash shown here.



The scroll saw is a versatile tool that excels at fretwork, inlay, marquetry and other intricate work that requires little or no sawkerf. Extremely fine work is easier if you use an auxiliary

top of hardboard, which provides zero blade clearance for full support of fragile materials. And the extra top helps to prevent small pieces from falling to the floor.

Getting the Most from a Scroll Saw

These versatile saws cut everything from abalone to zinc

by Spider Johnson

If you're considering a scroll saw or if you already have one that sits unused and dust-covered in the corner of your shop, you're missing out on an extremely versatile tool. A scroll saw is good for a lot more than making knickknacks for the county fair. It can handle fretwork, inlay and marquetry. Scroll saws cut a fine kerf with excellent control in a wide range of materials including wood (up to 2 in. thick), paper, metal, plastic, rubber, wax, leather, glass, ceramic tile, plastic laminate, bone and abalone.

Basically, a scroll saw is a motorized coping saw. It holds a fine blade and moves the blade in short vertical strokes, cutting on the down stroke. Because of this cutting action and the small teeth on its blade, scroll saws are remarkably safe tools, a quality to remember if you have young woodworkers in the house. The tool's simplicity, modest maintenance requirements and ease of use make it a great tool for beginners. And the saws are more affordable than they used to be.

The scroll saw's unique quality comes from its vertical cutting motion and blade tensioning system. Modern scroll saws are not the same animal as the old saws that broke blades by the boxful. Modern parallel-arm scroll saws maintain constant blade tension and can be adjusted to use extremely small blades—qualities old scroll saws couldn't match. The straight up-and-down cutting action leaves a smooth cut. And the blade-speed control offered on some saws allows extremely fine work on fragile materials. With just a little attention to machine and stock preparation, anyone can produce excellent work on one of these machines.

Five factors for smooth, clean cuts

There are five keys to controlling the quality of cut: blade speed and alignment, proper blade selection, preparation of the workpiece, blade lubrication and cutting technique.

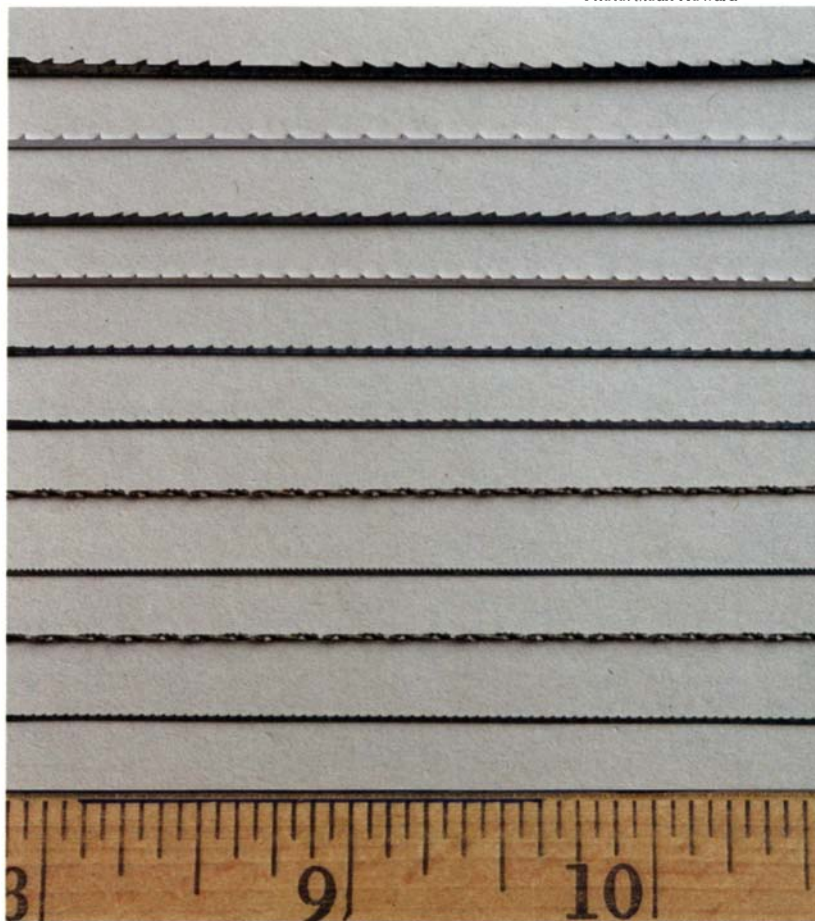
Blade speed and alignment—Despite what you may have heard, blade speed by itself is one of the least important factors for good results. Soft materials need a slower blade speed for a controlled cut. Higher speeds will cut harder materials faster. My rule of thumb is to match the speed with your ability to control the cutting. A high-speed-only saw, for instance, makes it difficult to cut intricate shapes in soft materials. But with a well-aligned saw and proper preparation, most materials can be cut on any saw.

More important is blade alignment: How straight does the blade track as it makes a cut? To check a scroll saw's alignment, place a small, light object with a straight edge, like a credit card or business card, on your scroll-saw table next to the side of the blade. After unplugging the saw, rotate the motor by hand so that the blade moves up and down, and watch the credit card to see if there is any side-to-side movement of the blade (see the top photo to). The more side-to-side movement, the more difficult it is to



Checking blade alignment is easy. Place a credit card against the side of the blade, and rotate the motor by hand. Any misalignment shows up as a gap between the blade and the card.

Photo: Sloan Howard



Scroll-saw blades come in a variety of styles and sizes for most cutting needs, from soft woods to hard metals. Sizes, shown here in various tooth designs, range from the fine no. 2/0 to a heavy-duty no. 12.

control the cut and the more frequently blades will break as they bounce off the sides of the kerf with each stroke. Try to check a saw before buying it because I don't know of any way to correct improper alignment. If your saw is out of alignment, though, don't throw it out. Proper cutting techniques, as I'll discuss later, can help compensate for some misalignment.

Picking the right blade—The blade is just as important as the saw it's mounted in. Most scroll saws use 5-in.-long blades that range in size from no. 2/0, the finest (.022 in. wide by .010 in. thick), up to no. 12, the heaviest, which are .061 in. wide by .022 in. thick (see the bottom photo on this page). For my marquetry

Blade selection guide

Use this chart as a starting point. You'll get the best results by experimenting to find the best blade for your technique and application. Blade sizes vary in thickness and width by manufacturer. The best direct comparison of blades is teeth per inch (tpi). Here are four axioms for blade selection:

1. There is no "right" sawblade for a particular job. Each size blade will accommodate a range of thicknesses and materials.
2. Generally, finer blades are best for thin materials. Feed rates should be slower. Fine blades make smoother cuts but break more frequently.
3. Select the coarsest blade that still makes a satisfactorily smooth cut.
4. The final compromise between smoothness, speed and durability is based on personal preference and experience.

Material	Thickness	Teeth per inch	Blade
Softwood	½ in.	20	Standard
	1 in.	15	Standard
		10	Ground
	1½ in.	14	Standard
		8	Ground
Hardwood	½ in.	16	Standard
		10	Ground
	1 in.	14	Standard
		8	Ground
	1½ in.	6	Standard
		10	Rip
Veneer	⅛ in.●	30	Standard or double
	¼ in.●	25	Standard or double
	¾ in.■	30	Double
Soft metal (brass, aluminum, zinc)	⅛ in.	50	Jewelers
	¼ in.	36	Jewelers
	½ in.	40	Jewelers
Hard metal (steel, hardened aluminum)	⅛ in.	36	Jewelers
	¼ in.	40	Jewelers
	½ in.	25	Jewelers
Plastic	¼ in.	16	Standard
		10	Ground
Rubber	¼ in.	14	Standard
Synthetic countertop	½ in.	14	Standard
	¾ in.	12	Standard
		10	Rip
Paper	¼ in.▲	16	Standard
		10	Ground
	¾ in.▲	14	Standard
		10	Ground
Wax	1 in.	32	Spiral
Leather	¼ in.	10	Ground
Glass, ceramic tile	up to ¼ in.	none	Diamond
Bone	⅛ in.	16	Standard
	¼ in.	14	Standard
		10	Ground
Plastic laminate	⅛ in.●	23	Standard
	¼ in.●	18	Standard
Mother-of-pearl or abalone	⅛ in.●	25	Standard
	¼ in.●	20	Standard

● Thickness of backer board that piece is mounted on

■ Thickness includes veneer stack with poster board on top and bottom.

▲ Thickness of stack

work, I use as thin a blade as possible, usually a 2/0 with the appropriate number of teeth per inch for the material being cut, as shown in the chart at left. Thin blades break more often than thick ones, so beginners will probably be better served by starting with a no. 5 to a no. 9 blade to avoid the frustration of frequently breaking blades.

Blades also vary by tooth design. Standard blades with evenly spaced teeth are designed for cutting wood or plastic. Double-tooth blades have pairs of teeth that are separated by spaces. They clear chips quickly and cut smoothly in a variety of materials, such as wood, plastic, rubber, bone, ivory, horn and paper.

Jeweler's blades are tempered blades with very fine teeth, from 36 teeth per inch (tpi) to 50 tpi. They are designed to cut only metal because their fine teeth will clog quickly in wood. Most blades are milled out of metal. But you can buy ground blades. They're more expensive (about \$7-\$12 per dozen vs. \$4-\$5 for milled blades), but they're sharper and have no set, so they deliver the smoothest cut (for sources of blades, see the box on p. 74).

The chart at left will help you pick the right blade for the job. But in general, when cutting wood, select the smallest usable blade based on the total thickness of the material. When inlaying a thinner material, like brass, into wood, choose a blade appropriate for the thicker material.

Softwoods with a high moisture content, like some cedars, or the powdery sawdust of dry white pine can create lots of friction, meaning lots of blade breaks. In these cases, a skip-tooth blade that's slightly larger than recommended in the chart at left will yield better results.

For soft or hard metals, the proper blade is a hardened, metal-cutting blade, fine enough so that three teeth always touch the material being cut. This can vary a little, depending on how fast you want to go (bigger blade) or how smooth or intricate a cut you want (smaller blade).

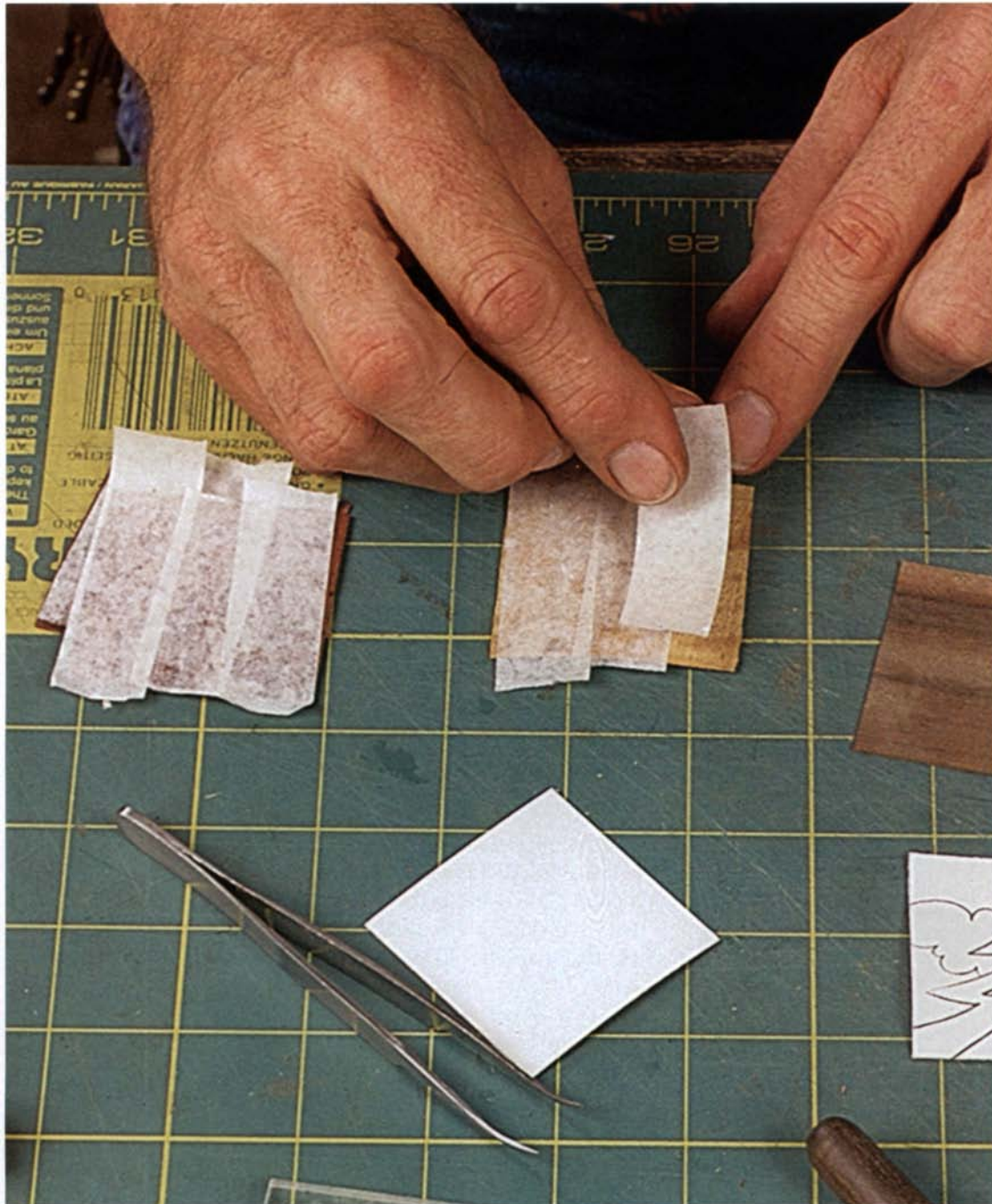
Impossibly intricate shapes and inside cuts can be made in glass or ceramic tile using a round diamond-coated blade.

Preparation of workpiece—The scroll saw can make cuts that other saws can't, such as the enclosed cuts in fretwork or sharp-cornered cuts with tiny kerfs that need no sanding. For most work in solid stock, you can sit down at the scroll saw and begin cutting without any special preparation of the material. But for cutting thin or fragile materials, I've found some tricks that increase my success rate and yield better results.

Thin, brittle veneer can break apart when being cut. By applying a layer of thin veneer tape, as shown in the photo on the facing page, and then rubber-cementing the veneer tape side to a piece of cardboard or poster board, almost any design can be cut successfully. (Veneer tape is available from Constantine, 2050 Eastchester Road, Bronx, N.Y. 10461; 800-223-8087.)

The design you're cutting out can either be drawn or rubber-cemented on top of the veneer tape. Rubber cement can be removed easily from the bottom of the veneer with a rubber-cement eraser before gluing the veneer to a ground piece later. Be sure to remove all traces of rubber cement before gluing because any remaining cement will inhibit good bonding when using water-based glues.

A similar method also works for cutting lots of other materials, such as thin sheet brass, bone, synthetic countertop materials, mother-of-pearl or abalone. The first step is to apply a design to the piece. Then, using double-faced tape or rubber cement, stick the piece to a ground piece (for inlay work) or cardboard backing piece. Especially fragile materials, such as mother-of-pearl or abalone, should be sandwiched in cardboard (avoid breathing the



Protecting fragile veneers—
To prevent tiny pieces of veneer from breaking, the author applies a layer of veneer tape to the face of the material. Then the veneer is rubber-cemented to a poster board or cardboard backer for support. The pattern can be drawn on or rubber-cemented to the veneer tape.

dust because it can contribute to silicosis, a lung disease). When cutting bone, be sure to flatten the back side on a belt or disc sander to prevent the piece from rocking on the saw table. The rocking will break blades.

The cardboard-sandwich technique also works for cutting several layers of veneer at the same time. I apply veneer tape to the face of each layer of veneer. Then I stack the veneers, adding random dabs of rubber cement on 4-in. by 5-in. or larger pieces to keep the veneers from slipping around. I sandwich the veneer stack between cardboard, rubber-cement the pattern to the top of the sandwich and saw the sandwich along the pattern lines, as shown in the top photo on p. 74.

Fretwork shows up frequently on period pieces, architectural detailing and musical instruments. Fretwork is a natural for the scroll saw because the cut is so smooth that little, if any, sanding is needed. To simplify cutting repetitive patterns, make several photocopies of your original artwork, tape the copies together to create a pattern and rubber-cement the pattern to the stock before cutting. If the wood is thin, layer two or three pieces togeth-

er in a sandwich, and cut several at once from the same pattern.

Metals $\frac{1}{16}$ in. thick and thinner must be sandwiched between pieces of cardboard or poster board to keep the sheets from distorting as they're being cut. The sandwiching material can be rubber-cemented to both sides of the metal or taped in place. Thin sheets of metal, such as brass or copper, can be layered for cutting multiples. Rubber-cement the sheets together. Apply the rubber cement evenly to both surfaces, wait for it to dry and then press the pieces together. Then tape their edges to prevent the sheets from sliding around or creeping.

The protective paper attached to both sides of sheet plastic seems to keep the plastic from melting when cutting. If this paper is missing, use rubber cement to glue on a replacement piece.

An auxiliary table, made from thin aluminum or hardboard, attached to the scroll-saw table will prevent small pieces from falling through the table's blade opening, as shown in the photo on p. 70. This auxiliary table is particularly useful when sawing small veneer pieces, which seem to have a remarkable ability to blend perfectly with any sawdust on the floor.



Stack veneer to cut multiple copies. After applying veneer tape to the face of each layer, sandwich the veneers between cardboard or poster board, and then tape them together. A pattern on top of the stack guides the cuts.



Lubrication is the key to cutting hard or delicate materials. In most cases, a block of paraffin that's rubbed frequently against the blade works quite well, even when cutting something as fragile as a bone inlay.

Lubrication—Blades cut easily and last longer if they're lubricated. This is especially helpful with metal and important when cutting synthetic countertop material, bone, glass, ceramic tile or dense woods, such as ebony, cocobolo, rosewood, lignum vitae, desert ironwood and osage orange.

For the occasional small part you might need to cut, no fancy or messy oil-lubrication jigs are needed. A piece of paraffin rubbed frequently against the sawblade, as shown in the bottom photo, works well. I like paraffin best, but almost any lubricant will work, from hand lotion to Vaseline to pipe-cutting fluid. Small amounts are sufficient—too much lubricant makes a mess.

To cut a thick sandwich of several layers, use waxed paper inserted between the layers. The waxed paper acts as an extra lubricant to reduce blade breakage.

A small, spray bottle of water works well for cutting glass or ceramic tile with a diamond blade. A paper towel under the bottom blade holder helps control the mess.

Cutting technique—Proper cutting technique is a combination of machine setup and correct feed rate for the blade, material and thickness of material. To start, tighten the blade tension until there is only about 1/8 in. of blade deflection when you press on the front of the blade. Adjust the nozzle for the blower that keeps dust away from the line of cut so that the air blows away from you. If your machine doesn't have a blower, consider adding a bellows, compressed air line or even a small aquarium pump.

Beginners should use the hold-down arm for cutting most materials until they are used to holding the stock firmly against the table (the blade tends to lift the stock off the table on the upstroke). Always use the hold-down when cutting metal, and be careful not to get your fingers between the material and the table. They'll get pinched if the blade grabs the workpiece.

Feed rate depends on how well you can control the cut. Soft, delicate materials should be fed with light pressure and slow blade speed (if blade-speed control is available). Generally speaking, use a slow speed for soft metals like silver, gold, aluminum, soft copper and brass. But remember that metal will take much longer to cut at slower speeds than wood. For thick metals, use a faster speed, and plan to break a few blades, even when you keep them lubricated. With 1/4-in.-thick steel, you'll cut roughly 1 in. per blade.

To prevent binding, practice relaxing your grip on the workpiece every few strokes. This technique will allow the blade to snap the piece back into alignment before you feed the stock into the blade again. □

Spider Johnson has collaborated with his wife, Lora Hunt, on their marquetry murals and sculptural pieces in Mason, Texas, since 1979. Ron King of Wilmington, Del., has worked with scroll saws for more than 20 years and offered technical assistance on this article.

Sources of supply

The following manufacture or supply scroll-saw blades.

American Intertool, Inc., 1255 Tonne Road, Elk Grove Village, IL 60007; (708) 640-7766

American Saw & Manufacturing, 301 Chestnut St., East Longmeadow, MA 01028; (800) 628-3030

The Olson Saw Co., 16 Stony Hill Road, Bethel, CT 06801; (800) 272-2885

Advanced Machinery Imports, PO Box 312, New Castle, DE 19720; (800) 220-4264



Supporting Drop Leaves

Six ways to keep them solid and level

by Christian H. Becksvoort

A sagging leaf on a drop-leaf table can be a chronic nuisance, to say nothing of the Christmas turkey that could end up in your lap. I've come to rely on six different support systems to keep leaves solidly in place. My favorite is a smooth-acting, pull-out slide that can be sized appropriately for end tables or dining tables. The pull-out slide's simple appearance and operation complements the Shaker-style furniture that I prefer. But no matter what system you choose to support

table leaves, you have to hinge the leaves to the table. Let's take a look at the best way to accomplish that.

Drop leaves require a special joint and hinge

The earliest examples of drop-leaf tables tended to be rather sturdy and often had but one leaf. These primitive tables had butt joints between the top and leaf and used plain butt hinges, as shown in figure 5 on p. 76. A better way is to cut a rule joint

where the leaf meets the tabletop, and use a special hinge made specifically for the job (see "Routing a Rule Joint," *FWW* #80, pp. 48-51).

Drop-leaf hinges, as shown in figure 6 on p. 77 have the barrel on one side and the screw countersinks on the other. One leaf of the hinge is longer than the other to span the gap at the edge of the leaf created by the rule joint.

The rule joint consists of a quarter-round with a fillet along the edge of the top and a

Fig. 1: Spinner leaf supports

Spinner supports are quick to make and easy to install on table rails without a lot of extra work.

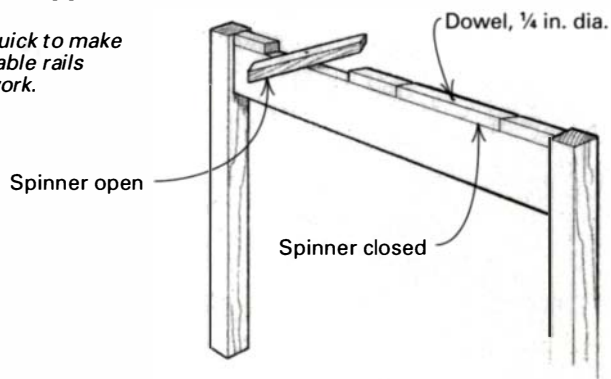


Fig. 2: Swing arms

Swing arms usually are joined to a secondary rail by finger or knuckle joints. These joints require more work than spinners but will hold more weight. And swing arms don't interfere with drawers.

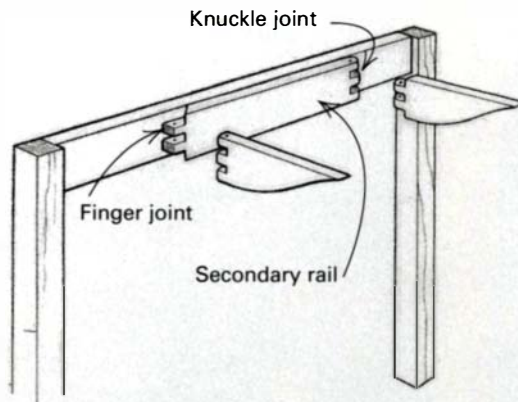


Fig. 3: Swing legs

By transferring the load directly to the floor, swing legs can handle more weight than swing supports.

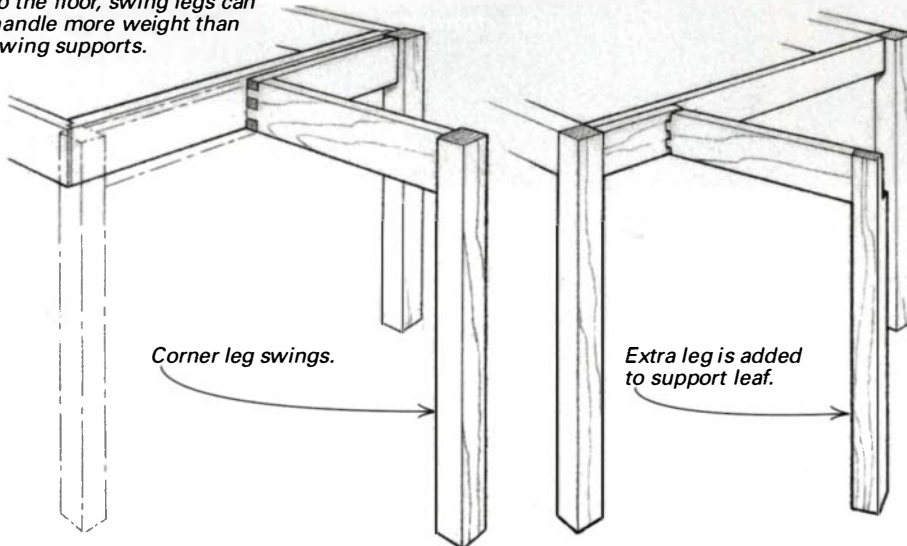


Fig. 4: Gate leg

The lower stretcher creates a secondary point of contact for a sturdy gate-like structure that will handle large, heavy leaves.

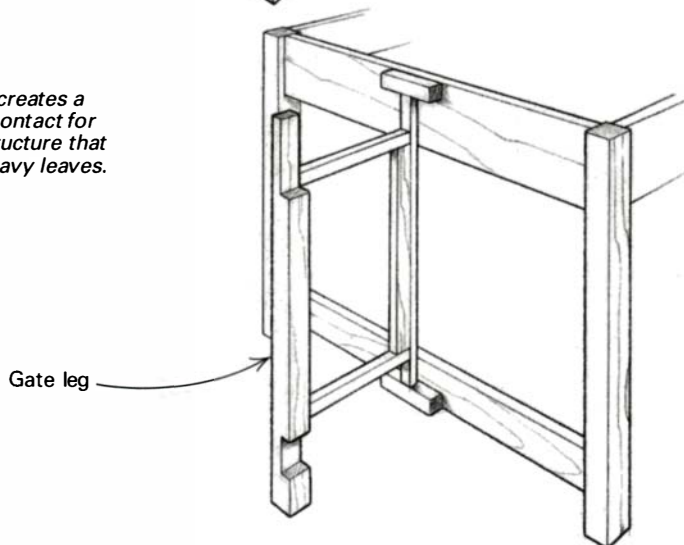
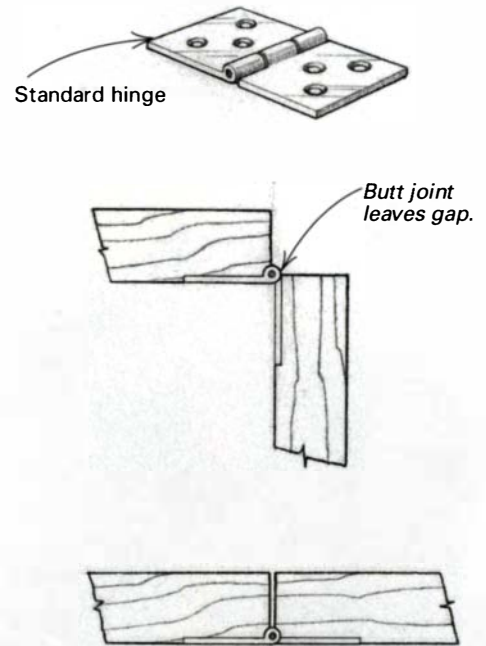


Fig. 5: Standard hinge

A standard hinge leaves an awkward stepped gap between table and leaf when leaf is in the down position.



cove along the edge of the leaf. The rule joint provides a smooth transition from top to leaf, whether the leaf is in the up or down position. It also discourages crumbs, tablecloths and fingers from becoming caught in the closing joint.

Six different support systems

Each of the six support systems has advantages for particular applications. Spinners (see figure 1) are compact, uncomplicated and work well with smaller leaves, such as those on side tables. Swing arms (see figure 2) also are best for small, light leaves. Swing legs (see figure 3) and gate legs (see figure 4) can be used for smaller leaves but are best for heavy loads, such as dining table extensions, because they transfer loads directly to the floor.

Swing and crane supports (see figure 7 on the facing page) are a compromise between swing arms and swing legs. Because the load of the leaf is distributed between the table's rail and stretcher, these supports will hold more weight than swing arms. But swing and crane supports lack the solid support gained by the swing legs' contact with the floor.

Sliding supports (see figure 8 on p. 79) can be proportioned to work well with small, light leaves or leaves that must support heavier loads, as long as the leaf is restricted to half the width of the tabletop.

Fig. 6: Drop-leaf hinge

For best appearance, drop leaves use a rule joint and a special hinge made specifically for this joint.

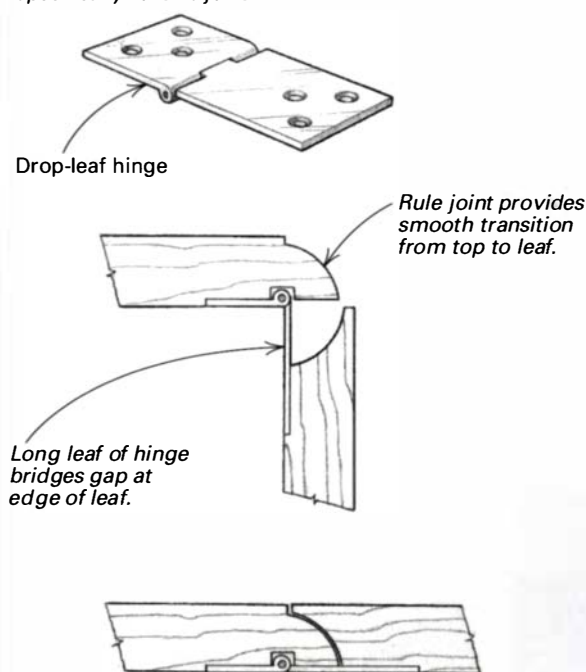
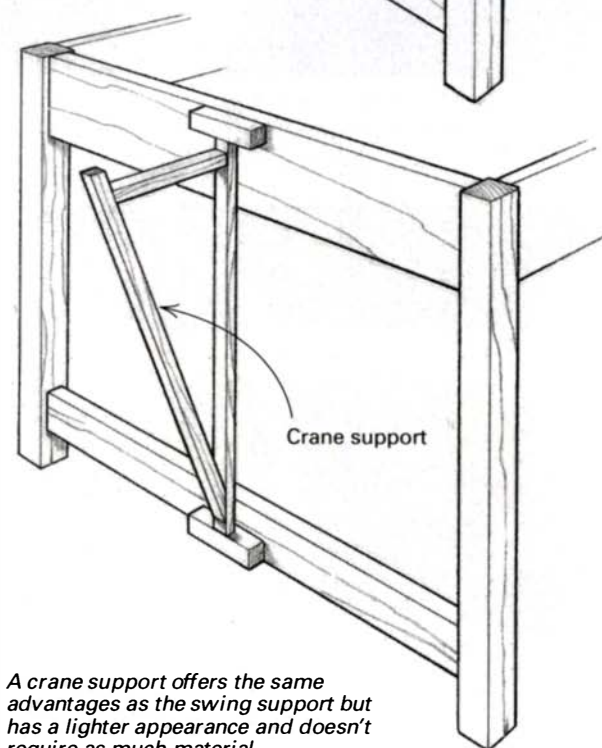
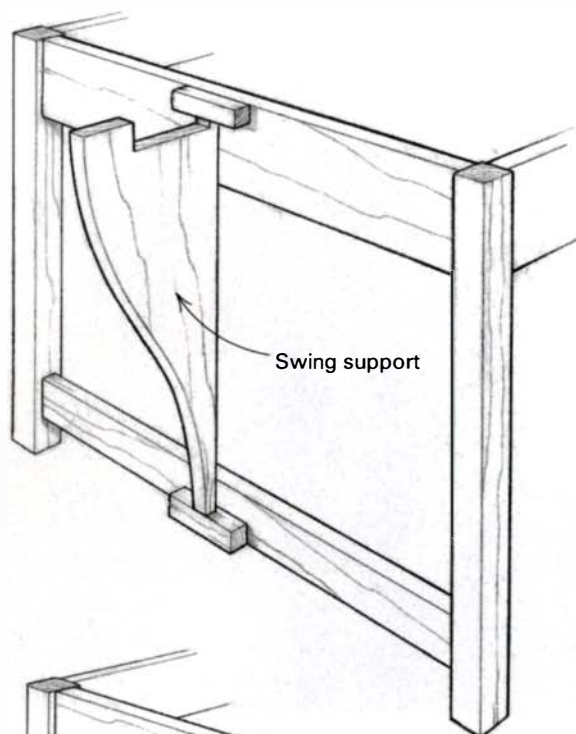


Fig. 7: Swing and crane supports

A swing support can handle heavy leaves because of the triangulated weight distribution. A swing support is easy to add to a table.



A crane support offers the same advantages as the swing support but has a lighter appearance and doesn't require as much material.

Spinners—A spinner is basically a stick that pivots on top of the table's side rail to support the leaf. Because only half the overall length of a spinner supports the leaf, it should be as close to twice the width of the leaf as table width and rail length permit. For example, a 10-in. leaf should have about an 18-in. spinner. Half the spinner supports the leaf while the other bears against the underside of the tabletop.

You make spinners right along with the rails. Just start with stock that's a little longer and a little wider than the finished rail. Rip a 1-in.- to 1½-in.-wide strip from the top edge. Then crosscut the strip at 45° to create the spinners, as shown in figure 1 on the facing page. The 45° cuts let the spinners rotate in only one direction and create positive stops when the spinners are closed.

Glue the pieces that were between and on the ends of the spinners back onto the rail, using the spinners as spacers. On the drill press, drill a ¼-in.-dia. hole through the center of each spinner. Then clamp the spinners into position on top of the rail, and drill through the spinners and into the rail about 1 in. Remove the spinners, and glue a ¼-in.-dia. dowel about 2 in. long into the rail. Redrill the spinners' holes about ⅛ in. larger than the dowel, so the spinners will rotate freely on the dowel. After the rails are cut to length and width,

tenoned and sanded, slide the spinners over the dowels, and trim off any excess dowel length. After the table is completed, glue a small block to the underside of the tabletop to stop the spinners at 90° to the rail in the open position.

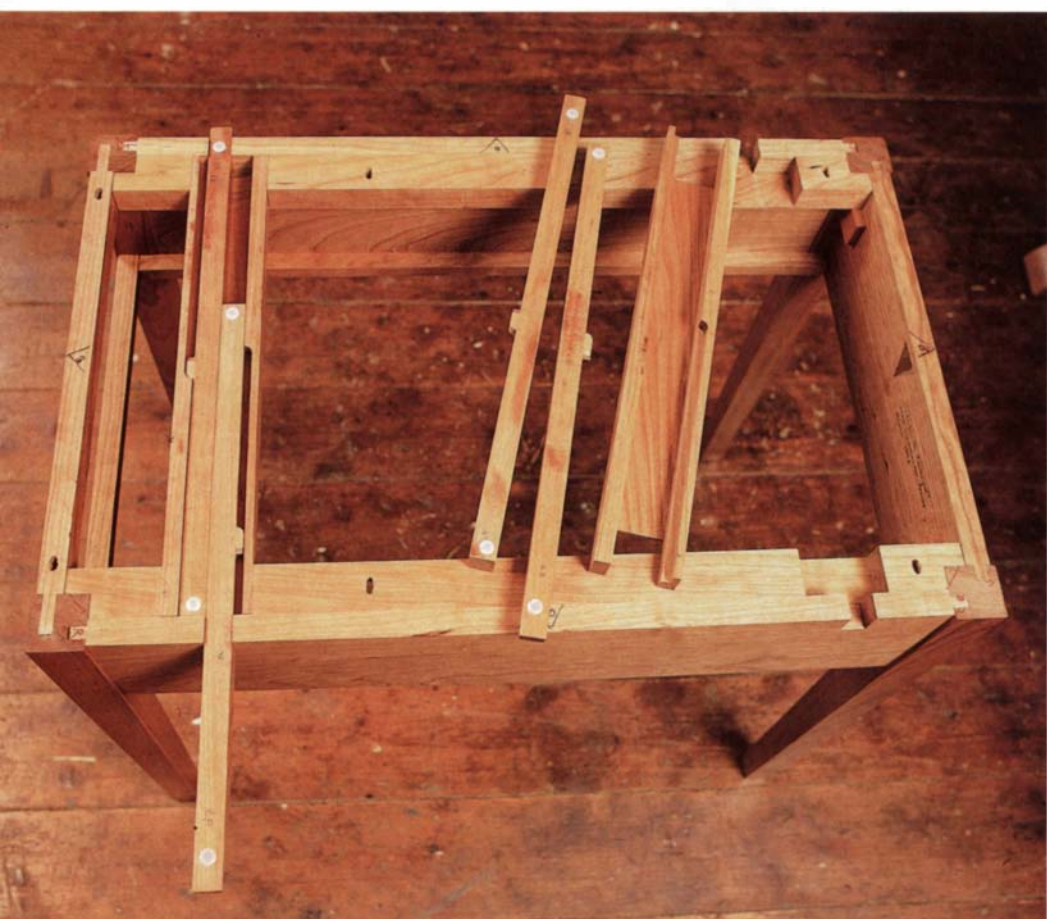
Swing arms—Swing arms are braces attached to a table's rail that pivot 90° to the rail to support leaves. Swing arms are usually built as part of a secondary rail assem-

bly that is applied to the outside face of the table's side rails. Swing arms are fastened to the secondary rail with either finger joints or knuckle joints, as shown in figure 2 on the facing page.

Finger joints are probably more common because they are easier to cut. Their interlocking parts are square-cornered like a box joint instead of rounded as in a knuckle joint. If you use a finger joint, undercut between the fingers, and round off the in-



A sliding drop-leaf support is a neat, clean installation. It provides firm support that won't sag with use. The $\frac{3}{8}$ -in.-long finger pull at the support's end is all that protrudes when fully retracted.



Housings protect the sliding supports from damage or interference by the drawer's contents. The housings drop into mortises in the drawer kickers. Nylon bumpers make for smooth sliding action.

side corner of each finger for clearance. After cutting the joint, slide the pieces together, and drill a hole for a pivot pin. The end of the support can be shaped as desired, but traditionally, it has an ogee shape.

Swing legs—A variation of the swing arm is the swing leg. As with the swing arm, one end of the support arm is joined to a secondary rail by finger joints or knuckle joints. However, the arm portion of the support is usually longer, and rather than being free, the opposite end of the arm is tenoned into its own leg. A variety of leg configurations is possible with swing legs, as shown in figure 3 on p. 76. Because of their direct contact to the floor, swing legs can handle heavier leaves than swing arms.

Gate legs—A permutation of the swing leg is the gate leg. If the drop-leaf table has lower stretchers between the legs, then the swinging legs also can include a lower stretcher for a two-point attachment at the top rail and at the bottom stretcher. This gate-like assembly, as shown in figure 4 on p. 76, is a sturdy support that can handle large, heavy leaves without racking. A gate leg can be attached to the primary rail and stretcher or to a secondary rail and stretcher, as was done with the swing leg.

Swing and crane supports—A swing support is a vertical brace, roughly triangular in shape, that pivots between the table's top rail and a lower stretcher to support a leaf. If, instead of a single vertical piece, the support is made of three separate pieces, as shown in figure 7 on p. 77, it is called a crane support.

Like the gate-leg table, swing and crane supports rely on the extra strength of two pivot points for greater strength and stability. The pivot points could be built into the top rail or stretcher, but frequently, they are added to the face. Swing and crane supports are sturdier than apron-mounted swing arms but not as strong as swing legs, which distribute the load directly to the floor. The size of the stretcher will ultimately determine the strength of a swing or crane support.

Slides are less likely to sag

Of all the methods for supporting a drop leaf, my favorite one is the sliding support. It's a neat, clean installation and provides firm support that is less likely to sag than other options.

Sliding supports, as shown in the top photo on this page, are relatively easy to make. In just a couple of hours, I can make

efficient wooden slides that are a real complement to a drop-leaf table. And if you are not a purist or are pressed for time, you can buy pressed metal hardware that accomplishes nearly the same thing (The Woodworkers' Store, 21801 Industrial Blvd., Rogers Minn. 55374; 800-279-4441).

Hidden supports slide smoothly—My approach is to build a U-shaped channel or housing that holds two sliding supports, one for a leaf on each side of the table, as shown in the bottom photo on the facing page. The design easily could be modified for tables with one leaf. The housing fits between the aprons of the table, and each support slides through a slot cut into the apron. Because this table includes a drawer, the housings also pass through the drawer kickers, which are support rails above the drawer that keep it from drooping when opened.

To create mortises in the kickers in this table, I glued 1-in.-thick stock onto $\frac{1}{8}$ -in.-thick strips, leaving two 3-in.-wide gaps in each kicker to hold the support housings (see figure 8 at right). The glued-up construction let me cut all the parts to size on the tablesaw. And this construction eliminated the need for a special process to cut out the mortises. I temporarily clamped the kickers in place at the top of the table's side rails while I fitted the slide housings.

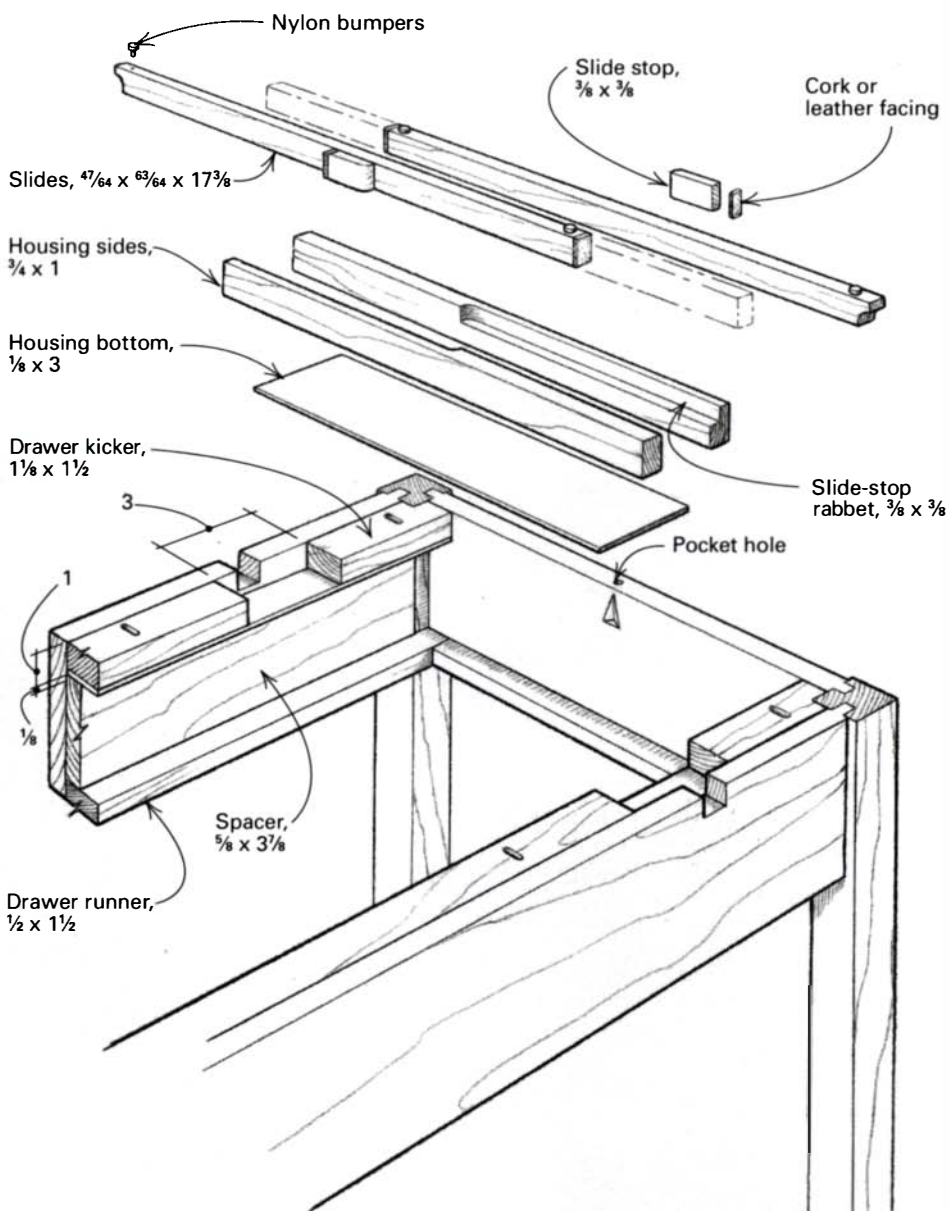
I also made the U-shaped housings by gluing the sides onto $\frac{1}{8}$ -in.-thick bottoms, leaving enough space between the sides for the slides to bypass each other smoothly. I routed rabbets for the slider stops into each of the side pieces (see figure 8). The housing's sides are long enough to span the table's side rails; the housing bottoms are shorter to fit between the kicker bottoms. The housings fit snugly into the gaps left in the kickers.

Tight clearance provides smooth action with no play—The slides have about $\frac{1}{64}$ -in. clearance for a snug fit inside the housings. The maximum length of the slide is determined by the distance between the side rails, plus the thickness of one side rail, plus $\frac{3}{8}$ in. for a finger pull that extends beyond the outside of the rail.

With the supports cut to size, I laid them in position in the housings, with one end extending over the table's side rails, and scribed the intersection on top of the rails with a sharp knife. Then I sawed and chiseled out the slots to allow the supports to extend through the rails. Next I glued stops in the appropriate locations on the sides of each support, and I drilled for and inserted thin, nylon stem bumpers (which

Fig. 8: Sliding drop-leaf supports

Slides that support table leaves fit together in a housing when not in use. Supports should be sized according to the size and weight of the leaves. These are suitable for leaves measuring 10 in. by 32 in.



are available from The Woodworkers' Store) on both ends of the top of the supports. The bumpers make the supports slide much easier.

Finally, I disassembled and finished all the parts and drilled screw holes through the kickers for attaching the tabletop. Then I glued kickers and support housings into place (see the bottom photo on the facing page), positioned the sliders and attached the tabletops with leaves that were already in place. □

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

Sources of supply

The following companies manufacture or supply machined-brass drop-leaf or rule-joint hinges.

Whitechapel, Ltd., PO Box 136, 3650 W. Highway 22, Wilson WY 83014; (800) 468-5534

Garrett Wade Co., Inc., 161 Avenue of the Americas, New York NY 10013; (800) 221-2942

Woodcraft Supply Corporation, 210 Wood County Industrial Park, PO Box 1686, Parkersburg WV 26102-1686; (800) 225-1153

Waterstone Upkeep

For the sharpest tools, keep stones wet and flatten them often

by William Tandy Young



Flat steel starts with flat stones. To get the backs of chisels and plane blades flat, you have to be able to depend on the flatness of your sharpening stones.

I wouldn't want to work wood without sharp tools, and I sure wouldn't sharpen them with anything but waterstones. Waterstones cut more quickly and efficiently than oilstones, and the finish they leave on a tool's edge is more consistent. The feedback they provide is tactile and immediate. I can feel the waterstones abrading the steel as I hone, and I know what kind of edge I can expect from each stone that I have.

I use the commonly available synthetic waterstones, as opposed to the natural wa-

terstones. The synthetic stones, which make up more than 99% of the waterstones sold in this country, are sold under such names as King, Dragon, Deluxe, Bester, Aquastone and Debado. These stones differ in composition and in the processes by which they're made, but generically speaking, they're all combinations of abrasive minerals (such as aluminum oxide or chromium oxide) in a matrix, or binder, of ceramic material.

Natural stones, besides being generally more expensive (sometimes extravagant-



A dedicated sharpening station makes sharpening less of a chore. The convenience of having an area specifically for sharpening will take much of the hassle out of the process. And it doesn't have to be pretty: Scrap materials work just fine.

ly so), also need to be treated differently. Most importantly, perhaps, natural stones should not be stored in water, or they could crack and eventually decompose. So for the purposes of this discussion, I will talk about the synthetic stones that I use and am familiar with.

Waterstones belong in that select group of tools whose actual performance is as good as the claims and fanfare that precede them. If you don't believe that, try talking to a woodworker who's switched from oilstones to waterstones. But waterstones don't work magically; using them effectively requires care and practice.

My first attempts at honing with waterstones were erratic and messy, and I found myself spending more time maintaining the stones than using them. Ultimately, though, I developed a sound technique. Working with waterstones is now a delight; I can sharpen my tools quickly and consistently, which in turn helps make hand-tool use a more fluent and vital practice in my shop. Here's a basic overview of how I have come to integrate the storage and maintenance requirements of synthetic Japanese waterstones into my shop space and routine.

Getting the stones ready

You don't need a huge collection of waterstones; I more than got by for years with just an 800-grit stone, a 1,200-grit stone and a polishing (6,000 or finer) stone. A nice addition would be a supercoarse stone, about 220- to 400-grit, to speed the preparation of new tools. Many woodworkers also use an intermediate stone, something around 3,000-grit.

Before soaking your stones, label their ends with a permanent marker. This tells you which grit is which at a glance and which face of the stone is which (top and bottom). This is important because you'll want to use each face of a stone for a different purpose. The top faces of coarse and intermediate stones are used for sharpening and the bottom faces for truing the next finer stone. The top face of your polishing stone is for sharpening flat blades; the bottom face is for honing tools that tend to wear a stone unevenly, such as carving tools.

Because I use both faces of each stone, I remove any bases that they are mounted on. The easiest way to do this is to hand-saw the bases off with the stone on its long edge and the top face of the stone bearing against a fence. Aim to split the glue line between the stone and the base, but don't actually cut into the stone itself. Once the base is off, you can sand any

traces of glue off the bottom of the stone using coarse sandpaper and a block.

Storage

I prefer keeping stones together standing on end in a 5-gal. plastic bucket rather than in individual food-storage containers or after-market stone ponds (see the bottom photo below). It would be too much fuss opening and closing the food containers every time I needed a stone, and the ponds just don't contain a sufficient volume of water. If you'll be moving the bucket around your shop, you can put a short length of wide PVC or other plastic pipe in the middle of the bucket to keep the stones from banging against each other.

I keep synthetic stones soaking continu-



Keeping slip stones in a separate smaller bin keeps them safe. Otherwise, the big stones in a bucket would stand a good chance of breaking the slip stones.



Salvaged 5-gal. bucket makes a good storage bin for waterstones because it contains plenty of water to keep the stones clean. Place a section of perforated rubber mat at the bottom of the bucket to cushion the stones and to keep them from sitting in a slurry of mud.

ously in a bucket of water, which I change fairly often. The water you use should be potable tap water at the very least. The tap water in my shop is rather nasty, so I use a canister filter on the faucet to remove any large impurities.

Like wood, the porous surfaces of waterstones will distort with wide variations in their moisture content, so it's best to keep them immersed in water. A stone that's flat when wet may cup or twist slightly as it dries. Likewise, a stone that's flat when dry is unlikely to stay flat when soaked.

Polishing stones (stones in the 6,000- to 8,000-grit range) are an exception to the "keep 'em soaking" rule. You can store a polishing stone either wet or dry. (If kept dry, spritz your polishing stone with water before use.) Either method is fine; just pick one and stick with it. If you keep your polishing stone dry, the small amount of water you use to hone will not measurably affect its flatness.

Some woodworkers keep stones of different grits in separate buckets. These woodworkers are concerned that particles from the coarser stones could scratch the finer stones or become embedded in them and then damage the steel they're sharpening. But I don't separate these stones, and I haven't had a problem. By keeping the bucket full of fresh water, changing the water frequently and swabbing the stones off as I pull them out for use, I've been able to keep the stones clean and uncontaminated by coarser grits.

Excess sharpening slurry, or mud, does settle and collect at the bottom of the bucket. To keep the ends of the stones from standing in this mud, I cut out a section of rubber floor mat and lined the bottom of the bucket with it.

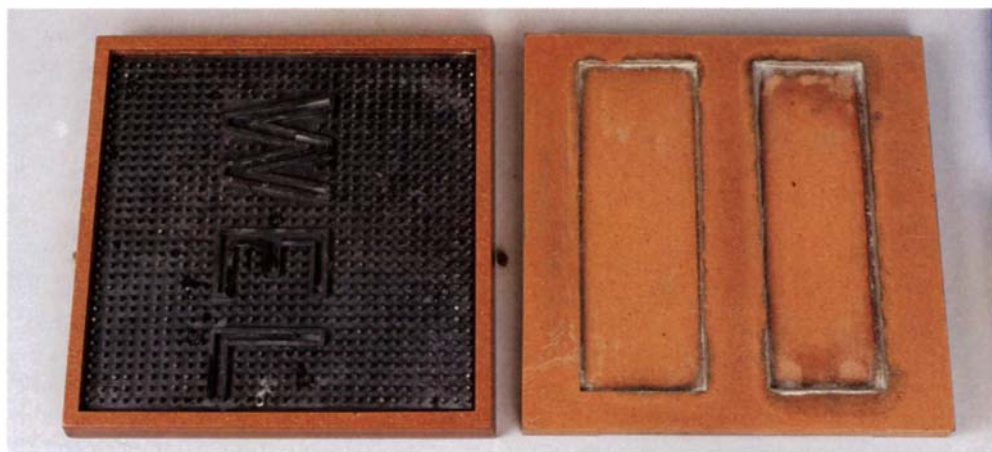
If you use a variety of waterstones from different manufacturers, you may choose to keep different brands soaking in different containers. Until recently, I'd worked mainly with King stones, but lately, I've begun using some of the newer ceramic stones (such as Bester and Aquastone). If kept in the same bucket with King or similar clay stones, the mud from the newer stones will completely envelop the King stones, requiring a good rinse before you can use them. It's also a good idea to keep small stones like slip stones soaking in a separate small tub, so they won't get chipped by the benchstones (see the top photo on this page).

Making a dedicated space for a sharpening station

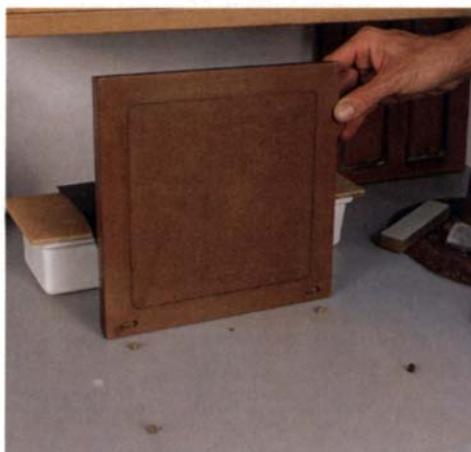
You should carefully consider where you plan to do the actual sharpening. A dedicated sharpening station is not an absolute necessity, but it sure helps. I put a simple table together from flakeboard offcuts and dressed up the top with a partial sheet of discount plastic laminate from the local building-materials supplier (see the photo at right on the facing page). The table is stoutly bracketed and screwed to a stud wall for rigidity.

Items I keep at the sharpening station include a squirt bottle, a sponge, a cotton rag, a covered leather strop block and a little container of camellia oil (available from

STONE-HOLDING SOLUTIONS



Trays keep stones from sliding around when you're sharpening. The old tray, on the right, is still in service and working fine after a dozen years. Water damage is just beginning to occur. The new tray uses a rubber mat to keep the stones from sliding around. The tray is kept in place with indexing pins set into the table.



Tray with a cleat makes a good short-term or job-site sharpening station. The author uses a scrapwood tray with a cleat that can be clamped in a vise.



The Japan Woodworker, 1731 Clement Ave., Alameda, Calif. 94501; 800-537-7820) to wipe blades with after sharpening and drying them. All but the camellia oil were free or cheap, and they all contribute to making sharpening quicker, cleaner or more effective. The camellia oil is a bit pricey, but a little goes a long way.

To hold the stones in place, I made trays out of water-resistant exterior grade, medium-density fiberboard (MDF). The trays hold the stones firmly, and they contain excess water and sharpening mud for easy

cleanup. I used four or five coats of Waterlox to seal the MDF thoroughly; polyurethane would work as well or better. The trays have slotted backs that register on dowel pins set into the tabletop. The two top pins fit into the back slots, and the two side pins restrict the tray's lateral movement. Another scrap of rubber door mat keeps the stones from sliding around in use (see the top and center photos on this page).

If you don't want to take the time to build a dedicated sharpening station, you could

make a tray with a cleat below to clamp in a vise, which is what I use when working on-site (see the bottom photo at left).

Flattening stones and keeping them that way

Initial preparation and maintenance involve essentially the same process: abrading any high spots until the stone is perfectly flat. If integrated into your normal sharpening routine, maintenance can become second nature, an automatic reflex that doesn't slow you down.

Because waterstones wear more quickly than oilstones, they need to be checked and trued frequently. I check my stones each time I use them and will typically retrue them several times during the course of preparing a new plane iron.

To flatten my coarsest stone, I use a $\frac{3}{8}$ -in.-thick sheet of glass, about 4 in. by 10 in., faced on both sides with 80-grit, cloth-backed, industrial wide-belt sandpaper. I went through the scrap bin of a local glass supplier, checking various pieces for flatness with a Starrett straightedge. When I found a good flat piece, I had the glass supplier ease the edges. I applied the paper to the glass with a solvent-based contact cement. Other adhesives like photo mount or water-based contact cements don't hold up in wet use nearly as well as the contact cement.

I use the sandpaper plate to flatten both faces of the coarsest stone in a set (an 800-grit, for example), working slowly and deliberately at my sharpening station (see the top photo on the facing page). I reserve the top face of the coarsest stone for sharpening and use its bottom face for truing both faces of the next finer stone, such as a 1,200-grit. I do this stone-to-stone face-truing right over the bucket, resting the back of my left wrist on my bent left knee to keep one stone stationary while rubbing the other stone around with my right hand (see the center photo on the facing page). To complete the process, I use the bottom of the 1,200-grit to true both faces of my polishing stone.

When the paper on my glass reference plate is worn, usually after a couple of months or more of use, I soak the plate in a bucket of water overnight and peel the paper off in the morning. I clean the contact-cement residue off with lacquer thinner. As soon as the glass is dry, I repaper both sides.

When using the trued bottom face of a coarser stone to flatten the slightly worn top face of a finer stone, the worn stone is usually a bit hollow from tools being sharpened more toward the center of the

stone. You can usually feel the worn stone grab the truing stone a bit as you rub the two together. When both stones slide together smoothly, the finer stone has been re-trued. You can also visually check the surface of most stones as you true them because low spots generally look darker than areas that have just been leveled (see the bottom photo).

Truing a hollowed stone face is a lot easier than flattening a domed, or convex, one. If I have to true a convex face, I do so by rubbing a small coarse stone or bit of coarse, cloth-backed sandpaper on a block over the central area of the stone to take the convex portion down just below flat. Then I flatten the face as usual with the bottom face of a full-size coarser stone.

Sharpening: putting steel to stone

To get the most out of your tools and to spend more time using them than sharpening them, take extra care in their initial preparation. True your stones often as you flatten the back of edge tools so that when you have achieved an even mirror-like shine on the back of a tool, you'll know that it's truly flat, not that you've worn the stone to conform to any inaccuracies on the tool surface.

A typical sequence in honing a previously well-prepared Western tool would be as follows: Check and re-true, if necessary, the top face of a 1,200-grit stone with the bottom face of an 800-grit stone. Then check the face of the polishing stone with the bottom of the 1,200-grit stone. Put the 1,200-grit and polishing stones (top side face up) in a stone holder on the sharpening bench. Raise some mud on the polishing stone by using a nagura stone, which is sold for that purpose. Or you may have already raised some mud as a result of truing the stone with the back of the 1,200-grit stone. Hone the bevel side of the tool on the 1,200-stone, and check that you've raised a burr. Sponge the tool off, and then hone the bevel side on the polishing stone. You should feel a smaller burr. Finally, polish the back of the tool, and then clean up.

The average time for a honing like this is a minute or two. I spend more time getting a blade in and out of a plane body than I do sharpening it. Once the blade is sharp, I wipe it dry, dry it for a couple of seconds with an electric hair dryer and then oil the business end with a bit of camellia oil. The slight film of lubricant prevents the tool from rusting and helps it cruise through whatever you're chopping or paring. Sharpening, after all, is essentially about reducing friction at the tool's edge.

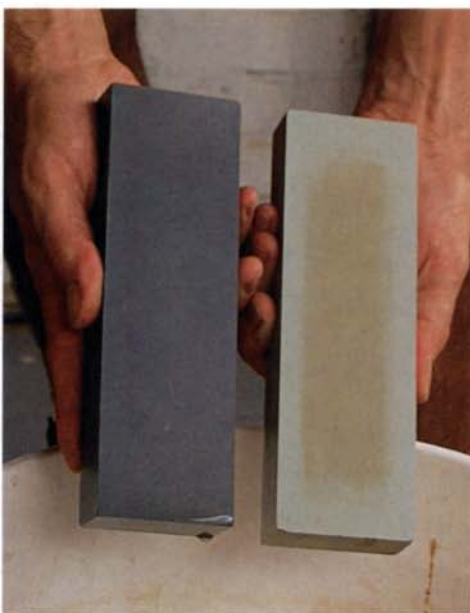


FLATTENING STONES

Glass plate with sandpaper flattens coarsest stone. A slow, steady motion ensures you don't round over the stone you're flattening. Industrial-weight, cloth-backed, 80-grit sandpaper makes quick work of removing any high spots.



Bottom of coarser stone trues both sides of finer stone. To flatten one stone with another, the author holds the finer stone steady in his left hand, resting his arm on his knee, while he moves the coarser stone around on the finer stone until it feels and looks flat.



Low spots show up as dark patches when flattening waterstones. Rubbing two stones together will cause the high areas of the finer stone to look shiny and new. This leaves any hollows or depressions looking dark and worn. When no dark spots remain, the stone is re-trued.

I sharpen tools one at a time, even when I have a batch to do, finishing each tool completely before beginning the next one, rather than sharpening all the tools on one stone and then letting them stay wet before taking the whole batch to the next stone; on a good piece of high-carbon steel, it doesn't take long before rust begins asserting itself, even if you've wiped off the tool with a rag. □

William Tandy Young is a furnituremaker, restorer and writer in Stow, Mass.

Waterstone video



William Tandy Young demonstrates his stone-maintenance routine and a typical honing sequence

in a 20-minute video tape (VHS only). To order, send \$10 to The Taunton Press, Order #011045, P.O. Box 5506, Newtown, Conn. 06470, or call (203) 426-8171.

Furniture Fit for Worship

Woodworkers show inspired work in religious pieces

by Alec Waters

Religion is a powerful catalyst for craftsmanship. The art and furnishings found in synagogues, churches, temples and other houses of worship are some of the finest ever made. Religious woodworking has captured the imagination of furnituremakers, sculptors and architectural woodworkers and inspired their highest skills. And their forms of expression—cabinetmaking, marquetry, carving and turning—have produced exquisite woodworking detail in everything from organs and altars to pulpits and pews.

As the pieces in the photos throughout this article show, crafts-

manship spans religious boundaries and denominations. Some of the pieces may reflect the contemporary architecture of their settings (see the photo on the facing page). Others are steeped in religious history, traditions and scriptures (see the top and bottom left photos below).

Religious pieces are functional art

Archeologists have unearthed thousands of wooden implements and vessels connected to early religious rites and ceremonies. Even in those early examples, there is something more than func-



Photo: Bobby Hanson

Inlays tell biblical stories—This Passover Seder tray (above), made by Lorelei and Alex Gruss of Brooklyn, N.Y., is 18 in. wide and made of purpleheart and ebony. One of the inlaid sides (left) shows Moses in a story from Exodus.



Photo: Bobby Hanson



Photo: David Leveille

Bold lines define the structure of William Keyser's music stand designed for a church choir. The piece is made of ash and laminated rosewood. Keyser, a professor at Rochester Institute of Technology, made the stand adjustable.



Photo: Mark Trade

Wispy carvings add life to a cabinet—Robert Spangler's carvings give depth to the mahogany doors of this synagogue ark in Iowa City, Ia. Alan Weinstein of Seattle, Wash., designed the carving so that it would spill off the door panels, which conceal the Torah.

tion at work. Religion seems to draw out the artist in some woodworkers. Some have devoted their careers to making pieces inspired by religion (see the bottom left photo below). Others have made just an occasional piece (see the bottom right photo), perhaps something in memory of a loved one.

Ecclesiastical furniture serves God and worshippers

Being able to execute spiritual pieces in wood is not easy. Religious woodworking must meet the requirements of clergy, congregation and building space. Liturgical furniture should enhance worship without competing with or diminishing the importance

of the ceremony. So the design and materials used in successful pieces involve the congregation mentally and spiritually in the service. The success of a particular piece also hinges on whether it acts in unison with other pieces in the worship area.

Church planning committees (often a collaboration of religious leaders, members of the congregation and an architectural consultant) usually commission the work. But in the end, it is a maker's creativity and skill—cutting, joining, shaping and finishing the wood—that enable a religious piece to transcend the ordinary. □

Alec Waters is an associate editor for Fine Woodworking.

Spiritual appreciation of material—*Influenced by an altar made by her late father, George, Mira Nakashima-Yarnall chose slabs of figured walnut and butterfly keys for a chapel altar in Lakewood, N.J.*



Photos: Alec Waters



Paying homage to symmetry—*The angular bases of these two oak candle stands (right) mirror each other and echo a central altar and surrounding furniture in a modern church. Reflecting the progression of line to curve, the stands were designed and made by J&J Millwork, an ecclesiastical woodworking firm in Kenosha, Wis.*



Photo: Jerry Albright

Prayer stand emphasizes contrasts—*Judy Linhart of Arizona used colors (cherry, rosewood and onyx) and textures (raised Hebrew letters) to create contrast in this daily-prayer stand (right) for an Orthodox Jew. The top lifts for storage.*

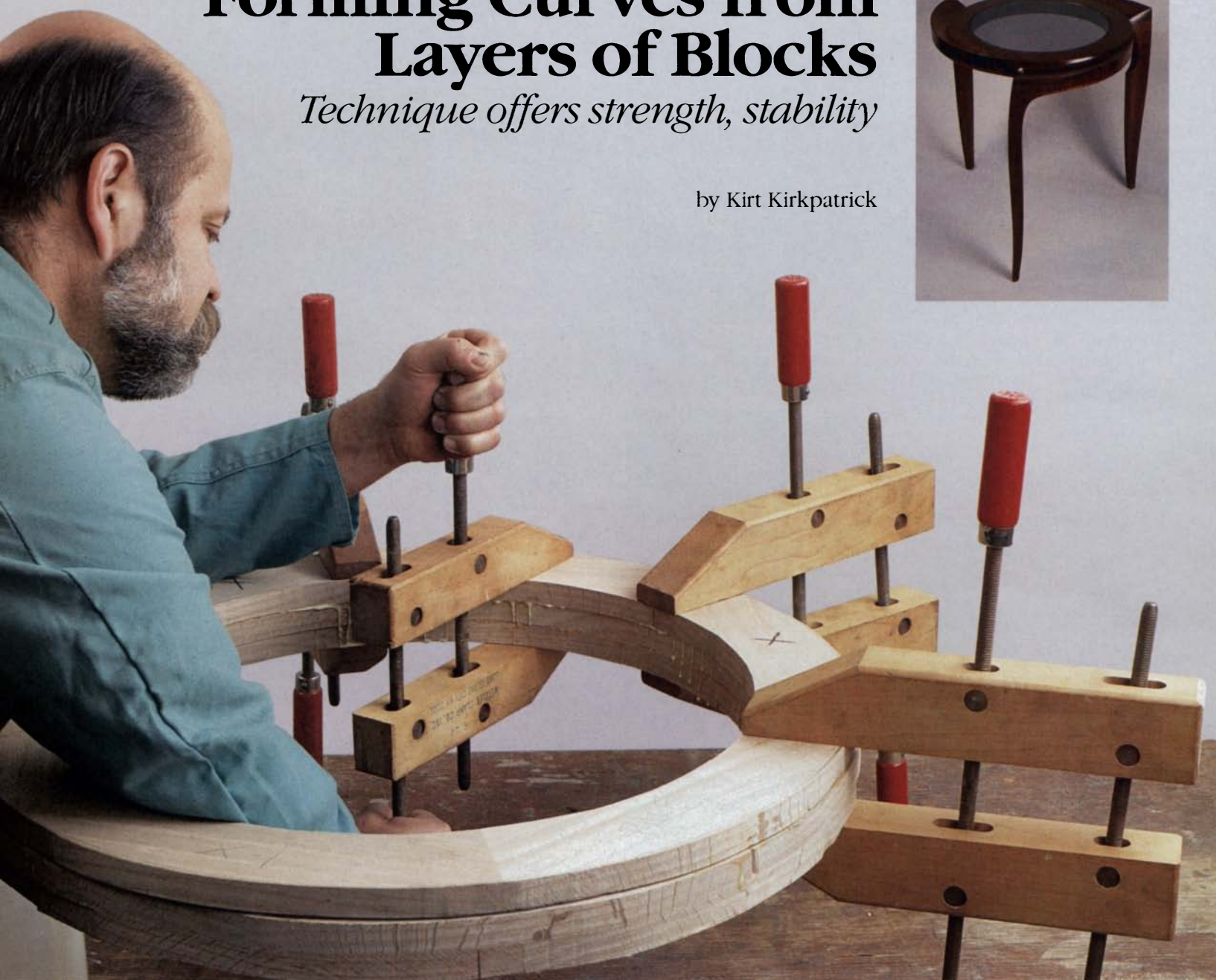


Photo: W. Scott Mitchell

Forming Curves from Layers of Blocks

Technique offers strength, stability

by Kirt Kirkpatrick



Bricklaid curves are built in layers. To build curved furniture parts, glue up blocks of wood in rings or arcs, and then layer them. The technique is strong and versatile, as shown in the circular apron in the glass-topped imbuia table.

Building furniture is a pretty linear process, as long as the parts are straight, the joinery is simple and the framework is rectangular. But many pieces aren't straight at all (see the inset photo above). Tables can have curved aprons and edges. Mirror frames are often oval or circular in shape. Drawer fronts can be serpentine. So what do you do when a piece of furniture throws you a curve?

I've found that segments of wood, glued together like a mortared wall, are just what the doctor ordered to make strong, stable curves. I first used this construction method, known as bricklaying, in 1975 while serving my patternmaker apprenticeship. I rarely make wooden patterns anymore, but I continue to use the bricklaying technique for curved furniture components. The bricklaid form can be a full circle, an arc or any curve. For strength, a curve needs at least two layers of glued-up segments, but three or more is best. A single layer isn't strong enough unless you use some additional joinery, like splines, biscuits or dowels

to bridge the butt joints between individual segments.

Just as with ordinary laminations, I always make the bricklaid form oversize. That way, I can adjust the layout of the finished part onto the glued-up stock. Once the glue sets, I can cut joinery into the form and shape and sand it just like it is a solid piece of wood. In the case of a circular mirror frame (like the one that's described in the story on p. 88), the form is ring-shaped. Bricklaid curves can be more complex, but because the mirror frame is simple, it's a good example of how the technique works. First, though, it's helpful to see why bricklaid segments are so versatile and to understand the importance of making accurate templates.

Why patternmakers use bricklaid segments

Patternmakers glue wooden blocks together like layers of bricks to build the curved areas of wooden patterns, which are full-sized models used to form molds in sand. The sand molds are then used to cast metal (for more on this, see the story on pp. 90-91).



Tempered hardboard is ideal for templates. Use a trammel, a straightedge and a knife to scribe a template for a segment of a circular frame. Then trace the template onto stock.



To get tight butt joints, trim the ends carefully. After bandsawing the segments, the author disc sands their ends just to the knife line (darkened with pencil). He'll sand inner and outer curves later.



Gluing up the segments. To form rings, apply glue to the ends of the segments; then rub the ends together to force out any air from the joints. A polished stone slab, as flat as a patternmaker's surface plate, makes an easy-to-clean assembly table.

Making a circular frame

The teak mirror frame in the photo at right consists of two ring layers, each with six segments. To make the frame, determine its inner and outer diameter. Have the mirror glass in hand so you can make the inner diameter of the frame 1 in. smaller, allowing for a 1/2-in. rabbet in the back of the frame. Next make a segment template (see the main article).



It's hard to tell this mirror frame is made of segments. The reason is that all the joints between segments and between layers are tight.

If you select a big enough board, all the segments will have the same color and characteristics. If not, cut the wood for the most visible layers from the same board.

Using the template, trace out 12 segments onto 3/4-in. stock. Bandsaw and sand the segment ends. Next glue up half-rings of segments, flipping every other one. When dry, true up where the halves will be joined. Flip opposite halves, and glue them into full rings. After the glue has cured, scrape the joints, so you can stack and glue two rings together. Clamp the form, and let it dry.

Trim the frame, and rout the back rabbet for the mirror. Using a roundover, chamfering or molding bit, ease the inner edge of the frame, and add an outside profile. Final-sand, apply a finish and then inset the mirror in the frame. —K.K.

The pattern can be reused to make many molds.

Patterns must be strong and stable. As long as the wood grain in the segments is about the same density and runs the same way (no short grain), movement of the form due to moisture exchanges should be uniform. In bricklaid circular and spherical structures, the grain configuration is especially important because the form must expand and contract concentrically without becoming oval-shaped. After a pattern has been used at the foundry, it is usually retired to a warehouse. It may sit there for years before it's needed again. This is another reason why patterns must be strong and hold their shape over time.

Segments are ideal for bowls and furniture

Bricklaid segments are common in woodturning. Stack-laminated segments can prevent bowls from warping. The grain of the segments can be arranged so that the bowl appears homogeneous. Or different woods can be used to make contrasting segments (for more on this, see *FWW* #64, p. 48). Layers can be built a couple at a time and once the glue has set, turned to make large, deep bowls safely. That way, you don't have to reach way inside the bowl with your tools.

Aside from circular shapes, you can bricklay wood into partial curves, such as arched door and window frames; waves in sculpture; and aprons for oval and semielliptical tables. I used this technique to form the built-up table edge in a large conference table.

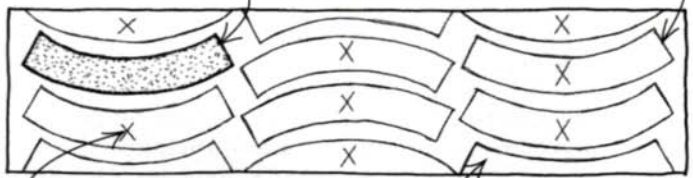
Complex furniture parts can be bricklaid, too. For example, to create flowing lines in a contemporary glass-top table (see the inset photo on p. 87), I bricklaid segments of imbuia that were all cut

Bricklaying a six-segment ring

Step 1

Use hardboard template to lay out and scribe segments on stock.

Segments are $\frac{1}{4}$ in. over-width to allow machining stock later.



Mark X's on top side of each segment.

Glue this piece to the run-off segment above.

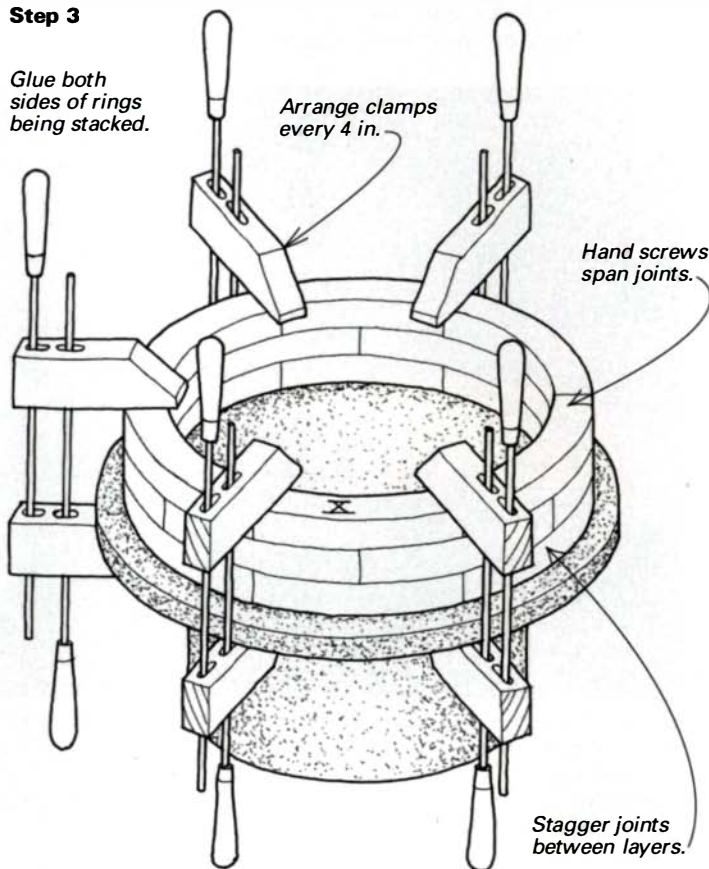
Grain direction runs lengthwise, never across.

Step 3

Glue both sides of rings being stacked.

Arrange clamps every 4 in.

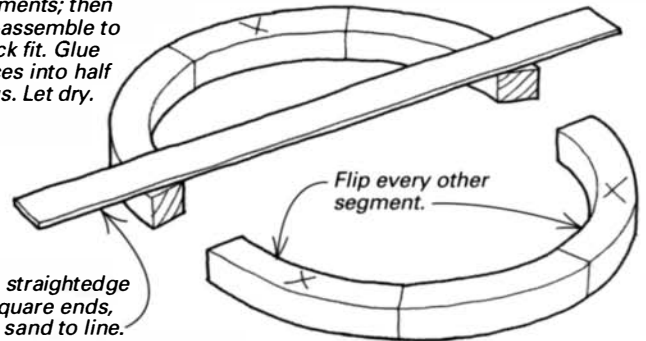
Hand screws span joints.



Stagger joints between layers.

Step 2

Cut out and sand segments; then dry-assemble to check fit. Glue pieces into half rings. Let dry.



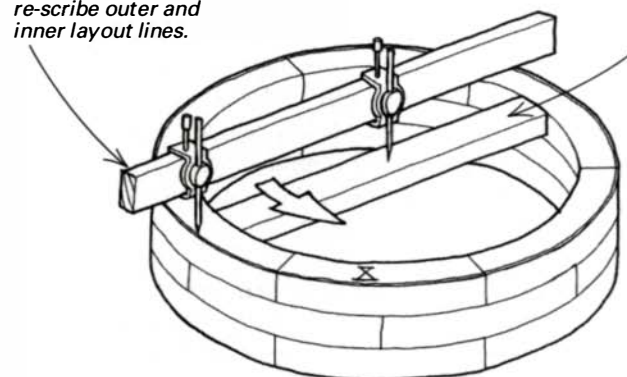
Use straightedge to square ends, and sand to line.

Flip opposite ring halves, and glue up into full rings. Let dry.

Step 4

Use a trammel to re-scribe outer and inner layout lines.

Insert and tack stick to give center point.



Drum sand inner border; then disc or beltsand perimeter.

Detail: Sanding to scribe lines

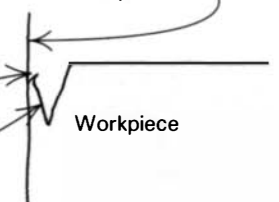
Scribed layout lines are more accurate than pencil lines.

Burr lifts and peels away as you approach bottom of "V."

"V" made by point or knife blade

Disc or beltsand to layout line.

Workpiece



from one board, and then I shaped them with a router jig and hand tools. The offset segments in the bottom layer provide sockets for the three legs—another advantage of the technique.

Strength comes from layers

Bricklaid forms derive their strength from bonded layers. The butt joints between segments are relatively weak because only end grain is being glued. To give those joints integrity, it's critical that the template used to lay out the segments be exact and that the segment ends be cut and sanded precisely to make the joints tight. By contrast, the bonds between adjoining layers of segments are strong because long grain is glued to long grain and because

each segment bridges a joint. This is why the joints in adjacent layers must be staggered (see the drawing above).

Start by making a segment template

I start by making a template for the segments using $\frac{1}{8}$ -in. hardboard like Masonite. For bricklaid forms that are full circles, I use six segments. This process requires only simple tools and basic geometry, which makes layout a breeze. But if you need to make an arc shape or curve with an odd number of segments, you can look up the proper angles and chord lengths from charts often printed at the back of geometry and trigonometry textbooks. For tools, you'll need a scribing knife, a steel straightedge and a trammel, which is

basically a large compass (see the top photo on p. 88). You can buy the trammel at most woodworking-supply stores.

To lay out the template for a six-segment circle, set the trammel $\frac{1}{8}$ in. less than the finished inside radius you want, and scribe about a quarter circle onto your piece of hardboard. Next, using the same center, scribe a quarter circle $\frac{1}{8}$ in. larger than the desired outside radius. Without changing the trammel setting, place one point on one end of the outside arc, and using the other point, drag a small hash mark across the outside arc. Now lay a straightedge from each point back to the center point, and scribe the ends of the segment (see the top photo on p. 88).

If you were to draw a full outside circle, you could use the same radius setting to step off points around the whole circle. You would get six equal divisions and end up at your starting point. Each of the six chords would be the same length as the radius. This is also an easy way to draw a hexagon or, by skipping every other mark, an equilateral triangle.

Bandsaw out the template, and drum sand the inside radius with a sanding drum mounted in a drill press or an oscillating spindle sander. Next take the template to the disc sander. If you don't own a disc sander, clamp your belt sander on its side. Make sure that the platen is perpendicular to your benchtop and that the belt can spin freely. As you sand the template, go easy, especially on the ends where the segments will contact one another.

The beauty of using scribed lines is that when you've sanded just up to the line (the bottom of the "V" made by the knife edge), a tiny burr will form and peel off the end (see the detail in step 4 on p. 89). So that you don't change the angle on the template ends, ease the piece into the disc (or belt) until you see an even burr lifting all along the top edge. Once you've sanded both ends, you'll wind up with a template for a six-segment, one-layer ring. The extra $\frac{1}{8}$ in. on the inside and outside circumference will allow for machining to exact size.

Lay out and cut the segments from stock

Select your stock, and plane all the boards to the same thickness. Trace out all the segments, so the grain runs lengthwise. If your wood is especially precious and you can permit a glue joint in the segments, lay them out close to each other across the width of the board, so they look like stacks of arches. Let the last segment run off the stock. Then glue up the waste from the other side (under the bottom arch) with the incomplete segment to make a full one (see step 1 on p. 89).

Bandsaw out all the segments, leaving a bit of your pencil line. Then go back to the disc sander, and just as with the template, carefully sand the segment ends (see the center photo on p. 88). Your disc sander's table angle could be slightly off, so mark all the segments with an X to identify the top side. You can cancel out any sander error by flipping every other segment when you glue up the ring (the X's let you keep track). Before you glue up, though, check your joinery by dry-assembling the form.

Glue up segments, then layers

If everything checks out, glue up the first layer. It's easiest to form half circles—groups of three segments—and then join the halves. Glue on a dead-flat surface, such as the machined top of your tablesaw (protected by plastic). I use a big polished gravestone as a surface for gluing up. When joining two segments, apply glue to both ends being joined, and rub them together as they lay flat (see the bottom photo on p. 88). Rubbing the joint will press out any air, which would compromise the glue bond. Stop rubbing when the segments come into line. You shouldn't need to clamp the segments, but if a particular joint wants to open up, span it with a

Patternmakers: masters of wooden curves

by Alec Waters

I peeked into the cavernous warehouse and saw what looked like spare parts for the Tin Man. The character in *The Wizard of Oz* came to mind because I was surrounded by hundreds of silver-painted wooden patterns. I was visiting the patternmaking shops in Atchison, Kan., where Kirt Kirkpatrick had learned his trade.

To see the fruits of a patternmaker's labor, look in your own shop. Your jointer tables and tablesaw trunnions probably are cast iron and each required a pattern at one time. The pattern was used to make an impression in sand—the mold for the casting. All the patterns I saw were unrecognizable, though. The more complicated ones looked like jigsaw puzzles.

When you're making impressions for a mold, the pattern has to be exact in size and shape. The casting will faithfully reproduce whatever is molded in the sand. In areas that won't be machined, the clearances can be critical, and the tolerances can be close.



Guiding molten metal at the foundry—Wearing a fire-proof suit, a worker at this Atchison, Kan., foundry guides a ladle as it pours liquid-hot alloy. The flask (frame), containing compacted sand, has an upper (cope) mold and a lower (drag) mold that were formed with wooden patterns.

pinch dog, lightly driving the prongs into the adjoining segments. Only do this if the holes created by the prongs will be buried by another layer or will be in an unseen part of the project, such as the back of a mirror frame. Let things dry.

After you have all the half-circle groups glued together, take a straightedge and draw a line across the ends of the outside segments. This will create a straight surface (like a diameter) where the half circles will be connected (see step 2 on p. 89). Use the disc sander to sand to these lines. Be sure to mark each group with an X, as described previously, and flip one of the halves. Glue the half-circles into full rings.

Once the glue has cured, you can either run the rings through a wide-belt sander, or you can scrape and sand the joints until the tops and bottoms are flat. Then as you glue the rings together, be

For example, the casting for an aircraft part often can't stray more than 0.010 in. to 0.015 in. from the dimensions shown on the blue print. To achieve this, the pattern must be oversized so that when the casting cools, it will be the intended size. Kirkpatrick told me of one pattern that was a few thousands of an inch shy in places. It had to be sprayed with thin coats of lacquer to bring it up to specification.

When a pattern is laid out, the patternmaker has to allow for the contraction of the metal in the mold as it cools off. To compensate for the change in dimensions, shrink rules are used, which have built-in shrinkage factors based on the metal being poured (see the photo at right).

Wood is the logical choice for patterns because it is relatively inexpensive, strong and tools easily. Patternmakers prefer woods that are dimensionally stable and shape consistently. The stock should have grain that is straight and tight. There should be no figure and no defects, such as knots or checks. For these reasons, clear mahogany and sugar pine are commonly used. If a pattern is too big to be made of solid wood, it can be made from bricklaid segments or from beveled, tapered pieces, like staves for a barrel. To sculpt the wood, patternmakers use bandsaws, routers, shapers, grinders and sanders (see the top photo).

Most patterns are made in two parts: the pattern, which describes the outside of the casting, and the core box, which forms the interior (cavity) shape. Core boxes can be complex, so they're made in sections, which can be removed without disrupting the sand. Each side of the pattern is slightly tapered, called draft, to allow the part to be withdrawn. Pieces often interlock or overlap (see the bottom photo), and frequently they are painted to indicate the order of assembly or the relationship to other pieces. Parts often will have appendages for anchoring, gas venting, cooling and pouring.

As soon as the pattern is assembled, it's coated with a release agent, such as non-stick paint or powder. Then a frame that looks like a big sand box is prepared to hold the bed of sand. The sand is mixed with binder additive to make it compact better.

sure to stagger the segment joints from one layer to the next. Apply glue to both surfaces. Repeat stacking and gluing layers until you achieve the form thickness you need. If you are forming an arc, follow the same basic procedure. Finally, clamp the form generously around the circumference (see step 3 on p. 89).

Mark and trim the form to final size

You'll need to make a center point on the same plane as the top of your form, so you can re-scribe the outlines with the trammel. To do this, fit a stick of wood between the opposite inside edges of the laminated form. The stick should look like a diameter. You can secure it with hot glue, auto-body filler or tack it with tiny brads (you'll be trimming off any adhesive residue or nail holes later). Use the trammel to find the center point on the stick, allowing



A disc sander is indispensable in a pattern shop. Using a 42-in. disc sander, Terry Scholz shapes a glued-up block, called a riser. The riser will be used to make a sand impression for a metal reservoir used in the casting process.



Tools only a patternmaker knows—Starrett squares and the Emmert vise are familiar to most woodworkers. But other items on this bench, like the ball-ended fillet irons and shrink rules (center), are best known by patternmakers.



A complex pattern from many pieces. To make a casting for a welding robot, Wilson Bros. Pattern Co. built this mahogany pattern. Each part is scribed on a painted hardboard layout board.

The last stop on my tour was watching a casting being made at one of the biggest foundries west of the Mississippi. As a pickup-truck-sized ladle of molten steel headed toward a sand mold (see the photo on the facing page), I suddenly realized the significance of all the patternmaker's meticulous work. If there were any errors in the pattern that made the sand mold, lots of money, labor and time would be poured down the drain. □

Alec Waters is an associate editor for Fine Woodworking.

enough excess stock all around the form for clean up. Re-scribe the inner and outer circles with the trammel (see step 4). If the form is shallow (say, two or three layers deep), you probably won't need the stick. Just secure the ring over a piece of hardboard marked with a center point, and extend one of the trammel points to re-scribe the boundaries. These should pretty much match the pencil lines you drew when you were tracing the individual segments. Use a drum sander and a disc or belt sander to trim the form to the new lines. If you have a big lathe, you can mount the form to a faceplate, and turn it down to your scribe lines. □

Kirt Kirkpatrick lives in Albuquerque, N.M. Formerly a journeyman patternmaker and boat builder, he now carves and builds furniture and doors.

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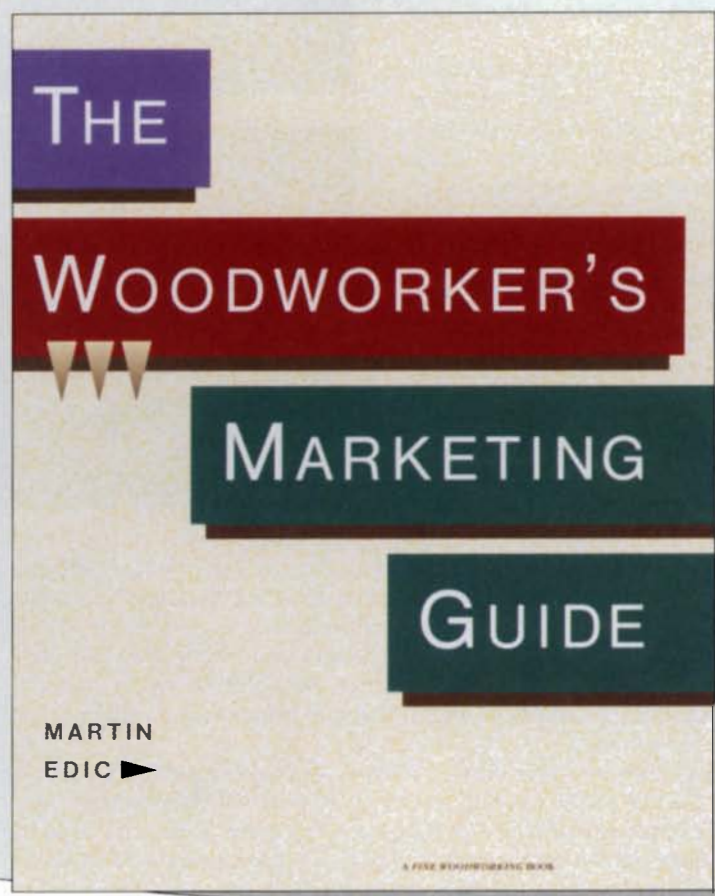
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12"	8-1/8"	04854-5KNA	\$5⁹⁹



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- Blade sold separately

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SPK-035	2	Ryobi AP12 planer	\$30.50
SPK-040	2	Ryobi AH-115 & AH-125	\$60.80
SPK-045	2	Makita 2030N planer	\$42.70
SPK-055*	2	Delta 22-540	\$30.20
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SJK-020	8" Knives for old Delta & Rockwell (3)	\$28.90
SJK-025	8-1/16" Knives for Delta DJ-20 (3)	\$29.60
SJK-030	12" Knives for Powermatic (3)	\$41.90
SJK-035	12-1/2" Knives for RBI 612 & 812 (2)	\$29.90
SJK-040	12-1/2" Knives for Grizzly & other (2)	\$30.90
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SJK-055	15" Knives for Grizzly & other imports (3)	\$52.90
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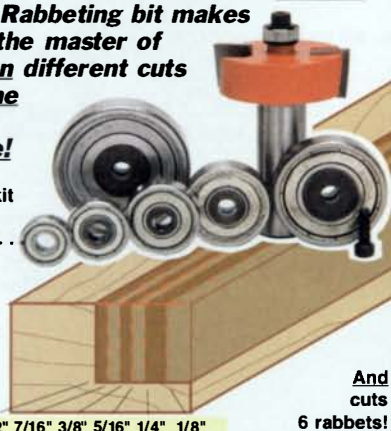


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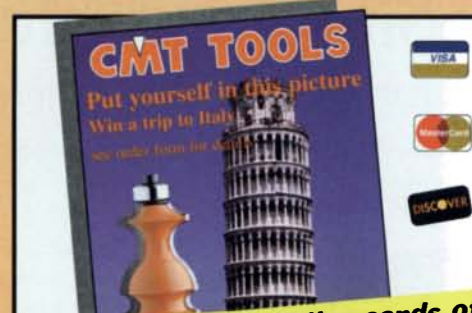


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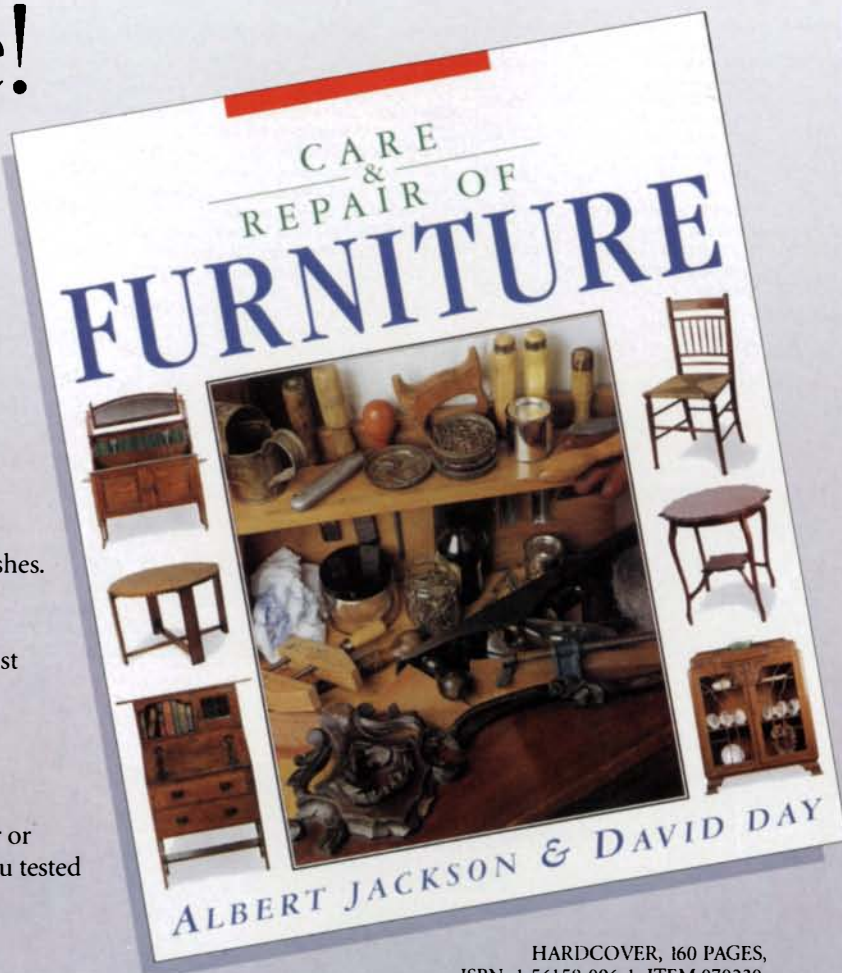
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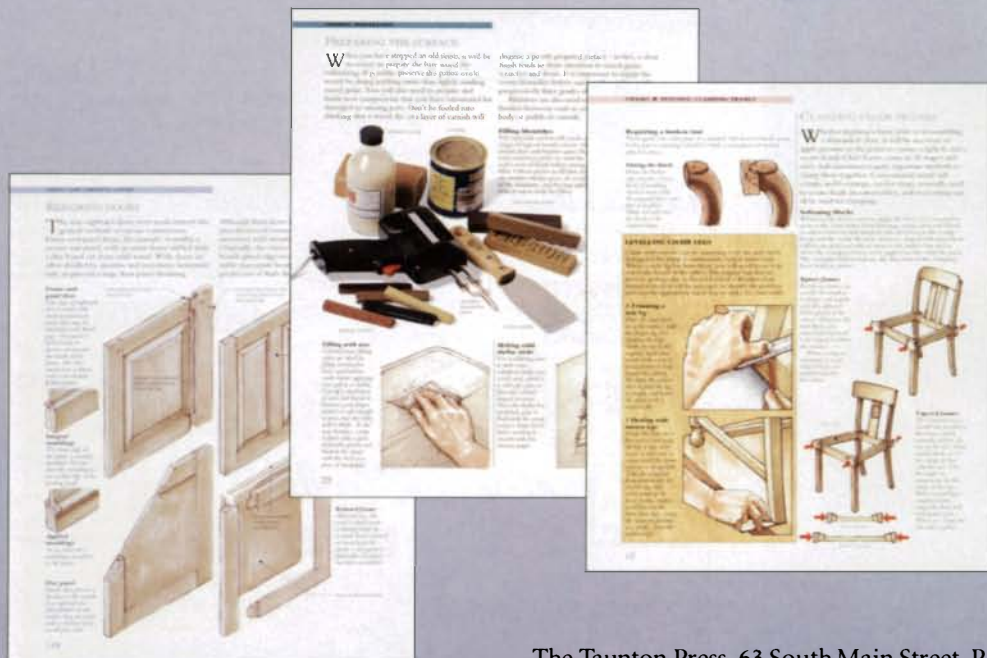
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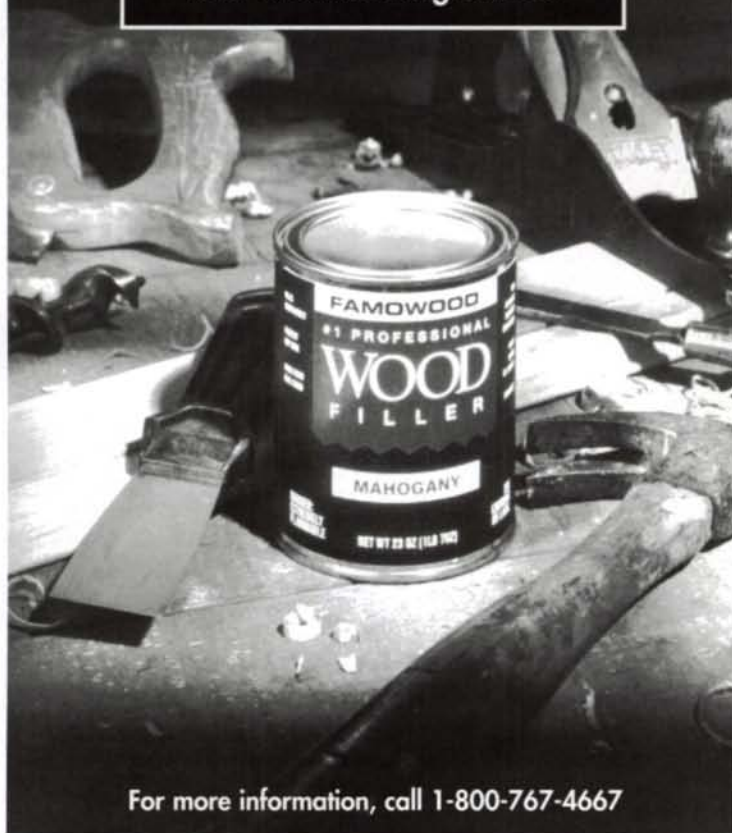
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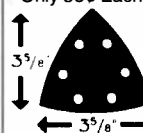
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23-980	10" Bench Grinder 1 HP	255	239
11-950	8" Drill Press	199	135
14-040	14" Drill Press	382	345
28-160	10" Hobby Band Saw	210	135
31-050	1" Belt Sander 2.0 amp	104	75
31-460	4" Belt/6" Disc Sander	198	129
31-430	1" Belt/8" Disc Sander	268	204
31-080	1" Belt/5" Disc Sander	134	89
40-560	16" 2 speed Scroll Saw	266	178
23-580	5" Bench Grinder 1/5 HP	68	52
11-990	12" Bench Drill Press	276	195
11-090	32" Radial Drill Press	399	305
43-505	1/2" Bench Router/Shaper	399	285
36-220	10" Compound Miter Saw	350	229
33-060	"Side Kick" Miter Saw	510	375
14-070	14" Floor Drill Press	450	349
40-640	20" Bench Scroll Saw	466	295
50-075	Dust Collector/Sweeper 3/4 HP	360	254
36-090	10" Sidekick Miter Saw	293	214
37-070	6" var. speed Bench Jointer	337	249
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35-616	Crosscut 10"	12"	60	55
35-617	Combo 10"	15"	50	54
35-619	Slide Cutoff/Rad Arm 10"	6"	60	63
35-624	Super Combo/10"	10"	80	78
35-031	Professional Grade 10"	15"	40	22

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#1	10"	6"	22.63	12.50	68.00
#2	12"	8-1/2"	25.95	14.50	78.00
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Item#	Bar Length	List	Sale	Box of 6
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3712	12"	11.80	6.65	37.25
3718	18"	13.00	7.45	40.50
3724	24"	14.25	7.99	42.50
3730	30"	15.88	8.85	47.75
3736	36"	17.36	9.99	53.95

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Item	Bar Length	List	Sale	Box of 6
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4518	18"	34.97	21.45	116.99
4524	24"	37.02	22.75	123.99

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7236	36"	36.88	21.50	119.00
7248	48"	40.54	23.50	129.00
7272	72"	46.64	28.50	162.50

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7313	3" x 18" Belt Sander	85	69
1605-02	Biscuit Joiner with case	221	129
2735-04	12 V cordless Drill kit with 2 batt.	249	144
2736-04	2735-04 w/keyless chuck	269	145
3810	10" Miter Saw 15 amp	365	229
5825	6-1/2" Worm Drive Saw	257	165
5660	NEW 8-1/4" 60" Circular Saw	238	149
5510	5-1/2" Circular Saw	166	110
77	7-1/4" Worm Drive Saw	257	144
77M	NEW 77 Mag Worm Saw	300	164
5660	NEW 8-1/4" 60" Worm Saw	282	174
5790	10-1/4" Circ. Saw 15 amp	472	318
5657	NEW 7-1/4" Circ Saw - pivot foot	205	118
5525	NEW 6-1/2" Circ Saw - big capacity	173	115
3400	10" Table Saw - Bench Top	270	178

FREUD

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LU82M010	Cut-off 10"	60	93	49
LU84M011	Combo 10"	50	78	42
LU85M010	Super Cut-off 10"	80	115	59
LM72M010	Ripping 10"	24	69	38
LU73M010	Cut off 10"	60	84	45
LU87M010	Thin Kerf 10"	24	72	39
LU88M010	Thin Kerf 10"	60	88	45
LU85M015	Mitre Saw blade 15"	108	175	99
LU91M010	Compound Miter Blade	60	88	54
LU98M010	Ultimate 10"	80	128	68
LU98M010	Non-Ferrous metal 10"	72	104	58
F410	Whisper Blades 10"	40	95	49
F810	Whisper Blades 10"	80	135	74
TK203	7-1/4" Framing - 24 tooth	31	18	
TK206	10" Framing - 24 tooth	39	25	
TK303	7-1/4" Finishing - 40 tooth	38	22	
TK306	10" Finishing - 40 tooth	47	25	
TK903	7-1/4" Combo - 30 tooth	33	19	
TK906	10" Combo - 50 tooth	53	29	
SD306	6" Dado - Carbide	215	112	
SD308	8" Dado - Carbide	230	119	
SD506	6" Super Dado carbide w/ case	292	155	
SD508	8" Super Dado carbide w/ case	344	168	
WC110	10 piece Chisel set w/ case 1/4" - 1-1/2"	143	92	
FB107	7 piece Forstner bit set w/ case 1/4" - 1"	92	54	
FB100	16 piece Forstner bit set w/ case 1/4" - 2-1/8"	338	189	
94-100	5 piece Router bit set w/ case w/ case	320	159	

FREUD POWER TOOLS

Model	Description	List	Sale
EB100	Edge Banding Machine	409	209
EDS132	13V Cordless Drill Kit w/ 2 batteries	415	209
JS102	NEW Biscuit Joiner w/adj. fence & cse	355	179
TR215	8-1/2" Slide Compound Miter Saw	688	369

The following tools have a \$30.00 rebate thru 3/31/95.
Price shown is before rebate.

JS100	Biscuit Joiner with case	334	164
FT2000E	3-1/4 HP Plunge Router var. speed	410	205

HITACHI TOOLS

Model	Description	List	Sale
C8FB	8-1/2" Slide Compound Saw	1400	575
C7BD	7-1/4" Circular Saw with brake	258	105
M12V	3 HP variable speed Router	476	239
TR12	Plunge Router 3 HP	389	188
SB-75	3 x 21 Belt Sander w/ bag - 2 speed	278	155
F1000A12	Planer/6" Jointer	4600	2349
P12R	12-9/32" Planer	1470	789
P12RA	12-9/32" Planer/6-1/8" Jointer	1940	989
C10FC	NEW 10" Miter Saw	432	255
P20SB	3-1/4" Planer 3.4 amp	179	95
FREUD LU91M008	8-1/2" carb. blade 48 tooth	Sale	54
C15FB	15" Miter Saw	1320	675
G12SA	4-1/2" Grinder 6.9 amp	160	89
DS10DVAK	12 volt cdl's Drill Kit w/2 batteries	393	199

Hitachi Air Tools

NR83A	Framing Nailer 2" - 3-1/2" Full Head	700	395
NR83AA	Framing Nailer 2" - 3-1/2" Clip Head	750	419
NT65A	16 ga. Brad Nailer 1" - 2-1/2"	610	335
NV45AB	Coil Roofing Nailer 7/8" - 1-3/4"	750	415
NV83A	Coil Nailer 2" - 3-1/4"	750	419
N5008AA	7/16" Stapler - 16 ga. 1" - 2" lgth	580	325

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 |

WEDGE SMART LEVEL

SM-PR2	2 FT Level with sensor	120	88
SM-PR4	4 FT Level with sensor	150	105
SM-PR6	78" Level with sensor	180	139

AEG POWER TOOLS

HBSE75S	3" x 21" var. speed Belt Sander	309	178
ABSE15S	1/2" cdl's 12V Drill complete w/cse	403	178
FSPE100X	NEW Barbell Grip Jig Saw w/case	274	159
BSPE100X	NEW Top Handle Jig Saw w/case	286	159
TXE150	6" var/spd Rand Orb Sander	304	139
SKS300	10" Compound Miter Saw	1019	559

DREMEL TOOLS

3950	Moto Tool Kit with bits & case	134	79
3952	Super Moto Tool Kit with accessories	152	95
1672	16" Scroll Saw - 2 speed "Best Buy"	302	174
1695	NEW 16" var. speed Scroll Saw	408	229

FEIN

Msx636	Oscillating Triangle Sander	Sale	185
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PONY

LP

DEWALT

Model	Description	List	Sale	Model	Description	List	Sale
DW944K	2-3/8" 9.6V cordless drill kit w/2 batteries	283	165	DW250	4.5 amp Drywall Gun, 0-4000 rpm, rev	169	94
DW945K	2-3/8" 12V cordless drill kit w/2 batteries	309	169	DW254	4.5 amp Drywall Gun, 0-2500 rpm, rev	169	94
DW364	7-1/4" Circ. Saw with brake, 13 amp	285	154	DW280K	NEW Screwdriver kit complete	207	119
DW306K	8.0 amp Recip Saw with case var. speed	291	164	DW318K	Top Handle Jig Saw with case	277	154
DW610	1-1/2 HP 2 handle Router	274	149	DW402	4-1/2" Grinder 6 amp	158	89
DW411	1/4 sheet Palm Sander, 1.7 amp	97	58	DW614	NEW 1-1/4 HP Plunge Router	290	145
DW705	12" Compound Miter Saw	706	359	DW615	1-1/4 HP Electronic Plunge Router	290	158
DW704	12" Miter Saw	570	325	DW624	3 HP Plunge Router	441	245
DW100	3/8" Drill, 4 amp, 0-2500 rpm, rev	118	68				
DW947K	3/8" 13.2 volt cordless Drill Kit	397	219				
DW420	NEW Palmgrip Random Orb Sander	120	69				
DW421	above Sander with dust collector	138	79				
DW930K	NEW 12 volt 5-3/8" Trim Saw kit	370	199				
DW930K	above Sander with dust collector	444	239				
DW444	NEW 6" Random Orbit Sander - PSA pad	266	149				
DW443	NEW DW444 with hook & loop pad	266	149				

SUPER SPECIAL

DW682K Biscuit Joiner with case.....Sale 219

SUPER SPECIAL

DW625 3 HP w/spd Plunge Router.....Sale 269
Includes FREE DW6966 fine depth adjuster.

NEW DEWALT CORDLESS DRILLS

DW952K	3/8" var/spd includes one 9.6V battery	280	159
DW953K	3/8" var/spd includes one 12V battery	306	175
DW962K	2 3/8" var/spd incl. two 9.6V XR batteries	324	179
DW972K	2 3/8" var/spd incl. two 12V XR batteries	352	189
DW991K	3/8" var/spd includes one 14.4V XR battery	370	199

Above drill kits come with charger & steel case

RYOBI

Model	Description	List	Sale	Model	Description	List	Sale
JP-155	6-1/8" Jointer/Planer	700	305	TSS220	8-1/2" Slide Comp. Saw	966	445
TS-254	10" Miter Saw	440	209	TS260	10" Compound Miter Saw	486	239
RE690	3 HP Plunge Router var. speed	500	228	TR300	3/4 HP Trimmer	174	85
R175	NEW 1-3/4 HP Plunge Router	158	95	DS1000	NEW Detail Sander	90	44
RE175	NEW 1-3/4 HP var/spd Plunge Router	210	124	DS2000	NEW Detail Sander - 2 speed	112	64
BE321	3" x 21" var. speed Belt Sander	310	139	DC500	NEW Detail Carver	120	64
SC160	16" Bench Scroll Saw	282	135	RS112	Palm grip Random Orb Sander	90	55
SC162VS	NEW 16" var. speed Scroll Saw	298	169	RS115	4-1/2" w/spd Random Orbit Sander	136	74
TFFD172VRK	9.6 volt cordless Drill Kit w/2 batteries	330	139	AP12	12" Bench Planer	884	395
TFFD222VRK	12 volt cordless Drill Kit w/2 batteries	365	155	JS45	Top Handle Jig Saw variable speed	98	59
TFF100	Flashlight uses 7.2, 9.6, or 12V battery	9.95	129	TDS4000K	12V Drywall Gun kit	420	129
JM100K	Biscuit Joiner with case	475	218	RA202	8-1/4" Bench Radial Arm Saw	800	389
BT3000	10" Table Saw with stand	1125	529	BS900	9" Bench Band Saw	340	169
				IDV28	28 Gal. Industrial Dry Vac.	225	119
				BMM240024	volt Mulching Mower	Sale	349
				W660C	7-1/4" Circ Saw 13 amp	184	79
				ML618	NEW Mini Lathe variable speed	418	225

SUPER SPECIAL

OSS450 NEW Oscillating Spindle Sander.....Sale 159

PANASONIC

Model	Description	List	Sale	Model	Description	List	Sale
EY6205EQK	Same as EY6205BC but comes with NEW Ironman battery	368	192	EY6181CRKW	NEW 9.6V PREDATOR Compact Drill Kit with 2 batteries	305	158
EY6207EQK	12V 1/2" Drill w/keyless chuck var. speed w/ 15 min. charger, case, & Ironman battery	420	229	EY6100CRKW	NEW 12V PREDATOR drill kit with 2 batteries, 1 hr charger, & case	358	185
EY6282EQK	Var. spd 9.6 volt Drill with 15 min. charger, case, and NEW Ironman battery	315	169	EY6100CQKW	Same as EY6100CRKW but has 15 minute charger	420	198
EY62821DKW	9.6 volt Drill kit w/2 batteries	395	162	EY6100EQK	NEW 12V PREDATOR drill kit w/NEW Ironman battery, 15 min. charger, & case	375	199
				EY6100EQKW	Same as EY6100EQK but with 2 Ironman batteries	473	225

Ironman Battery = Battery has 40% more life and 20% more torque!

WERNER LADDERS

Introducing a full range of Werner brand ladders at discounted prices! Werner ladders - A name you can stand on.

FIBERGLASS STEP - TYPE 1- 250# RATING

6004	4'	13'	55.95
6005	5'	16'	66.95
6006	6'	18'	69.95

FIBERGLASS STEP - TYPE 1- 250# RATING

6004-S w/pail shelf	4'	15'	61.95
6005-S w/pail shelf	5'	18'	71.95
6006-S w/pail shelf	6'	20'	76.95

FIBERGLASS STEP - TYPE 1A- 300# RATING

6204	4'	14'	63.95
6205	5'	18'	75.00
6206	6'	20'	86.95

ALUMINUM LADDER JACKS

Must be installed on Type 1 or Type 1A ladders only

Model	Width	Spans	to Rung	Attaches	Sale
10-14-02	14"	2 rung	2 rungs	76.95	
10-20-02	20"	3 rung	2 rungs	83.95	
10-20-03	20"	3 rung	3 rungs	93.95	

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

DAVID WHITE

Model	Description	List	Sale
LP6-20	Sight Level package - 20x	310	195
LP6-20XL	LP6-20 w/9056 tripod & 7620 rod	375	259
L6-20	Meridian Level - 20x	290	188
L78-300	Level Transit - 26x	695	439
L78-300P	above level w/optical plummet	821	518
L76-900	Level Transit - 20x	389	239
LTP6-900	above level with tripod & rod	601	375
ALT6-900	Automatic Level - Transit - 18x	638	395
ALTP6-900	above level w/9066 tripod and 7620 rod	708	469
AL6-18	Automatic level - 18 X	449	315
ALP6-18HD	above level w/tripod and rod	570	375
ALP6-20	NEW Automatic level 20x with tripod & rod	710	429
AL8-25	Automatic Level - 25X	906	645
AL8-22	Automatic Level - 22X	599	399
AL8-26	Automatic Level - 26X	854	569
ALP6-26	above level w/9075 tripod and 7620 rod	977	645
ML100T	NEW Laser Level	1099	945
ML100	NEW Laser Level w/ detector	1249	1075

AIRY AIR NAILERS

Model	Description	List	Sale
0241SK	Brad Nailer 3/8" - 1-9/16"		
	Same as Senco SLP-20	180	98
0250SK	Brad Nailer 3/4" - 2"		
	Same as Senco SLP-20	296	164
0626SK	1/4" Crown Stapler 3/8" - 1"		
EZ-1	New Multi-Purpose Nailer & Stapler	180	99
	Above nailers come with case, fasteners, oil, and wrenches		
0565T	Angle Finish Nailer 1" - 2-1/2"	386	205

Airy nailers use Senco brand fasteners

PORTA NAILERS

Model	Description	List	Sale
401	Porta Nailer complete	265	205
501	Face Nailer complete	265	205
1000	Genuine Porta Nails 1000 Qty		15.89
5000	Genuine Porta Nails 5000 Qty		71.50
10,000	Genuine Porta Nails 10,000 Qty		121.85

Most Tools In This Ad Shipped Federal Express for \$9.00!

SEE NEXT PAGE FOR MORE SPECIALS!

PORTER CABLE

ROUTERS

Model	Description	List	Sale
630	1 HP Router 6.8 amp	200	129
690	1-1/2 HP Router 10 amp	260	138
9690	690 Router w/steel case	305	145
691	1-1/2 HP Router D handle	285	155
695	1-1/2 HP Router/Shaper	400	223
696	Heavy Duty Shaper Table	230	129
100	7/8 HP Router	190	109
5060	"Stair Ease" Stair Template	208	145
5061	"Stair Ease" Hard Wood Template	243	149
5008	Dovetail Template kit	130	85
5009	Mortise & Tenon Jig	75	48
693	1-1/2 HP Plunge Router	320	174
6931	Plunge Router Base	125	77
5116	16" Omni-Jig	470	258
7116	24" Omni-Jig	535	294
7310	5.6 amp Laminate Trimmer	165	95
7312	5.6 amp Offset Base Lam Trimmer	230	128
7319	5.6 amp Tilt Base Lam Trimmer	182	115
97310	Laminate Trimmer Kit complete	360	198
7518	3-1/4 HP 5 speed Router	510	268
7519	3-1/4 HP 2 handle Router	445	239
7536	2-1/2 HP 2 handle Router	365	205
7537	2-1/2 HP "D" handle Router	385	214
7538	3-1/4 HP var. spd Plunge Router	445	239
7539	3-1/4 HP var. spd Plunge Router	510	269

JIG SAWS

7549	Top handle Jig Saw	270	135
7649	Barrel grip Jig Saw	270	149

SANDERS

Model	Description	List	Sale
351	3"x21" Belt Sander without bag	280	154
352	3"x21" Belt Sander with bag	290	155
352VS	3" x 21" Belt Sander var. speed w/case	305	169
360	3"x24" Belt Sander with bag	365	194
361	3"x24" Belt Sander without bag	345	189
362	4"x24" Belt Sander with bag	380	205
363	4"x24" Belt Sander without bag	360	195
503	3"x24" Belt Sander w/bag Worm Drive	352	199
504	3"x24" Belt Sander Worm Drive	565	349
330	1/4 sheet Palm Sander \$10 rebate	110	60
7400	7" Vertical Grinder 12 amp	260	145
7401	7" Polisher 8 amp	270	149
7403	6" Power Paint Remover 8 amp	290	165
7402	7" Vertical Disc Sander 8 amp	260	145
505	1/2 sheet Orbital Pad Sander	230	128

RANDOM ORBIT SANDERS

332	Palmgrip Random Orb Sander	120	69
333	above Sander with dust bag	135	75
334	333 sander with PSA pad	135	74
7334	5" Pad 6000 rpm	225	122
7335	5" Pad var. speed with case	245	132
7336	6" Pad var. speed with case	250	137
73333	Dust Collection Kit	31	24.50

RECIPRO SAWS

9627	Recipro Saw 2 speed 8 amp	244	148
9629	Recipro Saw variable speed 8 amp	270	148
9637	Full var/spd Recipro Saw 8 amp	270	148
9647	TIGER CUB Recipro Saw	210	119

DRILLS

Model	Description	List	Sale
7556	1/2" Right Angle 330/700rpm Drill w/cse	385	224
666	0-1200 rpm 3/8" var. speed Drill 4 amp	230	128
7557	3/8" variable speed angle Drill	295	195
97751	1/2" var. speed Hammer Drill w/case	270	155
2620	3/8" HD var. speed Drill 0-1000 rpm	185	88
6611	New 3/8" Drill 0-1000 rpm 5.5 amp	220	119
6614	New 1/2" Drill 0-750 rpm 5.5 amp	230	128
6615	New 6614 with keyless chuck	230	128
9852	12 volt 3/8" Drill w/cse 0-400/0-1000 rpm	280	154
9853	9852 with keyless chuck	280	154
9853K	9853 Drill Kit with extra battery	Sale	164
9855	12V 1/2" Drill w/cse 0-350/0-1000 rpm	335	188
8500	12 volt battery for above Drills	69	45
9840	9.6 volt cordless Drill Kit with 1 hour charger, 2 batteries, & case	289	164
8400	9.6 volt battery for above Drills	67	49

SAWS

314	4-1/2" Trim Saw 4.5 amp	255	142
9314	above Saw with case	280	155
345	6" Saw Boss 9 amp	190	104
9345	345 comp. w/case & carbide blade	220	124
7700	10" "Lazerloc" Miter saw	634	339
1400	14" abrasive cut-off machine	372	215

PLANERS

9118	Porta Plane w/carbide cutter & case	390	215
9652	Versa-Plane w/carbide cutter & case	479	319

BISCUIT JOINER

Model	Description	List	Sale
550	Pocket cutter with case	330	179
555	Plate Biscuit Joiner with case	320	159
5554	1000 Assorted Biscuits		29
5553	1000 #20 Biscuits		29
5552	1000 #10 Biscuits		29
5551	1000 #0 Biscuits		29

SUPER SPECIAL

556 555 Joiner w/5556 tilt fence.....Sale 165

DRYWALL GUNS

7399	Drywall cutout unit 5.6 amp	140	84
6645	New 0-2500 Drywall Gun 5.2 amp	195	95
96645	New Screwdriver Kit	226	129
1700	Heat gun 750° - 1000°	120	74

NEW TOOLS

NEW TOOLS		
340	NEW 1/4 Sheet Orb Sndr w/dust pickup.....	89 55
511	NEW Cylindrical Lock installation kit	250 149
310	Production Laminate Trimmer	250 145
312	NEW Production Offset Lam. Trimmer	295 169
410	Underscribe Trimmer	266 155
347	NEW 7-1/4" "Framers" Circ. Saw	225 139
447	NEW 7-1/4" "Framers" Circ. Saw w/broke225	124 124
743	NEW 3/4" Saw - left hand version	225 129
9743	NEW 7/43 Saw with case	255 148
9347	NEW 3/4" Saw with case	255 148
843	NEW 4/47 Saw - left hand version	245 139
7800	NEW Drywall Sander	585 329
7810	NEW Vyl/Ox/Vacuum for above sander	255 259

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MAKITA

CORDLESS			
Model	Description	List	Sale
6070DW	3/8" var. speed rev. Drill 7.2 volt.....	128	64
6071DWK	3/8" variable speed rev. Drill with removable battery 7.2 volt.....	216	125
5090DW	3/8" Panel Saw 9.6 volt.....	270	145
6010DWK	3/8" Drill Kit 7.2 volt.....	182	105
4390DW	9.6 volt Recipro. Saw Kit.....	258	148
ML900	Incandescent Flashlight 9.6 volt.....	37	37
6172DWE	7.2V 3/8" var. spd Drill Kit w/2 batt.....	220	109
T220DW	Cordless Stapler Kit 9.6 volt.....	370	198
DA391DW	3/8" angle Drill Kit 9.6 volt.....	312	179
6012HDWE	9.6V 2 speed Drill Kit w/ 2 batteries.....	243	135
6093DW	9.6V var/spd Drill Kit complete.....	283	135
6093DWE	6093DW Drill Kit with 2 batteries.....	270	139
6095DW	6093DW Kit with keyless chuck.....	291	135
6095DWE	6095DW Drill Kit w/2 batteries.....	270	139
6095D	6095DW Drill only and case.....	Special	69
6201DWE	9.6V Drill Kit with 2 batteries.....	155	155
6211DWE	12V "MacPak" Drill Kit w/2 batteries.....	330	165
6011DWE	12 volt Drill Kit w/ 2 batteries.....	330	165
632007-4	9.6 volt Battery.....	47	30
632002-4	7.2 volt Battery.....	39	28

SANDERS			
Model	Description	List	Sale
BO4530	6" Round Sander.....	117	68
BO4550	1/4 sheet Pad Sander w/bag.....	98	52
9900B	3"x21" Belt Sander w/bag 7.8amp.....	344	175
9924DB	3"x24" Belt Sander with bag.....	329	184
9401	4"x24" Belt Sander with bag.....	378	229
GV5000	5" Disc Sander.....	123	79
9207SPC	7" Sander-Polisher 1500-2800 rpm.....	350	189
BO5001	NEW 5" Random Orbit Sander.....	120	69

PLANERS			
Model	Description	List	Sale
2012	12" portable Bench Planer 12amp.....	959	539
N1900B	3-1/4" Planer with case.....	244	129

SAWS			
Model	Description	List	Sale
5007NBA	7-1/4" Circ. Saw w/electric brake.....	263	135
JR3000V	Var. speed Recip. Saw w/case.....	252	135
9820-2	Blade Sharpener.....	394	205
4301BV	Orb var. speed Jig Saw 3.5 amp.....	292	158
2414B	14" Cut-off Saw ACDC.....	403	225
4320	Var. spd economy Jig Saw 2.9 amp.....	156	98
LS1030	10" Mitre Saw.....	428	229
2708W	8-1/4" Table Saw.....	585	298
2711	10" Table Saw with brake.....	1067	585
5077B	7-1/4" Hypoid Saw.....	281	155
5007NB	10" Circular Saw 13 amp.....	232	124
5007NBK	5007NB Saw w/ plastic case.....	Sale	129
LS1211	New 12" Slide Compound Saw.....	1550	865
LS1011	10" Slide Compound Saw.....	509	509

ROUTERS			
Model	Description	List	Sale
3606	2 Handle Router 1 HP.....	180	109
3620A	1-1/4 HP Plunge Router w/case.....	220	135

GRINDERS			
Model	Description	List	Sale
N9514B	4" Grinder 4.6 amp.....	111	65
N9501B	4" Grinder 4.0 amp with case.....	168	99

DRILLS			
Model	Description	List	Sale
6402	3/8" Drill 0-1200 rpm 5.2 amp.....	199	112
6404	3/8" Drill 0-2100 rpm 2.8 amp.....	112	58
6510LVR	3/8" Drill 0-1200 rpm 3.5 amp.....	168	98
6302	1/2" Drill 0-550 rpm 5.2 amp.....	228	129
6013BR	1/2" Drill 550 rpm 6 amp.....	280	149
DA3000R	3/8" angle Drill 0-1400 rpm.....	314	179
HP2010N	1/2" v/spd Hammer Drill w/cse.....	335	199

DRYWALL GUNS			
Model	Description	List	Sale
6820V	0-4000 rpm 5.2 amp.....	171	99
6802BV	0-2500 rpm Screwdriver 4.8 amp.....	223	145

BOSCH

ROUTERS			
Model	Description	List	Sale
1608	5.6 amp Laminate Trimmer.....	168	95
1608LX	same as above w/trimmer guide.....	191	110
1608T	5.6 amp tilt base Trimmer.....	191	104
1609	5.6 amp offset Base Trimmer.....	239	139
1609K	Laminate Installers Kit w/1609.....	343	184
1608U	Underscribe Laminate Trimmer.....	227	145
1609KX	Same as 1609K&Underscribe base.....	405	228
1601A	1 HP Router 25,000 rpm.....	191	119
1604A	1-3/4 HP 2 handle Router.....	250	139
1604AK	same as above w/case & access.....	318	185
1606A	1-3/4 HP D handle Router.....	295	179
1613	1-3/4 HP Plunge Router.....	163	169
1613EVS	2 HP v/spd Plunge Router.....	359	194
1614	1 HP Plunge Router.....	245	149
1614EVS	1-1/4 HP v/spd Plunge Router.....	483	159
1615	3 HP Plunge Router.....	430	245
1615EVS	3 HP var. spd Plunge Router.....	505	278

SUPER SPECIAL			
B1650K	NEW Biscuit Joiner.....	Sale	155

SAWS			
Model	Description	List	Sale
1587VS	NEW Top Handle "CLIC" Jig Saw.....	292	149
1587DVS	above saw with dust collection.....	295	194
1584VS	NEW "CLIC" Barrel Grip Jig Saw.....	285	149
1584DVS	above saw with dust collection.....	295	189
BC	Bosch metal cse for above Jig Saws.....	32	194
BBA	30 of Bosch's best Jig Saw blades.....	28.99	
1632VSRK	Recip Saw 8.4 amp Orb var spd.....	225	154
1655	7-1/4" Circular Saw.....	210	125
B4050	NEW In Line Jig Saw.....	199	115

SUPER SPECIAL			
1584VS or 1587VS	with steel case and 30 Bosch Blades.....	Sale	189

PLANERS			
Model	Description	List	Sale
3272K	3-1/4" Planer with case 4.2 amp.....	187	115
1593	NEW 3-1/4" Planer 6.9 amp.....	304	179

SANDERS			
Model	Description	List	Sale
1272D	3"x24" Belt Sander with bag.....	375	204
1273D	4"x24" Belt Sander with bag.....	380	215
1273DVS	Var. speed 4"x24" Belt Sander.....	415	225
3270DVS	3" x 21" v/spd Belt Sander w/bag.....	270	165
3283DVS	5" Random Orbit Sander.....	169	98
3283DVSX	above sander w/discs and case.....	199	118
1370DESK	6" Random Orbit Sander.....	427	228
1289D	1/4 sheet Sander with bag.....	107	68
B7000	NEW Corner Detail Sander.....	122	68

DRILLS			
Model	Description	List	Sale
1195VSR	3/8" var. speed Hammer Drill.....	229	135
1194VSR	1/2" var. speed Hammer Drill.....	282	149
1194VSRK	Same as above with case.....	313	169
11212VSR	"Bulldog" 3/4" SDS Rotary w/cse.....	390	195
11304	"The Brute" Breaker Hammer.....	2240	1199
11305	Demolition Hammer 10 amp.....	1199	715
3050VSRK	9.6 volt cdc Drill Kit w/2 batteries.....	149	149
3051VSRK	3050VSRK with keyless chuck.....	299	149
3054VSRK	NEW 12V Cordless Drill Kit with 2 batteries.....	330	185
1021VSR	3/8" Drill 4.8 amp 0-1100 rpm.....	203	112
1023VSR	1/2" Drill 4.8 amp.....	227	119
1942	Heat Gun 600° - 900°.....	125	78
11310EVS	Demolition Hammer.....	879	535
11222EVS	NEW 1-1/8" SDS Rotary w/cse.....	849	395
11220EVS	1-1/2" Spline Hammer Drill.....	889	489
11210VSR	3/4" Rotary Drill var speed.....	355	189
1420VSR	Drywall Gun 4.8 amp 0-4000 rpm.....	179	98

GRINDERS			
Model	Description	List	Sale
1347AK	4-1/2" Grinder with case & access.....	185	109
1348AE	5" Grinder 8.5 amp.....	225	129

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Grit	Box/10	Case/50	
120x	16.30	77.40	
100x	16.30	77.40	
80x	16.75	79.50	
60x	17.40	82.65	
40x	17.40	82.65	
36x	18.60	88.35	
	19.25	91.40	

3" X 21"			
Grit	Box/5	Case/25	
120DP	9.30	39.50	
100DP	9.30	39.50	
80DP	9.45	40.00	
60DP	9.60	40.80	
50DP	9.60	40.80	

3" X 24"			
Grit	Box/5	Case/25	
120DP	9.60	40.80	
100DP	9.60	40.80	
80DP	10.20	43.35	
60DP	10.50	44.60	
50DP	10.50	44.60	

4" X 24"			
Grit	Box/5	Case/25	
120x	28.90	137.20	
100x	28.90	137.20	
80x	29.40	139.65	
60x	30.25	143.50	
50x	30.80	146.30	
40x	31.90	151.50	
36x	33.00	156.75	

6" X 48"			
Grit	Box/5	Case/25	
100x	7.25 ea.		
80x	7.25 ea.		
60x	7.70 ea.		
50x	8.00 ea.		
40x	8.40 ea.		
36x	8.75 ea.		

SUPER 77 SPRAY ADHESIVE			
Model	Quantity	Sale	
8500B	Box of 50	11.65	
8500C	Case of 600	98.95	

8560 MASK			
Model	Quantity	Sale	
8560B	Box of 20	16.95	
8560C	Case of 160	119.95	

PRODUCTION SANDPAPER 9" X 11" Sheets			
Grit	Sheets	Sale	
220A	100	22.50	
180A	100	22.50	
150A	100	30.00	
120C	100	30.00	
100C	100	30.00	
80D	50	19.00	
60D	50	21.95	
50D	50	24.00	
40D	50	26.00	
36D	50	28.50	

WET OR DRY SANDPAPER 9" X 11" Sheets			
Grit	Sheets	Sale	
600A	50	22.00	
500A	50	22.00	
400A	50	22.00	
360A	50	22.00	
320A	50	22.00	
280A	50	22.00	
240A	50	22.00	
220A	50	22.00	

GARNET SANDPAPER 9" X 11" Sheets			
Grit	Sheets	Sale	
280A	100	24.00	
240A	100	24.00	
220A	100	23.50	
180A	100	23.50	
150C	100	30.50	
120C	100	30.50	
100C	100	30.50	
80D	50	20.00	
60D	50	21.00	
50D	50	24.00	

MILWAUKEE

RECIP SAWS			
Model	Description	List	Sale
6527	Super Sawzall variable speed 8 amp with case & Quick Loc Cord.....	320	172
6528	6527 with Wired Cord.....	316	172
6507	"The Original" Sawzall with case.....	264	144
6508	6507 with Wired Cord.....	260	144
6511	2 speed Sawzall with case.....	249	139

CORDLESS			
Model	Description	List	Sale
0406-1	9.6V cordless var./spd. Drill with 2 batteries, charger, and case.....	332	159
0399-1	12V cordless variable speed Drill with battery, charger, & case.....	315	172

SUPER SPECIAL			
0407-1	Same as 0399-1 but with keyless chuck and 2 batteries.....	Sale	172

SAWS			
Model	Description	List	Sale
6539-1	Screwdriver 190 rpm.....	130	75
6540-1	6539-1 with bits & case.....	165	95
6546-1	Screwdriver 200 & 400 rpm.....	141	84

CORDLESS			
Model	Description	List	Sale
6215	16" Chain Saw.....	375	219
6365	7-1/4" Circular Saw.....	218	122
6367	above Saw - double insulated.....	213	128
6366	6365 Saw with fence & blade.....	228	129
6368	6365 Saw w/fence, blade & case.....	249	139

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MAGAZINES
for fellow enthusiasts

Shelf-pin hole boring with a router

I like the uncluttered look of shelf pins rather than metal standards for hanging adjustable shelving. But I don't have a multi-spindle boring machine, so I've spent lots of hours drilling long rows of holes with a hand drill.

I have used various jigs and fixtures to speed the process and to orient the holes precisely, but I still would define the task of drilling a kitchen's worth of shelf-pin holes as "boring." (And I don't mean the verb.)

To make sure I'd have no rocking shelves or loose pins, I had to pay strict attention to how I held the drill as it made



Photo: Craig Wester

Bore shelf-pin holes quickly and accurately with a router. Teamed with a $\frac{5}{8}$ -in. template guide on your plunge router, M.E.G. Products' router template for shelf-pin hole boring will let you bore about as quickly as you can move the router.

each hole, and I had to stop frequently to remove waste from the drill bit. After boring each hole, I waited for the drill to stop turning, so I wouldn't damage the guide bushings in one of the fixtures I used.

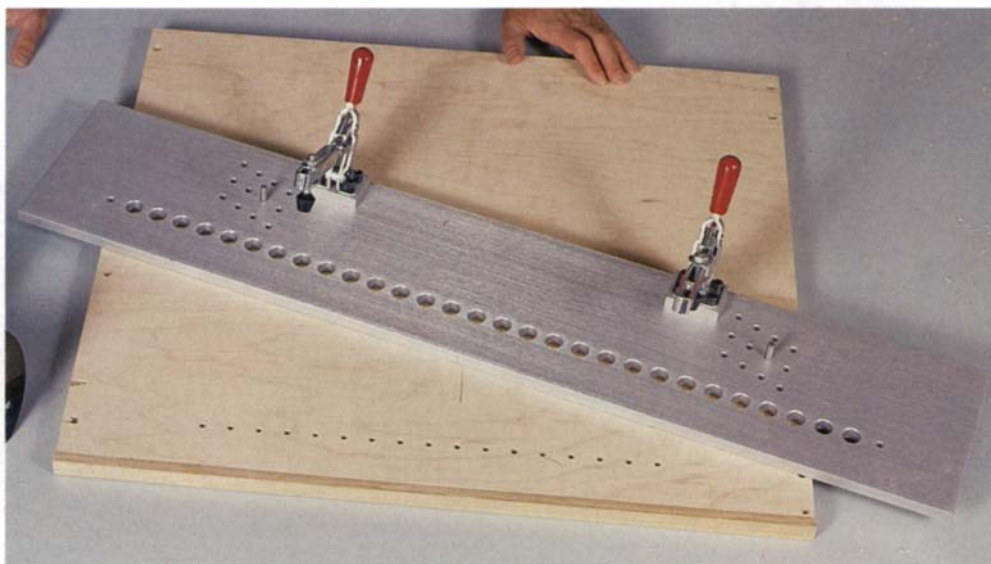
To remedy these technical problems and to reduce the tedium inherent in line boring with a hand tool, Charles DiFranco of M.E.G. Products (9 John Lenhardt Road, Hamilton Square, N.J. 08690; 609-587-7187) designed a hole template to work with a plunge router (see the top left photo). Using a router to produce holes makes a lot of sense because the tool does all the work for you. Gravity helps draw the bit down, the plunge-rod springs return it, and the baseplate and collet ensure precise hole alignment. And unlike a drill bit, the cutter is self-clearing, so there's no need to turn off the tool between holes.

To use this system, chuck a $\frac{1}{4}$ -in. straight bit into your router (or a $\frac{3}{16}$ -in. bit if you want to use 5mm pins), and attach a $\frac{5}{8}$ -in. template guide to the baseplate. Then clamp the machined $\frac{1}{2}$ -in.-thick aluminum template to the stock at the centerline

mark (two toggle clamps are bolted to the underside of the template). You can set the distance from the edge to the line of holes with stop pins that protrude beyond the bottom of the template and rest against the side of the workpiece (see the photo below). The range is from 1 in. to $3\frac{3}{4}$ in. from the edge. Then all you do is plunge away. I found that with just a little practice, I could produce a line of holes almost without looking, going just as fast as I could slide the router and drop the template guide into each guide hole.

The current model of the M.E.G. shelf pin boring guide is set up to create a line of holes on 1-in. centers. The guide, at 36 in. long, is long enough to drill a full row of holes in a standard kitchen base or wall unit. To extend the row, drop a $\frac{1}{4}$ -in. dowel through the index hole into the last hole. The guide sells for \$224 plus shipping. According to DiFranco, a second model will be available soon. This model is set up on 32mm centers with the stop-pin holes bored to accommodate standard European hardware.

—Jim Tolpin



Toggle clamps secure the template to your work, and stop pins establish how far the line of holes is from the edge of the work. The result is precise and predictable work.



Photo: Vincent Laurence

AngleWright miter gauge for 45° and 90°

Most tablesaws come with lame excuses for miter gauges. And if you buy a used saw, half the time there isn't a miter gauge at all. AngleWright Tool Co. has just the thing. The company's precision miter gauge won't address all your tablesaw crosscut needs because it can be positioned only at 90° and 45°. Still, it's very

Precise milling and quality materials make for an accurate gauge. AngleWright's new miter gauge can be set at 45° and 90° only, but that takes care of woodworkers' needs most of the time.

much worth considering. Unless you're making octagonal planters for your deck or building a hot tub, you're probably cutting at those two angles more than 90% of the time anyway. I know I am.

The AngleWright gauge has seven holes in it: a pivot hole, three registration holes and three holes through which the gauge can be locked down to the miter bar with a brass knob. The pivot hole and the three registration holes are lined with bronze bushings, which slide over fixed pins in the miter bar (see the photo at left). The gauge can be set at any one of its three po-

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C1703 — 1/2" Shank

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sitions (90° or 45° to either side) by screwing down a brass lock knob onto a threaded pin that comes out of the miter bar. The gauge is accurate to better than one-fiftieth of a degree.

In addition to having a precisely milled face and precisely drilled registration holes, the AngleWright miter gauge has

three drilled and tapped holes on the side of the miter bar. The holes contain nylon-coated Allen-head setscrews (the nylon keeps them from coming loose or moving, due to vibration) with 3/16-in. Teflon tips. The setscrews allow the bar to be custom-fit to the miter-gauge slot on your tablesaw, eliminating any slop and pre-

serving the gauge's accuracy.

The AngleWright miter gauge sells for \$79.95 and is available through the Woodsmith shop catalog (2200 Grand Ave., Des Moines, Ia. 50312; 800-333-5441) or directly from the AngleWright Tool Co. (P.O. Box 25632, Los Angeles, Calif. 90025; 310-471-7432).
—Vincent Laurence

Router mortising guide is built for keeps



Photo: Vincent Laurence

Fixtures used to make mortises with a router can be pretty simple. They often consist of a face piece (with a cutout in it, for a template guide) on which the router moves, and a piece of hardwood that's screwed to the face piece to fix the side-to-side position of the mortise. The piece of hardwood is clamped to the workpiece to position the mortise in the other plane. These throw-together fixtures often are made from Masonite, medium-density fiberboard (MDF), plywood or whatever happens to be in the shop. And that's as it should be.

But now there's Mr. Mortise (see the photo at left). Ken Picou, a woodworker from Austin, Texas, has come up with a simple, indestructible fixture to replace the scrap-stock face you may be using. His fixture is a 1/2-in.-thick piece of phenolic-resin board faced with melamine—a hunk of plastic that will outlast your grandchildren.

Router-mortising fixture is virtually indestructible. Built to yield uniform mortises for decades, Ken Picou's Mr. Mortise, made of phenolic-resin board, costs slightly more than a good router bit.

The fixture is 5 in. wide by 8 in. long and has a hole in it to accommodate a router-template guide, along with 12 countersunk holes through which you can screw into a hardwood fence.

A 3/4-in. template guide and a 1/2-in. router bit will give you a 1/2-in. by 2-in. mortise. Varying the bit size or clamping stops to the fixture gives you the option of altering the mortise size: a 3/8-in. bit will yield a mortise that's 3/8 in. by 1 7/8 in. The fixture costs \$35 plus \$3.50 shipping.

For those really in a hurry or without access to a fully outfitted shop, Picou also sells tenon stock that's just slightly oversized (to compensate for differences in bits, template guides and regional and seasonal humidity fluctuations) for the two mortise sizes mentioned above. A couple of swipes with a handplane or a few seconds with a belt sander will get the stock to fit your mortise.

The stock costs \$15 for a 5-ft. section. A starter kit (consisting of the fixture and 5 ft. of stock) is \$45 plus \$3.50 shipping. For more information or to buy Mr. Mortise, contact Ken Picou at 5508 Montview St., Austin, Texas 78756; (512) 454-3425. —V.L.



Photo: Alec Walters

Universal edge-to-edge clamp holds oddly shaped parts. This clamp is expensive and requires drilling holes in the back of your workpiece, but it's versatile and well-made.

Universal edge-to-edge clamp solves tricky clamping situations

The Universal edge-to-edge clamp handles a host of special clamping situations better than conventional clamps.

Based on the miter clamp formerly manufactured by the Adjustable Clamp Company, the Universal clamp was designed by W. "Mac" MacNiven Conard, an enterprising carpenter from Vermont. The clamp's design makes it particularly good for clamping miters and end-to-end joints on curved, tapered or straight pieces (see the photo at left).

The clamp uses 1/2-in. threaded rod and a 3/8-in. guide rod, both of which pass through two steel blocks. Turning the handle moves one of the steel blocks along its length while the other block remains stationary. The guide rod keeps the two blocks aligned.

Studs that screw into the blocks fit in counterbored holes in the workpieces. This allows for clamping pressure at or

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Wood Magazine test, Sept., '93, pg. 45.



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bought your dado set!!

David Sharp
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blade would be worth buying. Now
having bought and used one, I have
found all of your outrageous claims to
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Peter Lauritzen - Carpentry
Tesque, NM

P.S. I hope to see these available
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skisaws

"They are right now, Peter."
Jim Forrest

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years of working.

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comparison to any
other blades on the
market and your WW
I & II blades.

Kenneth L. Salisbury
Huntsville, AL

(From Another Customer)

In closing I would like to add that the Woodworker II blade is by far the finest saw blade that I have ever used. I also have the Forrest dado set which is without a doubt, the king of all dado sets. I work exclusively with red oak and oak veneer plywood and the dado set performs splinter-free cuts as advertised.

It is a pleasure to purchase a product that does what it is advertised to do. Thanks for making such a fine product.

Dennis R. Schule, Owatonna, MN

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14" x 30T x 1"	195	139
12" x 40T x 1"	183	129
12" x 30T x 1"	162	119
10" x 40T x 1/8" or 3/32"	156	119
30T 1/8" or 3/32"	136	99
9" x 40T	146	109
30T	125	99
*8-1/4" x 40T 3/32"	136	99
8" x 40T 3/32"	136	99
30T 3/32"	115	89
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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
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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
New 7-1/4" x 60T x 5/8" 3/32" K	150	109

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near the center of the workpieces' thickness, thereby reducing or eliminating any twisting. Custom blocks or studs can be made and attached to the clamp with standard socket-head cap screws, making the clamp even more versatile. And it can be used effectively for edge-gluing or joining cabinet face frames.

The clamp's major weakness is that, in its stock configuration, you have to drill holes into the underside of your workpieces for the ends to get a grip. This is fine when the holes won't show, but it may be unacceptable in some instances.

I showed this clamp to more than a half-dozen woodworkers and carpenters, and they all loved it. Each recounted situations where the Universal clamp would have saved the day. This clamp is, without a doubt, a quality piece of hardware, which is reflected in its steep price. The clamps cost \$85 a pair, and you would probably need at least two pairs to make them worthwhile.

To purchase the Universal edge-to-edge clamp or for more information, contact W. MacNiven Conard at P.O. Box 250, Ver-shire, Vt. 05079; 802-685-4441.

—Mario Rodriguez

Clamp pads prevent marring

To prevent clamps from leaving dimples (or worse) on a project you're clamping up, you need to get something between the steel clamp and wood. You can juggle with pieces of scrap as you're trying to twist a clamp handle and keep everything



Clamp pads prevent marring. For a few dollars, you can cover your clamp faces with Clamp Champs polyethylene pads.

in alignment, or you can stick something to your clamp faces.

I recently tried a product in our shop called Clamp Champs and found that they work well, and they cost next to nothing. Clamp Champs are self-adhering, polyethylene pads that give a bit, so your wood doesn't have to (see the photo at left). You can still over-tighten the clamp and leave a mark or cause the Clamp Champs to shift on the clamp face, but you would have to be torquing down on the clamp like crazy. And that shouldn't be necessary in the first place. The polyethylene material resists glue, so you don't have to worry about leaving part of the pad on your project.

The pads are available from McFeely's (P.O. Box 3, Lynchburg, Va. 24505; 800-443-7937), Woodworker's Supply (1108 N. Glenn Road, Casper, Wyo. 82601; 800-645-9292) and The Woodworkers' Store (21801 Industrial Blvd., Rogers, Minn. 55374-9514; 800-279-4441). Prices are about \$2 to \$2.50 for enough pads for three to six clamps, depending on the size of the clamp faces. In addition to the round pads, small sheets you can cut yourself are available, and a similar product is available for bench vises.

—V.L.

Mohawk Match-All stain and grain system

This color-matching system is a quantum leap forward in custom matching background color and grain color to yield all-but-invisible repairs. The kit includes a deck of wood color cards, each with a window cut in the center (see the photo at right). You lay the color cards on the piece to be matched until you have a close approximation of color.

The cards provide a specific formula for each shade. A device that comes with the kit allows for perfect measurements, drop by drop. The kit comes with 11 bottles of stain color. Each should last a long time. Four colors of graining liquid are included, allowing you to paint in grain lines with a super-fine brush supplied with the kit.

The color cards will get you a reasonably good match in seconds—even with no prior experience at color matching. The actual color mixing is done in a watch-glass type of container, which, when inverted, gives you a good indication of what the color will look like under finish. If you're not satisfied with the results, then wipe off the glass with the brush cleaner, and start over.

It's easy to fine-tune the colors. The kit also will help a great deal in matching toned, factory finishes that are layered on in stages, making them almost impossible to match with a single application. By thin-



Even a beginner can match a finish color. A virtually invisible match can be made by using the deck of color cards that comes with the Mohawk Match-All stain and grain system, following the recipe on the card and tweaking the formula, if needed.

ning colors with the clear base, you can create your own glazing colors of any degree of translucency to match factory-finishing techniques effectively.

This kit offers a quick boost in furniture touch-up skills, and it will help you understand color-mixing faster than any other means I know of. It will increase a beginner's confidence level and make a pro look even more professional, yielding fast, accurate matches right out of the box.

The colors and vehicle are water-based, safe and leave no tell-tale ridge line. The

kit costs \$119. For the name of a dealer near you, contact Mohawk Finishing Products (4715 State Highway 30, Amsterdam, N.Y. 12010-9204; 800-545-0047).

—Robert Judd

Jim Tolpin is a writer and woodworker in Port Townsend, Wash. Vincent Laurence is an associate editor of FWW. Mario Rodriguez is a contributing editor to FWW. Robert Judd is a furniture refinisher in Canton, Mass.

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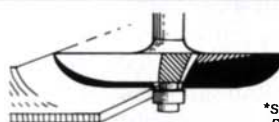
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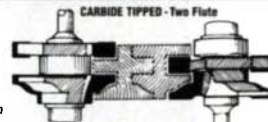
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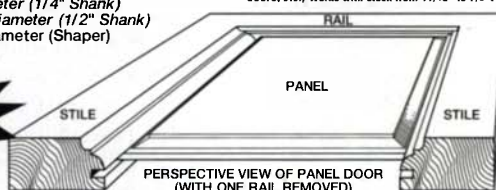
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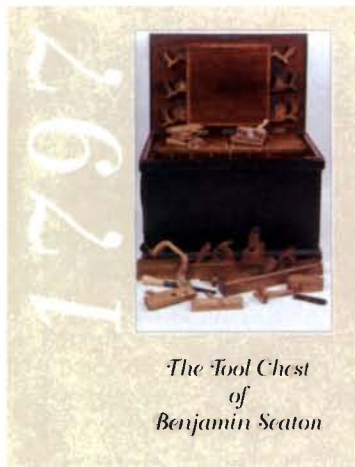


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The Tool Chest of Benjamin Seaton: 1797, Jane and Mark Rees, editors. *The Tools and Trades History Society. Distributed by Astragal Press, P.O. Box 239, Mendam, N.J. 07945; 1994. \$13.50, paperback; 72pp.*



*The Tool Chest
of
Benjamin Seaton*

The remarkable subject of this book, Benjamin Seaton's tool chest, is a main attraction at the 18th-century tools exhibit at Virginia's Williamsburg. This chest is full of tools in almost unused condition.

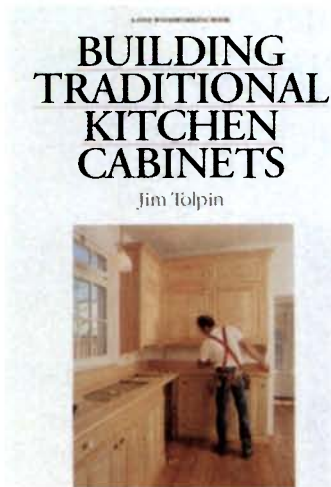
Although small, this book provides a history of the Seaton family, a complete illustrated inventory of the tools and detailed diagrams of the tool chest. The chest, fitted with a "simple but effective" dust seal around the lid, is an ingenious collection of tills, drawers, bins and

wells—all precisely measured to accommodate everything a cabinetmaker needed to earn his living.

The writers provide thorough descriptions of the tools by type and use, describing their manufacture and quality. Many of the tools are still in their original packing. There are numerous bits of credible detective work that reveal a clear and interesting picture of a first-rate 18th-century cabinetmaker's tool chest, as well as solid speculation on the quality and selection of the particular tools in this chest.

—Mario Rodriguez

Building Traditional Kitchen Cabinets by Jim Tolpin. *The Taunton Press, 63 S. Main St., P.O. Box 5506, Newtown, Conn. 06470-5506; 1994. \$19.95, paperback; 208 pp.*



Jim Tolpin

I guess all of us woodworkers, no matter how experienced we are, have wished we could get help from some white-haired old man in bib-front overalls who had been building cabinets all his life. Unfortunately, most of us had to learn woodworking the hard way, by trial and error. Maybe that's why I appreciated Jim Tolpin's book as much as I did.

The book does a great job of filling the role of experienced advisor and, at the same time, being totally up to date on the latest tools, hard-

ware, materials and methods. It is an easy reading, step-by-step tour through the entire process of building a kitchen, from the earliest stages of design and layout to the final door and drawer adjustments. It even helps the adventurous build countertops.

I was especially glad to see so much emphasis on the proper layout of a kitchen. No matter how attractive a set of cabinets might be, the bottom line is how well the kitchen functions. And as in everything else, kitchen layout and function have changed with our modern lifestyles.

Tolpin also realizes that in teaching this trade the old saying that "a picture is worth a thousand words" definitely applies. *Building Traditional Kitchen Cabinets* is full of really good photos and drawings. Tolpin has done a nice job of mixing the

beautiful look of the traditional styles with all the latest methods of construction, which in most cases are faster and stronger than the hammer-and-nail methods of earlier times. And in approaching the topic this way, Tolpin has given the reader a number of options for each phase of the project.

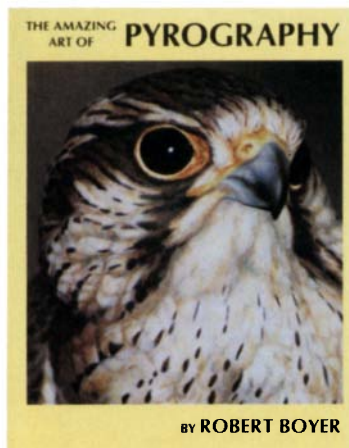
Most professional cabinetmakers have their favorite methods and may be fairly set in their ways. But we are not being smart if we aren't willing to see how others build their cabinets and then make the judgment as to which method works best. I get a lot of my information in this business from hanging around and working with my fellow woodworkers, and that is the feeling I got from reading this book.

I always figure if I find one new method in a book that saves me lots of time, materials and headaches, the book has paid for itself. This book will become reference library material that I probably will turn to many times. As for the novice who's thinking about building his own kitchen, the book is excellent. It is designed for the small shop with minimal tools and space, or even building on site.

I wish that I'd had this book in my meager woodworking library 15 years ago when I undertook my first kitchen.

—Tom Jordan

The Amazing Art of Pyrography by Robert Boyer. *Evanston Publishing, Inc., 1216 Hinman Avenue, Evanston, Ill. 60202, in association with B.E.M.I. Publishing Co., 2650 Davisson St., River Grove, Ill. 60171; 1993. \$49.95, hardback; 422pp.*



BY ROBERT BOYER

What is pyrography, anyway? It's the art of using fire or heat to create designs on wood or other materials, and the heft of this book is a good indication that there's a resurgence of interest in the topic. This handsomely presented book has some glaring faults, but overall, it is the most complete treatment of wood burning that I've seen.

To meet the demand for sophisticated woodburning equipment, manufacturers have developed rheostat-controlled burners that range

from a few dollars to a few hundred. The author owns Leisure Time Products, a River Grove, Ill., company that makes woodburning equipment at the higher end of the price scale. So it probably should be no surprise that he spends far too much time promoting his own products. Grammatical errors and sloppy proofreading also are weaknesses.

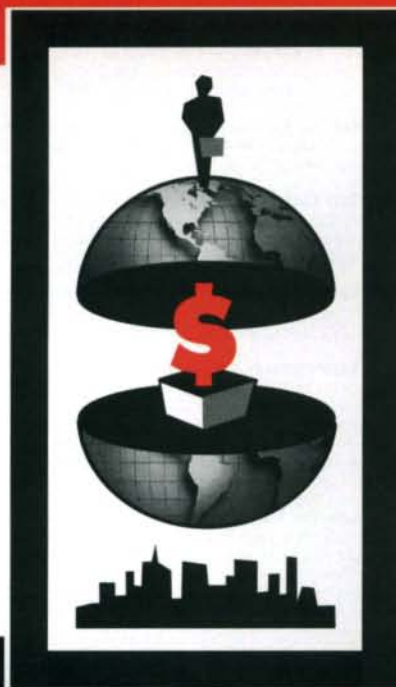
Still, there are some excellent chapters that cover everything you would ever want to know about woodburning, including selection of wood, preparation for burning, creating a realistic-looking bird, marquetry, burning on plastic—even burning on tree fungus.

The volume comes with many color photos and a gallery of pyrographic art at the end. Despite its shortcomings, this is the definitive work on woodburning today. It would be of immense value to anyone who wants to develop or hone these skills.

—Edward A. Beckstrom

Mario Rodriguez is a contributing editor to Fine Woodworking. Tom Jordan makes furniture and cabinetry at Kansas Mesa Woodworks, a shop he owns in Colbran, Colo. Edward A. Beckstrom is an amateur woodworker and carver. He teaches part-time at Auburn University at Montgomery in Alabama.

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Events

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.

ALASKA: Meetings-Alaska Creative Woodworkers Association meets at 7 p.m. on the fourth Monday at the Anchorage Museum. No meeting in June or July. For more info, call (907) 345-3077.

CALIFORNIA: Workshops-Woodworking for women. Furnituremaking with hand tools using traditional joinery, weekends. San Francisco. For more info, contact: Debey Zito (415) 648-6861.

Workshops-Classes on woodfinishing and decorative painting for furniture and cabinets. For schedule, write Studio 1829, 1829 Stanford St., Santa Monica, 90404. (310) 453-0230.

Workshops-Shaker bench, sofa table, Mission lamp table, Adirondack chair, more. Saturdays and Sundays. No experience necessary. Private instruction available. For more information, contact the Woodworkers Place at (818) 952-3177.

Workshop-Woodworking and carving. Martin Pierce Furnishings, 5433 W. Washington Blvd., Los Angeles. For more info, call (213) 939-5929.

Shows-North California Woodworking Show, April 21-23; South California Woodworking Show, April 28-30. Long Beach Convention Center, Hall A, 300 E. Ocean Blvd., Long Beach 90802. Contact The Woodworking Shows, 1516 S. Pontius Ave., Los Angeles, 90025. (310) 477-8521.

Show-The Santa Clara Valley Carvers 28th annual show, April 8-9. Prospect High School, Prospect Road and Lawrence Expressway. For more information, contact Don Guidoux at (415) 948-9869.

Show-California Open-Wildlife Art Show & Carvers Competition, March 18-19. City of Industry. For more information, call or write Thelma Jennings, 12834 Carriage Road, Poway, 92064. (619) 748-6643.

COLORADO: Classes-Woodworking and related classes, year-round. For more info, write Red Rocks Community College, 13300 W. 6th Ave., Lakewood, 80401. (303) 988-6160.

Show-Colorado Woodworking Show, May 12-14. National Western Complex, Expo Hall, Humboldt St., & E. 47th Ave., Denver, 80216. For more information, contact The Woodworking Shows, 1516 S. Pontius Ave., Los Angeles, CA 90025. (310) 477-8521

CONNECTICUT: Exhibition-Masters of Their Craft, featuring Dennis Elliot. March 18-April 23. Silvermine Guild Arts Center, 1037 Silvermine Road, New Canaan. For more information call (203) 966-5617.

Call for entries-Guilford Handcrafts Exposition, July 20-22. Deadline: March 11. For more information, write 38th Annual Guilford Handcrafts Exposition, PO Box 589, Guilford, 06437, or call (203) 453-5947.

Class-Wood Sculpture-Song Bird Carving, with Mary Worilow. March 23-26. The Guilford Handcraft Center, Inc. PO Box 589, 411 Church St., Guilford, 06437. (203) 453-5947.

Classes-Winter schedule available for hands-on wood-working and furniture finishing classes. Call or write Bob Van Dyke at Harris Enterprise Corp. 80 Colonial Road, Manchester, 06040. (203) 649-4663.

FLORIDA: Exhibition-Marriage in Form featuring Kay Sekimachi and Bob Stocksdale, thru March 8. Tampa Museum of Art, Tampa. For more information, call Kenna Moser (415) 329-2605.

Show-Florida Woods, May 12-June 23. For more information contact Dunedin Fine Art Center, 1143 Michigan Blvd., Dunedin, 34698.

Show-Central Florida Woodworking Show, March 3-5. Florida State Fairgrounds. For more information, contact The Woodworking Shows, 1516 S. Pontius Ave., Los Angeles, CA 90025. (310) 477-8521.

Meetings-South Florida Woodworking Guild meets every second Monday, 7 p.m. Constantine, 1040 East Oakland Park Blvd., Ft. Lauderdale. For further information, contact Woody McLane at (305) 565-2729.

Meetings-Central Florida Woodworkers Guild meets the second Thursday of each month at 7:30 p.m. Woodcraft Supply Corp., 246 E. Semoran Blvd., Casselberry. For more information, contact Roger Lovell at (407) 841-6155.

Show-26th annual SFCC spring arts festival, April 1-2. Gainesville. For information, contact the Spring Arts Festival, 3000 N.W. 83rd St., Gainesville, 32606. (904) 395-5355.

Meetings-Palm Beach Country Woodturners, monthly meetings. For more info, call Steve Blank (407) 747-7035.

ILLINOIS: Show-Chicagoland Woodworking Show, April 7-9. Odeum, North Hall, 1033 N. Villa Ave., Villa Park. For more information, contact The Woodworking Shows, 1516 S. Pontius Ave., Los Angeles, CA 90025. (310) 477-8521.

MAINE: Workshops-Two-week basic and intermediate furnituremaking courses. Faculty includes Peter Korn, John McAlevey. For info, contact Center for Furniture Craftsmanship, 125 W. Meadow Road, Rockland, 04841. (207) 594-5611.

MASSACHUSETTS: Show-Massachusetts Woodworking Show, March 31-April 2. Eastern States Exposition. For info, contact The Woodworking Shows, 1516 S. Pontius Ave., Los Angeles, CA 90025. (310) 477-8521.

Classes-Woodworking classes, throughout most of the year. For information, contact Boston Center for Adult Education, 5 Commonwealth Ave., Boston, 02116. (617) 267-4430.

Instruction-Full-time program in fine furniture construction. Complete facilities. For more info, contact Wm. B. Sayre, Inc., One Cottage St., Easthampton, 01027. (413) 527-0202.

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: Call for entries-Wood Concepts 95, Oct. 1-Nov. 9. Deadline: April 21. For entry form and information, contact Columbia Art League, 1013 E. Walnut St., Columbia, 65201. (314) 443-2131.

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

NEW HAMPSHIRE: Classes-Fine arts and studio arts. Manchester Institute of Arts and Sciences, 114 Concord St., Manchester, 03104. (603) 669-2731

Classes-Various woodworking classes. 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 chair-making workshops, year-round. For more info, contact Mary Sweet, Dana Robes, Wood Craftsman, Lower Shaker Village, Enfield, 03748. (603) 632-5385.

Classes-Make a Windsor chair with Michael Dunbar. For info, contact: Michael Dunbar, PO Box 805, Portsmouth, 03802. (603) 431-4676.

NEW JERSEY: Show-Waterloo Arts and Crafts Festival, May 6-7. Waterloo Concert Field, Waterloo Road, Stanhope. Contact: Stella Show Management Co. at (201) 384-0010.

NEW MEXICO: Classes-Woodworking classes. For more information, contact 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-Traditional 18th-century wood-working techniques with Mario Rodriguez. For more info, 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-Woodworking, traditional and contemporary; turning and finishing with Maurice Fraser and Bill Gundling. All levels. The Craft Students League at the YWCA, 610 Lexington Ave., New York City. For more info, call (212) 735-9731.

Classes-Wood inlay, sharpening, routing, woodcarving, veneering, finishing, tablesaw techniques, more. Saturdays. Jan. thru April. For more information, contact Albert Constantine & Son, Inc., Woodworking Classes, 2050 Eastchester Road, Bronx, 10461. (718) 792-1600.

Exhibition-Woodworkers Expo 95, March 25-26. Saratoga Springs City Center, Saratoga. For more info, contact Joe Schanz, Woodworkers Expo 95, Northeastern Woodworkers Association, PO Box 94, Rexford, 12148-0094. (518) 783-8113.

Show-Greater Buffalo Woodworking Show, March 17-19. Erie County Fairgrounds, International Agri-Center, 5820 S. Park Ave., Hamburg, 14075. The Woodworking Shows, 1516 S. Pontius Ave., Los Angeles, CA 90025. (310) 477-8521.

Class-Intermediate Woodworking and Furniture Design, with Dennis Fitzgerald, thru May 9. For more information, contact the Division of Continuing Education, SUNY, 735 Anderson Hill Road, Purchase, 10577-1400. (914) 251-6500.

NORTH CAROLINA: Meetings-North Carolina Woodturners, second Saturday of each month. For more information, contact PO Box 1833, Hickory, 28603. (704) 324-5960.

Show-Charlotte Woodworking Show, March 10-12. Merchandise Mart. Contact The Woodworking Shows, 1516 S. Pontius Ave., Los Angeles, CA 90025. (310) 477-8521.

OHIO: Meetings-Cincinnati Woodworking Club meets from 9:00 a.m. to noon on the second Saturday of Jan., March, May, Sept. and Nov. Reading High School, 801 E. Columbia Ave., Reading. For more information, contact Cincinnati Woodworking Club, 5974 Gaines Road, Cincinnati, 45247.

Classes-Turning and carving, Jan. thru May. Contact: The Hardwood Store, 1695 Dalton Drive, New Carlisle, 45344. (513) 849-9174.

Workshops-Windsor chairs, taught by Joe Graham. For more information, contact Lenox Workshops 1192 Webster Road, Jefferson, 44047. (216) 576-0311.

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 Rendt, Philadelphia Windsor Chair Shop, PO Box 67, Earlville, 19519. (215) 689-4717.

Show-The 19th annual Mid-Atlantic Woodcarving Show, April 1-2. Pennsylvania State Univ., Abington campus gymnasium, Woodland Road, Abington. Contact: (215) 757-2152.

Show-22nd annual Woodcarvers and Wildlife Art Festival, March 18-19. Student Union Building, Millersville University, Millersville. Contact Mark Lenox at (717) 768-3092.

Classes-Bowl turning with David Ellsworth. Three-day weekend workshops in private studio, beginner to intermediate, Jan. thru March. Contact: David Ellsworth, Fox Creek, 1378 Cobble Road, Quakertown, 18951. (215) 536-5298.

Show-Fort Washington Crafts Festival, March 17-19. Fort Washington Expo Center. For more information, contact Sugarloaf Mountain Works, Inc., 200 Orchard Ridge Drive, Suite 215, Gaithersburg, MD 20878. (301) 990-1400.

Show-Harrisburg Woodworking Show, March 24-26. Farm Show Complex. Contact The Woodworking Shows, 1516 S. Pontius Ave., Los Angeles, CA 90025. (310) 477-8521.

Meetings-Black Hills area woodworkers interested in organizing for purposes of sharing information and working toward a show. To be on mailing list, call (605) 343-1878.

Show-Philadelphia Furniture Show, April 21-23. Penn. Convention Center, 12th & Arch St. Philadelphia. (215) 440-0718.

SOUTH DAKOTA: Classes-Various classes and workshops for beginning and experienced woodworkers. Iron Mountain Wood Shop, 4302 S. Highway 79, Rapid City, 57701. (605) 343-1878.

TENNESSEE: Workshops-Woodturning and coopering, thru March. Arrowmont School of Arts and Crafts, PO Box 567, 556 Parkway, Gatlinburg, 37738-0567. (615) 436-4101.

TEXAS: Meetings-North Texas Woodworker's Association meets the third Tuesday of each month. Contact Bruce May, North Texas Woodworker's Association, PO Box 831567, Richardson, 75083. (214) 271-0125.

Classes-Woodworking classes year-round. Bowl turning basics to advanced furniture and cabinetry. For info, write to Woodshop, Inc. Woodworking School, 1225 West College, Suite 612, Carrollton, 75006, or call (214) 466-3689.

Meetings-Woodturners of North Texas meets the last Thursday of every month, 7:30-10 p.m. For more information, contact the Paxton Beautiful Woods Store, 1601 W. Berry St., Fort Worth, 76110. (817) 927-0611.

Classes-Carving classes every Thursday, 6:00-9:00 p.m. Classes are taught by Don Schol. For more information, contact the Paxton Beautiful Woods Store, 1105 Sixth St., Carrollton, 75006. (214) 245-1192.

Exhibition-20th annual Texas Crafts Exhibition, April 1-2. For further information, contact the University of Texas at Austin, Winedale Historical Center, PO Box 11, Round Top, 78954. (409) 278-3530.

Show-North Texas Woodworking Show, May 12-14. Tarrant Country Convention Center, East Hall, 1111 Houston St., Fort Worth. For more information, contact The Woodworking Shows, 1516 South Pontius Ave., Los Angeles, CA 90025. (310) 477-8521.

Show-Houston Woodworking Show, May 19-21. Astroarena, Hall B, Fannin at the 610 exit, Houston. For more information, contact The Woodworking Shows, 1516 South Pontius Ave., Los Angeles, CA 90025. (310) 477-8521.

VERMONT: Courses-Yesterday Design and Building School. For more information, contact the school at Route 1, Box 97-5, Warren, 05674. (802) 496-5545.

VIRGINIA: Show-Spring in the Valley Arts and Crafts Show, April 21-23. Salem Civic Center, Salem. For more information, contact Kathy Hudson, Fair Director, PO Box 1369, Salem, 24153. (703) 389-6163.

WASHINGTON: Juried show-Kitsap County Woodcarvers Club 9th annual show and sale, March 18th-19th. Westside Improvement Club, Bremerton. For more information, contact Steve Harcharik, 1356 Kitsap Lake Road N.W., Bremerton, 98312. (206) 377-1057.

Workshops-Basic woodworking, plane making and chisel use. Maine guide canoe workshop, canoe restoration, March thru April. Center For Wooden Boats, 1010 Valley St., Seattle, 98109. (206) 382-2628.

CANADA: Workshops-Traditional Windsor chairmaking. Weekly courses. For more info, contact David Goodwin, Village Chairmaker, Sparta, Ont., N0L 2H0. (519) 775-2751.

Association-Canadian Woodturners Association. Markham, Ont. For more information and to receive the quarterly newsletter, call (905) 479-0755.

Meetings-West Island Woodturners Club (Montreal) meets every Tuesday, Sept. thru May. For more information, contact Dennis Brown, 8817 Cure Legault, Lasalle, Que. H8R 2V9. (514) 366-6071.

Show-March 3-5, Ottawa Civic Centre, Lansdowne Park, Ottawa. For more information, contact Cryderman Productions Inc., 136 Thames St., Chatham, Ont. N7L 2Y8. (519) 351-8344.

SCOTLAND: Workshops-Ongoing workshops. For more information, contact the Myreside International School of Antique Furniture Restoration, Myreside Grange, Gifford, East Lothian, EH41 4JA. (062 081) 0680.



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Studley chest now a puzzle

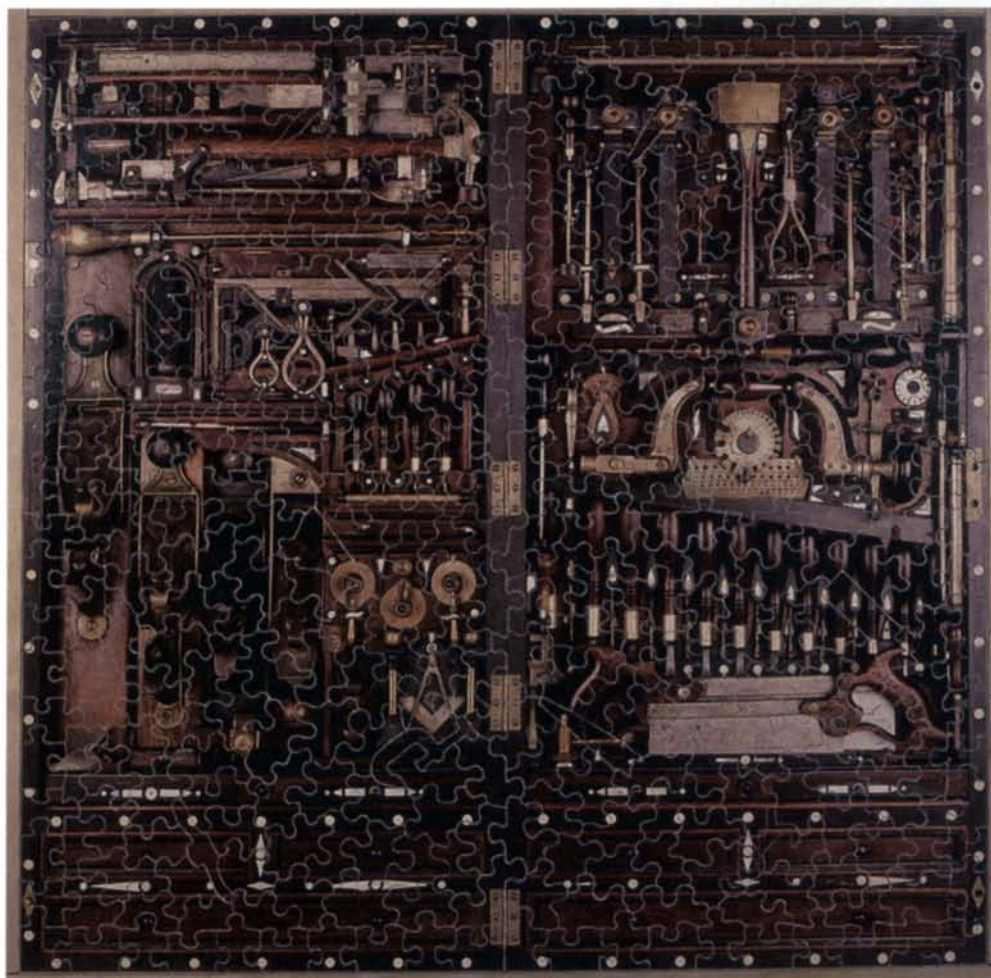
No doubt the most famous tool chest in America is the one fashioned by Henry O. Studley sometime around the turn of the century (see *FWW* #100, pp. 52-55). Now on display at the Smithsonian Institution in Washington, D.C., the chest is a marvel of ingenuity. The tool chest made the back cover of *FWW* in 1988 and went on to become a hugely popular poster. Now the tool chest has been made into a jigsaw puzzle (see the top photo below).

Evan J. Kern, a retired Kutztown (Pennsylvania) University dean who makes and sells puzzles these days, took a 16½-in. by 16⅞-in. poster of the tool chest and glued it to ¼-in. plywood. Then he chopped it

into 453 pieces. A dozen of the pieces are recognizable tools, but the rest are the same kind of interlocking pieces you'd find on any jigsaw puzzle. Kern cut out the puzzle freehand on an 18-in. scroll saw in about four hours. To house the puzzle pieces, Kern constructed a mahogany, ebony, holly and birch plywood case (see the bottom photo).

Don't look for the puzzle in any stores. Kern made just three, intending to keep one and sell the other two. He's had good response, but Kern still owns the puzzles. He thinks the \$450 price tag has been scaring potential buyers away.

—Scott Gibson, editor



First a poster, now a puzzle. Pennsylvania puzzle maker Evan Kern has reduced H.O. Studley's famous tool chest to 453 interlocking pieces of ¼-in. plywood. Putting them together might take you as long as it did Studley to stow his 300 tools after a day's work.

No cardboard for this box. A custom puzzle deserves a custom box. Evan Kern made this one from mahogany, holly, ebony and birch plywood.



A gift for Duluth



A bell tower for Duluth. A Japanese temple bell that was rediscovered in Duluth, Minn., in the 1950s eventually led to a once-in-a-lifetime commission for two local woodworkers.

During World War II, the small Japanese town of Ohara donated its 300-year-old cast bronze bell to the war effort. The bell, taken from a Buddhist temple, was to be melted down for soft metal munitions. It was a great sacrifice for Ohara because the bell had been made by a famous artist. What would this half-century-old tale have to do with a couple of furnituremakers in Minnesota? Plenty, as it turned out.

For whatever reason, the bell was never melted. After the war, sailors on the U.S.S. Duluth found the bell in a scrap yard, and they took it back to the United States. The sailors gave it to the city of Duluth, Minn., and it was displayed as a war trophy in City Hall. In the early 1950s, the dean of horticulture at Chiba University in Japan was visiting Duluth. He saw the bell and recognized it for what it was. He knew where it belonged. One thing led to another, and the bell was returned to Ohara in 1954.

All of this history was soon forgotten by most people in Duluth, but Ohara never forgot the gesture. After all, Duluth didn't have to return the bell.

In 1990, Ohara asked Duluth to become its sister city, and in 1991, Ohara commissioned the casting of another bell. This bell, along with the money to build a tower to house it, was given to Duluth. That's where I came in. Jeff Kern, a furnituremaker and carpenter, and I got the job of building the new tower.

We started working on the project in 1993 and finished it late the following spring. The tower (see the top photo on this page) is made of recycled, old-growth cypress from Louisiana. The wood is massive, dense and heavy (the legs of the tower are 10-ft.-long pieces of 10x10 material).

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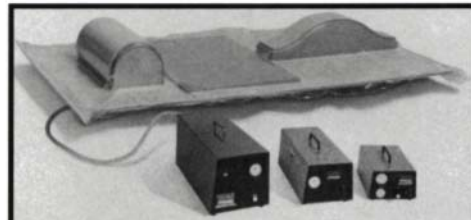


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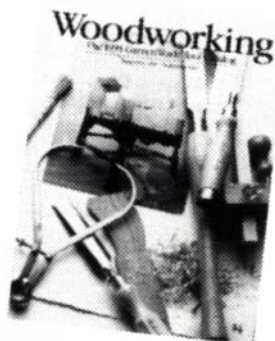
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and a joy to work. We used traditional Japanese joinery throughout and Japanese hand tools for most of the work. The tower was built indoors over the winter, and then it was taken apart to be reassembled on the site.

Much of the joinery in the tower is complicated (see the photo below), and the project was a giant stretch for us. We progressed from feeling overwhelmed by the task at hand to being proud of the finished product.

We also progressed from the independence and stubbornness born of many years of self employment to a true partnership and friendship. Once in a lifetime, every craftsperson should be blessed with a project this much fun.

—Grey Doffin, Duluth, Minn.



When carpentry is cabinetry. Some of the traditional Japanese joinery in the cypress bell tower by Grey Doffin and Jeff Kern looks as if it's been borrowed from furnituremaking.

Stanley planes in cyberspace

I'm far more comfortable with a hand-plane than with a computer, but all things seem to be converging in the electronic age. *Fine Woodworking's* publisher, Jim Chiavelli, last fall showed me a document he'd downloaded from the Woodworkers' Forum Library on CompuServe, which is part of the computer-accessed network now called the "information superhighway." It caused me to reconsider my digital obstnacy.

The document, called "Stanley Blood and Gore," is the author's take on all of Stanley's planes (excluding the Victor, Defiance, Gage and Four Square lines). The author, Patrick Leach, is a software engineer living and working in Massachusetts who's been collecting and using hand-planes for 15 years.

His treatise takes its objective information (lengths, weights and so forth) from Alvin Sellens' book, *The Stanley Plane* (continued on p. 122)

Boxes that fit the owners

It's probably fair to say that I developed my interest in making these whimsical boxes as a child. My father had a home workshop, and I came across a pie-shaped scrap of cherry that I tucked away. The little piece of wood stayed with me for a long time, and in 1985, I made my first box with it. It was called *Cherry Pie*.

I've made many boxes since then. Many of them use food as a theme (see the photos at right). But not all of them (see the bottom photos). Food seems to lend itself well to the surprises I try to build into the boxes. And since I've had a string of successes with this theme, I guess I'll continue to explore it.

Some boxes are commissioned as gifts. If that's the case, I'll find out what I can about the person who is to receive the box. I want to know about his likes and dislikes, his hobbies and anything else that will help me make the box meaningful.

I don't tell the client what my idea is, though, and I won't build to the client's idea (yes, I have a day job). I'm not trying to be autocratic, but some concepts evolve and improve as I work on them. If the client doesn't like the result, he isn't required to purchase the piece. So far, that hasn't happened.

I use a variety of materials in the boxes: silver, mother-of-pearl, abalone, tinted epoxy and dyed veneers, as well as a number of species of solid wood.

It might take me a couple of weeks of evenings and Saturdays to make a box, probably 15 or 20 hours in all, and I make a half-dozen or so a year. Even though I pursue a variety of other woodworking projects, the boxes are really my favorites. They seem to smile up from the bench as I work on them.

—Larry Pillot, Cleveland, Ohio



The Earle of Sandwich—Maple, mahogany, chestnut and acrylic paint.



OOPS—Bird's-eye maple, dyed holly veneer, mother-of-pearl, mahogany and silver.



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(now out of print), but goes far beyond that to provide tips on what to look for when buying a used handplane, what to avoid and which planes are worth having. There's plenty to disagree with, but the document is intended as one woodworker's (and collector's) opinion. It's entertaining, and unless you're intimately familiar with Stanley planes, you'll learn something, too. For information about CompuServe, call (800) 848-8199.

—Vincent Laurence, associate editor

A birthday bash for Rude

Several hundred woodturners gathered at Arrowmont School of Arts and Crafts in Gatlinburg, Tenn., last October to celebrate their craft and honor one of its legendary practitioners. About a dozen lathes were whirling as notable turners, such as David Ellsworth, John Jordan, Bonnie Klein and Del Stubbs, gave workshops on various techniques.

The three-day show also raised money for a scholarship fund and the school's new woodturning shop. But it was really organized to pay tribute to Rude Osolnik (see the photo below) and his late wife, Daphne, who finished most of Rude's early pieces.

Rude is prolific at collecting as well as turning. Among other achievements in a long career, Rude was named a Fellow of the American Crafts Council in 1994. The highlight of the show was a roast featuring Rude's closest friends, like Dale Nish and Ray Key, who shared tales about the turner and his shop in Berea, Ky.

Dick Burrows, the master of ceremonies, and Albert LeCoff, director of the Woodturning Center in Philadelphia, Penn., presented Rude with a giant turned walnut candle that show participants had prepared. The big candle had 80 small, uniquely turned candles, one for each of Rude's continuously productive years. His birthday is in March.

—Alec Waters, associate editor



Rude Osolnik (left) with master of ceremonies Dick Burrows in Gatlinburg, Tenn., last fall.

A raven's tale in African mahogany



Mark King & Friends, a woodworking shop in Whitefish, Mont., based the design of this African mahogany entry door on the cosmology of American Indians of the Northwest (see the photo above left). Mark King and Tom Radziewicz collaborated on the 98-in. by 42-in. *Raven Door*, which uses mother-of-pearl, abalone, malachite, veriscite and rhodochrosite (see the photo above right). Radziewicz, who spent 150 hours on the carving alone, recounted this American Indian story in explaining the door's intricate detailing:

In the beginning of the world, the sun, the moon and the stars were held captive by a greedy chief. The rest of the world was in darkness. A raven, looking for a way to liberate the hostage light, noticed that the chief's daughter frequented a particular stream to collect water. The raven transformed itself into a hemlock needle, floated into the water and was later consumed by the chief's daughter along with a sip of water. She became pregnant and gave birth to the raven, now in the form of a son. The raven grew quickly and was

Myths of the Northwest. The Raven Door gets its detailing from an American Indian story about the origin of light in the world: a cunning raven stole it from a chief who didn't want to share.

The glint of green is veriscite. One of three types of stone used in the door, veriscite makes a fitting eye for the raven.



soon bugging his grandfather, the greedy chief, to see where the sun, moon and stars were stashed.

Once the secret was revealed, the raven resumed its natural form, grabbed the loot and flew off. For the raven's efforts, the world was blessed with light.

Barry Hood of Helena etched the sun into the central window panel, and the moon is carved into the transom over the door. The door is on display at Tom O'Keefe & Co. in Whitefish, the gallery that provided the stone used in the detailing. —S.G.

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.

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It probably won't come as much of a surprise that the man who made this collection of boxes spends most of his time building guitars and lutes. Musicians may know Ervin Somogyi of Berkeley, Calif., as a maker of fine acoustic guitars. He carves the decorations for box lids like these into book-matched panels of spruce or cedar entirely by hand. Then he and assistant Kalia Kliban place the panels into the lids. Depending on the complexity of the design, Somogyi and Kliban might take a couple of weeks to finish a single box.

