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WOODWORKER'S JOURNAL

Vol. 21, No. 2 March/April 1997

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Page 44

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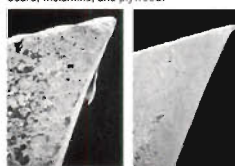
	LIST	SALE
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WOODWORKER'S JOURNAL

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On the cover: Woodworker's Journal executive art director Darlene Luther and friend Alexandria tend to the flowers under their garden arbor.

Cover photograph: StudioAlex

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Reader's Information Exchange



In spite of deadlines and other pressures, we usually manage to have fun putting together an issue of *Woodworker's Journal*. This one, with its emphasis on outdoor projects, proved especially enjoyable. I guess it has to do with the pleasure that we as woodworkers get from seeing our work used and appreciated. Putting projects outdoors for all the world to admire gives us even greater satisfaction. We hope you'll find these offerings useful as well as fun to build.

That brings me to another point: If you have a special outdoor project that you'd like to have help building, or if you have one you'd like to share with other readers, let us know about it. Write us a letter, give us a call, or E-mail us with your suggestion.



New Opportunity To Win Tools

I like contests (even though I never win). To give you another shot at winning a \$1,000 gift certificate for tools and supplies, we've joined forces with The Woodworkers' Store of Medina, Minnesota. You'll find details on entering our latest sweepstakes on page 78. The deadline for this one is April 30th, so I suggest you send in that entry right now, before you forget.

Get Them Started Early In Woodworking

I've been actively working wood for most of my adult life. My son Brad, as well as sons-in-law Dave Marx and Bruce Berendts, also pursue woodworking as a hobby and/or vocation. Bruce recently completed an oak Arts and Crafts-style entertainment center of his own design. So, no one was much surprised when his shop assistant, six-year-old daughter Laura, asked for REAL woodworking tools for Christmas.

The word got passed along to Grandpa, who happily provided some of the essentials—tool box, hand saw, hammer, combination square, clamps, screwdriver, measuring tape, box nails, and eye protection—to get her started. However, birdhouse-building is tops on her agenda, so Laura will soon be needing more specialized tools...and Grandpa will shortly be wishing he'd gotten her a larger tool box.

Charles Sommers

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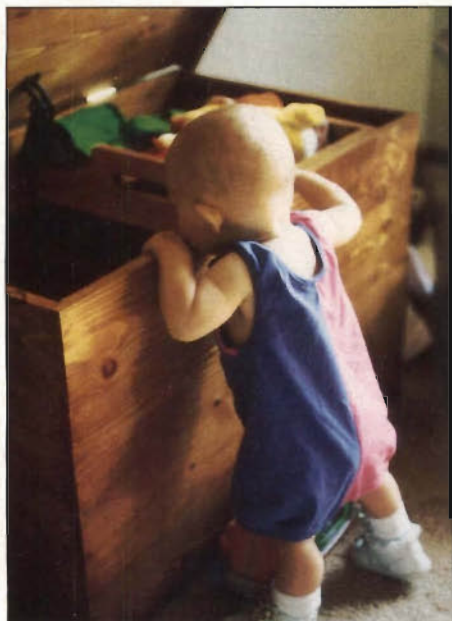
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READER LETTERS



I recently completed the toy chest from the Nov./Dec. '91 issue for my new granddaughter. I followed the plans for the box and tray, but I made the lid flat. The flat lid offers some advantages over the barrel shape, mainly that you can sit on it or use it for display space. I appreciate your magazine and have been referring to past issues for many years.

Charles Steward
Longmont, Colo.



Here is a "show and tell" of my Bad Puppy intarsia project from *Woodworker's Journal*, May/June '94. I like the colors and grain of natural wood, so I used no pigments except on the nose. I used six types of wood including hard and soft maple, sycamore, poplar, black walnut, and mahogany. This is my favorite and most successful of several Robert Hlavacek intarsia projects that I have made.

Richard Finley
Springfield, Mo.

Tool Prize Winner

For being selected as the winner of the tool-prize drawing, Ward Clark will receive a Makita model 6233DWAE cordless drill. This 14.4-volt cordless drill features a 2.0 amp/hour battery for extended run time, two variable-speed settings, a keyless chuck, and externally accessible brushes.

The names of readers whose project photos appear in Reader Letters are entered into a tool-prize drawing for each issue. To become eligible, send us a good photo and description of a project you've built from the pages of *Woodworker's Journal*. Send your submissions to: Reader Letters, *Woodworker's Journal*, P.O. Box 1790, Peoria, IL 61656.



DRAWING WINNER!

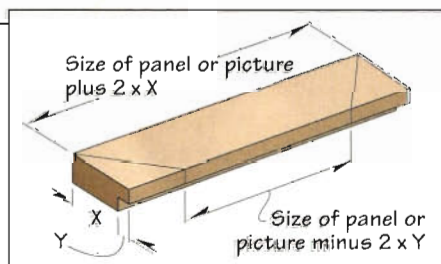


Thanks for the great plans for a glass display case in the May/June '96 issue. It arrived just as I was planning a case for my wife's dolls of Jesus and the children. I used aquarium adhesive instead of the corner posts and installed a six-watt light in the top that lifts off for easy replacement.

Ward Clark
Ludlow, Mass.

Correction

Figure 4 on page 38 of the Jan./Feb. '97 issue has an incorrect callout. The correct version of the drawing appears at right. We apologize for any inconvenience.



New Source for Filter Bags

The CleanStream dust-collector filter bags we reviewed in the last issue will no longer be carried by Grizzly Imports. You can, however, order the bags from the Woodcraft catalog, phone: 800/225-1153.

Continued on page 8

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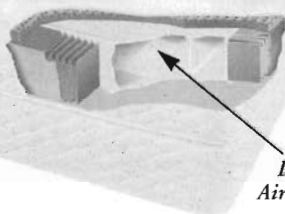
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Continued from page 6



Your Shaker Clock design from the Jan./Feb. '88 issue was the only one that I've found that includes measured drawings from a clock at Hancock Village. I used cherry instead of butter-

nut and pine, and I changed the dial mount to accommodate the available dial. The dial from Hancock Village was no longer available, but I found a close match from S. La Rose Company, in Greensboro, N.C. I made hands to match the original from some sheet brass I bought at a model store.

Bill Hopkins
Des Moines, Iowa

New Tormek Owner's Manual

On behalf of Tormek USA, I'd like to thank you for your review of the Tormek water-cooled grinding system in the Nov./Dec. '96 issue. I'd also like to point out that the owner's handbook has now been completely revised. The new handbook contains many new pictures and hints, and all of the measurements are now in both metric and fractional sizes.

Geoff Brown
for Tormek USA
Warwickshire, England

Editor's note: To see how the Tormek compares with the other water-cooled sharpening systems, turn to our review of wet-wheel grinders on page 80.

Comparing Tools For Pocket-Hole Joinery

I applaud *Woodworker's Journal* on their use of pocket-hole joinery in the

Sept./Oct. '96 issue. However, I would like to make a correction regarding the discussion of pocket-hole tools in the special gluing and clamping section.

The article says that the Porter-Cable 550 cuts the pockets and drills the pilot holes in one operation, but this is not the case. The 550 cuts the pockets with a router-like bit, but the pilot holes for the screws must be drilled as a second step. The article also states that the Kreg Jig works slower than the 550, which I question. The Kreg Jig enables you to cut the pockets and drill the pilot holes in one operation by using a step-drill bit. This efficiency allows many cabinet shops, to use a Kreg Jig as their primary joinery tool for face frames, cabinet carcasses, and other cabinet and furniture elements.

Mike Upah, Marketing Director
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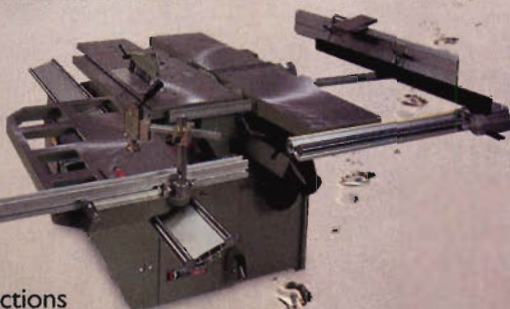
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Wisconsin

CLUB SPOTLIGHT

Millwaukee-based Guild Stays Busy With Education, Outreach



If you're searching for ideas to invigorate your woodworking club, take a look at the Wisconsin Woodworker's Guild. Although it normally meets in the humble basement of a bowling alley, this Milwaukee-

based group carries on one of the liveliest woodworking programs in the country. In the last few years, the Guild has featured a regular stream of notable speakers, doubled its budget, and launched a community outreach program that has membership growing by double-digit increases. "The Guild is founded on three basic pillars," says president Walt Hadcock, "fellowship, education, and service to the community." Recently, it's been the education program—the workshops, speakers, and seminars—that has helped the group break free from a ho-hum monthly routine. "We went from a club that met once a month "Hadcock reports," to a club that hosts as many as three events every month."

Hands-On Seminars Popular

These extra events include frequent hands-on seminars taught by nationally known woodworkers, some lasting for several days. Although the club

The Wisconsin woodworker's guild annual Lumbering Workshop has grown over the years into a family event featuring food, fun, and woodworking demonstrations and seminars.



charges admission to these special workshops, they have no problem filling the rosters on a first come/first served basis.

Recent seminars have featured Windsor chairmaking with Michael Dunbar, furniture construction with Marc Adams, green woodworking with Drew Langsner, and router techniques taught by Patrick Spielman. Guild members who have developed a particular skill also conduct workshops. Member instructors donate their time, so admissions collected at these events go to help pay for the outside speakers.

Last year, the group launched an informational program on the history of furniture, one of its most ambitious so far. Greg Landrey, director of furniture conservation at the Winterthur Museum in Delaware, opened the series with a lecture on 18th-century styles. According to Randy Johnson, chief organizer of the event, future speakers will include Eugene Landon, an expert on the Federal period; Gregory Weidman, curator of the Maryland Historical Society; Robert Mussey, founder and chief conservator of the Society for the Preservation of New England Antiquities; and Randall Makinson, director of the Gamble house in Pasadena, California (designed by Greene and Greene).

Working With the Museum

The club presents many of the furniture-history lectures in cooperation with the Milwaukee Art Museum, which owns a sizable collection of American antiques. These cooperative ventures typify the group's approach to community outreach. According to Hadcock, the Guild maintains reciprocal relationships not only with the museum and its subsidiary groups but also with other, smaller clubs that specialize in carving and miniatures.

"At some point, every guild or club has to make a conscious decision whether it will be inclusive or exclu-

sive," observes Hadcock. "The Guild decided a few years back to pursue an inclusive course. This means more than just reaching out to the community. You also have to go out of your way to welcome visitors and strive to get all of the members involved in activities. Otherwise, you get into a situation where your visitors just pass through, a core group of people do everything, and the rest of the members just sit on the sidelines."

The strategy has paid off. Today, the group lists 250 active members, which reflects recent net growth of 10 percent a year. Some members come from as far away as Madison and northern Illinois. One member drives in from Stevens Point, Wisconsin, a six-hour round trip.

With its growing roster, the Guild takes in enough funds to invest some back into the club. About \$3,000 a year is earmarked for the library, part of which goes to retain a retired school librarian. This individual also handles books and tapes during the meetings, allowing members to keep focused on the woodworking content of the proceedings.

Surprisingly, the Guild's \$35 membership dues account for only a third of its annual revenues. The remainder comes from workshops, raffles, and other fund-raising activities.

Borrow From the Tool Crib

The Guild's budget also maintains a "tool crib" from which members may borrow used tools. "We chose hard-to-find hand tools," says Hadcock, "the

kind of tools the average woodworker might not buy because he wouldn't use them enough. We ruled out power tools because of the liability issue." The crib inventory lists such specialized items as Shaker box forms, Windsor chairmaking tools, thread cutters, and a Kreg Jig for drilling pocket holes.

Besides an ongoing educational agenda, the Guild's calendar also includes plenty of fellowship and fun. For the past three Septembers, members have gotten together for a "lumbering workshop." This popular event has evolved from a muddy day of strenuous log-sawing to a large-scale picnic with a full slate of family activities. In December, the group convenes for a holiday feast, during which handmade toys are collected to benefit local charities.

With such a crowded schedule, the Guild now publishes an annual calendar. It features photos of projects and speakers, and lists the where-and-when for each month's events. "Committing to a calendar 12 months in advance was a real struggle at first," Hadcock recalls, "but now that we've got the schedule, it's become a big benefit as a planning tool."

If you're interested in learning more about the Wisconsin Woodworker's Guild, write the group at P.O. Box 137, Milwaukee, WI 53201; or call Walt Hadcock at 414/241-3763. If you'd like to see your club featured in this column, write us at *Woodworker's Journal*, PJS Publications, Inc., P.O. Box 1790, Peoria, IL 61656. WJ

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Tuning and Using A Japanese Hand Plane

by Craig Moro

No other tool or technique can unlock the beauty of a piece of wood as well as a Japanese hand plane. The shavings that float up off the chip breakers of these simple tools leave behind a satin-smooth surface that appears almost polished. We asked contributor Craig Moro to provide a guide for those of you who would like to learn more about this enjoyable tool.



There are many ways to smooth wood. Most of them are easier than mastering a Japanese hand plane. So why bother?

For me, the answer is pleasure. Quietly pulling a super-thin shaving off a prized piece of wood calms the mind, unlike the nerve-rattling noise and dust of a sander. Watching the rich

color and grain of the wood emerge from under the plane is a joy that every woodworker should experience.

Although the techniques I describe here may look daunting, don't be intimidated. A Japanese hand plane is no more difficult to tune than one of its Western-style steel counterparts. Most of the steps will take you only a

few minutes, and you'll never have to repeat the difficult ones.

Cutting On the Pull Stroke

Japanese planes cut wood with a beveled plane blade and chip breaker, but their similarity to Western planes ends there. The body of the plane

consists of wood and contains no moving or mechanical parts. A Japanese plane cuts on the pull stroke rather than relying on the pushing motion required by Western planes.

Japanese planes come in as many different configurations as those we're more familiar with in the West. They cut curves, moldings, grooves, rabbets, dados, and more. Flat-soled models can be set up for truing, roughing, or smoothing. Since most of us rely on machines these days to do our truing and thicknessing, I'll concentrate here on the correct setup for a smoothing plane.

For several reasons, I suggest starting out with a small plane of 36-48mm blade width. For one, this size rests comfortably in your hand and pulls more easily than a wide-bladed tool. The smaller planes also give you better balance and control for planing end grain. In addition, a small plane follows minor dips and rises in a board, taking a continuous shaving as it goes.

Climate Makes a Difference

Japanese plane irons arrive in the U.S. only partially fitted into their block. This is done deliberately to give the block a chance to adjust to a user's climate. (Japan tends to be humid, but the warehouse in California might be very dry.) After you receive a mail-ordered plane, let it sit in your shop for a week or two and let the block acclimate to its new surroundings.

While you're waiting, you can condition and sharpen the blade. On these planes, we shape the block to fit the iron, so have the blade razor-sharp and ready to go before you touch the block.

Preparing the Blade

The Japanese make their blades by laminating an extremely hard steel cutting edge to a softer, more malleable body. (See *figure 1* and *photo A*.) After removing the protective lacquer, you'll see that the hard steel of the cutting edge is brighter than the soft, grayish steel that makes up the rest of the iron. The advantage: This harder steel will hold a razor-sharp edge for a long time, while the softer steel makes the blade less prone to cracking.

(Samurai swords were made in a similar way.) The softer metal also absorbs the blows of the small hammer you use to adjust the blade's position.

Now, take a look at the "flat" or front face of the blade. You'll see that it is slightly hollow and has narrow flat surfaces at the cutting edge and sides. These surfaces will still show some coarse machine marks and may not yet be truly flat.

Polish To a Mirror Finish

Rub this face against a flat abrasive surface such as a diamond plate or sharpening stone using the appropriate lubricant. Apply a bit of extra pressure near the cutting edge. Japanese woodworkers use a flat steel plate and an abrasive powder such as carborundum for this purpose, then switch to waterstones to hone the bevel. Whatever type of stone or plate you choose, it must be dead flat. An out-of-flat oilstone or waterstone can be flattened by rubbing it with water or oil on a sheet of wet/dry sandpaper (220-grit or coarser) adhered to a pane of 1/4" plate glass.

As you flatten the "flat," you should see the milling marks disappear and a bright surface spread across the area just behind the cutting edge. When the brightened area reaches from corner to corner, change to an 800- or 1200-grit stone, then finish with a polishing stone (6000- to 8000-grit) to hone the flat areas mirror-bright. Note: The grit numbers cited here are for Japanese waterstones.

Now, hone the beveled back face of the blade, beginning with an 800- to

1200-grit stone. After you've raised a burr, check the geometry of the cutting edge. A smoothing-plane blade should show a very slight curve, as shown in *figure 1*. New blades usually come with the correct profile ground in. When necessary, you can re-create the curve by subtly varying the pressure of the blade on the stone or by taking a few strokes on each corner of the bevel with only the corner touching the stone.

Finish honing the beveled face with a polishing stone until the bevel shines like a mirror. You should be able to feel a burr at this point. To remove it, hone the flat side again with about 10 strokes on the polishing stone. Now, take several light strokes on the beveled face, then several more on the flat side. Repeat this sequence until the burr has disappeared.

Don't use a strop on a Japanese plane blade. Stropping tends to break off the burr, leaving a jagged edge. Also, be sure to maintain the manufacturer's bevel angle on the cutting edge,

Figure 1 Japanese plane blade

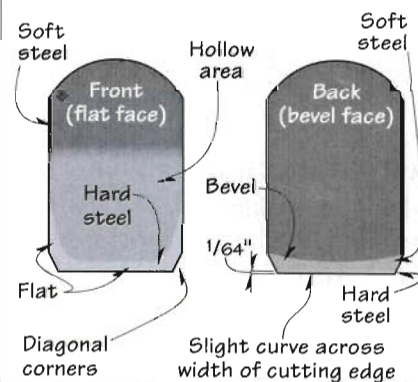


Photo A: On a Japanese plane blade, the mirror-polished hard steel takes and holds an edge well, whereas the duller soft steel adds mass and keeps the hard steel from cracking. Note the blade maker's inscription.





Photo B: To remove the blade, tap gently on the chamfered edge along the back end of the block, alternating from one corner to the other. As you tap, hold the blade and chip breaker with a finger to keep them from flying out.

and don't add the secondary or micro-bevel that is often recommended for Western tools. (You do, however, put a micro-bevel on the chip breaker.)

Always dry your blades immediately after sharpening to prevent rust. Many users keep an oiled cloth nearby to treat the blade after sharpening. Japanese woodworkers prefer to use camellia oil, which will not stain wood or interfere with glue joints.

Tune the Chip Breaker

Like the plane blade, the chip breaker must be carefully tuned and honed. Start by flattening the back

face just behind the edge where shown in *figure 2*, then hone and polish this face and the bevel just as you did with the blade. Finish by honing a 5° micro-bevel on the leading edge of the main bevel. (See *figure 3*.)

Lay the sharpened plane blade on your bench flat side up and set the chip breaker on it. Position the leading edge of the chip breaker just behind the cutting edge of the blade. If the chip breaker rocks, you'll need to gently bend one of the "ears" on the rear corners of the chip breaker. (See *figure 2*.) Do this on an anvil by tapping one of the ears with a small hammer. When your chip breaker sits flat

without rocking, you're ready to fit it and the blade into the wooden block.

Shape the Block To Fit the Blade

Before you condition the block, you'll need a quick lesson in how the Japanese install and remove plane blades. The blade and chip breaker on these tools are wedged into place with a friction fit. Tapping on the chamfer at the rear of the body loosens the blade for removal (*photo B*). To seat the blade and also to adjust it laterally, you tap gently on its back end.

Japanese tool suppliers sell small "octagon" hammers for this purpose. The hammers are classified by weight; I use the 150-gram size. These tools have one slightly rounded face and one flat face. Use the rounded face to strike the block or plane blade. (For mail-order information, see Sources at the end of the article.)

As a first step, widen the chamfer at the top rear edge of the block using a chisel, a file, or another small plane. Next, remove the chip-breaker pin by grasping it with pliers and wiggling it until it protrudes through the hole in the side of the block. Grab this end with the pliers, pull the pin out, and set it aside. This will make it easier to insert a chisel to work on the blade bed and grooves.

You may have noticed by now that the plane iron tapers in thickness

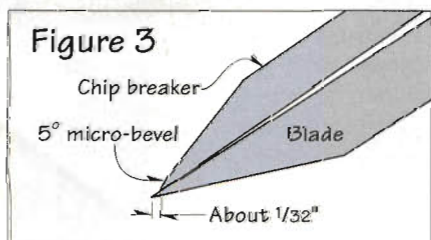
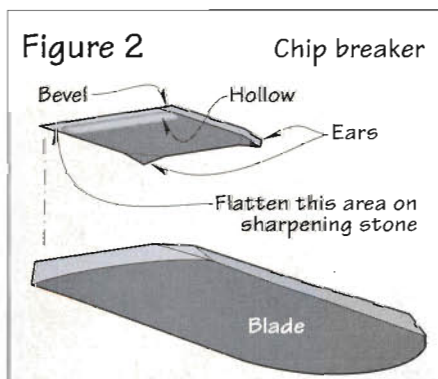


Photo C: If the blade fits too tightly, pare back the bottoms of the blade grooves to allow side-to-side adjustment.

along its length. This causes it to wedge itself in the block. Unless you live in Florida or Hawaii, the block has probably shrunk a little since leaving Japan and will need some adjustment before you can set the cutting edge below the sole.

Pare the Side Grooves And Blade Bed

To make the blade fit the block, you'll need to pare the side grooves and blade bed. (See *figure 4*.) Before you start, however, notice the blade angle line, i.e., the shoulder of the blade groove that bears directly against the top face of the blade. Don't touch this line with the chisel. I've seen more than one plane damaged by inexperienced users (I did it on my first plane) who tried to make the blade fit quickly by paring back this line.

Instead, push the blade by hand into the block as far as it will go. You need a little clearance ($\frac{1}{32}$ " to $\frac{1}{16}$ ") between the blade and the side walls of the block opening so that you can adjust the cutting edge parallel to the sole. If there's not enough clearance for this, remove the blade and pare away a bit of wood from the bottoms of the grooves using a narrow chisel (*photo C*). Again, make sure you adjust the *depth* of the grooves, not their *width*.

Once again, push the blade in as far as it will go and recheck its position. If the cutting edge is $\frac{1}{16}$ " or less from the mouth opening, you should be able to tap it the rest of the way down.

Mark the High Spots

If the blade won't move or it's still farther than $\frac{1}{16}$ " from the mouth opening, remove it. Rub a soft pencil or black felt pen all over the edges and back (beveled) face of the blade and push it into the block as before. Give the blade one or two light taps, then remove it again. Now, pare away the dark spots using a sharp chisel and an extremely shallow cut (*photo D*).

Push the blade in and tap it again lightly to see if the cutting edge has gained any ground. If so, tap the blade forward until a tiny bit of the edge protrudes beneath the sole. You may need to repeat this process two or

three times before the blade extends far enough.

If you accidentally pare away too much wood and find that the blade will not wedge tightly until it protrudes too far, don't panic. Instead, glue a piece of paper or two to the plane bed to tighten the fit.

With the edge of the blade protruding slightly, check the width of the cutting edge relative to the mouth opening. The edge should fit the opening as shown in *figure 5*. If it's wider, chips may lodge between the blade and the block, which will impair the plane's function. In this case, grind or file back the blade's diagonal corners, then polish the flat again to remove any burr you may have raised. As you continue to sharpen the blade in the future, you'll need to grind these diagonals back periodically to maintain the proper blade width.

Next, insert the chip breaker pin and the chip breaker. Tap the chip breaker forward until its front edge is $\frac{1}{32}$ " or slightly less from the cutting edge of the blade. (See *figure 3*.) To do this, you may need to pare a little wood from the sides of the block where they bear on the chip breaker.

Condition the Sole

Once the blade fits, you're ready to condition the sole of the block. First, tap the rear corner chamfer to retract the cutting edge of the blade into the block, but don't remove the blade entirely. The pressure of the blade wedged into the

block causes a slight bulge in the sole, so any work on the sole must be done with the blade in place.

To start, flatten the sole by rubbing it on a piece of sandpaper placed on your jointer bed, saw table, or other dependably flat surface. (I use 220-grit wet/dry.) Take care that you don't rock the block while rubbing. As you work, check the sole with a straightedge frequently and stop as soon as it's flat.

Notice in *figure 6* the "ears" cut into the sole at the sides of the mouth opening. If the block maker has not cut these notches already, do it now by making shallow stop cuts with a chisel

Figure 4 Japanese plane block (top view)

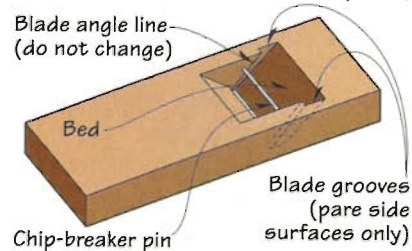


Figure 5 Mouth and blade (bottom view)

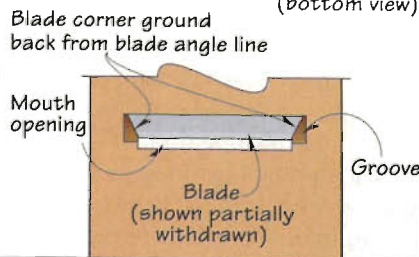
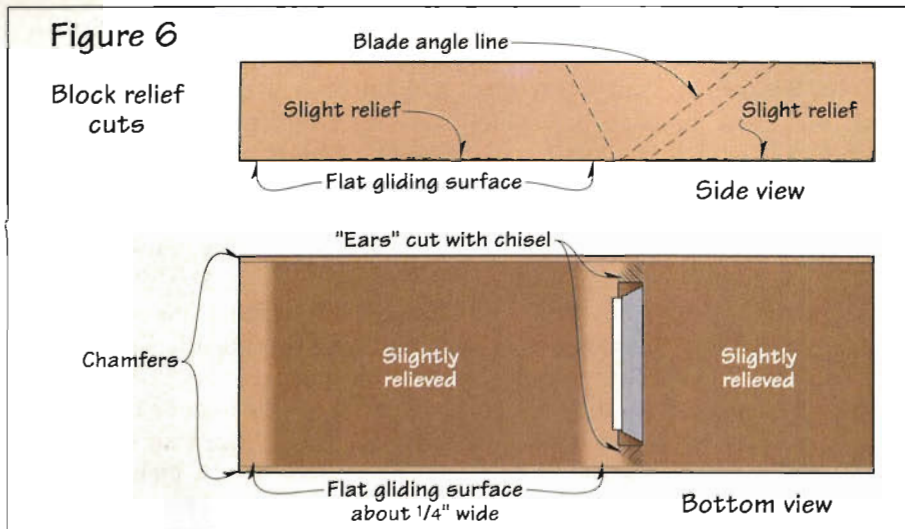


Photo D: Pare paper-thin shavings from the blade bed to seat the blade in the correct position.

Figure 6

(hand pressure only) and paring away a few paper-thin shavings where indicated. This will help minimize the gliding surface area around the mouth, making it easier to keep this area flat. Routine maintenance of the sole will obliterate these ears eventually, so you'll need to recut them.

You'll also need to periodically chamfer the sole's edges. These chamfers prevent splintering when you scrape the sole across the grain, as described in the next steps.

Hollow the Relief Areas

Using a try square, mark two 1/4"-wide strips across the sole: one along its leading edge and one just in front of the mouth opening. These will become the gliding surfaces shown in figure 6. Check these with a straightedge to make sure they're flat.

Next, draw hatch marks across the entire surface of the sole except on these gliding surfaces. Using a scraper plane or wide chisel held perpendicular to the sole, scrape the marked areas lightly until the pencil marks disappear. Then, check the sole with a straightedge. It should rest flat on the gliding surfaces and show just a sliver of light at the relieved areas. If the straightedge contacts any area other than the two gliding surfaces, relieve those areas by scraping a bit more.

This subtle hollowing of the sole serves several purposes. Reducing the area that makes contact with the workpiece eases friction and reduces the amount of effort required to pull the plane. When it's time to reflaten the

sole, you need surface only these two small areas. The two gliding surfaces also burnish the wood as the blade cuts, adding to the plane's polishing effect.

Use Winding Sticks To Check For Twist

As a final step, check the block for twist or wind. To make winding sticks for this purpose, cut two 1 1/2 x 12" strips from scrap wood or plywood that measures 1/4" to 3/8" thick. Make sure the strips match in width, then darken the edge of one with a felt-tip pen.

Set your plane on a bench with the sole up, and prop the front with a small block so it's fairly level. Place the unmarked winding stick on the front gliding surface and the one with the darkened edge on the surface in front

of the mouth. If necessary, scrape the front gliding surface until the sticks are parallel, then check with your straightedge to make sure that this surface still protrudes from the relieved area.

Congratulations! Your plane is now ready to use.

It's optional, but I recommend sealing the block. This will make the wood less prone to movement and reduce the time you'll have to spend maintaining the sole. To do this neatly and thoroughly, I remove the blade, form a small tray of aluminum foil around the block, and then pour a 50/50 blend of tung oil and mineral spirits into the block opening. Let the block sit in this puddle for a day or two, then wipe it down. After a few days of curing, the block should be ready to use.

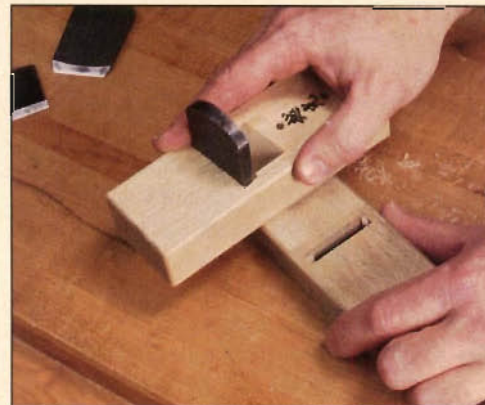
How To Use the Plane

As with Western tools, you'll need a stop to hold the workpiece as you smooth wood with your new plane. I cut a 10" dovetail groove in my bench top and made several dovetailed runners of various heights that slide into this groove. I change runners according to the thickness of my workpiece. Remember that you'll be cutting on the pull stroke, so locate the stop appropriately for left- or right-handed use.

Adjust the cutting depth on your plane by tapping the blade forward until the edge barely protrudes through the sole. Tap the blade from side to side as

"You Mean I Need Another Plane Before I Can Use the First One?"

No, but it sure helps. The scraper plane shown *right* makes it easy to condition and maintain the sole of a Japanese smoothing plane. The scraper plane's blade fits into the block at 90° and has no chip breaker. You sharpen and fit the blade as you would on a smoothing plane, but you keep the scraper plane's cutting edge straight (no curvature) and don't relieve any areas on the sole. (To order a scraper plane, see Sources.)



A scraper plane makes it easy to relieve portions of the sole on a smoothing plane.

needed to make the blade parallel to the mouth opening. Then, tap the chip breaker's edge to within about 1/2" of the cutting edge. Now, take a shaving on a piece of scrap, planing in the direction of the grain.

As for how to grip the plane, there is no single correct method. I like to hold the front of the block with my right hand and cradle the rear with my left, wrapping one finger behind the blade. Because I press down as I'm pulling forward, I've made my bench a little lower than the standard Western cabinetmaker's. Keep your feet well apart and try to lower your center of gravity as you pull.

Blade angle lines on most Japanese hand planes are cut into the block at about 38° from horizontal. This angle works well on softwoods, poplar, bass, and most domestic hardwoods. If you work mostly in very dense materials such as rock maple or tropical hardwoods, you may want to acquire a high-angle plane. (Check with the supply houses listed in Sources, both of which deal directly with plane makers in Japan.) 

Photographs: Randall Sutter

SOURCES

Hida Japanese Tool Co.
800/443-5512

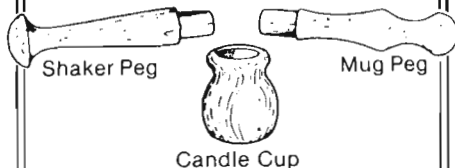
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Vacuum Clamping

Tired of fighting with clamps? Check out this high-speed, hands-off technique for holding your work. *by Bob Colpetzer*



Vacuum-clamped template eliminates the need for clamps, double-faced tape or hold-downs.

Whether you're sanding, routing, scraping, or planing, half the battle is just getting the workpiece to stay still. The conventional methods—clamps, bench dogs, hold-downs, and double-faced tape—all have their limits and inconveniences. Those shortcomings, however, almost all disappeared from my shop when I started using a vacuum-clamping system.

With vacuum-clamping, you can summon a one-ton grip with just the flip of a switch. A particleboard-and-laminate fixture holds the workpiece from underneath, and the entire top face of the workpiece remains free of obstructions. You'll never again have to stop a sander or router to move the clamps.

If you've ever struggled with pads to protect a workpiece from the dents caused by metal clamps, you can rest easy with vacuum clamps. On the clamping surface of a vacuum-clamping fixture, a perimeter of

closed-cell foam tape seals the air space between the workpiece and the fixture. The tape also cushions the workpiece so that, despite tons of clamping pressure, you won't mar or dent the wood.

Some Of Its Many Uses

For template or pin routing, I've found vacuum-clamping to be the perfect system, especially when making multiples. Instead of adhering the template to the workpiece with double-faced tape, just turn your template into a vacuum fixture. Then, vacuum the workpiece to the fixture and rout around the perimeter of the fixture in one non-stop pass.

A vacuum-clamping straightedge, T-square, and feather board also see plenty of use in my shop. In addition, I've made right-angle fixtures that hold large and unwieldy panels upright on edge. But what makes vac-

Editor's Note

This is the second article in our series on the uses of vacuum technology in woodworking. To learn more about vacuum veneering, see the Sept./Oct. '96 issue of *Woodworker's Journal*.

uum clamping such a great system is that you can custom-design your own fixtures to serve practically any clamping need. (See *page 20* for more information on these fixtures.)

To get started in vacuum-clamping, you'll need an air compressor. The rest of the equipment you can purchase for as little as \$100. Manufacturers sell a variety of clamping fixtures, but you can build many of these easily in your own shop.

How Vacuum Clamping Works

At sea level, the earth's atmosphere weighs about 15 pounds per square inch. If you build a sealed air chamber and remove all the air from it (i.e., create a vacuum) then the full weight of the atmosphere presses down on the top of the chamber.

A perfect vacuum measures 29.92 Hg (inches of mercury displaced) at sea level, and every 2 Hg equals one pound of air pressure per square inch. A well-designed pump and vacuum-clamping fixture can produce about 26 to 27 Hg. This equals nearly a ton of clamping pressure for every square foot enclosed in the vacuum chamber.

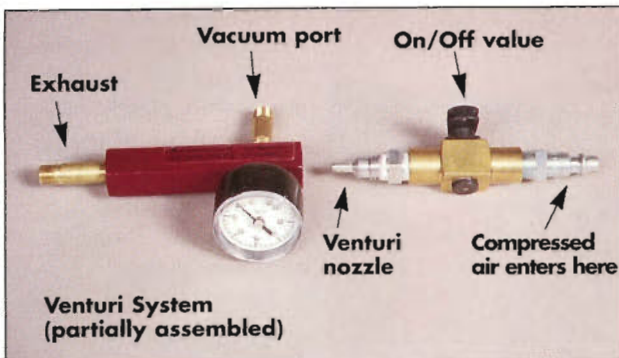
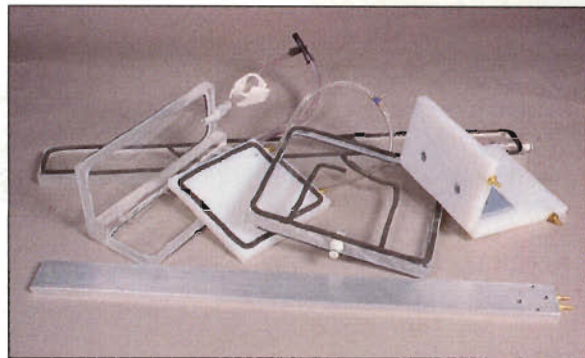


Photo A: Compressed air forced through a venturi produces a vacuum at the port angled 90° to the air flow.

Photo B: A sample of vacuum-clamping fixtures sold by manufacturers.



Choosing Equipment And Accessories

To create a vacuum for clamping, I prefer to use a venturi-based system. A venturi (*photo A*) requires an air compressor to generate the air flow. The venturi itself has no moving parts, so it will last almost forever. (The alternative to a venturi, an electric air pump, sees plenty of use in vacuum veneering; but few pumps will stand up to the frequent on/off cycles required for vacuum-clamping.)

A venturi creates a vacuum when the compressed air shoots past a port angled at 90° to the air flow. This reduces the air pressure at the port, forming a vacuum.

Venturis are rated according to their CFMs (cubic feet per minute of air flow), and the size of air compressor needed to generate this flow. For example, a 1-CFM venturi usually requires a 1/2- or 3/4-hp compressor. For a 2-CFM venturi, you'll need a 1-hp compressor. The higher-CFM venturis overcome leakage in the vacuum chamber faster and can maintain a constant 26 or 27 Hg. Smaller venturis, depending on the tightness of the air seal, may not be able to maintain this level of vacuum pressure, but they can still clamp efficiently.

Fixtures, Tape, And Fittings

The firms that sell venturis also market clamping fixtures (*photo B*) and the closed-cell foam vacuum tape that seals the air space (*photo C*). The tape comes in thicknesses of 1/8" to 1/4" and widths of 1/4" to 3/8".

Go with the wider tape on larger vacuum chambers. I found that the wider tape flexes less under a strong side load and gives you an extra margin of safety when you use the straightedge or T-square fixture as a fence. Use the narrower tape when you must curve or conform it to the shapes of intricate routing templates.

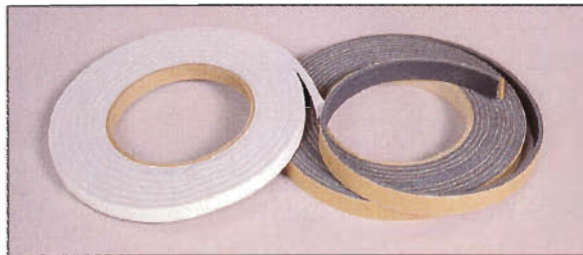


Photo C: Closed-cell foam tape creates a vacuum chamber by sealing the gap between the fixture and the workpiece.



Photo D: Quick-connect fittings make it easier to move from one fixture to the next.



Photo E: The base for any fixture can be built from particleboard and surfaced with melamine or plastic laminate.

To connect your fixtures to a vacuum hose, you'll also need some fittings. I recommend investing in those carried by the manufacturers (*photo D*). Early in my vacuum-clamping experience, I spent a tidy sum for brass fittings at the local hardware store. Since then, I've discovered that the manufacturer's quick-connect fittings are easier to use and not much more expensive.

Selecting a Substrate For Vacuum Fixtures

You can make vacuum-clamping fixtures out of any flat, non-porous material. For my fixtures, I prefer laminate-faced 3/4"-thick particleboard (*photo E*). I also use melamine-coated particleboard and band the edges with an iron-on polyester edge banding. (See the Sources listed at the end of the article.) This saves me from having to apply laminate to the top and bottom faces of the fixture. Laminate and melamine hold tape well and won't leak air.

In addition to being non-porous, laminate-faced particleboard offers another benefit. Before applying the laminate, I rout the necessary grooves in the particleboard. These grooves become air-evacuation channels under the laminate that connect vacuum ports drilled through the face of the fixture. This technique allows me to build more than one vacuum chamber on a single fixture, as shown on the Double-sided Bench Plate drawing on page 23.

You can also build your fixtures from aluminum stock or

plastic sheet goods. If you go this route, make sure the material has sufficient thickness and strength to resist bending under the vacuum pressure. Baltic-birch plywood or close-grained solid stock such as maple will also work. Avoid softwoods, porous or open-grained hardwoods, and unsurfaced particleboard. These materials do not hold a vacuum well.

Anchor Fittings To Hardwood

To secure a tight connection with the hose fitting, I glue a $\frac{3}{4} \times \frac{3}{4}$ " hardwood nose piece to the particleboard on any edge that will get a fitting. Then, I cover the entire fixture with plastic laminate. I drill the hole for the fitting through the laminate and hardwood last.

The vacuum chamber on the face of the fixture must be bordered with vac-



Photo F: Seal unused vacuum ports with plastic tape.

uum tape. The fewer seams in the tape, the better your seal will be, so bend the tape into an unbroken radius at the corners wherever possible. You can also apply tape to both faces of a fixture so that it will clamp itself to your benchtop or any other flat surface.

To seal off the unused sections of the fixture, place vacuum-tape "gates"

across the areas you need to isolate. I cover the exposed vacuum ports with plastic tape as shown in *photo F*. This plastic tape comes in a variety of colors and can be found at hardware stores.

When gating off areas of a fixture, proceed with caution.

Remember that as you shrink the size of the vacuum chamber, you also reduce the clamping force. At 13 pounds per square inch, for example, a 12x12" area receives 1,872 pounds of clamping pressure, and a 6x6" area sustains 468 pounds. A 2x2" vacuum chamber, however, will have a measly 52 pounds of clamping force.

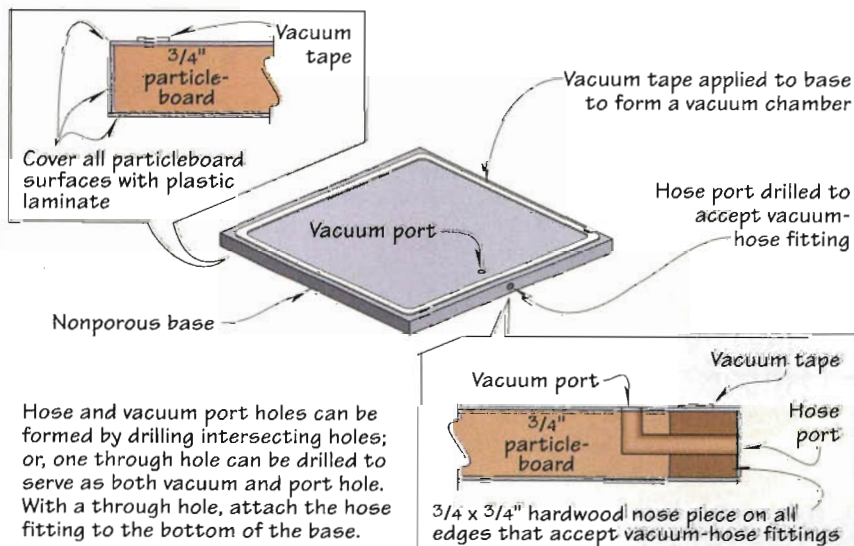
NINE VACUUM CLAMPING FIXTURES

The Basic Vacuum-Clamping Fixture

This shows the parts needed to make a fixture: a nonporous clamping base, a hose port drilled into a hardwood nose piece, a vacuum port drilled through the laminate top, and a perimeter seal of vacuum tape.

Builder's Note

The lengths and widths shown in the drawings suit my needs, but feel free to modify these designs or develop different fixtures to meet your own needs.

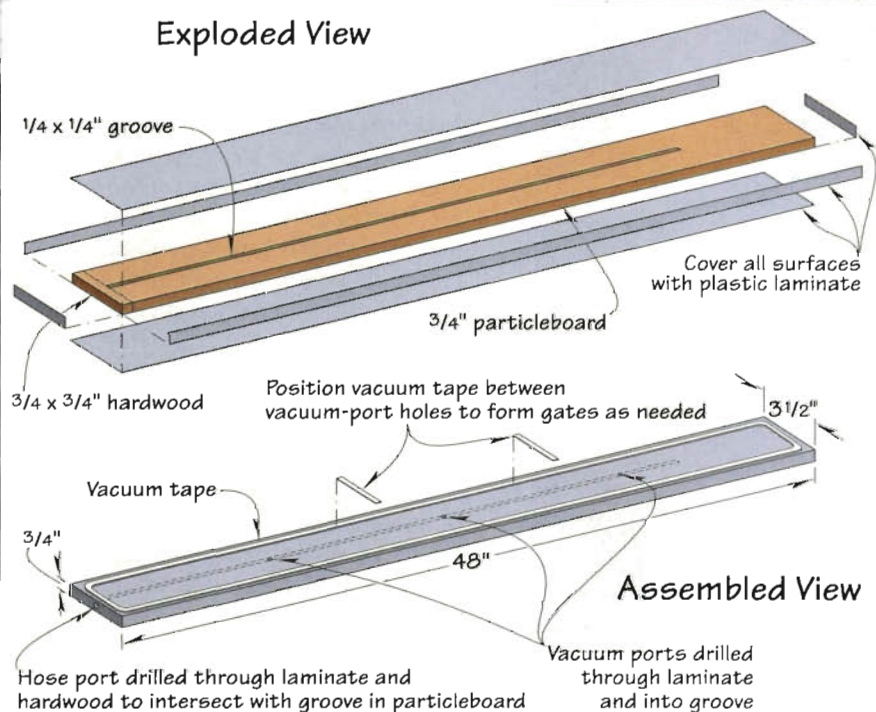


Straightedge

The straightedge can serve as a fence or hold long narrow stock. It works great as a fence for cutting coves on the tablesaw as shown *below*. To adapt the clamp to hold shorter pieces, place vacuum-tape gates across the fixture and seal the unused ports with plastic tape. This isolates the area where you need the vacuum. If the fixture spans the miter-gauge slot,

you'll need to gate off the area over the slot.

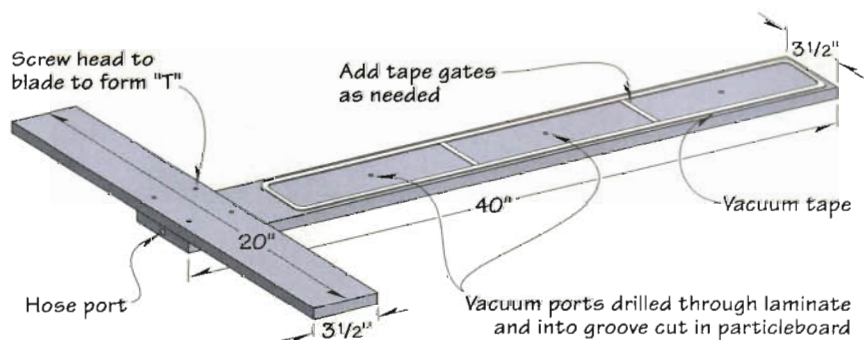
Exploded View



Vacuum straightedge being used as a tablesaw fence to cut a cove.

T-Square

To rout dados, align the head on this jig with the edge of a workpiece and use the vacuum to clamp the blade to the workpiece. Construct the blade of the T-square just as you would the straightedge *above*, then laminate the head before screwing it to the blade.

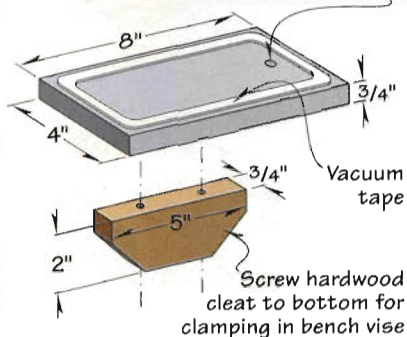


Vacuum T-square works without metal clamps that would interfere with the router's operation.

Bench-Vise Fixture

You can clamp this fixture in your bench vise using the cleat on the bottom, or secure the vacuum-clamping platform flush with the top of your vise. You need not laminate the cleat, but do laminate all surfaces on the vacuum-clamping platform before screwing the cleat to it.

Drill vacuum port hole completely through base. Attach vacuum hose fitting in the hole from the bottom



Fixture cleat clamped in vise.



Fixture clamped flush with benchtop.

A COUPLE OF TIPS ON WORKING WITH VACUUM CLAMPS

Unlike traditional clamps, vacuum clamps are either all the way on or all the way off. You can't back off on the pressure a bit and nudge a workpiece to a line once you turn the vacuum on. You'll also find that the tape holds the workpiece up off the base of the fixture, sometimes making visual alignment difficult.

When using the straightedge or T-square as a guide for my router, I work around this by using a shop rule to position the fixture before turning on the vacuum. First I mark the centerline of the dado or groove to be cut on the workpiece. Then, I butt the end of the rule into the edge of the fixture and align the mark on the workpiece with the dimension on the ruler that corresponds to half the diameter of the router base.

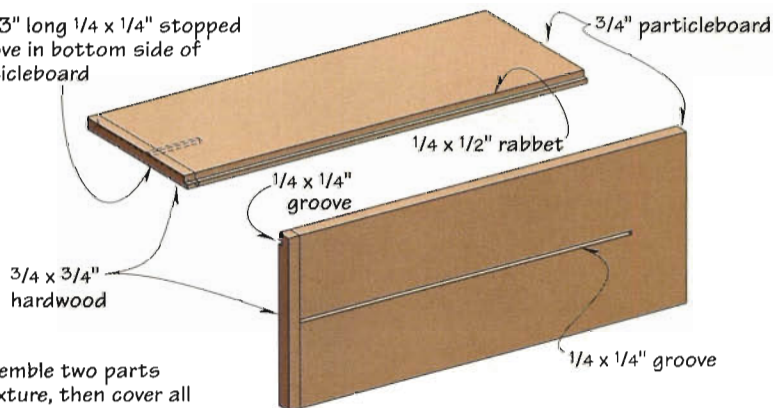
Another suggestion: Push down on top of a workpiece or fixture after you turn on the vacuum. This compresses the vacuum tape a bit and helps you reach full vacuum pressure sooner.

Bench-Edge Fixture

The bench-edge fixture clamps horizontally to your benchtop and vertically to the workpiece. With the vacuum on, it anchors stock on edge for planing, sanding, or routing. To make the fixture, attach the hardwood nose pieces, rout the rabbets and grooves, then glue the two pieces of particleboard together.

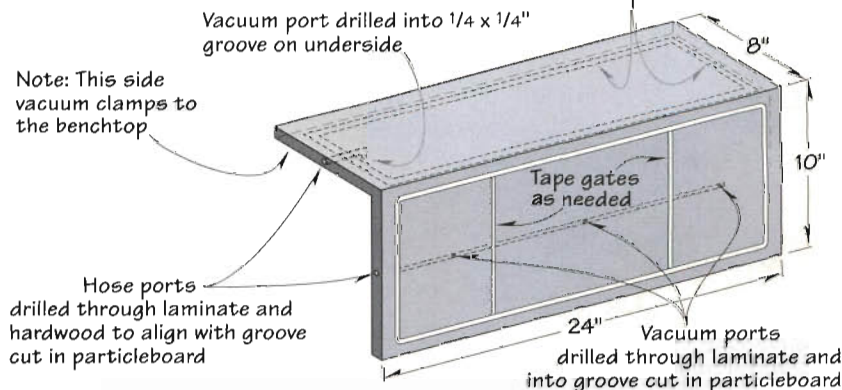
Apply the laminate last. Also, you'll need two hose-port fittings, an extra section of vacuum hose, and a Y-connector to lead to the venturi.

Cut 3" long 1/4 x 1/4" stopped groove in bottom side of particleboard



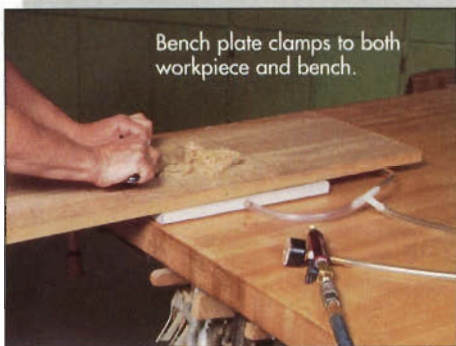
Assemble two parts of fixture, then cover all surfaces with plastic laminate

Note: This side vacuum clamps to the benchtop



Edge fixture clamps panel vertically.

Bench plate clamps to both workpiece and bench.



Double-Sided Bench Plate

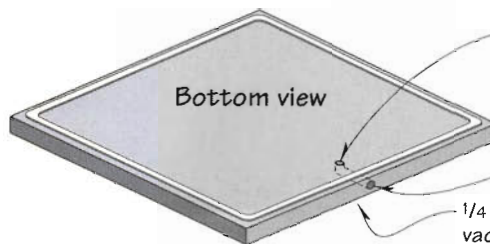
With its two vacuum chambers, this fixture clamps itself to both your workpiece and your bench, one on top and one on the bottom. Again, you can create different-sized vacuum chambers on the top face by cordoning off different areas with vacuum tape and sealing the unused vacuum ports with plastic tape.

Vacuum ports drilled through laminate and into 1/4 x 1/4" groove cut in particleboard

Apply vacuum tape to create 3 separate chambers so fixture can be used to clamp different-sized workpieces

Top view

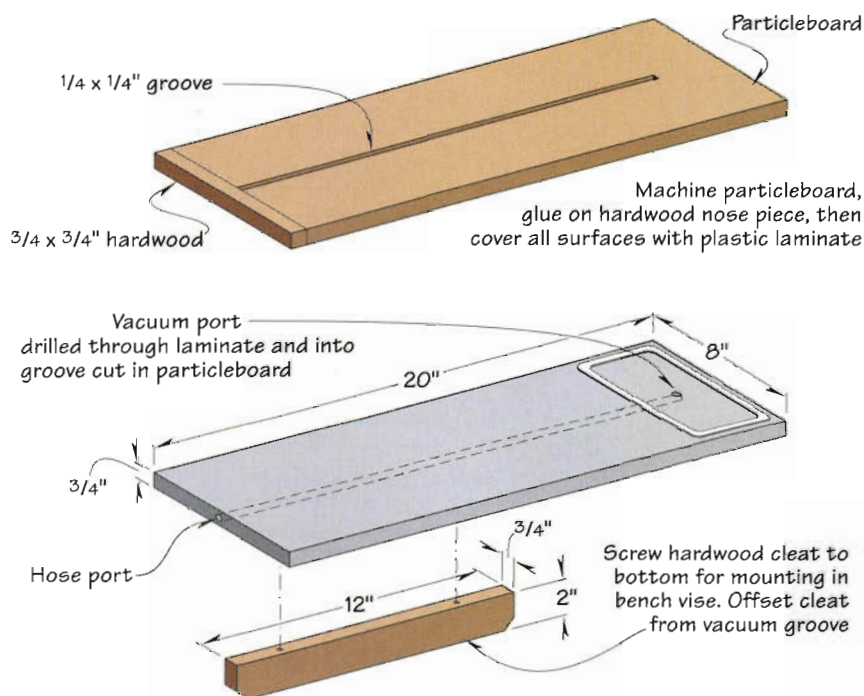
Top hose port drilled through laminate and hardwood to the groove cut in the particleboard



Vacuum port

Hose port

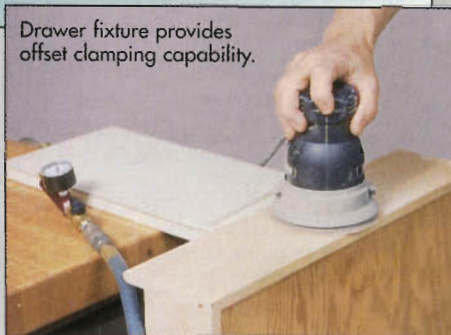
1/4 x 1/4" stopped groove connects vacuum-port and hose-port holes



Drawer-Clamping Fixture

This fixture offers a simple means of holding an assembled drawer or box steady for sanding. To use it, clamp the cleat in your bench vise with the vacuum chamber extending out over the end of your bench. Then, position the drawer over the vacuum tape and turn on the clamp.

Drawer fixture provides offset clamping capability.



Continued on Page 25



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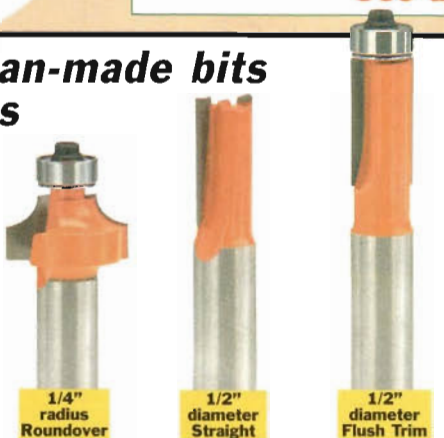
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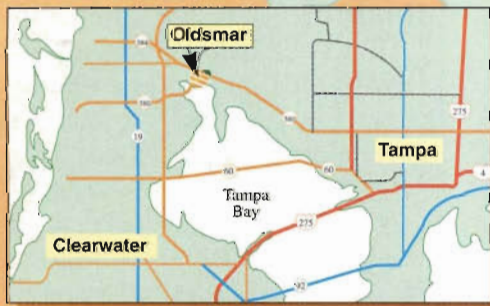


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- Void where prohibited
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- Only official entry forms accepted
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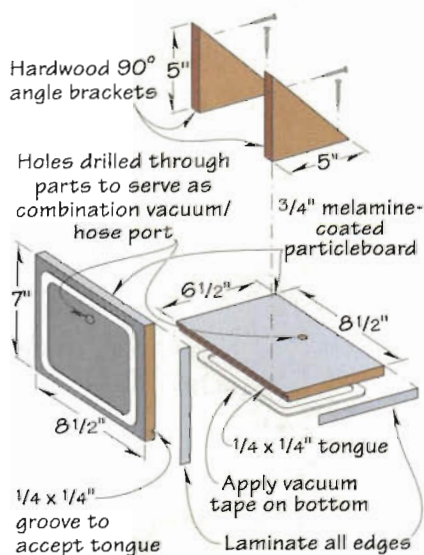
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Right-Angle Fixture

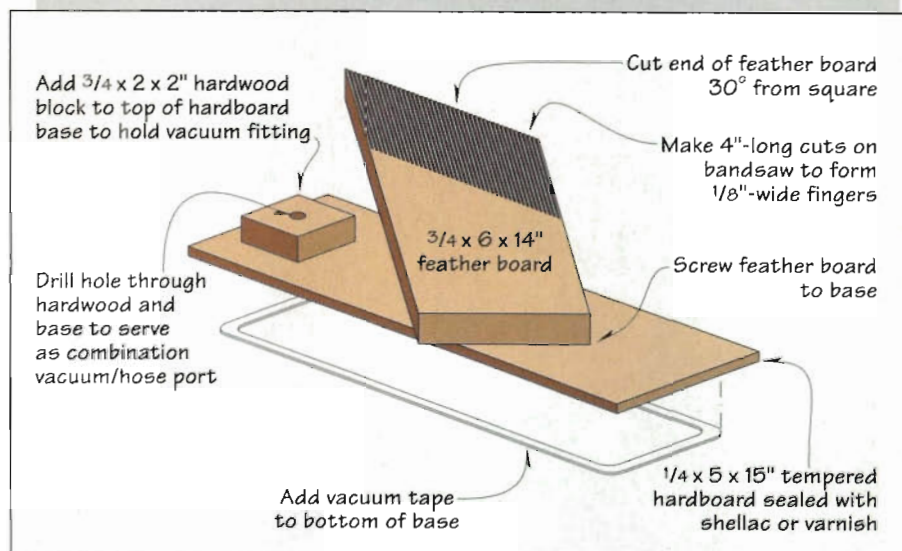
Used for positioning and assembly, this fixture holds two workpieces at right angles while you nail or screw them together. You can also vacuum-clamp this fixture to your benchtop to hold small workpieces upright on edge. As with the bench-edge fixture, assemble the two pieces of particleboard first, then laminate the whole fixture. Screw the hardwood brackets to the fixture last. This fixture requires two hose-port fittings, an extra section of vacuum hose, and a Y-connector to lead into the venturi.



Vacuum-assisted feather board for table saw.

Vacuum Feather Board

With a vacuum assist, you'll have no trouble positioning this feather board anywhere on your table saw or router table. Cut the clamping base from $\frac{1}{4}$ " tempered hardboard and add a $\frac{3}{4}$ " x 2" block as shown for the hose connector. To prevent the hardboard from leaking air, coat both faces and all of the edges with shellac or varnish.



SOURCES

Quality VAKuum Products VP2 Standard Kit (\$99) includes a venturi, gauge, on/off valve, 10' of tape, and 5' of hose. The company also sells a **PED-VAC** system that can be turned on and off with a foot pedal and includes a venturi, gauge, 75' of tape, a 5' hose, and foot pedal. **PED-VAC** prices range from \$230 to \$305.

Clamping fixtures available include a 30" straightedge (\$39), a right-angle clamp (\$45), and a two-sided base plate (\$24).

Additional vacuum-clamping and veneering products are also available, and you can upgrade to the firm's other systems. Credit is given for returned equipment, so the cost of the upgrade is only the retail difference between the two systems.

Quality VAKuum Products, Inc.
800/547-5484

Vacuum Pressing Systems

VC90 Kit includes a 1-cfm venturi, gauge, muffler, on/off valve, in-line filter, 10' of hose, 25' of tape, and fittings. **VC100 Kit** includes same components and price but comes with a 2-cfm venturi. Price: \$139.

Vacuum Pressing Systems
207/725-0935

Woodhaven #601 Vacuum Kit

Includes a venturi, filter, on/off valve, muffler, 6' of tubing, 17' of tape, and fittings. Price: \$99.99.

Woodhaven
800/344-6657

Polyester edge banding to match laminates and melamine. Price: \$7.50 for 25' plus s/h.

Woodworker's Supply
800/645-9292

CONTEMPORARY DINING TABLE

by Douglas Stowe



On this dining table, designer and builder Doug Stowe offers a novel solution to the age-old problem of seasonal wood movement. He assembled the “bread-board” ends and tabletop panels with a tenon glued in each corner, but otherwise left the panels free to move. This forces any movement of the wood toward the center, where two lengthwise openings provide sufficient room for expansion.

Editor's Note

We present this table as a companion piece to match the angle-front sideboard featured in the Jan./Feb. '97 Woodworker's Journal. In a future issue, we'll show you how to build the dining-room chairs that complete the three-piece set.

BILL OF MATERIALS

TABLE

PART	T	W	L	MTL. QTY.
A Top panels**	13/16"	19 7/8"	62 5/8"	C 2
B Center divider	13/16"	1 3/4"	64 1/2"	C 1
C Breadboard ends	13/16"	5"	42"	C 2
D Leaves**	13/16"	12"	42"	C 2
E Aprons—side*	13/16"	4"	62 3/4"	C 2
F Aprons—end*	13/16"	4"	35"	C 2
G Cross supports	13/16"	3"	35 1/8"	C 2
H Legs*	1 5/8"	1 5/8"	29 7/8"	C 4
I Leaf support guides	3/4"	1 3/4"	16"	C 8
J Leaf supports	3/4"	2 1/2"	28"	C 4
K Leaf support pulls	7/8"	1"	3"	C 4

*Parts cut to dimension during construction. Please read all instructions before cutting.

**Parts edge-glued from narrow stock.

MATERIAL LIST

C—cherry

SUPPLIES

#20 biscuits; 4—steel glides (3/4" dia.); 4—1/4x2 1/4" lag screws; #8x1 1/4" flathead wood screws; #6x1 1/4" face-frame screws; 3/8" birch dowel; finish; adhesive-backed felt. For other parts, see Source at end.

Working with wide panels of solid hardwood poses an interesting challenge. Wood responds to seasonal changes in humidity and temperature by shrinking and expanding. I learned this the hard way.

The first table I constructed was commissioned by a friend who insisted that I use kiln-dried wood. He'd heard that kiln-dried wood was "stabilized" and wouldn't shrink or swell. Without thinking much about it, I screwed the top directly to the base. After a few rainy days, the top took on the curvature of a small planet.

I did manage to fix the problem, but not without learning some critical lessons about the nature of wood. Since then, I discovered that we can do things that allow wood to expand and contract and at the same time add visual interest to the design.

Rather than use a conventional breadboard-end design in which the tabletop edges expand beyond the breadboard ends during the wet season, and shrink during the dry season, I incorporated a center divider and left a narrow "expansion gap" along both of its edges. Five loose tenons span this gap, floating in mortises without glue. They keep the divider and panels aligned without restricting panel movement.

Look at the Exploded View, and you'll notice that my modified breadboard ends have tongue-and-groove joints that hold the two panels flat. I anchored each panel to the breadboard ends with a single tenon positioned near the outer edge of the tabletop. This way, the panels can expand toward or shrink away from the center divider (*photo A*).

The breadboard ends prevent the panels from warping (as does any conventional breadboard end). They also offer several additional advantages over other designs. For one, they control the direction

of the wood's cross-grain expansion and contraction. For another, the ends of the breadboards always remain flush with the outer edges of the tabletop. And, the tabletop doesn't have those grooves you find in a frame-and-panel top, which typically fill up with crumbs and collect spilled liquids.

Making the Top

I began by planing 5/4 lumber for the top pieces (A, B, C, and D) to 7/8" thick. (I'll finish-sand them to final

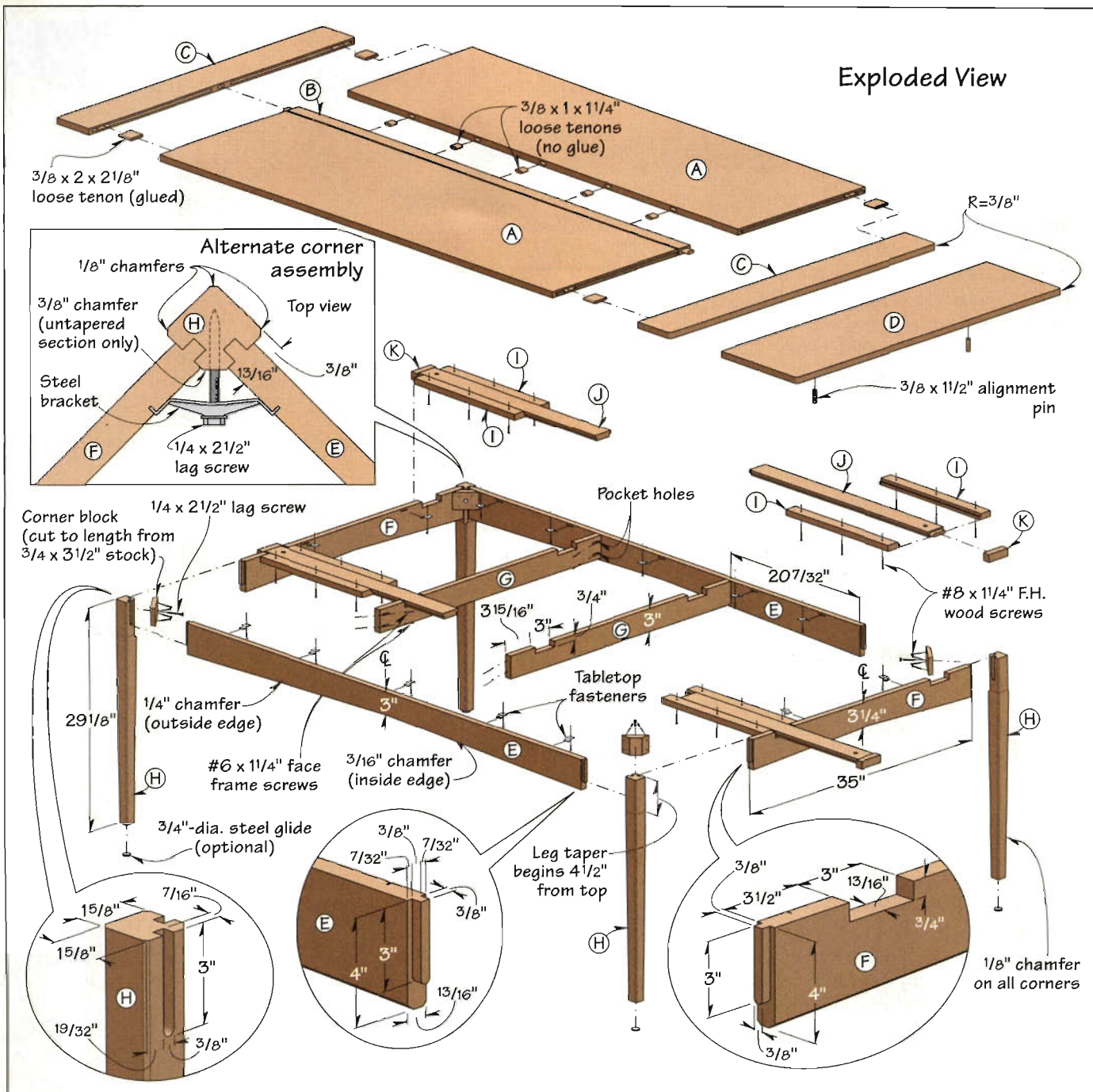
thickness later.) Next, I arranged the boards so that the curvature of the growth rings alternates from piece to piece. This helps minimize the warp that might occur in a wide glued-up panel. I also hid sapwood streaks on the underside, so only clear heartwood showed on top. I suggest you prepare the stock for the aprons (E, F) and the cross supports (G) at this time as well, since they must be machined to the same final thickness.

I edge-glued the two top panels (A) using #20 biscuits to align the boards. I glued up the two leaves (B) at the same time so I could dimension and finish them along with the top panels.

I used a 24" drum sander to bring the top panels, breadboard ends, center divider, and leaves to a uniform 13/16"-finished thickness. In the past, I've belt-sanded similar tabletops, but having uniform panel thickness from end to end and edge to edge makes the job of tenoning the panels much easier.



Photo A: The tabletop's lengthwise center divider with its two expansion gaps adds visual interest and gives the two large panels room to shrink or swell as environmental conditions change.



Next, I cut the panels to width and length as dimensioned in the Bill of Materials. Before cutting the tongues on the panel ends, I used a plunge router and mortising jig (the same jig I used to rout the sideboard in the Jan./Feb. issue) to rout the mortises into both ends of each panel to accept loose tenons. (See *figure 1*.)

Routing the ends of these long panels presented a challenge. To control the router and keep it balanced, I stood the panels on end and clamped them vertically to the workbench.

Next, I attached the jig and stood on a wooden crate to rout the mortises. Fortunately, the top panels require only four of these mortises.

Note: Center the mortises carefully so you can later cut the grooves without adjusting the fence or jig. I pencil-marked start and stop lines along the edge of the breadboard ends, then indexed the cuts from the top face of both ends.

I also used the mortising jig to cut the mortises in the breadboard ends (*figure 2*), and to rout the grooves for

the panel tongues. Note: I cut the grooves slightly deeper ($\frac{7}{16}$ ") than the length of the panel tongues to ensure that the tongues wouldn't bottom out.

Accuracy Critical On Divider Tenons

After mortising and grooving the breadboard ends, I cut the tongues on the panel ends using my handheld router and a piloted rabbeting bit. Again, it's a good idea to test the setup on $\frac{1}{16}$ "-thick scrap first to make sure

the resulting tongue fits precisely in the groove and that the tops of the breadboard ends and panels come together flush.

Next, I laid out and then cut the tenons on both ends of the divider (B) by laying them flat on the tablesaw and cutting away the waste with repeated passes over a dado head. To prevent the stock from tipping or shifting, I suggest you use a tablesaw sled or cutoff box, preferably one that clamps your stock. You'll need to round over the tenon edges so they'll fit the mortises.

Note: The accuracy of your setup for cutting the tenons on the ends of

the dividers is critical. The loose tenons in the table fit into mortises that are indexed off the same face—the divider tenons offer no such luxury. Also, make certain that the distance between the tenon shoulders on the divider and on the top panels match perfectly.

To keep the panels and center divider aligned, I routed matching mortises in the edges of these parts for loose, unglued tenons where dimensioned on the Tabletop drawing. These mortises must align for structural integrity. For a good technique see "How to Rout Matching Mortises" on page 31. I made my

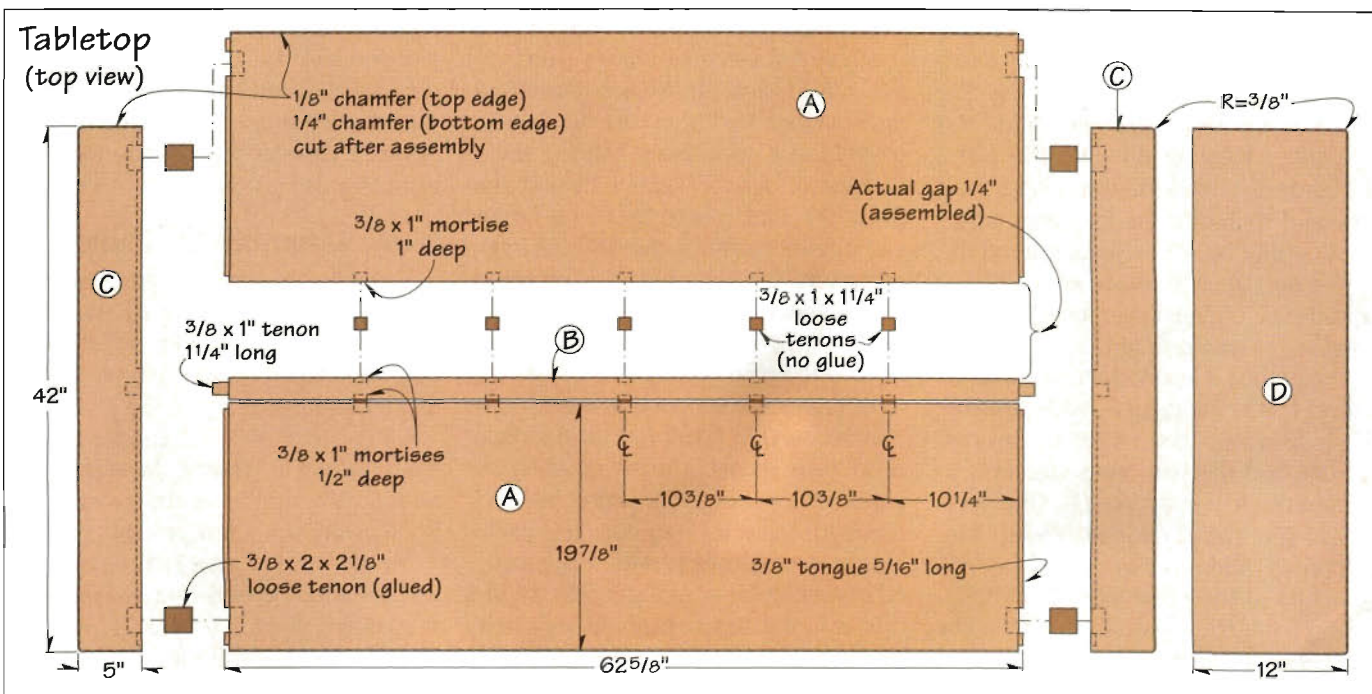
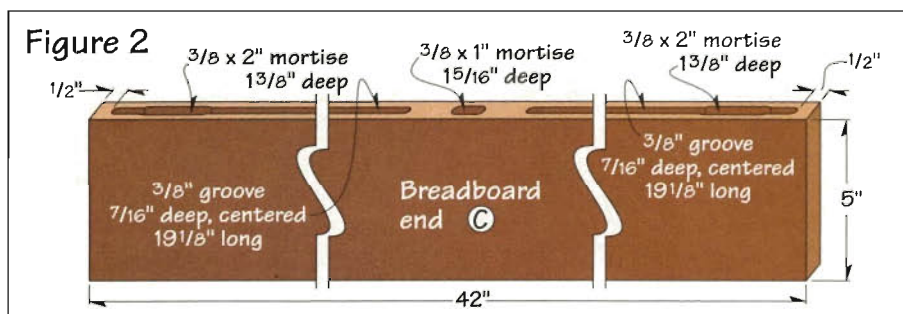
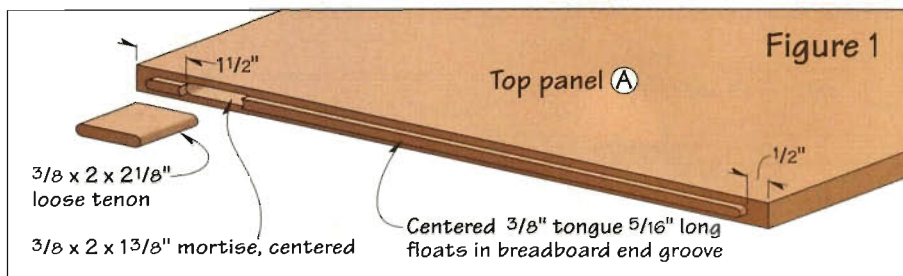
loose-tenon stock by surfacing cherry to $\frac{3}{8}$ " thick, ripping it to 1" wide, and then routing all four edges with a $\frac{3}{16}$ " round-over bit and table-mounted router.

Cut and Taper the Legs

I wanted the table to disassemble easily for moving, so I cut open mortises in the legs and mating tenons on the table aprons. To secure the legs to the table frame, (and also keep the knock-down feature) I installed wooden-corner blocks, then drove lag screws through them and into the legs where shown on the Exploded View.

Note: If you don't wish to maintain the knock-down capability, go ahead and glue up the joints as you assemble the table frame. If you'd prefer to use steel corner brackets (see alternate corner assembly detail), you'll need to cut kerfs in the aprons for the bracket "ears" before assembly. (See Source at end.)

I cut the leg mortises with my plunge router and a $\frac{3}{8}$ " straight bit, but you may prefer to use your table-mounted router for the job. I attached an edge guide to my router to position the cut and clamped a stop block to the leg and bench—this held the leg in place and limited mortise length. I cut the mortises only $\frac{7}{16}$ " deep so as not to weaken the legs.



After you cut the mortises, the legs are ready for shaping. To do this, make a template of the leg taper from a piece of $\frac{1}{4}$ " hardboard cut to the same dimensions as the unfinished leg. Draw a line from one edge, starting $4\frac{1}{2}$ " down from the top, to the bottom end, finishing $\frac{1}{4}$ " in from the edge. Bandsaw just wide of this line, then joint the taper straight. Use this template to lay out tapers on each leg, then cut the leg tapers to match the template. Then, taper all legs to this shape on the jointer. (For an alternate technique, see "Tapering Legs on the Jointer," in the Jan./Feb. '97 issue of *Woodworker's Journal*.)

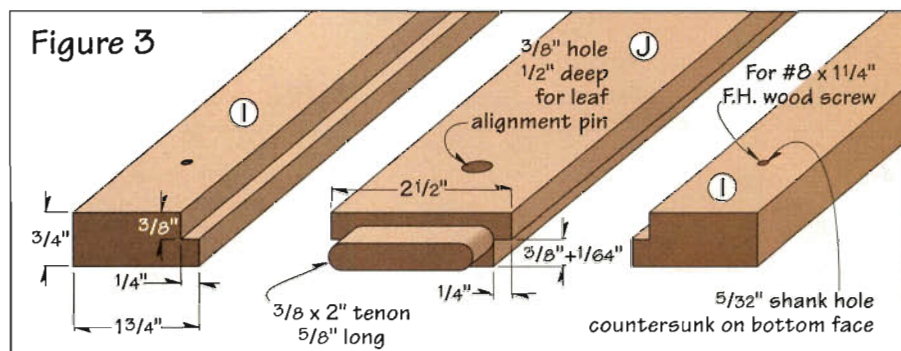
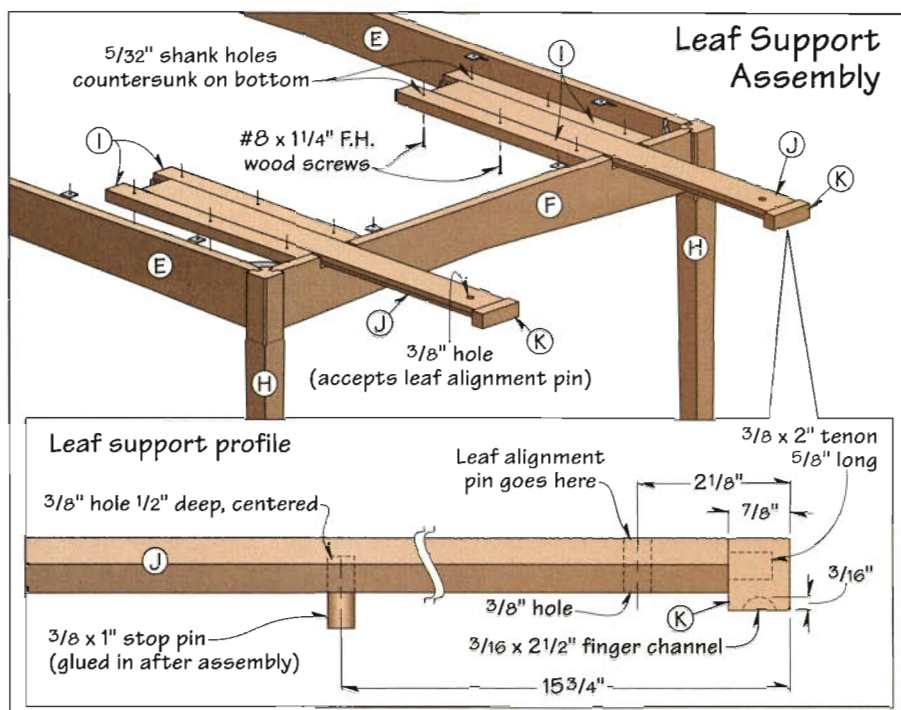
After cutting the tapers, I routed $\frac{1}{8}$ " chamfers on the tapered section of all leg corners. To provide a flat entry surface for the corner-bracket lag screws, I chamfered the inside corner of the top (untapered section) of each leg. (See the corner assembly detail on the Exploded View.)

Make the Aprons and Cross Supports

If you haven't already done so, cut the table aprons (E, F) and cross supports (G) to dimension. Next, cut the apron tenons using the tablesaw and a dado head. With a sharp chisel, round the bottom edges of the tenons to fit in the routed mortises.

I tapered the aprons very gradually from the ends to the centerline. To shape them, I first scribed the lines on each stacked pair of aprons and bandsawed them to shape, keeping the blade just wide of the line. (See the Exploded View for dimensions.) Next, I clamped a straightedge along each line and routed to the line using a pattern-cutting bit. Then, I chamfered the lower outside and inside edges of the aprons as dimensioned on the same drawing to soften them.

Using the tablesaw, dado head, and a cutoff box, I gang-cut 3"-wide notches 1" deep across the edges of the end aprons and the two cross supports to accept the leaf supports (J). (For locations, see the Exploded View.) The supports slide between guides (I) attached to the underside of the tabletop (*photo B*). Next, I cut the eight guides and four supports, then cut a $\frac{3}{8}$ " tenon $\frac{5}{8}$ " long on one end of each



support to attach a pull (K). (See the leaf support profile on the Leaf Support Assembly drawing.)

To make the four pulls (K), I first machined a piece of cherry stock to $\frac{3}{8}$ x 1 x 24". Using the plunge router and jig, I cut four $\frac{3}{8}$ x 2" mortises $\frac{5}{8}$ " deep in one of the 1"-wide faces, spacing them at least 3" apart. Next, I turned the piece 90° and routed 2 1/2"-long finger channels centered in the $\frac{3}{8}$ "-wide edge using a $\frac{1}{2}$ "-diameter core-box bit set to cut $\frac{3}{16}$ " deep. I then crosscut the pulls to 3" long, broke the sharp edges, and sanded them smooth.

To rabbet the supports and guides as dimensioned in *figure 3*, I used a dado head to cut most of the rabbet, then finished with a router, straight bit, and fence to make a clean cut. You could also make multiple passes with a piloted rabbeting bit or straight bit. Cut the rabbet in the supports about $\frac{1}{4}$ " deeper than the mating rabbet on the guides. This will provide clearance for

the leaf support when you attach the guides to the underside of the table.

I drilled a $\frac{3}{8}$ " hole through each leaf support to accept the leaf alignment pin, and a $\frac{3}{8}$ " hole $\frac{1}{2}$ " deep in the bottom face for a stop pin to limit its travel. (See the leaf support profile on the Leaf Support Assembly drawing for their locations also see *photo C*.)

Now, Assemble the Table

I glued and clamped the tabletop first. To do this I inserted the loose tenons dry (without glue) into the mating mortises between the center divider and panels.

Note: I cut these 1"-square tenons from $\frac{3}{8}$ "-thick cherry, leaving them about $\frac{1}{4}$ " short so they wouldn't impede any wood movement.

Next, I spread glue in the top-panel and breadboard-end mortises and on the center divider tenons. The panel tongues float (without glue) in the breadboard end grooves. I inserted



Photo B: The underside of the table. Note how the leaf support slides freely between the two leaf support guides attached to the top. Author also used wooden corner blocks to attach legs to aprons.



Photo C: The two leaves rest on simple, slide-out supports. Note alignment pins and felt strips on leaf underside. Supports have stop pins underneath, finger pulls on ends.

the loose tenons into the mortises in the ends of the top panels, joined these panels and breadboard ends, then used pipe clamps and padding strips to pull the breadboard ends tight while checking the assemblies for square.

After the glue dried thoroughly, I rounded the outside corners of the breadboard ends and the four corners of each leaf to a $\frac{3}{8}$ " radius. Then, I routed a $\frac{1}{8}$ " chamfer along the top out-

side edges of the panels, breadboard ends, and leaves, and a $\frac{1}{4}$ " chamfer along the bottom edges.

Next, I dry-assembled the legs and aprons and secured them using a nylon web clamp. With that clamp in place, I drilled pilot holes and attached the corner brackets to the aprons. Then, I attached the cross supports to the aprons with pocket holes and face-frame screws and cut slots into the

aprons to accept the metal tabletop fasteners. (See the Exploded View for fastener locations.)

For the next assembly, I placed the tabletop upside down, then centered the leg/apron assembly on it and clamped it in place. To secure the top to the aprons, use the metal table-top fasteners. (See Source.) Or if you prefer, use the biscuited buttons I detailed in the sideboard arti-

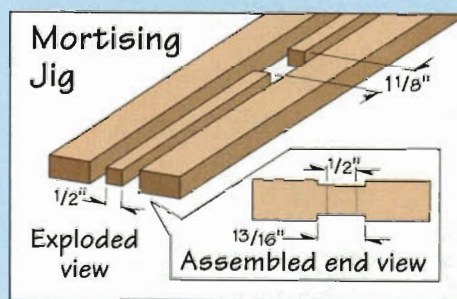
How To Rout Matching Mortises

To accurately position the 20 mortises needed to hold the loose tenons between the center divider and top panels of the table, we recommend you make a slotted jig like the one shown here. The jig provides start and stop points for a bushing-guided plunge router and straight bit.

Start with a straight, flat piece of solid stock approximately $\frac{3}{4}$ x 4" and exactly as long as your center divider, minus the tenons. Joint one edge of the stock and rip the other edge parallel to it. Next, rip a strip off of one edge that's exactly as wide as the outside diameter of your guide bushing (typically about $\frac{1}{2}$ "). Then rip the remaining piece exactly in half.

Layout the mortise centerlines on one of the halves of the jig stock using the dimensions given in the Tabletop Exploded View. Then, locate the slot opening lines across the edge by marking lines $\frac{9}{16}$ " to the right

and left of each centerline. This results in five openings measuring $1\frac{1}{8}$ " long. Cut your $\frac{1}{2}$ "-wide stock to the lengths between the slot marks to make the filler

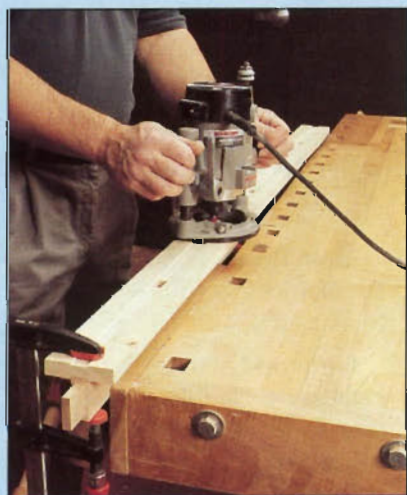


strips. (Note that the two filler strips on the end are slightly longer than the four equal-length center strips.)

Now rip about 12" of $\frac{7}{16}$ "-thick scrap stock to exactly $1\frac{1}{8}$ " wide, and crosscut this length into five pieces about $1\frac{1}{2}$ " long. These will act as spacers. Edge-glue and clamp the assembly with the spacers between the filler strips. Remove the spacers before the glue cures.

After the glue cures, joint one face of the jig and thickness the other, removing only enough material to flatten any irregularities that may have cropped up while the parts were clamped. Finally, rout a centered $\frac{13}{16}$ " groove on both faces the full length of the jig to index and center the stock.

Clamp the jig to the workpiece and rout the mortises using a $\frac{3}{8}$ " straight bit and a $\frac{1}{2}$ " o.d. bushing. When using, index the end of the jig on the same end of each table piece, and the mortises will align perfectly.



Slotted jig ensures perfectly matched sets of mortises for the center divider and panels.

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cle in the Jan./Feb. '97 issue of *Woodworker's Journal*.

Next, I positioned and attached the leaf supports and guides to the underside of the table panels with countersunk #8x1¼" flathead screws (no glue). I placed a 3¾"-wide, 16"-long spacer between the side aprons and outside guide to square the guides to the end aprons so the leaf supports wouldn't bind. I cut four 1" lengths of ¾" dowel for the stop pins, sanded a chamfer on both ends, and glued them into the holes in the bottom faces of the leaf supports.

To locate the two alignment pins on the underside of each leaf, I first pulled the leaf supports out to the limit of their travel and inserted dowel centers in the holes in each pair of supports. Then, I positioned each leaf against the table top, aligned their edges, and pressed down on the leaf supports to mark the center points.

At these points, I drilled ¾" holes ⅝" deep. I cut two 3"-long ¾" dowels, sanded a slight ½"-long taper on both ends of each, then bandsawed two 1⅝"-long pins from each. I chamfered the straight ends, then glued two pins into the holes on each leaf.

I sanded any parts requiring it to 220-grit; then applied the finish. To cushion the contact between the leaves and supports, I adhered strips of adhesive-backed felt to each leaf where it contacts the supports. (See photo C.) Because the table was to stand on a hard-surface floor, I also attached a ¾" glide to the bottom of each leg. 

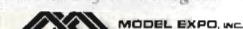
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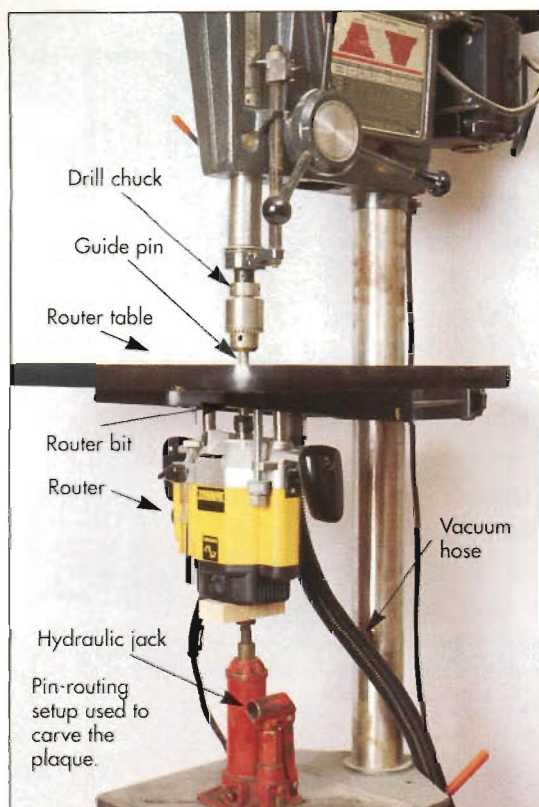
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INVERTED-PIN ROUTING

A Great Way To Make One Or Many Signs

Wooden signs add an elegant, hand-crafted look to any setting. You'll find making them fun and possibly even profitable. Over the years, the router has become the woodworker's tool of choice for sign-making. Its speed, convenience, and precision make for nearly effortless carving, and the ever-increasing variety of bit profiles offered by manufacturers further enhances its usefulness as a creative tool.

Combine the router with a carefully made template, and you have a swift, efficient sign-making system that allows you to cut as many copies as you want. Even changes come easy. If you want to make identical address signs for others on your street, for example, just change the numerals. You can even rout the street address right into a panel of your garage door.

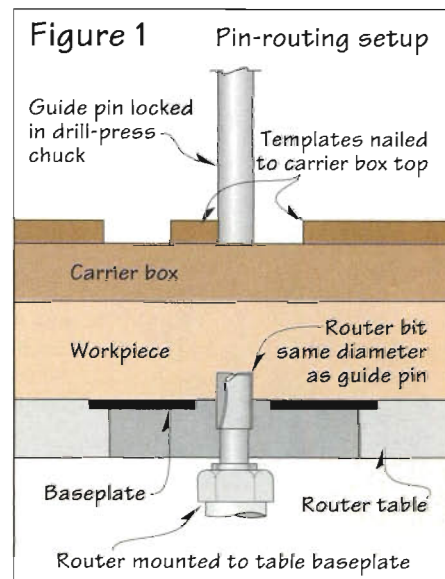
When we planned the routed house plaque project for this issue (*pages 60-64*), selecting the technique for making it was pretty easy. Since few of us have the motor skills to do acceptable freehand letter routing, copy-routing with rigid templates was our clear choice. Once you've made an accurate template, you can hardly go wrong.

Rather than simply cutting letters to depth in the face of the plaque, we opted for the reverse look: three-dimensional letters and borders protruding from a relieved background. This called for selectively removing surface stock from around the letters and borders. To get the professional look we were after, we made full-sized letter and border templates, smoothing away the bumps and rough edges before ever turning on the router. This way, we could rout with confidence, knowing that we'd already refined the errors out of the system.

We considered the available tools in our shop and decided on the inverted-pin routing technique. (See the lead photo.) In our setup, a straight router bit centers directly under a guide pin of equal diameter. (See *figure 1*.) The positions of the bit and pin remain fixed. You move the template and workpiece, *not* the router. When you feed the template along the guide pin, the bit cuts an exact duplicate of the template into the workpiece face. Because the workpiece completely covers the bit at all times, this is also the safest routing system going.

This technique requires a carrier box to hold the workpiece and tem-

plate. You simply tack-nail the individual letter templates to the top of it to form a complete pattern. (For details on how we prepared our templates and carrier, see *pages 60-64*.) Using a same-diameter guide pin and router bit allows you to make all template parts full-sized. This eliminates the calculating you'd have to do to compensate for differences in bit and bushing diameters. Note: For some projects, it may be desirable to use different guide pins and cutter



diameters to make variations of the original pattern.

Our drill press-mounted router table converts to a pin-routing system without any modifications. The drill-press chuck holds the guide pin. (To order this table, see Source at the end of the article.)

Almost any table-mounted router can be modified for use as a pin router. Simply construct a frame or bar above the table that will secure a guide pin and center it over the router collet. Our setup limits the width of plaque one can make to about twice the throat depth of the drill press. A 16" throat, for example, permits you to work a 32"-wide sign. Our drill press had more than enough capacity to handle the 13½x16½" sign we made.

Setting Up Our System

The router table's metal frame clamps to the drill-press column with one bolt. You can position the frame anywhere along the column to set table height exactly where you want it. The router table sits on top and screws to the mounting frame.

After mounting the table, we removed our router's baseplate and

attached the router to the baseplate on the table. (The manufacturer supplies a template for locating and drilling the mounting bolt holes.) After mounting, you drop the plate with router attached into the table opening. The generously sized opening allows us to maneuver our large router (with baseplate attached) through it without removing the handles. A little tweaking quickly levels the plate with the table.

Since we planned to rout the plaque face to depth using several shallow passes, we needed an easy way to raise the router. Inverted-pin routing doesn't require a plunge model, but you do need a way to adjust bit height. We could've used the router's own elevating system but instead opted to go with a hydraulic jack under the router as shown in the lead photo. The drill-press table, which we had lowered earlier to provide room for the router table, provided a perfect platform for the small jack. By leaving the router's plunge mechanism loose, we could raise the router motor simply by pumping the jack.

For pin-routing, the guide pin must be positioned squarely over the router bit. To align them, first make certain that the drill head is tight on the column. Next, lock one end of a ½" guide pin (or ¼", depending on your router's collet) into the drill's chuck and lower the quill. Move the router table around until you can insert the free end of the guide pin squarely into the router collet. When these parts align, tighten the screws to lock the table in position. Do not move either part or disrupt this alignment.

Prepare the Router

After aligning the chuck and collet, raise the drill-press quill to lift the guide pin out of the collet. Lock the router bit you'll use in the collet and elevate it until the top is level with the table surface. Note: As with other routing tasks, we find that we get better results (and also ease the wear on router bits) by making multiple shallow passes. We routed our house plaque (shown on page 60) in three ⅛" increments, then finished with a very shallow (⅓₂") cleanup pass.

Note: If you wish to give the background a hand-carved look, skip the

TEN RULES FOR YOUR SAFETY

Before attempting any new or unusual router application, familiarize yourself with the general operation and handling of the tools involved.

- 1** Read the operator's manual to learn the tool's applications, limitations, and potential hazards.
- 2** Disconnect the electrical cord from the power outlet before mounting the router, changing a bit, making adjustments, or adding/removing any router accessories.
- 3** To avoid accidental motor starts, make certain you've set the switch to "Off" before plugging in the cord.
- 4** Before using a router, double-check the bit to see that it's secure in the collet. Place three-fourths of the shaft length in the collet. The end of the shank should be about ⅛" from the collet bottom.
- 5** Use a router table, fence, guide pin, and, whenever possible, a bit guard. Secure the router to the table before using.
- 6** Wear eye and ear protection. Loose clothing, jewelry, and unconfined hair pose hazards during any power tool operation. Use a respirator or dust mask if necessary.
- 7** Use only sharp, clean bits. Discard damaged or unsafe bits.
- 8** Make shallow, incremental cuts to avoid damage to the bit and chipout on your workpiece.
- 9** Feed the workpiece against the rotation of the bit. Never force the workpiece or overload the bit or router.
- 10** Reduce motor speed for bits over 1¼" in diameter.

shallow cleanup pass. Instead, remove small chips from the background using a small, palm-type carving chisel. To texture or stipple the surface, we've found that leather-working tools work well.

Lock a guide pin of the same diameter as the bit in the drill chuck. Since the minimum letter spacing on our pat-



Photo A: To use the inverted-pin router, place the plaque blank in the carrier box, lower the guide pin to the carrier, and elevate the router bit. Then, maneuver the carrier and templates around the guide pin.

tern was $\frac{3}{16}$ ", we made the first cuts around and between the letters using a $\frac{3}{16}$ " straight bit. After routing the detail work, we switched to a $\frac{1}{2}$ " straight bit and pin to clean out the large open areas. Note: Always change guide pins when you change bits and check to make sure their diameters match.

Wood chips and dust eject downward through the baseplate opening. To keep the operation neat, install a dust collector on the router if it has one, or rig up a vacuum system under the table. (The DeWalt router we used has a collector that mounts on its base.) Dust removal on our setup was more efficient once we

removed the smaller insert ring from the baseplate.

Rout the Plaque

Figure out how much you'll need to adjust the router to elevate the bit to first cutting depth ($\frac{1}{8}$ "). With our system, we simply had to determine how many times to pump the jack so we could duplicate this elevation after starting the router.

Mount the plaque blank in your carrier box. We made our carrier fit snugly around the blank; if yours doesn't, place small wedges between the blank and the carrier walls. Place the carrier on

the router table with the pattern side up, sign face down. Lower the chuck until the guide pin touches the surface, then raise it about $\frac{1}{16}$ ". Now, lock the quill in that position (*photo A*).

Position the guide pin a safe distance from any letter or border, turn on the router and vacuum, and then elevate the bit $\frac{1}{8}$ " to plunge it into the workpiece. Maneuver the carrier, letting the guide pin follow the contours of the letters, numerals, and borders.

Feed the workpiece against the rotation of the bit (clockwise for a table-mounted router), moving from a routed area toward uncut wood. We routed

BITS FOR SIGN AND PLAQUE CARVING



Ball-bearing guides. Pilotless bits can be converted to top bearing bits for pattern and template duplicating. By selecting bearings with different diameters, you can alter the bit's cutting depth or offset. Install the bearing and collar over the shank as shown and tighten the set screws in the collar with a hex wrench.



Straight bits. They cut straight walls, flat bottoms, and adapt to a variety of uses. They come in a full range of diameters and lengths. Some can be purchased with guide bearings attached.

Bits (left to right): $\frac{1}{4}$ " hinge-mortising (2), $\frac{1}{2}$ " flush-trim (2), $\frac{3}{4}$ " straight (2), 1" pattern-cutting (2).



Lettering and edging bits. The first four "lettering" bits make interesting special-effect cuts for incised letters and grooves. Available sizes and shapes vary with the manufacturer. We use edge-treatment bits such as the chamfering (shown), round-over, cove, Roman ogee, bullnose, and beading to finish sign edges. They're offered in many shapes and sizes, both with and without guide bearings.

Bits (left to right): $\frac{3}{8}$ " ovolo (1), $\frac{3}{4}$ " V-groove (2), 1 1/4" 60° lettering (1), $\frac{3}{4}$ " Ogee (1), 1 1/4" 30° chamfering (1).



Round-nose bits. These bits cut decorative, round-bottom slots and grooves. They work the best for cutting attractive incised letters in a sign's surface. Available in standard diameters and with a variety of cutter lengths.

Bits (left to right): $\frac{3}{4}$ " core-box (2), $\frac{1}{4}$ " veining (2), $\frac{1}{2}$ " round-head (1)*.



Side- and bottom-cutting bits. We've found these bits very useful for pin-routing applications. They cut straight walls and flat, extra-clean bottoms. The dish cutter forms a straight edge, rounded corner, and a flat bottom in one pass. Selection of cutter diameters and lengths is limited.

Bits (left to right): $\frac{3}{4}$ " dado cleanout (2), 1" dish cutter (2), $\frac{3}{4}$ " bottom-cleaning (2).

*Bit Source: 1—CMT Tools; 2—MLCS

You can use a number of different router bits to carve signs and plaques, and new ones are being designed every day. The photos *above* show bits that we've used for this purpose in our shop. If you're not sure how a bit's profile will look, test it first, trying it in different diameters and depths.

We generally prefer carbide-edged bits over those made of high-speed steel. Carbide bits cost more, but they hold their edges longer and will take more sharpenings. You'll find that carbide quality varies with the manufacturer, but let usage dictate your selection: for your most-often-used bits, spend the extra money to buy better quality. If you work frequently with hardwoods or manmade materials such as particleboard, MDF, and plastic laminates, make carbide bits your choice.

Whenever possible, buy $\frac{1}{2}$ "-shank bits. They're stronger and less apt to deflect, bend, or break than their $\frac{1}{4}$ "-shank counterparts. If you don't have a $\frac{1}{2}$ " collet, buy one if it's available for your router.

Several manufacturers now offer anti-kickback bits. This design limits the cutter "bite" and reduces the chance of kickback, making them safer to use. We find this feature especially desirable on large, open cutters like round-over, rabbet, cove, and similar edge-treatment bits, and we recommend them especially to less experienced operators. Other factors, such as number of cutting edges (single or multiple), cutting angle, hook angle, end relief, body or side clearance, and finish can make a difference in how a bit performs and wears.

Carving a plaque using the inverted-pin routing technique described in this article does not require guide bearings on the router bits or guide bushings on the router base. Other template-routing applications, however, do require them. You can buy bits with bearings permanently attached, but they usually cost more than those without. A less costly option for some applications is to buy bearingless bits and attach a bearing when it's required. Most manufacturers offer bearing kits for both $\frac{1}{4}$ " and $\frac{1}{2}$ " shanks that include a selection of outside diameters. (See photo 1.)

around the perimeter of the border and letters, cutting across the grain first wherever possible, then with the grain. We left tight corners and intersections until last to minimize chipout along these edges. Note: Remember to rout the interiors of closed letters such as D, O, and P.

After you've routed around all letters and borders, raise the bit another $\frac{1}{8}$ " and repeat the operation. Then, raise the router a third increment and rout again. When you think you've routed around all parts, stop the router, raise the quill, turn the carrier over, and examine the plaque for missed areas. If you need to, replace the carrier, reset the quill, and rout those areas. Following a specific route can help you minimize misses.

To speed routing of the waste from the large background areas, switch to a larger guide pin and matching straight or bottom-cleaning bit. We used a $\frac{1}{2}$ "-diameter pin and $\frac{1}{2}$ " dado clean-out bit for this. Note: The same-sized pin protects the work because it prevents the bit from passing between any templates that are spaced less than $\frac{1}{2}$ " apart. Repeat the routing procedure, this time cleaning out the uncut template areas. (For details on routing and shaping the plaque's arc, see *page 63*.)

If you want to shape the plaque's outside edge, remove the plaque from the carrier. Mount a suitable piloted bit in the router collet, then rout around the perimeter using the same technique you'd use on any other workpiece—end grain first, then edge grain. 

Photographs: Kevin May

Produced by: Charles Sommers

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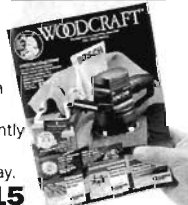
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A CRAFT SCHOOL VACATION

by Charlotte LeGates

A couple of weeks at "summer camp" can hone your woodworking skills and inspire your creativity

At one workbench, a professional chef inserts an oak strip between two pieces of walnut to define a cabinet joint. At the next, a computer software designer cuts her first dovetails. Across the room, a third student attaches a laminate to his music stand. It's the second week of Michael Pierschalla's wood workshop at the Penland School of Crafts near Penland, North Carolina, and participants are busily turning ideas into furniture.

For weekend woodworkers who want to use their vacation to build skills and creativity, "Penland means instant empowerment," says instructor Pierschalla, who conducts several summer workshops and a more intensive eight-week session at the North Carolina institution. By showing students what they can do with a sharp chisel and plane, he tries to "demystify woodworking."

Students respond. They arrive with partially formed notions about simple chests and hall tables, or, in the case of the more ambitious, frame-and-panel cabinets. They leave with well-crafted, expressive pieces that most never dreamed they could create.

A School For Exploring

Penland is one of several independent schools throughout the United States that bring experienced artisans together with novices and hobbyists to explore such crafts as printmaking, pottery, weaving, metalworking, glassblowing, and papermaking. Its rustic, summer-camp accommodations and simple but well-prepared meals help keep fees in a range that's



The woodshop at Penland School of Crafts. Nestled in the Appalachians of North Carolina, the school provides a setting that inspires creative woodworking.

accessible even to limited budgets.

As a result, Penland attracts a wide variety of participants. Father-and-daughter glass blowers and a couple pursuing weaving and ironmongery mingle in the communal dining hall with college-age art students, middle-age singles, and retired seniors.

Each of Penland's summer wood workshops, which last from seven to 17 days, accommodates up to 10 students. They work in a shop equipped with first-quality planers, tablesaws, and jointers, assorted sanding equipment, and the usual array of small power and hand tools.

Woodworking instructor Michael Pierschalla lectures, demonstrates, and works one-on-one with students.

Complementary Teaching Approaches

Pierschalla and assistant instructor Steve Tengelsen make sure that students get individual attention. The two also complement each other. "Michael is the purist," comments Howard Greene, a disabled veteran who recently traded cattle for goat-raising on his Tennessee farm. "He emphasizes hand methods. Steve prefers to get it done well but quickly using power tools."

The two instructors will often demonstrate contrasting methods for reaching similar ends—chopping mortises by hand with a chisel, for instance, versus machining them with a router. As a result, students develop a clearer understanding of their choices when they approach future projects.

Finding Penland

Woodworkers often discover the school through hearsay from friends who've attended non-woodworking sessions. Carolina Beach dentist Vince Smith scoped out Penland's woodworking facilities while spending two days there with his wife, Vicky, who had enrolled in a pottery course. He returned later for the wood workshop because it matched his intermediate-level woodworking skills and luckily coincided with the next pottery class Vicky planned to take.

The Penland environment appealed to Smith, who finds the book-learning approach to techniques frustrating. "I learn much faster when someone actually demonstrates and explains it to me," he says. Take his attempt to follow the knife-changing instructions that came with his new jointer. "I was lost," he admits. That changed once Pierschalla demonstrated the process and then had Smith practice on his own. "It's not hard once you know where you're going and how to check your work," says Smith.

Knife-changing wasn't the only new skill Smith acquired. "I learned how to use a biscuit joiner and how to com-



Workshop participant Vince Smith confers with instructor Pierschalla about gluing up his telephone table.



bine a bandsaw cut with jointer cleanup to produce straight lines," he adds. His mahogany and purpleheart telephone table called for a number of challenging taper cuts, but over the course of the workshop, he found that the challenge gradually gave way to mastery. "After you do those tapers 20 times," he observes, "you get them down pat."

A Place To Explore Design

For those who have never before worked with a nationally known designer who integrates shop techniques with expression and creativity, Pierschalla's workshops are a revelation. Focusing on students' sometimes rudimentary sketches and half-articulated concepts, he asks questions and suggests directions to help them develop projects that fit their individual skill levels and the workshop's duration.

"You want to think about the human form," he says to one student who has been drawing the same design over and over, to his own dissatisfaction. "Look at a photograph and trace the essential lines—the trunk, the torso, the limbs. Let someone else's decision guide you. They've already posed the model. Now, think about what you can reduce it to." In a few hours, the student returns with regenerated sketches.

Tengelsen, who during most of the year executes commissioned bookcases, tables, and kitchen cabinets in his studio/shop near Penland, tries to

help students balance the search for perfection with the satisfaction of completing projects. Asked how the woodworker knows when to stop sanding, he replies, "the day before you have to deliver the piece to the customer." Tengelsen encourages students to try new tools and techniques and build skills that will give them satisfaction in the short term as well as over a lifetime of woodworking.

Using Plans

Pierschalla and Tengelsen work not only with those who want to build their own designs but also with those who arrive at the workshop with plans from books or magazines. "Copying is a good tool in the educational process," Pierschalla says. "It was the classic form of art education in the past. We see talented builders today who are not interested in innovation but who are satisfied making beautiful objects designed by others." He cites as an example a harpsichord maker in Boston with whom he has worked extensively.

Still, Pierschalla tries to help workshop participants **integrate** their own ideas into the plans of others. "If people want to make copies, I'll help

them make good copies," he says. "But I'll also show them why the instructions they start out with are only half a set. You can't make something by hand," he concludes, "without revealing things about yourself."

The workshop's two weeks pass all too quickly for most students, but their effect is long-lasting. For one participant, Pierschalla's demonstration of the cabinet scraper opens a whole new approach to smoothing wood. For another, his homemade iron-and-vinegar solution brings a historic dimension to ebonizing. Pierschalla's techniques for recovering from sawing mistakes give hope to those who haven't yet learned to "measure six times before cutting."

Not every lesson takes, of course. During the second hour of the hand-cut dovetails demonstration, one student mutters "somewhere out there

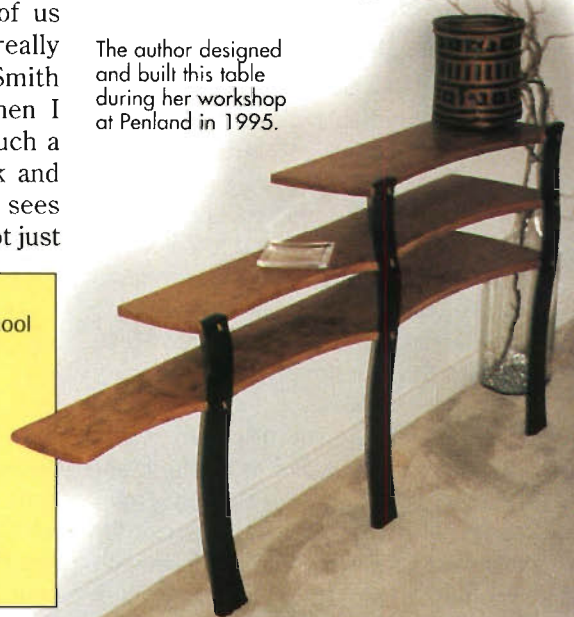
are a router and dovetail jig with my name on them."

Still, it's all but impossible to leave Penland without new attitudes and a new enthusiasm. "How many of us take learning vacations and really enjoy them?" Greene asks. Smith amplifies the point: "Before when I built projects, I was always in such a hurry that I refused to go back and correct mistakes." Today, he sees woodworking differently: "It's not just

a matter of getting it done, but of doing it right."

He's among the many who will return to Penland. 

The author designed and built this table during her workshop at Penland in 1995.



For information on the Penland School of Crafts, contact the director:

Ken Botnick

Penland School of Crafts

Penland, NC 28765-0037

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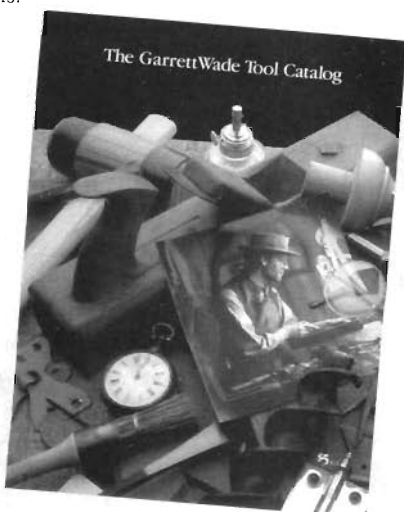
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202/223-4449
E-mail: rgould@nas.edu

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If anybody knows where I can get plans for a kiln to dry approximately 100 to 500 board feet of lumber, I'd like to hear from you.

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Before You Start

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The construction-grade cedar you find may have a high moisture content and will probably have knots. To avoid stability problems later on, buy the lumber ahead of time and let it acclimate to your shop for a couple of weeks. If you have to buy stock with knots, try to avoid the large, loose ones. You can putty knots that loosen up in the course of acclimating with a product such as P. C. Woody, an epoxy paste that contains fine wood dust. Once dry, it sands well and accepts stain, although the filled areas will likely go darker than the surrounding wood.

We designed the arbor to break down into three parts for easier storage. (See *photo A*.) If this feature doesn't interest you, we suggest pegging and/or gluing the bridle joints for greater stability. Also, anchor the arbor to the ground with steel rods or lengths of $\frac{1}{2}$ " electrical conduit attached to the post grooves with galvanized or stainless-steel screws.

First, Let's Prepare the Posts

Step 1. Joint and plane four 4x4x96" posts (A) to $3\frac{1}{2}$ " square. Select the best pair of adjacent faces on each post and mark these two faces "X" and "Y," as shown in *figure 1*, to establish their position. (Also see the top view detail that accompanies the Exploded View drawing on the *page 46*.) Square one end of each post, then crosscut the other end to 84" long.

Step 2. Groove the posts. To do this, first mount a $\frac{3}{4}$ " dado head on

BILL OF MATERIALS

FRAME

PART	T	W	L	MTL.	QTY.
A Posts*	$3\frac{1}{2}$ "	$3\frac{1}{2}$ "	84"	C	4
B Crown rails*	$1\frac{1}{2}$ "	$7\frac{1}{2}$ "	60"	C	2
C Gussets	$1\frac{1}{2}$ "	$5\frac{1}{2}$ "	$12\frac{5}{8}$ "	C	4
D Purlins*	$1\frac{1}{2}$ "	$3\frac{3}{8}$ "	31"	C	5
E Caps	1"	5"	5"	C	4

LATTICE

F Side rails	$\frac{3}{4}$ "	$3\frac{1}{2}$ "	$20\frac{1}{4}$ "	C	2
G Lattice 1	$\frac{3}{4}$ "	$\frac{3}{4}$ "	$20\frac{1}{4}$ "	C	18
H Lattice 2	$\frac{3}{4}$ "	$\frac{3}{4}$ "	16"	C	10
I Lattice 3	$\frac{3}{4}$ "	$\frac{3}{4}$ "	48"	C	4
J Lattice 4	$\frac{3}{4}$ "	$\frac{3}{4}$ "	32"	C	4
K Lattice 5	$\frac{3}{4}$ "	$\frac{3}{4}$ "	30"	C	2
L Lattice 6	$\frac{3}{4}$ "	$\frac{3}{4}$ "	15"	C	2
M Lattice 7	$\frac{3}{4}$ "	$\frac{3}{4}$ "	14"	C	4

*Parts cut to final size during construction. Please read all instructions before cutting.

MATERIAL LIST

C—cedar

SUPPLIES

#8x2" brass or stainless-steel flathead wood screws; #8x2 $\frac{1}{2}$ " flathead wood screws; 4d galvanized finish nails; anchoring rods; polyurethane glue; putty or caulk; oil-based primer and enamel or sealer.



Photo A: Three parts make up our arbor—two lattice sides and the crown assembly. Tongues cut into the crown rails fit into slots centered on the post ends. The resulting notched bridle joints make the structure stable without screws or other fasteners.

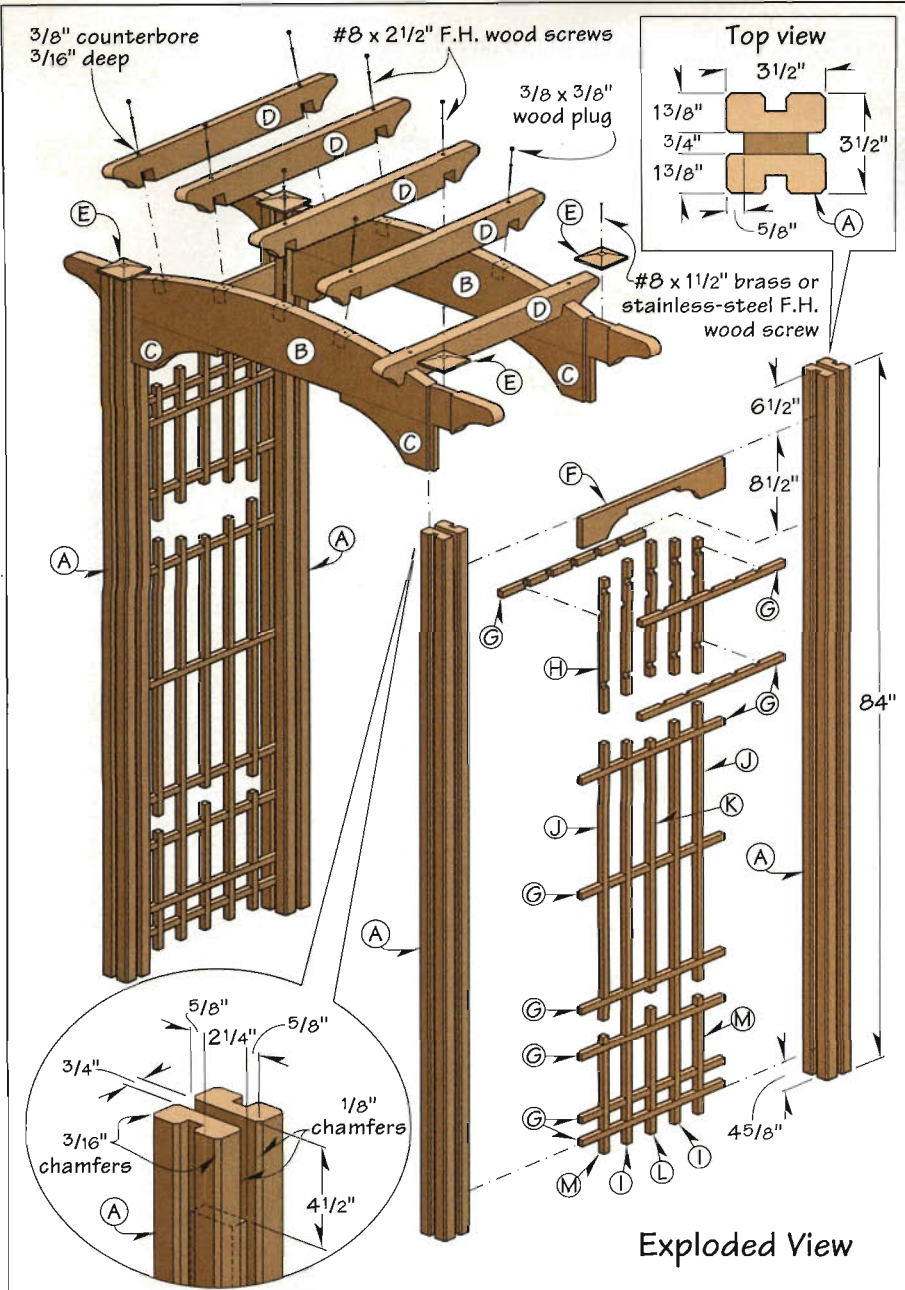


Figure 1 Post positions

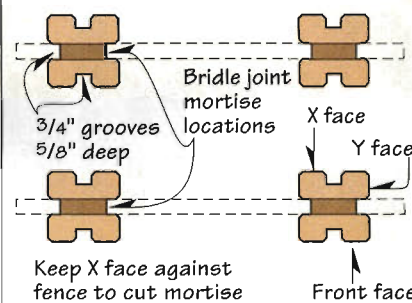
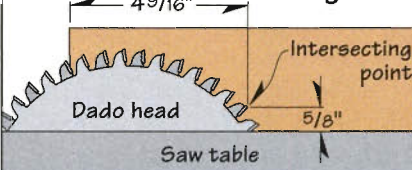


Figure 2



forward until its leading edge reaches the stop. Slot the remaining three posts this way.

Step 4. Using a hand saw, finish the cut to the bottom of the bridle joint mortise by sawing along both edges of the slot as shown in *photo B*. Chop out the waste between the kerfs with a chisel and mallet to square the bottom of the mortise.

Step 5. Using a chamfer bit and a handheld router, cut a $\frac{3}{16}$ " chamfer along all four outside edges (not the ends) of each post. Cut smaller ($\frac{1}{8}$ ") chamfers along both edges of each post groove. Note: Cedar splinters easily, not only as you work it in the shop, but as it ages. Chamfering the edges minimizes this problem and improves the posts' appearance.

your tablesaw and elevate it to cut $\frac{5}{8}$ " deep. Set the rip fence to center the dado on the face of a post. To cut the first pair of opposite grooves (and the ones that will be mortised for the bridle joints), first place the "X" face against the saw's rip fence and cut the groove. Next, flip the post end-over-end, place the same marked face against the fence, and groove the second face. Groove the remaining two faces by placing the "Y" faces against the fence and following the same procedure. Note: Using this approach ensures that the grooves you cut into the posts will align the bridle joint.

Step 3. Without moving the rip fence, cut a $\frac{3}{4}$ "-wide, $4\frac{9}{16}$ "-deep bridle joint mortise in the top end of each post. To do this, raise the dado head to its full height. On one face of a scrap 1x4, scribe a 9"-long line $\frac{5}{8}$ " up from the bottom and a vertical line $4\frac{9}{16}$ " from the end. Next, position this piece alongside the dado head parallel to the fence and slide it forward until the front of the dado blade aligns with the point where these two lines intersect. (See *figure 2*.) Clamp a stop to the rip fence marking this forward position of the scrap piece. Now, place the "X" face of one post against the rip fence, turn on the saw, and slide the post

Make the Crown Rails And Gussets

Step 1. Face-joint and plane two 62" lengths of 2x8 stock for the crown rails (B) and a 26" length of 2x6 for the gussets (C) to $1\frac{1}{2}$ " thick. Next, crosscut the gusset stock into two $12\frac{5}{8}$ "-long pieces. Trim the 2x8s to final length.

Step 2. Cut a tongue on one end of each gusset as dimensioned on the Frame Parts drawing *opposite*. Note: For safety reasons, we recommend you use a sliding crosscut box on your tablesaw to cut these tongues and also the tenons on the crown rails. (See *Woodworker's Journal* Nov./Dec. '88,

Frame Parts

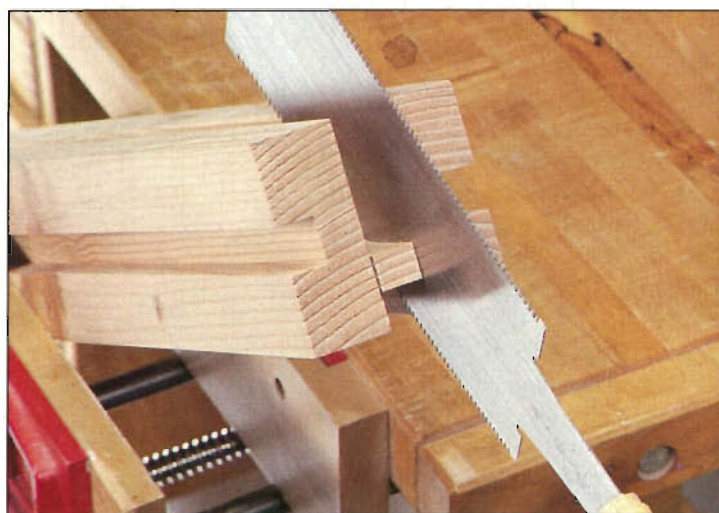
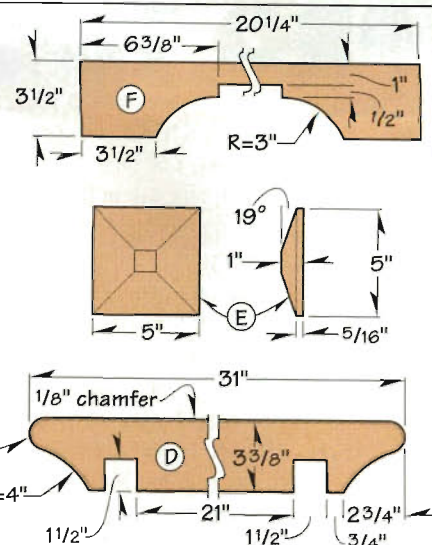
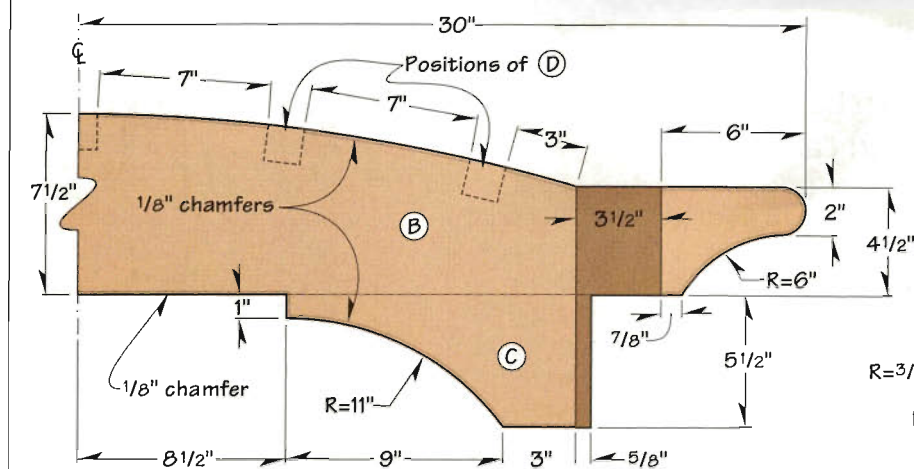


Photo B: Using the dado walls to guide the hand saw, complete the slot cuts in the post ends.

Figure 3

Cutting the crown-rail tenons

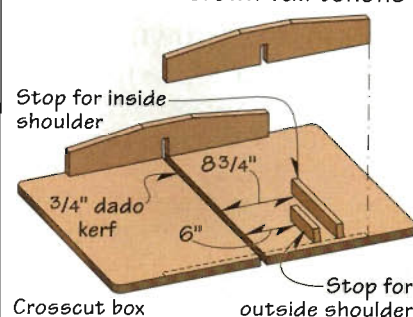
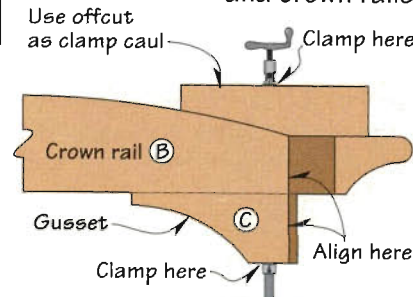


Figure 4

Aligning and clamping the gussets and crown rails



pages 32-33 for details on making this fixture.) Cut a test tongue on scrap first. Remove material equally from both faces of the stock and sneak up to the proper thickness—you want a sliding rather than snug fit in the post slots for the breakdown capability. When you're satisfied with the tongue's fit in the groove, cut tongues on the four gussets. Save this dado-blade setting for the following step.

Step 3. Again using the crosscut box, dado-cut the tenons on the crown rail blanks to fit the bridle mortises of the posts where dimensioned on the Frame Parts drawing. (The length of these pieces made it hard to hold them flat on the saw table. We set up a support alongside the table-saw by clamping a 36"-long 1x6 on edge in a folding table to support the workpieces while making these cuts.) To complete this operation, set a stop

6" from the blade as shown in *figure 3* to establish the outside shoulder of the tongue. When test-cutting the tenon on scrap, make several passes across the dado head to clean out the material. Sneak up to its final width by test-fitting it in the post's slot as you work. Once you're satisfied with the fit, set a second stop on the crosscut box to limit the tongue's width. Then, cut the tenons on both ends of the crown rails.

Step 4. Using a compass, trammel points, or flexible straightedge, scribe the arched profiles of the crown rails and the gussets as dimensioned on the Frame Parts drawing. (For help in laying out the long arc on the crown rail, see the Pro Tip on the *page 48*.) Next, stack the two pairs of parts using double-faced tape, then band-saw each to shape, keeping the blade just wide of the line. Sand to the line.

Note: Save the waste pieces from the top edge of the crown rails to use as clamping cauls in the next step.

Step 5. Glue and clamp the gussets to the crown rails where shown on the Frame Parts drawing. (We used polyurethane glue.) Note: Align the tongues carefully, both lengthwise and side to side. As shown in *figure 4*, we used the waste pieces from the previous step as clamping cauls. Allow the glue to dry, then sand the joints flush.

PRO TIP

A flexible straightedge can help you draw long curves such as the one required on the crown rail. First locate the coordinate points for the ends and center of the arc, measuring from the centerline and bottom edge of the blank. (See the Frame Parts drawing.) Next, drive a small finish nail in the waste area $\frac{1}{4}$ " above each point. Position a 1×48 " strip of strong but flexible $\frac{1}{4}$ "-thick stock against the nails. Apply pressure to the centerline to bow it uniformly against the center nail. Then, hold the strip firmly in place and trace around the inside of it.

Make the Purlins, Then Assemble the Crown

Step 1. For the purlins (D), cut five 31" lengths of 2×4 stock. Surface these blanks to $1\frac{1}{2}$ " thick, then joint and rip them to finished width. Lay out the notches in the purlins where dimensioned on the Frame Parts drawing. Dado-cut the notches.

Step 2. Lay out the end profiles on the purlins. Bandsaw and sand them to shape.

Step 3. Rout a $\frac{1}{8}$ " chamfer on all edges (excluding the notches) of the five purlins. Also, chamfer the edges of the crown rail/gusset assemblies—except for the curved profile on the top edge and the tongues—where shown on the Frame Parts drawing. (You'll hand-chamfer the top edge after assembling the crown.)

Step 4. Using a drill press and fence, counterbore and drill shank holes through the notched area of each purlin (centered on the notches) where shown on the Exploded View drawing.

Step 5. Mark the locations of the purlins on the two crown rails. (See the Frame Parts drawing.) Dry-assemble the purlins and crown rails. Next, using the shank holes in the purlins as guides, drill pilot holes in the rails. Glue and screw the purlins to the crown rails. Now, using a file or rasp, chamfer the top edges of the crown rails (between the purlins) to match the routed chamfer.

Step 6. Cut ten $\frac{3}{8} \times \frac{3}{8}$ " face-grain cedar plugs. Glue them into the counterbored holes in the purlins, then sand them flush.

Machine the Post Caps And Lattice Pieces

Step 1. Resaw or surface enough of your leftover stock to 1" thick to make four 5"-square blanks for the post caps (E). Cut the squares, then drill a centered countersunk shank hole for a #8 flathead wood screw through each. Scribe a line around all four edges of each cap $\frac{5}{16}$ " from the bottom face.

Step 2. Sand the caps to the profile shown in the Frame Parts drawing. To do this, tilt the table on your stationary belt sander to 19° from horizontal (*photo C*). Attach a carrier block to the bottom face of each cap to hold it square to the table. Sand the top face to the $\frac{5}{16}$ " line on all four edges. You can also bandsaw these beveled facets.

Step 3. You'll need about 12 linear feet of 1×8 cedar for the lattice pieces, but cut some extra to allow for knots. Note: Four pieces must be at least 48" long. Surface the rough stock to $\frac{3}{4}$ " thick, then cut a 21"-long piece and set it aside. Rip the remaining material into $1\frac{1}{16}$ "-wide strips, then surface the ripped edges to $\frac{3}{4}$ " to square them.

Step 4. To determine the actual length of the side rails (F), dry-assemble the crown and four posts. Measure the distance between the posts on one side from groove to groove. (Ours measured $20\frac{1}{4}$ ".) Rip two rail blanks to width from the piece you set aside,

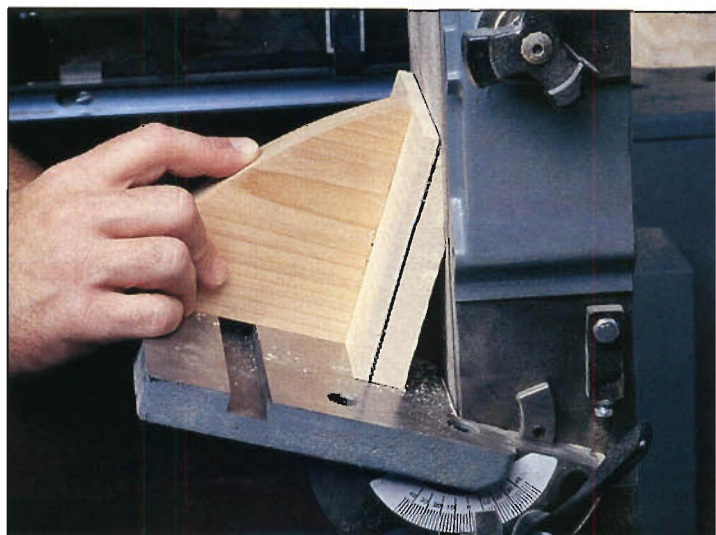
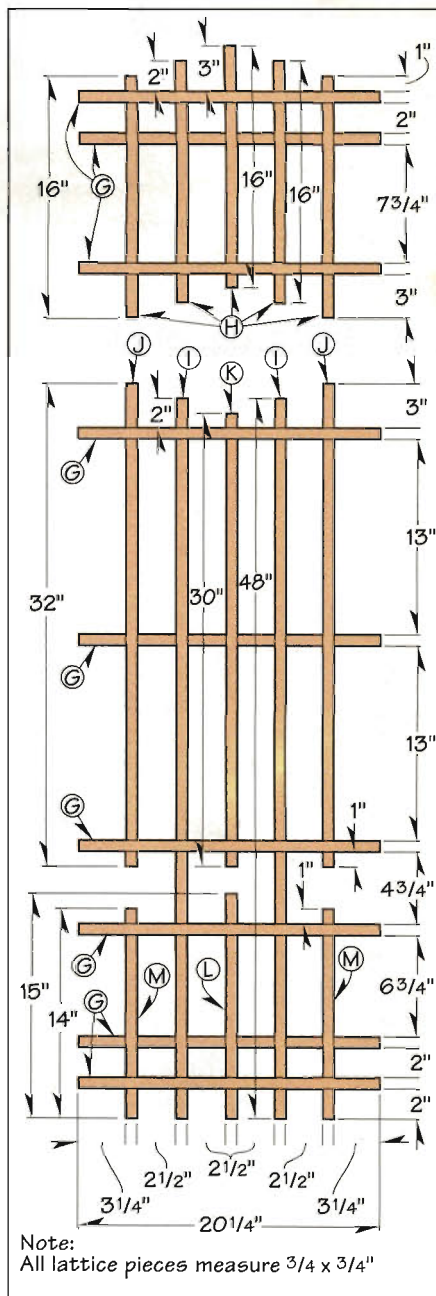


Photo C:
Sanding the caps to profile using the stationary belt sander.

then crosscut them to the measured length. Note: You'll also crosscut the horizontal lattice pieces (G) to this same length.

Step 5. Lay out the profile on one side rail blank as dimensioned on the Frame Parts drawing. Stack the two blanks using double-faced tape, then bandsaw and sand them to shape.

Note: Before cutting individual lattice pieces, study the Lattice Assembly drawing *opposite*. The lattices are interwoven using half-lap joints. Because they are symmetrical, many of the pieces can be ganged and dadoed at the same time. For example, the horizontal pieces are the same length and their half-lap locations are identical, even though they alternate front to back. Also, you can save considerable measuring time and accurately position the half-lap dadoes by setting the rip fence for one set of cuts, using several spacers with the rip fence to index other cuts, and rotating pieces end for end to repeat identical cuts on the opposite end.

Step 6. Cut the lattice parts to the lengths specified on the Bill of Materials. (We cut the longest lattice pieces first.)

Step 7. Lay out the parts for both lattices on the floor or bench top as they appear on the Lattice Assembly drawing. Make sure you alternate the top-bottom-top positions of the horizontal pieces (G). To avoid errors, mark the face to be notched on every piece, and always make certain the marked face is down when dadoing.

Step 8. Before cutting any parts, rip one 6" length of scrap to 3 1/4" wide, a second to 2" wide, and a third to 1" wide to use as spacers. Next, mount a 3/4" dado head on your tablesaw, setting it to cut 3/8" deep. Test the width and depth on scrap lattice stock to make sure the lapped pieces will fit flush when joined together.

Step 9. Dado the horizontal pieces for both lattices first. To do this, position the rip fence 6 1/2" from the inside dado blade. Place the horizontal pieces on the saw table, marked face down. Align the edges against the fence, and, using the miter gauge, cut the second dado in from the edge. Rotate the pieces and dado the opposite end. Next, place the 3 1/4" spacer

against the rip fence and cut the outermost dado in all pieces; flip the pieces and repeat. Finally, to cut the middle dado notch. To do this, move the fence and center the horizontal pieces over the dado head.

Step 10. To notch the vertical pieces, arrange them in like groups, marked faces turned down. Set the fence 3" from the inside dado blade and cut all pieces with dadoes starting 3" from the end. Next, using the 1" spacer, cut the vertical pieces requiring notches 2" from the end. Use the 2" spacer to cut those pieces to be notched 1" from the end. To cut the dadoes for the special lattice pieces, i.e., the second from the top and bottom, and the two parts (I), first align them, then gang-cut at the same time to avoid errors.

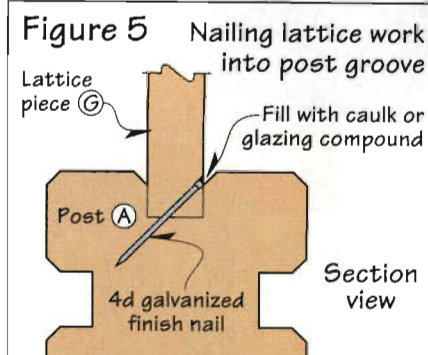
Note: Because of the shallow depth of these dado cuts, we worked with the ends of the lattice pieces against the rip fence or the spacers and used a push block across the tops of the pieces to safely apply uniform pressure on the workpieces as they were fed across the dado head. If you're concerned about the safety of this procedure on your saw, we suggest you align the part ends against an offset block rather than the rip fence.

Assemble the Latticework, Then Paint the Parts

Step 1. Dry-assemble the lattice, then adjust the fit of any parts that require it. Apply a drop of glue in the dadoes, assemble the parts, then lay the panels on a flat, smooth surface. Allow the glue to cure. Later, lightly break all corners with 180-grit sandpaper.

Step 2. Finish-sand all parts to 180-grit. Before assembling the arbor, apply finish. (We primed and then painted our arbor using white oil-based enamel. For a natural finish, apply an outdoor sealer. Note: If painting, avoid overloading paint in the bridle joints, or you may end up with a too-tight fit.

Step 3. After the paint has dried thoroughly, lay one post on a level floor with the bridle-joint slot oriented horizontally. Assemble the ends of one side rail and one set of latticework (without



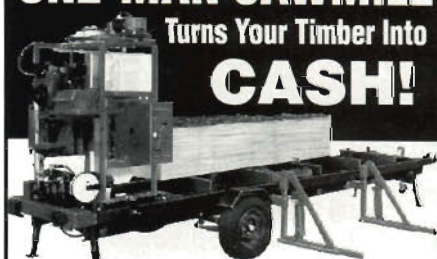
glue) into the groove, positioning them where dimensioned on the Exploded View drawing. Prop up the pieces using 1 3/8"-thick scrap to level them. Drill 3/32" pilot holes where shown in figure 5, then toe-nail the ends into the post using galvanized 4d finish nails. Assemble a second post to the opposite ends of the parts, butting the two posts against a wall to keep them aligned. Repeat this procedure to assemble the other side.

Step 4. Fill the nail holes with a flexible product that matches the color of your arbor. (We used white silicone caulk, although glazing compound would work.) Next, slide the two side assemblies onto the crown, and stand the arbor upright. Position a cap on the top end of each post, then drill pilot holes through the shank holes in the caps. Drive #8x2" brass or stainless-steel flathead wood screws. 

*Project design: Bob Colpetzer and Dick Coers
Photographs: StudioAlex, Randall Sutter
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PRO TIP

The width of profile cut by your panel-raising bit determines the final size of the crown. To calculate the crown's width and length, make a test cut on scrap. Measure the width of the crown.

To calculate the crown's length, measure the length of the panel (rail plus stiles), then subtract the width of the bit's cut (to allow for a 1/8" reveal). To calculate the crown's width, add the width of the bit's cut, then add 1/8" for the reveal.

When working with wide and narrow pieces, you start with a piece wider for safer hand routing operation, then rip it to final width later.



Top of the morning to you!

Sunrise Door Mat

A pessimist might call it a sunset, but either way, this weekend project will add warmth and distinction to your home's entry—or, for that matter, to your new neighbor's. In fact, we've yet to see a nicer idea for a housewarming gift.

Before You Start

We preferred to use redwood for this project and spent considerable time picking through the stacks at the lumberyard. We uncovered a 10' length of quartersawn 1x8 that had a 3"-wide strip of sapwood along one edge. This was just enough stock to make up the contrasting sun and rays. We also prefer using quartersawn material because it offers more stability in a project and will stand up better to outdoor conditions. The contrasting sapwood gave us an effective design element to work with.

We strung the rays and spacers with $\frac{3}{16}$ " braided nylon. Unlike natural-fiber rope, it won't rot or go slack. Once you pull the nylon taut and knot it, it keeps pulling back. You can seal the cut ends by melting them briefly in a flame. A couple of drops of CA glue on the knots will keep them from coming untied. Start with at least 8' of rope—that should give you plenty to work with.

Prepare the Base And Sun First

Step 1. Face-joint and plane your stock to $\frac{3}{4}$ " thick. From the heartwood, rip and crosscut the base (A)

to the dimensions listed in the Bill of Materials.

Step 2. Select and mark a top face and inside edge on the base. Using a drill press and fence, lay out and drill $\frac{5}{8}$ " counterbores centered in the outside edge where dimensioned on the Exploded View drawing on page 52. Then, drill $\frac{1}{4}$ " holes through the base centered in the counterbores. Repeat this procedure to drill the two $\frac{3}{8}$ " counterbores, centering $\frac{3}{16}$ " shank holes in them.

Step 3. Lay out and bandsaw the half-round sun (B), keeping the blade just wide of the line. Next, sand to the line using your stationary disc sander. (We used lighter-colored sapwood for contrast.)

Build A Taper Jig, Then Make the Rays

Step 1. To make the rays (C), rip and crosscut fourteen 2x12 $\frac{1}{4}$ " blanks from heartwood stock and four from

sapwood. Mark an "up" face near the center of each blank.

Step 2. To cut the ray tapers, build the tapering jig as dimensioned in figure 1. Next, scribe both tapers (on both faces) of one of the ray blanks as dimensioned in figure 2. To position the cleats on the jig, clamp this marked blank to the base, aligning the left taper line with the left edge of the base. Now, place the two cleats along the right edge and lower end of the blank where shown, and screw them to the base. Add a third cleat on top to hold down the blanks while sawing.

Step 3. Set your tablesaw rip fence so the blade will cut flush with the left edge of the jig. Place a blank on the jig, then cut the left-hand taper. Cut this taper on all remaining blanks before cutting the right-hand taper.



Step 4. To cut the right-hand taper, use one of the tapered blank offcuts as a spacer. To position it on the jig, find your original ray blank with the layout lines on it. Flip it over so the “down” face is up, then align the remaining taper line with the left edge of the jig, and clamp temporarily. Now, insert the tapered offcut in the gap between the blank and the long cleat, sliding it forward to fill the gap between the blank and jig’s cleat. Screw the offcut to the jig, then cut the right-hand taper on each of the 18 rays (*photo A*). Note: Before making this cut make sure you now have the “down” face up.

Step 5. Drill two 1/4" rope holes through each ray where dimensioned in figure 2. To do this, position a fence and stop block on your drill press and adhere one of the tapered offcuts to the fence where

DOOR MAT

PART	T	W	L	MTL.	QTY.
A Base	3/4"	3"	31"	R	1
B Sun	3/4"	3" radius		R	1
C Rays*	3/4"	2"	12 1/4"	R	18
D Spacers*	5/8"	5/8"	1 1/2"	R	19

*Parts cut to dimension during construction. Please read all instructions before cutting.

MATERIALS LIST

R—redwood

SUPPLIES

3/16" braided nylon rope (approx. 8'); #8x3" galvanized deck screws; exterior clear finish; cyanoacrylate glue.

shown to level the rays during drilling. Note: Drill the holes perpendicular to the lengthwise centerline of the ray and slightly off-centered toward the “down” face of the

ray. Drill the hole through one end of each ray, then change the fence to drill the hole through the other end.

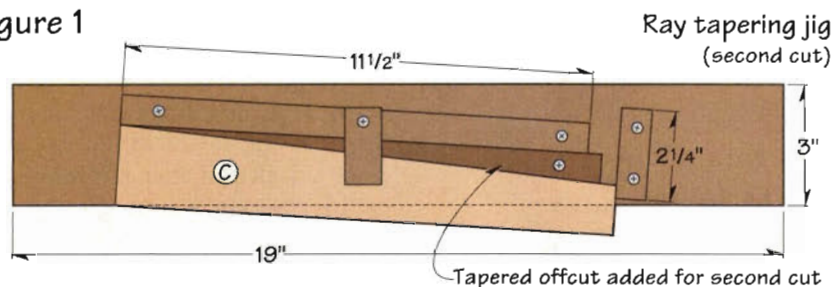
Machine the Spacers and Complete the Other Parts

Step 1. To make the spacers (D), collect 19 of the tapered offcuts from the rays. Using your tablesaw or bandsaw, resaw them to 5/8" thick.

Step 2. Using the same technique you used to drill the rays, drill a centered 1/4" rope hole through the edge of each offcut near the wide end where dimensioned in figure 3.

Step 3. To form the spacers, crosscut a 1 1/2"-long piece from the wide (drilled) end of each offcut. Note: To ensure that the cut is perpendicular to the spacer’s centerline, use a wide, square-ended stop block and extension on your miter gauge, and butt the wide end of the offcut

Figure 1



Exploded View

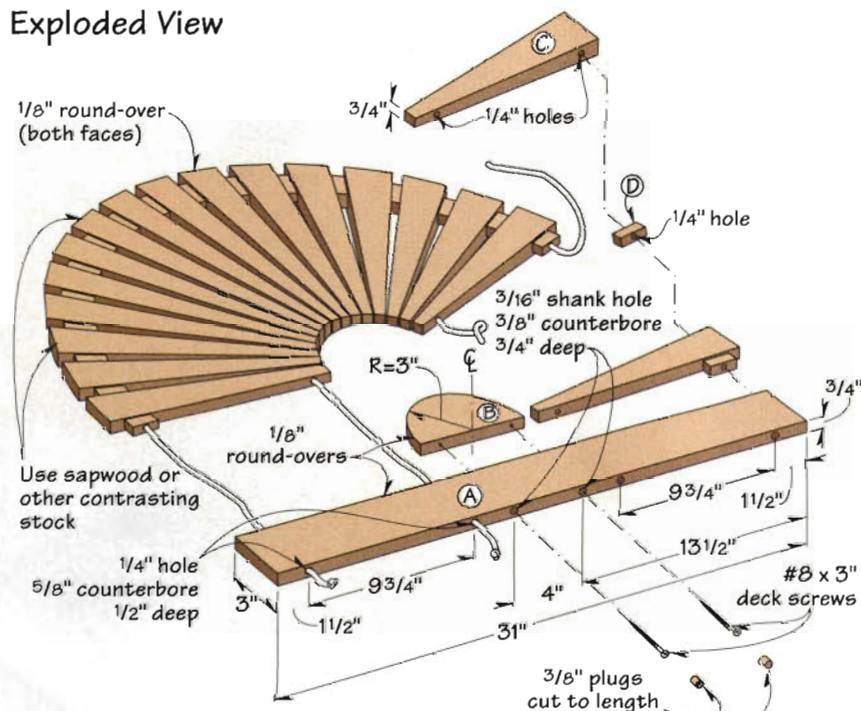


Photo A: To taper the second edge of each ray, attach an offcut to the jig from the first cut off a ray.

Figure 2

Laying out tapered ray

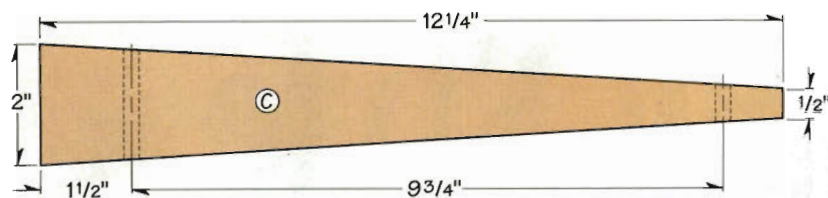


Figure 3

Drilling rope holes through rays

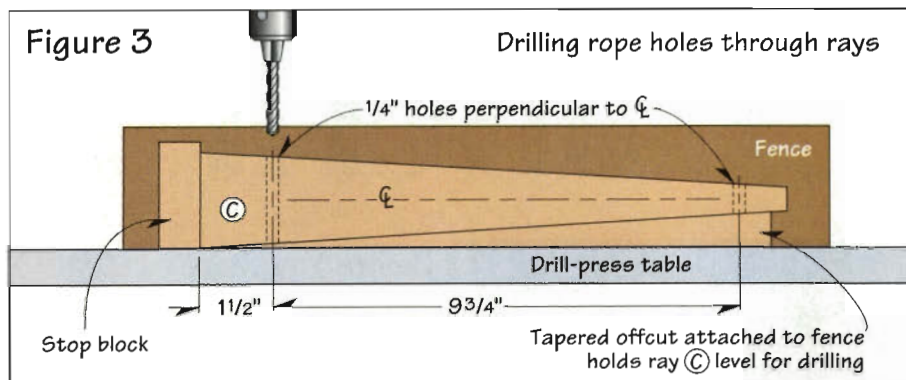
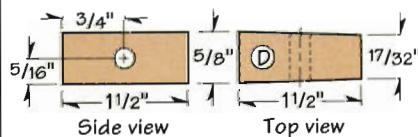


Figure 4 Forming the spacers



firmly against the stop block. For safety, use a push stick to hold it in place during the cut.

Step 4. Center the half-round sun along the inside edge of the base, then clamp it in place. Screw the base to the sun using #8x3" galvanized deck screws. Next, cut two 3/8" face-grain plugs from scrap stock, then glue them into the counterbores. After the glue has dried, sand the plugs flush.

Step 5. Using your table-mounted router and a 1/8" round-over bit, rout all edges on both faces of the base, sun, and rays. Then, finish-sand all parts, including the spacers, to 220-grit.

Finish All Parts, Then Assemble

Step 1. Apply an exterior clear finish to all parts. (We used Thompson's Water Seal, allowing the pieces to soak up as much as they'd absorb.)

Step 2. Knot one end of your 8' length of rope, then melt both ends in a flame to seal them. Before the nylon cools, put on a glove and shape the loose end to a point to make threading it

through the holes easier. Arrange the base and rays as shown on the Exploded View, positioning the sapwood rays appropriately. Thread the rope through one of the inside base holes, then through all 18 rays, and back through the other inside base hole.

Step 3. Clamp the base to your bench. Using a pair of pliers in each hand, pull the loose end of the rope as taut as possible. Then, knot the end as close to the base as you can. If you pull the rope taut enough, the knot should pop into the 5/8" counterbore when you release the rope. Cut the rope 1/2" from the knot, then heat-seal the cut end.

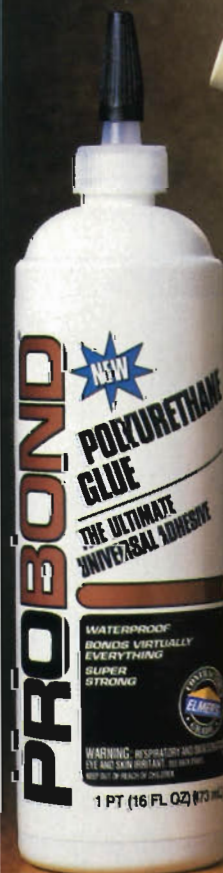
Step 4. Arrange a spacer between each pair of rays and between the last two rays and the base. Make sure the holes align with the outside ray holes and that the narrow ends of the spacers are closer to the center. Repeat the threading and knotting procedure, which should be easier this time since the rope has farther to stretch. Apply a couple of drops of CA glue to all knots to secure them, then tuck the ends of the rope into the counterbores with a screwdriver. Note: If the spacers don't appear to fit snugly between the rays, give them a little time. The rope allows a little bit of play, which gives the spacers a chance to find their own best fit. 

Photographs: StudioAlex, Kevin May

Illustrations: Don Pauli

Produced by: Doug Cantwell

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Craftsman-Style Outdoor Lantern



Mount this Craftsman-inspired lantern on a porch post, beside your front door, or along a garden path and you'll announce to all the world that "a woodworker lives here."

Before You Start

All of the material for this project came from a fairly clear 10' length of western red cedar 2x4. Plan your cuts carefully and you should have no problem extracting enough clear wood from between the knots. (For more about this material, see the Pro Tip *opposite*.)

Our lantern also offers a great opportunity to indulge in some dramatic "art glass" for the translucent panels. You can buy colorful glass in almost any shade at stained glass supply stores. If you can't find glass locally, see Sources at the end for a mail-order supplier.

First, Make the Frame Posts

Step 1. Face-joint and plane enough stock for the four posts (A) to $\frac{7}{8}$ " thick, then joint one edge of this piece. Rip the posts to $\frac{7}{8}$ " square, then cut them to length. Note: If you intend to form the mortises with a hollow-chisel mortiser, cut the posts $\frac{1}{2}$ " longer than finished length to make sure the hollow chisel doesn't tear out the $\frac{1}{8}$ " of stock between the mortise and the top end of the post.

Step 2. Lay out and cut mortises in the posts as dimensioned in *figure 1*. (We've found that a router or spindle mortiser works best on cedar.) Note: If you left the posts $\frac{1}{2}$ " longer as detailed in the previous step, start the top mortise $\frac{5}{8}$ " from the end, then trim off the extra $\frac{1}{2}$ " from that end.

Step 3. Tilt your tablesaw blade to 25° from perpendicular. Using a

miter-gauge extension and stop block, chamfer around the bottom end of each post. Remove just enough material to form a point in the center without shortening the length. You could also do this with a miter saw and a stop block clamped to the fence. (See figure 1.)

Machine the Rails, Then Assemble the Frame

Step 1. Surface plane enough stock for the eight rails (B) to $\frac{3}{4}$ " thick, then cut the rails to dimension.

Step 2. Using your miter gauge and tablesaw, cut tenons on the ends of the rails as dimensioned in figure 2. Round over the tenon edges with a rasp or file to fit the mating mortises. Next, miter-cut the tenons as shown. Note: When making this cut, keep the saw blade low so you don't nick the inside shoulder of the rails. Now, mark the inside face and bottom edge of each rail.

Step 3. Rout a $\frac{1}{4}$ " rabbet $\frac{1}{4}$ " deep on the inside edge of each rail where shown in figure 2 to accept the glass pane. Next, dry-assemble the rails and posts to check for fit. Mark the points on one post where the rail rabbets intersect it. Disassemble the parts, then transfer the points on that post to the remaining three posts.

Step 4. Set a fence on your router table to rout stopped rabbets into each post. Mark start- and stoplines on the fence. To prevent the cedar from splintering at the ends of the stopped rabbets, first cut a kerf with a hand saw across the stop marks on each post.

Rout the $\frac{1}{4}$ " rabbets, then square up the ends of each with a chisel.

Step 5. Sand the rails and posts to 220-grit and lightly break the edges (excluding the tenon shoulders). Then, using a polyurethane or other waterproof glue, glue and clamp the rails and posts in two stages. (We glued up two post-and-rail frames, then joined these two subassemblies using the remaining rails.)

Prepare the Roof

Step 1. To make a blank for the roof (C), cut three $3\frac{3}{8} \times 12$ " pieces from $1\frac{1}{2}$ "-thick stock. Note: This extra length

BILL OF MATERIALS

LANTERN

PART	T	W	L	MTL.	QTY.
A Posts	$\frac{7}{8}$ "	$\frac{7}{8}$ "	10"	C	4
B Rails	$\frac{3}{4}$ "	$1\frac{1}{2}$ "	$5\frac{7}{16}$ "	C	8
C Roof *	$1\frac{1}{16}$ "	9"	9"	C	1
D Buttons*	$\frac{1}{2}$ "	$\frac{5}{8}$ "	1"	C	4
E Vertical support	$1\frac{1}{16}$ "	$2\frac{1}{4}$ "	22"	C	1
F Horizontal support	$1\frac{1}{16}$ "	$2\frac{1}{4}$ "	$6\frac{5}{8}$ "	C	1
G Wings	$1\frac{3}{16}$ "	1"	$4\frac{1}{4}$ "	C	2

*Parts cut to final dimension during construction. Please read all instructions before cutting.

MATERIALS LIST

C—Western red cedar

SUPPLIES

#8x1 $\frac{1}{4}$ ", 1 $\frac{1}{8}$ " stainless-steel flathead wood screws; $\frac{1}{8}$ "-thick decorative or stained glass; waterproof glue; lamp cord; single-socket light fixture; exterior varnish or polyurethane.

PRO TIP

Western red cedar smells wonderful in the shop, but it has some peculiar traits worth noting. First, this super-soft wood damages easily. Lay a piece of cedar on a few harmless-looking wood chips, and you're liable to incur a rash of small dents on its surface. To prevent accidental marring and gouging, clean your bench top frequently, and remove unnecessary tools from the work area. Also, don't wear jewelry while working this material. A ring or a watchband brushed carelessly across a cedar surface can easily leave an unwanted scratch or indentation.

Cedar's other idiosyncrasy shows up whenever it comes in contact with moisture and steel. Condensation on the heads of steel nails or screws, for example, will soon make ugly black stains on this wood's surface. Even the corrosion-resistant coatings on most deck and other outdoor-rated screws fall victim to cedar's acidic tannins if there's moisture around. The only fail-safe solution is to use stainless-steel screws. If you can't find these locally, see Sources at the end of the article.

Figure 1

Locating mortises in posts

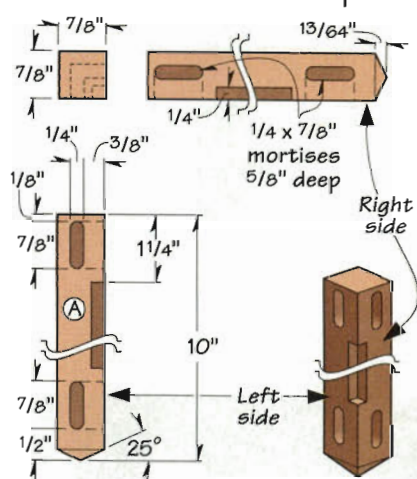
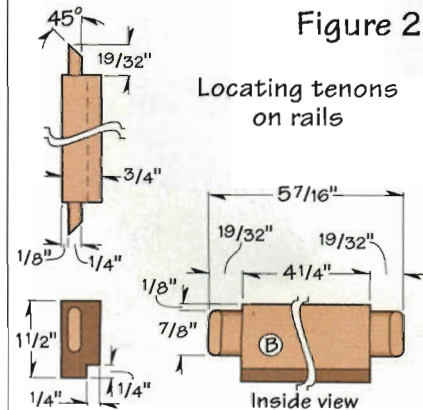


Figure 2

Locating tenons on rails



PRO TIP

The safest way to make the buttons (or any other small part) is to work with stock at least 12" long and do all of the machining on the ends or edges of the blank. Then, as the final step, cut the parts to width or length. To make these buttons, follow the cutting sequence described in steps 1 and 2 below. When you're done, you'll have a few inches of leftover waste stock, but your fingers will have been spared close encounters with the blade or bit.

the bottom of the roof as shown in *figure 3*. Then, hold the roof blank vertically against the fence and feed it carefully across the blade. Note: On some tablesaws, the blade may not cut the entire width of the bevel. This will leave a small point at the top of the facets. Remove these points with a sanding block, taking care to keep the lines crisp.

Step 4. Crosscut the rear (unbeveled) end of the roof blank to complete the 9"-square roof.

Assemble the Roof To the Frame

Step 1. To make the four buttons (D) that hold the roof to the frame, first cut a $\frac{1}{2} \times \frac{5}{8} \times 12"$ piece of stock. (For safety information on this procedure, see the Pro Tip above.)

Step 2. Drill and countersink a shank hole (through the $\frac{5}{8}"$ thickness) near both ends of each button blank where dimensioned in *figure 4*. Next, cut the rabbets across the ends. (We used the tablesaw, and cutoff box making multiple passes.) Then, crosscut the 1"-long buttons from the ends of the blanks.

Step 3. Set up your table-mounted router as shown in *figure 5*. Install a $\frac{1}{4}"$ slotting cutter (with the bearing removed) and elevate the cutter so the top cutting edge is just a hair more ($\frac{1}{64}"$) than $\frac{5}{8}"$ from the table surface. Set a fence so the bit cuts a

Exploded View

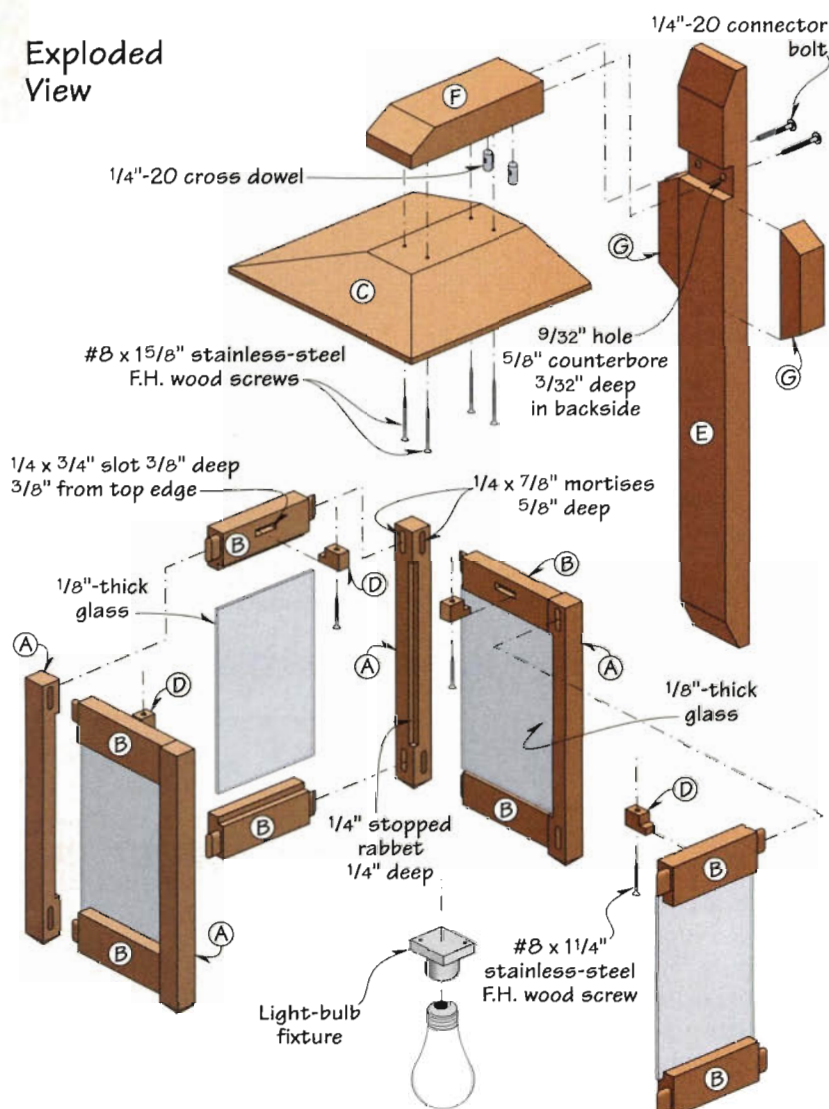


Photo A: Use an auxiliary fence and a feather board elevated above the blade to stabilize the piece when you cut the chamfers on the lantern roof.

will allow you to trim away any snipe left by the thickness planer. Increase the rough length if you need to. Joint the edges of each piece, then edge-glue and clamp them.

Step 2. After the glue has cured, face-joint and plane the blank to $1\frac{1}{16}"$ thick. Rip it to 9" wide, then crosscut one end to square the blank.

Step 3. Bevel-cut facets on the square end and both edges of the roof blank. To do this, tilt your tablesaw blade to 14° from perpendicular. Attach a tall auxiliary fence and feather board to your saw (*photo A*). Set the fence so that the bevel cut will leave a $\frac{7}{32}"$ square edge around

Figure 3

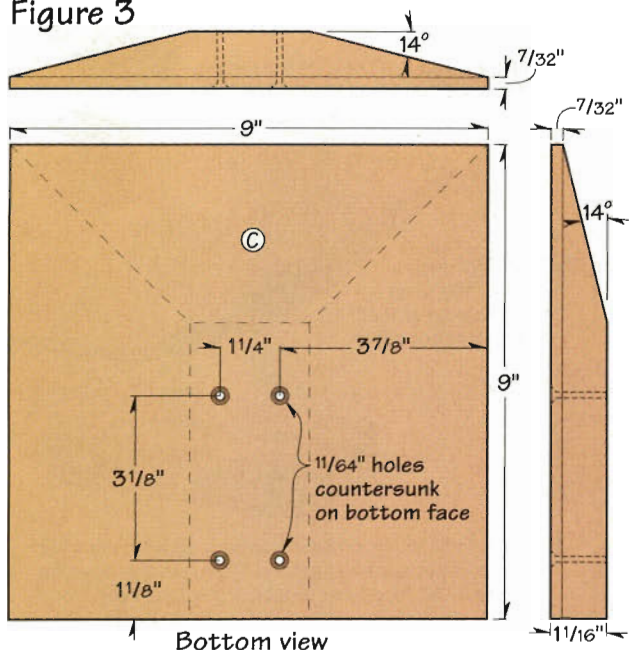


Figure 4

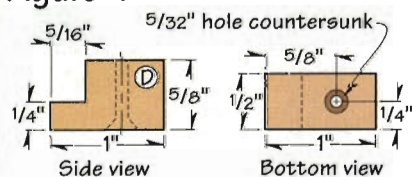
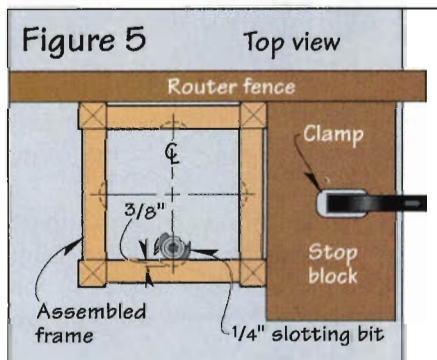


Figure 5



3/8"-deep slot when you push the lantern frame against it.

Step 4. To cut the button slots, place the frame top on the router table and position it so the bit centers on the length of a rail. Set the stop block. Clear the bit, turn on the router, then slide the frame forward against the stop block until it touches the fence. Note: Don't move the frame sideways along the fence; the arc formed by the cutter will accept the button. Slot the remaining three rails the same way.

Step 5. Insert the buttons into the rail slots you just cut. Next, invert the frame and center it on the underside

of the roof so that the overhang is equal on all sides. Mark the center-points of the button shank holes on the roof, then drill 7/64" pilot holes 5/8" deep.

Build the Supports

Step 1. Machine the stock for the vertical support (E), the horizontal support (F), and the wings (G) as dimensioned in the Bill of Materials. Note: We added the wings to cover up an electrical junction box. Measure your junction box to make sure the wings (when assembled to the vertical support) will cover it. If necessary, adjust the wing dimensions. Eliminate the wings if you don't have a junction box.

Step 2. Tilt your tablesaw blade to 30° from perpendicular and install a tall auxiliary rip fence. Then, cut the chamfers on the ends of the two support parts where dimensioned in figure 6 and figure 7.

Step 3. Using a dado head or crosscut blade, cut a dado in the vertical support to accept the square

Figure 6

Laying out vertical support

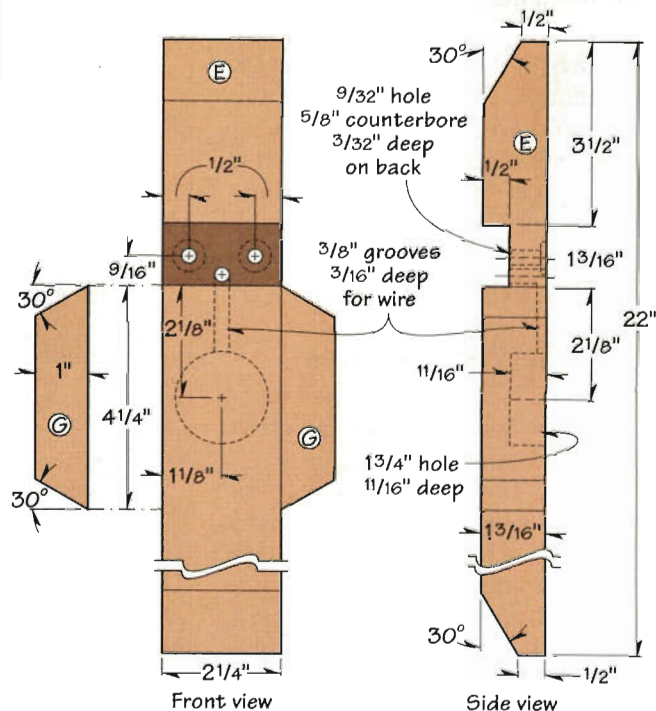
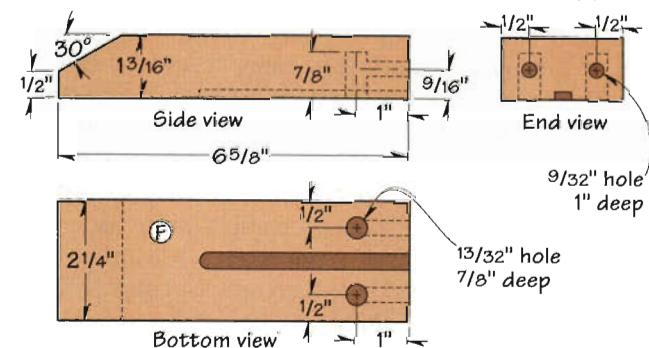


Figure 7

Laying out horizontal support



end of the horizontal support. (See figure 6.) Note: To ensure a snug fit, sneak up on the final dado width, test-fitting the horizontal support as you work.

Step 4. Using the drill press, counterbore and drill the two shank holes for the connector bolts in the vertical support. Next, dry-fit the horizontal support into the dado. Using the holes in the vertical support as guides, drill 9/32" holes into the end grain of the horizontal support. Next, drill the two cross-dowel holes in the bottom face of the horizontal support. Note: The size and location of these holes depend on the actual dimensions of your cross-dowels and connector bolts. Use the

hardware you have to determine these dimensions rather than those on our drawings.

Step 5. If you plan to connect the light to a wire lead (without a junction box), bore a $1\frac{3}{4}$ " hole $\frac{1}{16}$ " deep in the back of the vertical support to allow space for wire connections. (We used a Forstner bit.) Skip this step if you intend to mount the light over a junction box.

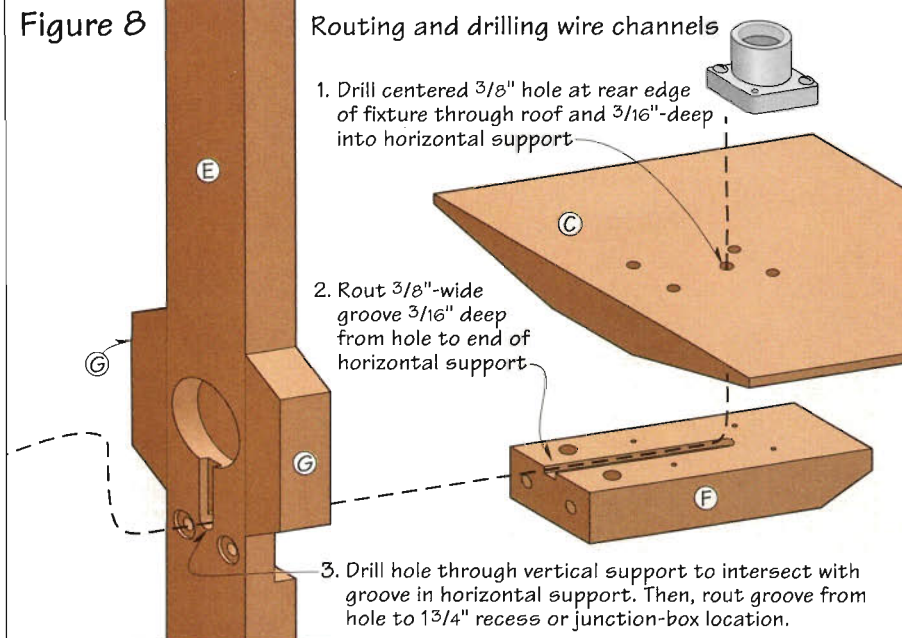
Form the Wire Grooves

Step 1. Assemble the horizontal and vertical supports using the cross-dowels and connector bolts.

Step 2. To attach the roof to the horizontal support, first countersink and drill $\frac{5}{32}$ " shank holes through the roof and countersink on the bottom face where dimensioned in figure 3. Next, turn the support assembly upside down and position the roof on the horizontal support so the end of the support aligns with the starting point of the bevel. (We placed a spacer block between the back edge of the roof and the vertical support to square the parts.) Mark the center-points of the four shank holes on the horizontal support, then drill these four $\frac{5}{16}$ " pilot holes. Now, temporarily screw the roof to the support.

Step 3. Center the ceramic lamp fixture on the bottom face of the roof, then drill a centered $\frac{3}{8}$ " hole through the roof at the rear edge of the fixture where shown in figure 8. Drill through the roof and $\frac{3}{16}$ " deep into the horizontal support.

Figure 8



Step 4. Disassemble the roof from the horizontal support, then disassemble the two supports. Rout a $\frac{3}{8}$ " groove $\frac{3}{16}$ " deep from the hole you just made to the unchamfered end of the horizontal support. (We used a table-mounted router, fence, and straight bit. For safety we used a push stick with a long bearing surface and handsaw handle.)

Step 5. Lay out and drill a $\frac{3}{8}$ " hole through the vertical support that intersects with the groove you just routed in the horizontal support. (See figure 8.) Then, rout a groove in the



Photo B: Two thin, springy sticks hold each glass pane in place while you apply silicone caulk.

back face of the vertical support (same dimensions as before) from this hole to the $1\frac{3}{4}$ " recess or to the point where the wires will emerge from the junction box.

How To Hang a Custom Light Fixture

The method you use to hang your lantern depends on the type of structure you'll mount it on. To hang it on a porch or deck post or on wooden siding, simply screw the vertical support to the mounting surface using two #8 flat-head woodscrews. Position the screws behind the glass panes to minimize their visibility, and countersink and counterbore the holes. Glue a cedar plug in the counterbore and sand it flush.

If you'll be mounting the fixture over a junction box, we suggest you attach it directly to the box. Use a pair of roundhead machine screws, threading them into the lugs on the top and bottom of the junction box. For this lantern, buy a pair of extra-long screws, since the screws provided with junction boxes are usually less than 1" long. Carefully transfer the lug hole centerpoints to the backside of the vertical support. Drill access holes for the screws through the back face, then counterbore the holes on the front face of the support so you can plug the holes and seal the screws. Make the counterbore large enough in diameter so you can install a washer under the screw heads.

Assemble and Finish, Then Install the Glass

Step 1. With the supports and roof disassembled, finish-sand all surfaces, then lightly break the edges. Reassemble the supports, then thread the lamp cord through the back of the vertical support and into the hole in the roof. Next, screw the roof to the horizontal support. Now, wire the light fixture and attach it to the underside of the roof.

Step 2. To finish our lantern, we used a blend of two parts Minwax Helmsman Spar Urethane to one part mineral spirits. We applied the

mixture liberally, allowed it to soak in, and then wiped off the excess. After 24 hours, we repeated the application again.

Step 3. We took the lantern frame to a glass shop, selected the glass, and had an employee cut the panes to fit into the 1/4" rabbets. If you cut the glass yourself, note that the panes butt together along their vertical edges. To allow for this, subtract twice the thickness of the glass from the width of two of the panes.

Step 4. Install the panes in the rabbets, then secure each pane temporarily with two thin strips of wood bent just enough to hold them firmly in place (*photo B*). Next, apply a bead of clear silicone caulk to the vertical (buted) seams. Note: Apply the caulk to the inside of the seams only—not between the glass and wood. Now, attach the glazed frame to the roof using the buttons. (For tips on mounting your lantern, see "How To Hang a Custom Light Fixture" *opposite*.) 

Project design: Dick Coers

Lead photograph: StudioAlex

Other photographs: Kevin May

Written by: Tom Jackson

SOURCES

Cross dowels. 1/4"-20, pack of 10. Catalog no. 31823, \$2.69 plus s/h.

Connector bolts. 1/4"-20x1 1/2", 10 per pack. Catalog no. 31831, \$3.69 plus s/h. Order either/both of the above from:

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Stainless-steel screws. #8x1 1/2", box of 100, catalog no. 0815-FA5, \$11.48 plus s/h; #8x1 1/4", box of 100, no. 0812-FSS, \$7.69 plus s/h. Order from:

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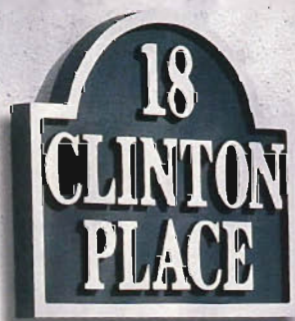
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Personalized Home Plaque

OUTDOOR
PROJECT



Don't settle for one of those store-bought house signs. With a little imagination, a router, and some inexpensive materials, you can produce a unique and distinctive plaque that will set your home apart from the others on the street and show off your craftsmanship as well.

Tailor the Design To Fit Your Needs

Plaque shape and size—For our routed plaque (shown *opposite*), we chose dimensions and colors that would complement the house we planned to mount it on. We started with a basic rectangle, which would accommodate two stacked names, and topped it with an arch for visual appeal. You may find other shapes you like better, and we encourage you to explore different options for your plaque. (See *page 64* for sample plaque shapes that you can adapt by simply copying and enlarging.)

Letter size—Make the letters and numerals large enough to be read easily from the vantage point of your visitors or the UPS driver. To be legible at 100' to 200', the letters and numerals should be 3" to 3½" high. Twice that distance calls for 7" to 8" letters. For distances of less than 100', you can reduce letter size to 2". (See *photo A*.) Color, contrast, and lighting also affect legibility, of course, but our sign-making experience tells us it's safer to oversize than to undersize the characters on a house plaque.

We wanted optimum legibility for a 100' viewing distance, so we chose 3" Roman capitals. If you look closely, you'll notice that letters of this style have serifs on their tips. Graphic designers disagree as to whether serif or sans serif type communicates more effectively, but we went with the serif because it makes a more classical impression than the plainer sans serif.

On the other hand, the serifs made for more difficult scrollsawing and they tended to break easily as we worked with them.

Trouble-free routing technique—Rather than rely on our freehand routing skills, we used the pin-routing technique described on *page 34*. To pin-route, you'll need to make a template, but this extra step gives you an opportunity to perfect the letters and pattern before you ever turn on the router. Once you've refined the template to your satisfaction, routing becomes simply a matter of following that pattern.

Professional-looking letters—To make our letters and numbers, we purchased a 3" cardboard alphabet stencil for about \$6 at a crafts supply store, which offered a variety of type styles and sizes. (See Sources at the end of the article.) With this stencil, you simply punch out the letters and trace their outline directly onto your letter stock (*photo B*). We used ¾" plywood for our letter stock but found that the thin plies occasionally broke at the delicate points. Based on this experience, we recommend ¼" plywood or ¼" tempered hardboard.

You can also find individual letters and alphabets in books, magazines, and computer software, or you can draw your own. Whichever source you use, simply enlarge the letters and numbers to the size you need. With an enlarging photocopier, you can scale the letters to the exact size you want.

Transfer your copied letters and numerals to the letter stock, then

MATERIALS AND SUPPLIES

Stock: 8/4 basswood or equivalent.

Supplies: Alphabet stencils, tracing paper, waterproof or water-resistant glue, plastic laminate, contact cement, ¼" hardboard or plywood, contact film, paint.

scrollsaw them to shape. We found it best to outline the letters with medium-weight lines, then keep the saw blade centered on the line while cutting. To avoid having to cut rounded inside corners, we drilled them with a correctly sized Forstner bit before sawing. After sawing, you can touch up the edges using a 1" belt sander or file. Try to make each letter perfect, because any imperfections on the template will be transmitted to the final product.

Size the Plaque To Fit the Message

Once you've sawn the letters, start laying out your full-sized plaque. To do this, arrange the words on a large sheet of tracing paper. This paper is translucent, and you can use it directly on the carrier box when assembling the template later (*photo C*). As you work, experiment with the layout. Try stacking the words as we did, stringing them along on one line, or arching them—any of

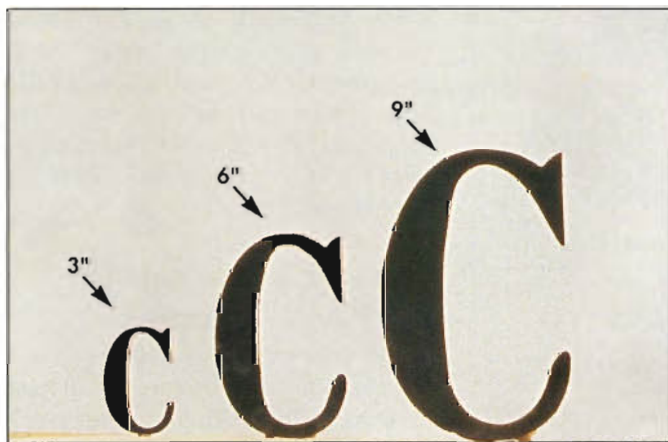


Photo A: Letter size is the key to legibility. If you aren't sure what size to use, make several sizes and test them.



Photo B: By using full-sized stencils, we were able to trace the letters directly to the letter stock for cutting.

these arrangements, if well-organized, can make for an impressive looking plaque.

Space the individual letters for best appearance. Remember that not all letters need to be placed exactly the same distance apart. Generally, narrower letters such as *I* and *J* can be spaced closer to their neighbors than wider letters like *C*, *M*, or *W*. Also, larger letters and those viewed from greater distances need to be spaced further apart to ensure legibility. Just keep in mind that wider spacing will require a longer plaque.

One more consideration: The letters must be spaced far enough apart so the router's guide pin can pass between them. Since we planned to use a $\frac{3}{16}$ " guide pin and router bit to cut the letters into the plaque (*photo D*), we had to position the template letters at least that far apart. (See *page 34* for more information about the technique we used.)

After you've laid out the wording, add the margins and borders. We wanted a $\frac{1}{2}$ "-wide border on all sides, but on larger plaques you may want to increase the width to $\frac{3}{4}$ " or 1" to maintain good visual balance and scale.

Next, Lay Out the Crown

Once you've established dimensions for the plaque's body, add the arc or crown to the top. To do this, scribe a vertical centerline from top to bottom on your full-sized layout. (See *figure 1*.) Next, using a compass, scribe several arcs of different radii, centering them at different points along the centerline (*photo E*). Then, select an arc that balances visually with the plaque body.

If you don't feel you have an artistic eye, a 1:2 (height to width) ratio forms a visually appealing shape. We came close to this ratio on our plaque by positioning the $5\frac{3}{8}$ "-radius arc so it extends $4\frac{3}{4}$ " above the rectangular body. It also starts and stops 2" in from both ends. We used the same radius to form the crown on the long one-line sample plaque shown in *figure 2*. It appears visually correct on that plaque too, proving that there's latitude in these kinds of design decisions.

The crown area on our plaque easily accommodated two numerals, and a

third could have been worked in. To squeeze in four or more numerals, we'd have had to enlarge the crown area. To enlarge a crown like this, either increase the arc's radius, or move the centerpoint up on the centerline, or do both.

To form the border of the arch, first mark its radius centerpoint on the centerline. We've marked this as R^1 on *figure 1*. Next, reset your compass to scribe the inside or bottom edge of the arch. To do this, subtract the width of the border from the R^1 dimension, reset your compass, then strike radius R^2 from the same centerpoint. To get our $\frac{1}{2}$ " borders, we subtracted $\frac{1}{2}$ " from R^1 ($5\frac{3}{8}$ "), which gave us an R^2 setting of $5\frac{1}{8}$ ".

If you want to make a very large sign, or if the arch radius exceeds the capacity of your compass, use a beam compass, or bend a flexible straight-edge to the required curvature and trace along it.

Prepare the Plaque Blank

Select the stock for your plaque, then joint it flat and square. We chose $\frac{6}{4}$ basswood because it machines easily and cleanly and offers sufficient durability for this application. For greater durability, use teak or clear, close-grained, quartersawn redwood.

If your glued-up blank will be small enough to pass through your surface planer, simply cut the pieces slightly overlong and edge-join them. Then,

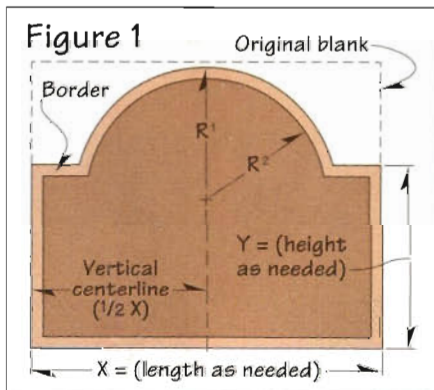


Photo C: Using the actual letters, lay out the sign wording on the tracing paper. Test several versions and select the most appealing.



Photo D: Space letters for optimum readability. Remember—diameter of guide pin and router bit determines minimum spacing.

plane the entire panel to thickness and trim it to final size.

If your planer can't accommodate the blank, rough-cut the stock to final length plus 1" and glue up two separate panels. Plane both panels to final thickness, then carefully edge-glue and clamp them. After the glue dries, scrape and belt-sand both surfaces as needed to remove squeeze-out and any unevenness. Then, square and trim the resulting blank to final size.

Since the plaque must withstand outdoor conditions, we selected wide stock to minimize the number of joints. Use a water-resistant or water-proof glue such as polyurethane, two-part resorcinol, or epoxy for all glue joints. (We used Titebond II.) Butt joints will suffice for small plaques. For larger or heavier signs, biscuit or spline the joints to increase joint rigidity.

Consider a Laminate For The Plaque's Surface

Plan your plaque's color scheme to complement the house or display area. Keep in mind that contrasting colors enhance legibility. We matched our letters to the color of

the house and set them off with a dark background.

You can paint the raised letters, or the background, or both. However, paint and wood preservatives weather quickly and require frequent maintenance, so you may want to consider using more durable alternatives.

On our plaque, we bonded almond-colored plastic laminate to the face. This provides a durable surface that won't require painting and that routs cleanly and crisply. The rubber-based contact cement won't give us any worries—it's waterproof. We did, however, prime and paint the edges of the letters, the exposed background face, and the plaque's outside edges.

As an alternative, you may want to try sandwiching different materials in layers. For example, you could adhere a light-colored surfacing material such as Corian to the face of a dark underlying layer of walnut, or vice versa. Then, rout through the Corian to reveal the contrasting walnut.

Prepare the Blank For Routing

To use the pin-routing technique described on *pages 34-37*, prepare the template as a mirror image of the finished plaque. In other words, for the sign to read correctly, *the template must read backwards*.

First, make a carrier box that fits snugly around your plaque blank. We made the sides and top of ours from $\frac{3}{4}$ " plywood using the dimensions shown in *figure 3*. It fit our blank tightly enough to prevent it from falling out. When sizing the sides, extend them $\frac{1}{4}$ " above the blank's top face to help you position and square the template borders and letters. Dry-fit the parts, then assemble the carrier box around your blank.

Take the full-sized tracing paper layout you made earlier, turn it over, and place it on the box top. You should be able to read the letters and numerals through it from the front side. If not, outline the letters with a felt-tip pen to darken them. Now, position the layout on the box top just as you want the plaque to appear.

Position all numerals, letters, and border parts on the paper layout.

Because you flipped the layout, the letters and words will appear backwards. This is necessary to produce the mirrored template you need. Attach the letters and border parts to the box top (*photo F*). Your template is now ready to use.

We routed our plaque face to depth in three $\frac{1}{8}$ " increments. Then, we made one final, very shallow pass to clean up the surface. Properly done, this will save you considerable hand cleanup.

To cut around the letters and borders, we used a $\frac{3}{16}$ "-diameter guide pin in the drill-press chuck and a $\frac{3}{16}$ " straight bit in the router. Note: The guide pin and router bit must be equal in diameter to produce an exact copy of the template.

After routing around the letters, we switched to a $\frac{1}{2}$ " guide pin and $\frac{1}{2}$ " straight bit to speed up routing of the large open areas. For final cleanup, we used a $\frac{1}{2}$ " bottom-cleaning bit to rout the bottom smooth. Note: After each routing step, stop, turn the work over, and inspect the face to make sure you haven't missed any areas.

Rout along the top or outside line of the crown border to the same working depth. Next, remove the plaque from the carrier and bandsaw just wide of this routed line. Then, trim to the line using a flush-trim bit to finish shaping the crown. Finish-sand the edges as necessary.

Paint the Plaque, Then Prepare It For Mounting

To speed up the painting process and minimize cleanup time, you may want to mask the raised letters and border. We covered our routed plaque with a sheet of contact film (the type sold for cabinet shelf covering, as listed in Sources). Buy the repositionable type, which has plenty of adhesion yet peels off easily.

Caution: Don't use this film if you're applying aerosol paints. Many of them contain solvents that react with contact film, leaving you with a mess.

Apply the film to the face of the plaque, then cut around the raised letters and borders with a sharp crafts knife (*photo G*). Remove the film from the background areas.

Paint all exposed areas including edges of the letters and borders. Apply one coat of quality weather-resistant, oil-base primer and several coats of a suitable oil-base enamel. Let each coat dry thoroughly between applications.

If you plan to mount the plaque on a post, select the appropriate screws, then drive them through the post and into the back of the plaque. To wall-mount the plaque, make a drilling template from a $\frac{3}{4}$ x 12" piece of scrap

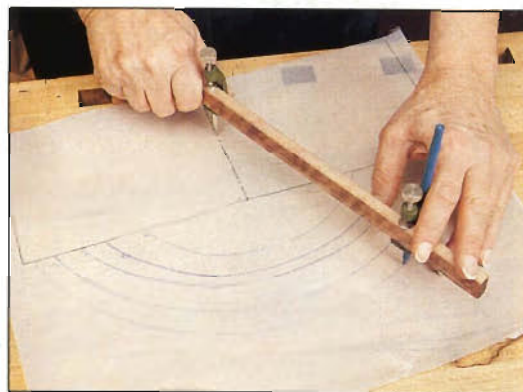
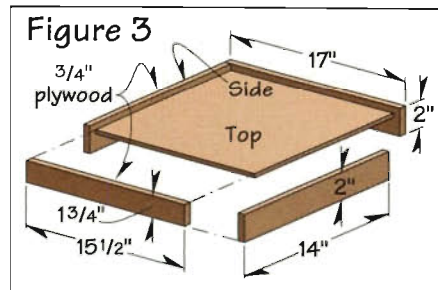


Photo E: Draw arcs of different radii, then select the one that best complements your plaque's rectangle or square.



Photo F: Position layout paper upside down on carrier, then tack nail templates to it. Layout should appear backwards.



Photo G: Apply the masking film to the plaque face, then cut around the letters and borders. Leave the film intact to mask areas you do not want painted.

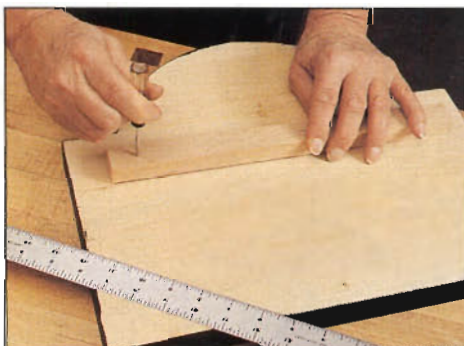
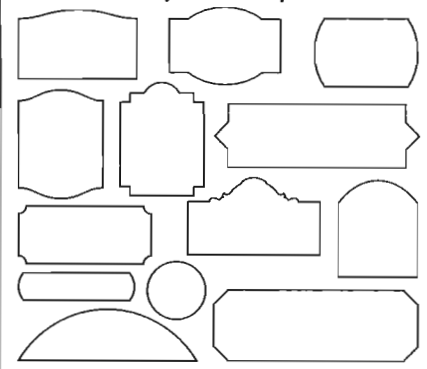


Photo H: Using a template ensures that the wall screws will match accurately with the keyhole slots cut into the plaque's back.

Plaque Shapes



wood. Drill two $\frac{1}{8}$ " shank holes through the blank, locating them 10" apart and equidistant from the ends. Center the template on the plaque's back (either horizontally or vertically) and mark the hole centerpoints (*photo H*). Then, using a keyhole bit in your table-mounted router, rout two 2"-long keyhole slots centered on these points.

Next, position this template on the wall and mark the hole centerpoints. Drill pilot holes, then drive #8 pan-head screws. Adjust the screw depth

so the heads fit into the keyhole slots but hold the plaque firmly against the wall. Note: Use screws or anchors that are appropriate for the surface. 

Lead photograph: StudioAlex

Other photographs: Kevin May

Produced by: Charles Sommers

SOURCES

EZ Letter Stencils. Available in a variety of type styles and sizes. To locate your nearest supplier, contact:

Geographics, Inc.
800/426-5923

Contact Film. Decorative film with "Quick-Start" repositionable backing. Distributed by Rubbermaid, Inc., Wooster, Ohio. Sold in supermarkets, home centers, and other retail outlets.

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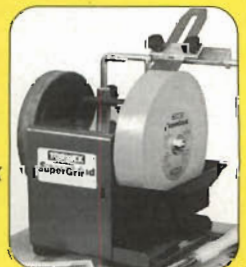
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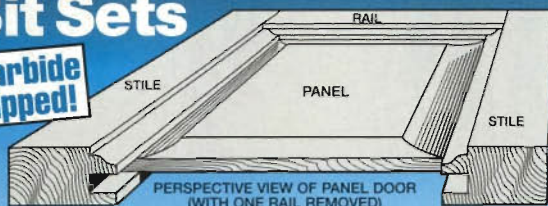
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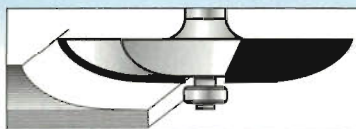
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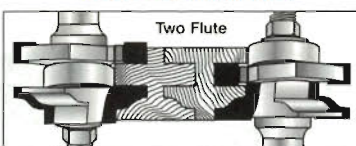
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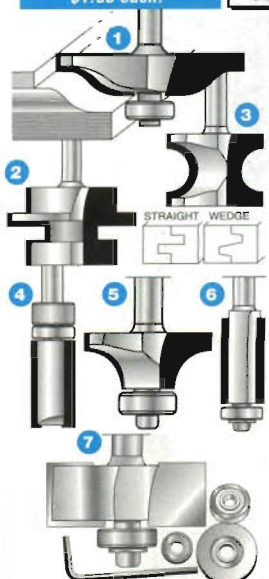
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Garden Gate



When our executive art director, Darlene Luther, complimented her neighbors on their garden gate, she got the full story behind it. While touring Virginia one summer, they had admired a number of gates in this style on some of the 18th-century estates. Back home, they worked up some sketches with a local craftsman, who came up with the elegant solution you see here. Don't be discouraged if our specs don't match your needs exactly. You can adapt the dimensions and detailing to fit just about any opening in any setting.



Before You Start

The 5 5/8"-square post on this gate is substantial, but the square finial profile requires no turning. You can shape the finial using a tablesaw and bandsaw by crosscutting a short section from the top of the post and working with the smaller piece, as we'll describe below.

Another challenge we faced was the scarcity of 2"-thick stock. The best solution, we decided, was to laminate fir, cedar, or redwood 2x material. A few extra minutes spent judiciously picking through the stacks at the local lumberyard should yield fairly straight-grained material with few knots. We planed the stock to 1 1/8" thick first, face-glued it together with waterproof polyurethane glue, then surfaced it again to the final 2" thickness.

The frame parts require laminated 2x6s. We used two thicknesses of 2x10s to make the blank for the curved top rail and molding. You'll have material left over after cutting the top rail, but using the wider stock allows you to lay out and machine the mortises square to the blank edges. Some of the scrap can be resawn to make spindles.

The contractor who built the gate had the hardware custom-forged, but we checked our catalog library and found some wrought-iron alternatives for the strap hinges and slide bolt. (See the Source listed at the end of the article.)

One final note: Although we show two matched gates in the photo, our Bill of Materials cover a single gate. You can, of course, increase or decrease the dimensions to span different opening widths. If you intend to span a 45" or wider opening, split the opening into two gates. Double the number of parts and machine identical parts at the same time.

Prepare the Frame Parts

Step 1. As described above, laminate and then thickness-plane two 10'-long 2x6s and two 4'-long pieces of 2x10. Crosscut the 2x6 lamination into a 60" length and two 30" lengths. Joint one edge of each piece, then rip the shorter pieces to 3 5/8" wide and 2" wide. Rip the longer piece into two 2"-wide strips. Save the offcuts.

Woodworker's Journal

BILL OF MATERIALS

GATE

PART	T	W	L	MTL.	QTY.
A Stiles**	2"	2"	51 1/4"	C	2
B Rail—middle	2"	2"	28 3/4"	C	1
C Rail—bottom	2"	3 5/8"	28 3/4"	C	1
D Rail—top*	2"	2"	28 3/4"	C	1
E Molding—curved top*	5/8"	2"	25"	C	1
F Molding—straight top**	5/8"	2"	25"	C	3
G Molding—panel**	5/8"	5/8"	25"	C	8
H Spindles**	1"	1"	18"	C	5
I Planking—panel**	3/4"	4 1/2"	31 1/2"	C	8
J Post	5 5/8"	5 5/8"	92"	C	1

*Parts cut to final size during construction. Please read all instructions before cutting.

**Multiple lengths required. Length listed is for longest part needed.

MATERIAL LIST

C—cedar
(fir or redwood
also acceptable)

SUPPLIES

Waterproof glue; #6x1 1/4" flathead wood screws; 1 1/4" brads; 3–14" strap hinges; 1/2" dowel; 1–latch or slide bolt. (For mail-order information, see Source at end of article.)

Step 2. From your 2"-square stock, cut the stiles (A) to length as dimensioned on the Front View drawing on page 69. Transfer the full-sized stile profile shown on the Stile Profile drawing to one end of each, then bandsaw the profiles to shape, keeping the blade just wide of the line. Sand the profiles to the line. Mark the appropriate edge of each stile "inside."

Step 3. Lay out and cut the mortises in the long and short stiles. (For dimensions and locations, see the Front View drawing.)

Step 4. From the 2x2x30" piece, crosscut the middle rail (B) to length. Then, cut the bottom rail (C) from the 2x3 5/8" piece. Finally, cut the top-rail blank (the 2x10 lamination) to the same length as the middle and bottom rails. Use a stop block to ensure identical rail lengths.

Lay Out the Top Rail

Step 1. On the top rail blank, lay out the tenon shoulder lines across the top face of the blank 1 5/8" in from each end.

Step 2. Clamp a long piece of scrap perpendicular to the blank as shown in figure 1. Mark the pivot point for a trammel point on the scrap. Set the other point to a 52" radius. Scribe the arc from the top intersection point of the tenon shoulder to the lower end. Note: You may need to adjust the centerline or the radius of the arc to make this top point hit the intersection.

Step 3. Lay out a second arc 2" from the previous line to define the lower edge of the rail. Then, mark a third and a fourth line 5/8" apart to define the top molding (E) that will also be cut from

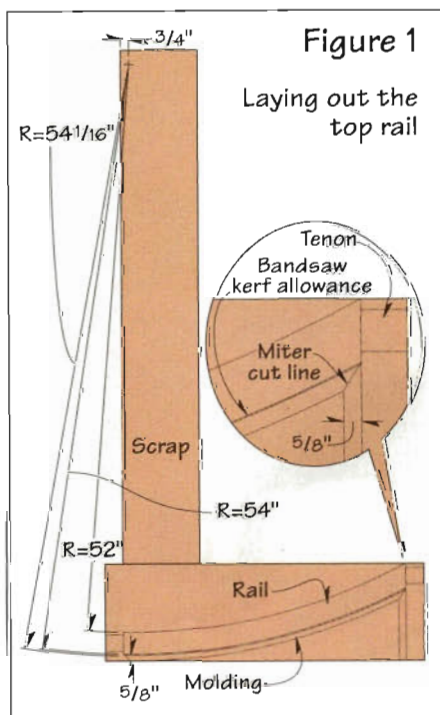




Photo A: Using trammel points and a beam, lay out the radii of the top rail and curved molding on the 2x10 blank. Note: We pre-cut the tenons to show how they square to the rail ends.

the blank. (See *photo A.*) Leave a $\frac{1}{16}$ " gap between the rail and molding layout to compensate for the bandsaw blade kerf.

Step 4. With the arcs complete, lay out the tenons parallel to the blank edges. Also, mark the miter cut line at the high end of the top molding piece where shown in figure 1. (Pencil in this line now will eliminate a lot of trial-and-error fitting later.)

Cut the Rail Tenons, Then Shape the Top Rail

Step 1. Set up your tablesaw with a miter gauge, extension, and stop block to make the initial tenon shoulder cuts on the three rails as dimensioned on the Exploded View detail. Make all of the $\frac{5}{8}$ "-deep shoulder cuts first. (See *photo B.*) Then, lower the blade and make the $\frac{1}{4}$ "-deep cuts. Note: On the bottom rail, this will make the tenons $3\frac{3}{8}$ " wide instead of $1\frac{1}{2}$ ".

Step 2. To cut the tenons to width on the top-rail blank, use a bandsaw or hand saw, then with a sharp chisel, pare to the line. Cut the tenon cheeks on the tablesaw using a tenoning jig. (See *photo C.*)

Step 3. Bandsaw the top rail (D) and top rail molding (E) to shape, keeping the blade just wide of the line. Sand to the line using an oscillating disc sander on the inside curves and a stationary disc sander on the outside curves.

Step 4. Dry-assemble the frame (stiles and rails) to check for fit and squareness. Keep the frame assembled for now.

Rout the Profile On the Moldings

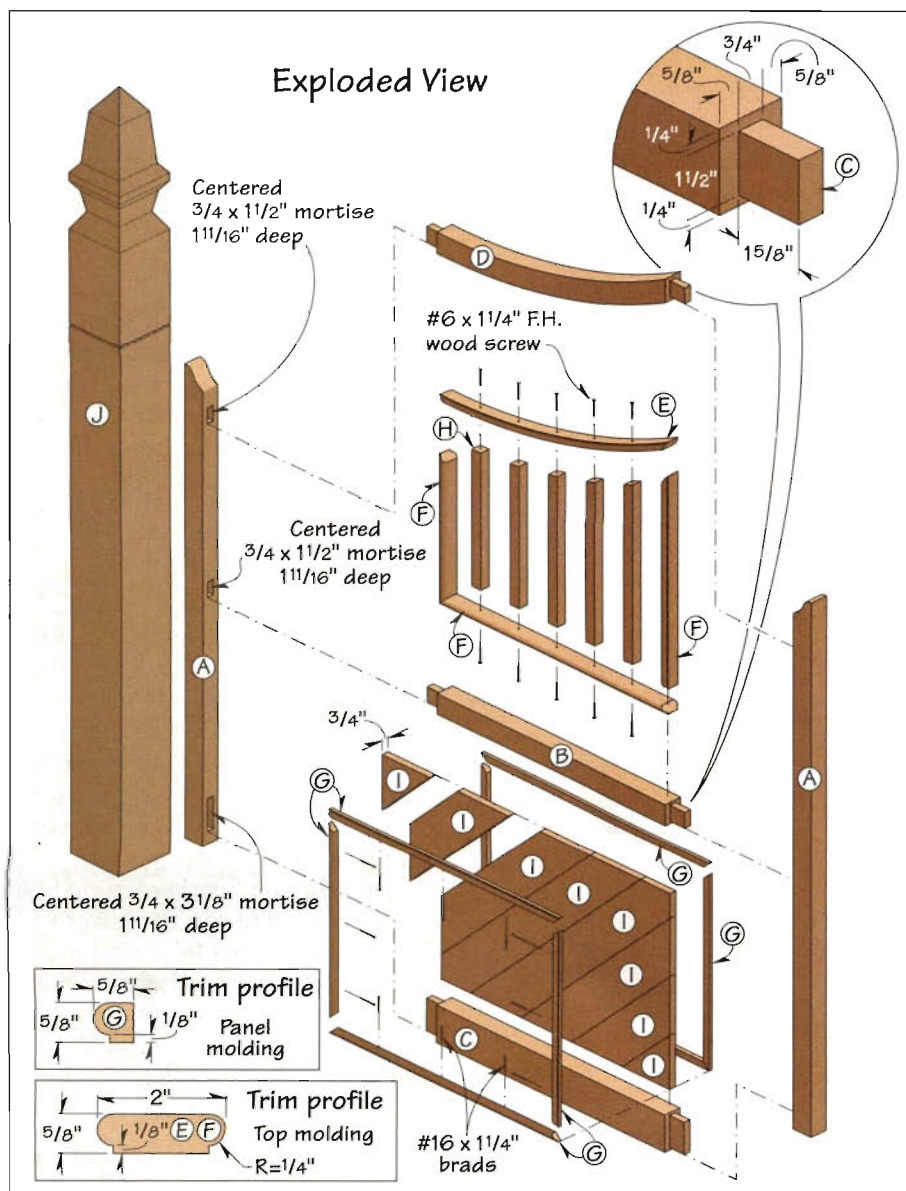
Step 1. From scrap or 1x stock, rip 13 linear feet of $\frac{3}{4}$ x2" material for the straight top moldings (F) and panel moldings (G). Note: You'll machine stock for both types of molding to the 2"-wide top molding profile to start. (See the trim details on the Exploded View.) To complete the panel moldings, you'll rip a $\frac{5}{8}$ "-wide strip from both edges of the top molding.

Step 2. Fit your table-mounted router with a $\frac{1}{4}$ " round-over bit and set it to cut a $\frac{1}{8}$ " shoulder. Rout both edges (on one face) of your molding stock where shown on the Exploded View detail. Next, lower the bit to cut a full $\frac{1}{4}$ " radius but no shoulder. Since you won't have sufficient riding surface for the bearing, set a fence flush with the front edge of the bearing. Flip the pieces over, and rout both edges on the opposite face.

Step 3. To rout the same profile on the curved top-rail molding (E), use a pin-routing fixture and a starter pin. If you're not familiar with pin-routing techniques, see the Pro Tip on *page 70*.

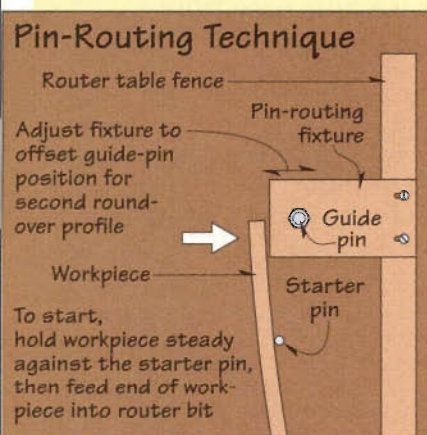
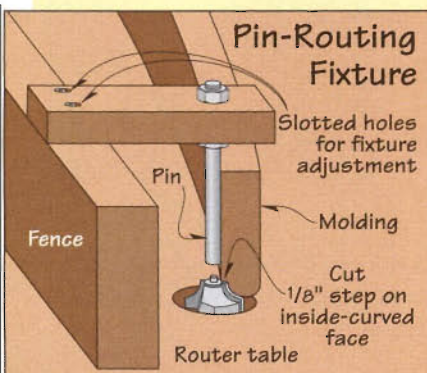
Fit the Moldings and Spindles To the Frame

Step 1. Cut a 26" length of straight molding, then miter both ends to fit the bottom edge of the spindle opening (top edge of the middle rail) where shown on the Front View. Next, miter-cut a 15" and a 21" length to fit the sides of the opening (inside stile edges). Use the miter cut line that you marked earlier on the top



PRO TIP

To make a pin-routing fixture for your router table, start by cutting off the head of a $\frac{1}{4}$ " machine bolt and mounting it in a block of hardwood using nuts and washers. (See the drawing *below*.) In your table-mounted router, install a $\frac{1}{4}$ " ovolo or other plunge-type bit that has all cutting surface on top instead of a bearing. (You could also remove the bearing from a $\frac{1}{4}$ " round-over or beading bit. Either of these bits should have enough cutting surface on its top to cut the $\frac{1}{8}$ " step.)



Drill two slotted shank holes in the block so you can adjust the pin's position, then drill pilot holes in the fence. Set the pin to rout the $\frac{1}{4}$ " round-over with a $\frac{1}{8}$ " step at the top on the inside curve of the molding. (See the trim profile detail on the Exploded View.) Note: Depending on your bit diameter, the $\frac{1}{4}$ " pin should be pretty nearly centered over the bit.

Install a starter pin in your router table where shown in the drawing *below*. (This is a separate pin, not to be confused with the pin positioned over the bit.) If your table is not equipped with a threaded hole for this purpose, make one by drilling a hole and installing a threaded insert where shown. Then, make the starter pin by cutting the head off a second $\frac{1}{4}$ " machine bolt and screwing it into the threaded insert.

To use this setup, lay your curved top molding on edge on the table. Hold the edge to be routed against the starter pin, then slowly feed the end of the workpiece into the spinning bit as shown in the drawing. Then, push the workpiece forward and rout the full length of the profile, finishing the cut with a push stick.

After you've started the cut, it's no longer necessary to use the starting pin as a contact point; we used it to steady the workpiece when starting a cut.

After you rout the stepped round-over along both edges of the inside-curved face, rout the simple round-over on the opposite face. To do this, adjust the pin position so the bit will cut just the $\frac{1}{4}$ " radius. (This offsets the pin slightly from the center of the bit.)

end of each board. Starting with the small corner piece (upper outside or lower inside corner), miter each plank to fit as shown on the Front and Exploded Views.

Step 4. Sand the planks to 150-grit, then prime and paint them, including the ends. (We used white oil-base primer and enamel.) After the paint has dried, assemble the planks into the frame opening and check for fit. If the paint has added enough width to prevent the planks from fitting, re-miter one of the small corner planks just enough to ease the fit. Then, touch up the primer and paint on the mitered ends.

Step 5. Glue, clamp, and nail the remaining set of molding strips around the edges of the opening to capture the planks.

Machine the Post

Step 1. Joint and plane a 6x6x96" roughsawn cedar post to 5 $\frac{5}{8}$ " square. Square one end, then crosscut the post to 92 $\frac{1}{8}$ ". Select and mark a top end of each. Now, crosscut a section 9 $\frac{3}{4}$ "-long from the top end for the finial. This will allow you to shape the finial without being encumbered by the lower section of the post. Note: Since you'll probably have to make two cuts to get through stock this thick, double-check your setup to make sure your blade is dead square to the table and fence.

Step 2. Bore four $\frac{1}{2}$ " dowel holes 2" deep in the mating ends of the top and bottom sections of each post. To do this accurately, make and use the drilling template shown in *figure 2*. (We recommend 6/4 or 8/4 hardwood scrap, depending on the length of your $\frac{1}{2}$ " bit.) Note: Drill the template on your drill press using a brad-point bit. Before drilling the posts (using the template and a portable drill), mark a mating corner on the two sections of the post. Index the holes from this corner on both parts by butting the two template cleats against the two adjacent faces as shown in the figure. Make sure to always align these corners when doweeling the sections together.

Step 3. Cut, groove, and chamfer four 3 $\frac{3}{8}$ "-long dowels. Set them aside for now.

Step 4. Using the dimensions shown on the Finial Profile drawing on *page 71*, lay out a full-sized finial template on graph paper. Adhere the layout to $\frac{1}{8}$ " tempered hardboard, then bandsaw it to shape, keeping the blade just wide of the

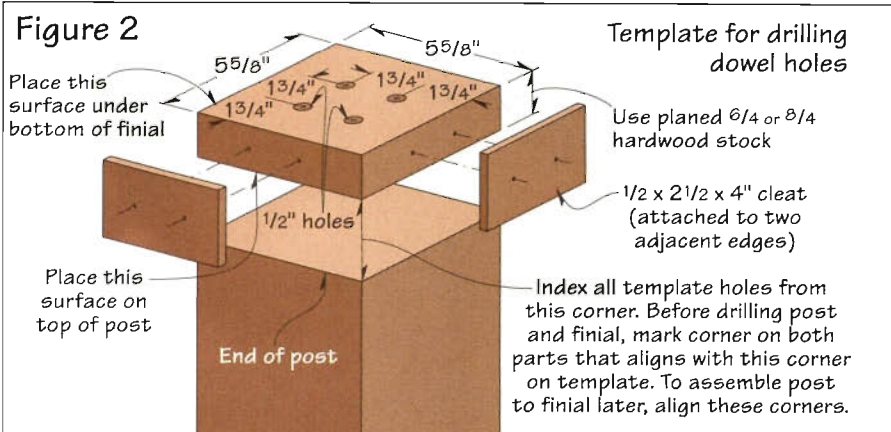
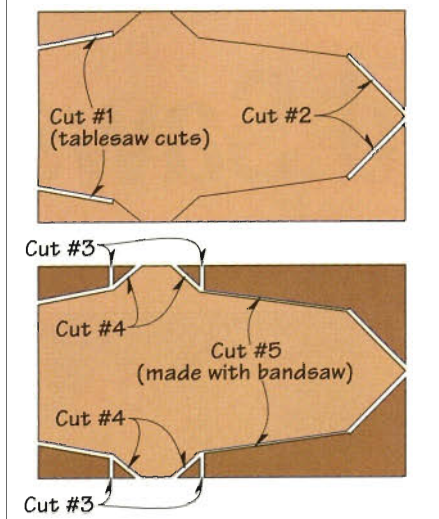


Figure 3 Cutting sequence for finial



line. Sand to the line. Then, transfer the layout to all four faces of the top post section.

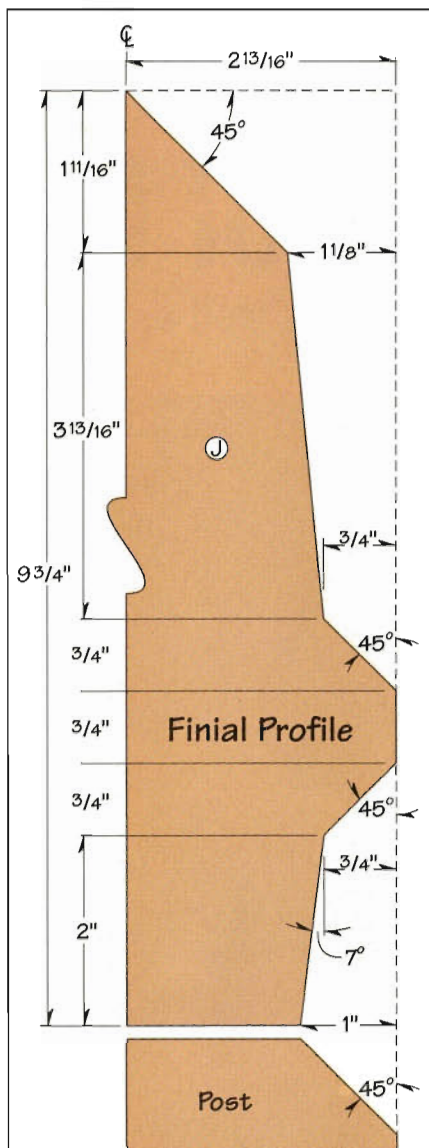
Step 5. As shown in figure 3, make cuts 1 and 2 on the tablesaw with the blank standing on end. Use the table saw for cuts 3 and 4 as well, but lay the blank horizontally. Finish up with cut 5 on the bandsaw. Note: Tape the offcuts back onto the blank to keep the blank square during the last two no. 5 cuts. Carefully file or sand out any saw marks.

Step 6. Using a couple of your $\frac{1}{2}$ " dowels, dry-assemble the completed finial to the top end of the post. Next, trace its footprint on the post end. Tilt the blade on your miter saw to 45° , then, using a stop block to ensure accuracy, cut a chamfer to this footprint line around all four faces of the post end to match the finial bottom. (Our chamfer measured 1". See the Finial Profile drawing.)

Step 7. Using a handheld router and a straight-edged guide clamped to the post, rout a $\frac{1}{8}$ "-deep V-groove around the four faces of the post 9" from the top end.

Now, For the Final Assembly

Step 1. Sand all post and gate parts to 150-grit. Apply epoxy glue to the end grain of the mating ends of the finial and post, and to the $\frac{3}{8}$ "-long dowels you cut earlier. Insert the dowels into the holes in the finial, then assemble it to the post. Remove glue squeeze-out.



Step 2. Dig a 9"-diameter post hole 24" deep. Set the post in the hole, plumb it, then brace it to keep it plumb. Pour concrete in the hole and allow it to set. After the concrete cures, remove the braces.

Step 3. To hang the gate(s), use three strap hinges per gate. (For mail-order information, see the Source at the end of the article.) Center a hinge on each rail, square it to the stile, then adjust the position horizontally. Note: Make sure that all three hinges align horizontally and are perpendicular to the stile. Drill holes and drive the screws.

Step 4. Prop the gate so that it has approximately 3" of ground clearance. Then, insert shims between the stile and post to allow the gate enough clearance to swing properly. Now, drill holes and attach the hinges to the posts. Check for proper action and clearance, then attach a slide bolt or latch. 

Photographs: StudioAlex; Kevin May
Produced by: Doug Cantwell

SOURCES

Strap Hinges. Colonial reproduction 14" wrought-iron hinges in two different styles, screws included. Spear-shaped tip, catalog no. 21008; heart-shaped tip, no. 21010. Price (either style): \$35 per pair plus s/h.

Slide Bolt. Wrought iron, hand-curved handle, $1\frac{3}{4}$ x6", screws included. Catalog no. 21041. Price: \$24.95 each plus s/h. Order either or both of the above from:

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In Defense of Hand Saws

These “relics” have a future as well as a past *by Michael Frutrick*

Whenever I teach a wood-working class, I get surprised looks if I suggest that someone try a hand saw. But at the custom furniture shop where I work, we use hand saws all the time—and not just to show off our traditional skills. We pride ourselves on our productivity, and at least some of the credit for it goes to these “relics.”

You can make almost any kind of cut with any kind of saw, but as woodworkers, we’ve developed specialized saws to serve various purposes. I’ll show you the saws that make my work easier on a daily basis and discuss several saws that I use less often. I’ll also explain how I use and maintain them to get the best results they can deliver.

The Crosscut Saw Handles Big Boards

Have you ever brought home a huge, beautiful plank that just needed the right cuts to fill the materials bill? You could barely lift it, let alone push it across the tablesaw and hope to get a clean cut. Nor could your radial-arm saw handle that kind of width.

I like working big boards, so I rarely start a serious project without the help of a crosscut hand saw. I own three of them. The longest, with its 26" blade, has only eight “points” (teeth per inch) and can cut thicknesses up to 6". Most power saws cut only half that deep and bog down easily when faced with thick timber.

The long straight blade of the crosscut saw slices the wood and carries the chips away, leaving the teeth in the kerf in contact with fresh wood. The hand saw’s human power supply

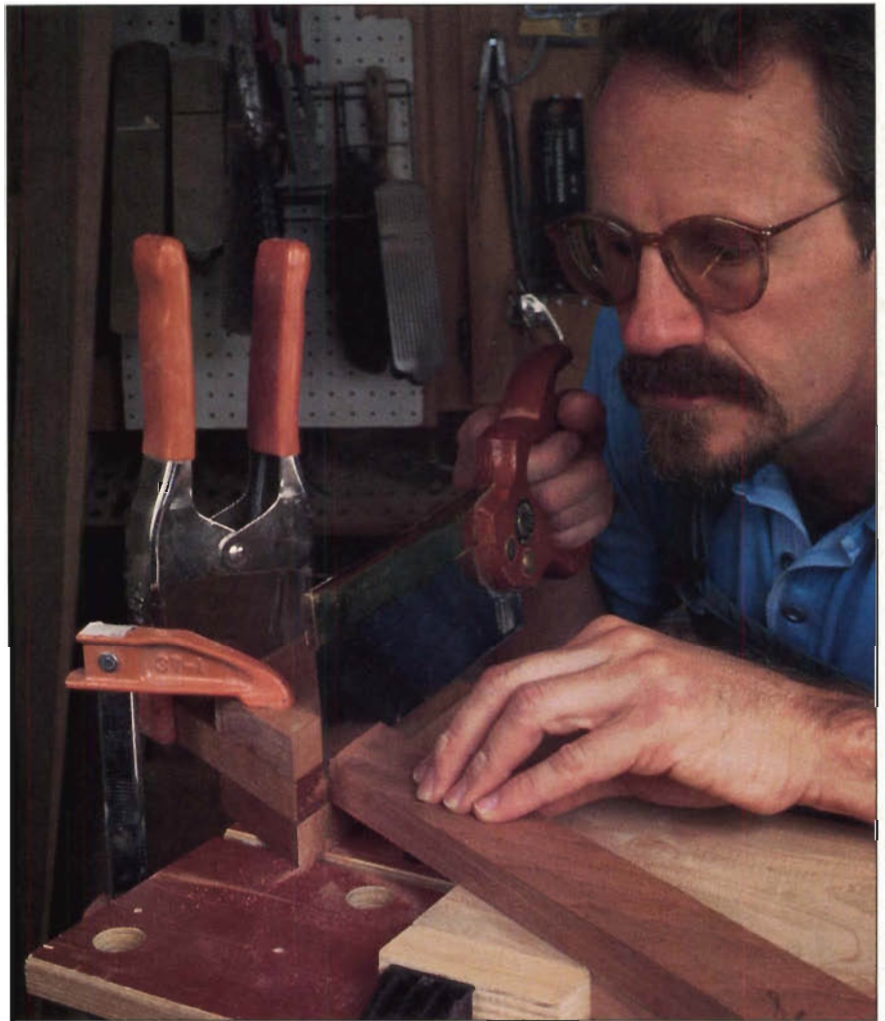
paces itself, with no motors burning out or circuit breakers blowing. The air doesn’t fill with smoke and dust—or cursing either, if you’re using the right technique.

Crosscutting: Use The Right Technique

For crosscut work that doesn’t require fine precision, I use stands or

sawhorses that measure roughly 20" high. They’re low enough that I can pin the board down with my knee, yet they hold it high enough that I don’t stab the ground with the saw (*photo A*). My body weight clamps the workpiece down quickly and without strain, stabilizing the work. This enables the saw to do its job smoothly and easily.

I choose a saw with as few teeth as possible that still makes a cut as



Author finds that hand saws increase productivity in the furniture shop where he works. Here, he cuts a 30° miter using an 8" tenon saw and shopmade U-guide. Note the second fence on the guide, which rides beneath the workpiece and helps keep the saw blade vertical during the entire cut.



Photo A: For larger-scale work such as panel-sawing, an 18"- to 20"-high sawhorse (or milk crate, shown here) supports the workpiece at just the right height: low enough to let you get a knee and plenty of body weight on it, but high enough that you don't stab the floor with the saw tip.



Photo B: To make a straight start on a small trim cut, clamp a slightly wider scrap board with the kerf already started underneath the workpiece, and use this kerf as a guide. The scrap board also minimizes tearout.



Photo C: Conventional backsaws come in three size ranges, represented here (top to bottom) by an 8" saw with 20 points (a tenon saw); a 12" model with 15 points; and an 18" saw with 10 points (a miter saw).

smooth as I need. Fine teeth cut smoothly but slowly, and they have shallow gullets that carry away less sawdust per stroke. Bigger teeth cut faster but leave more tearout on the back face of the stock. To cut plywood, with its tearout-prone veneers, I choose a saw with more teeth per inch. For roughing down 8/4 maple planks, I'll select a tool with the fewest (and largest) teeth.

Wood contains both water and sticky resins, so I always wipe the blade faces with paraffin to help the saw glide through the stock. This also prevents resin buildup and protects the saw from corrosion between uses.

Straight Sawing Depends On a Straight Start

A straight cut begins with the saw entering the workpiece at the correct angle. Zigging and zagging will wear you out, dull the saw, and require a lot of cleanup work. It

helps to lay out the cut with a clearly drawn line.

For casual work, there's an old rule of thumb that gets you off to a good start: Draw the tool backwards, guiding it with the knuckle of your thumb. For more precise work, there's a better method: Chop out a small starting groove with a sharp chisel. This gives me a surer start.

After two short strokes, I start the long, straight, steady strokes, angling the saw at 45° to the face of the plank and keeping the blade vertical. Straight strokes prevent binding, and long strokes carry the sawdust out of the kerf—so you're sawing wood, not regrinding sawdust.

Some woodworkers point their index finger forward in the direction

of the cut. I find that this helps at the start, but then I switch to a four-finger grip, keeping it relaxed but firm on the handle as the cutting progresses.

During trim cuts, the saw wants to break out of the kerf into the wide open spaces. I corral it by starting a cut in a wide piece of scrap, then clamp the scrap to the underside of the workpiece (*photo B*). The kerf not only holds the saw on course but also serves as a backing board, minimizing tearout on the bottom face of the stock.

When trimming a case assembly that won't permit attachment of a square scrap, I clamp or hold a T-shaped guide to the face of the work. The guide sits snugly against the cut line and the saw rides against it.

Precision Work Calls For a Backsaw

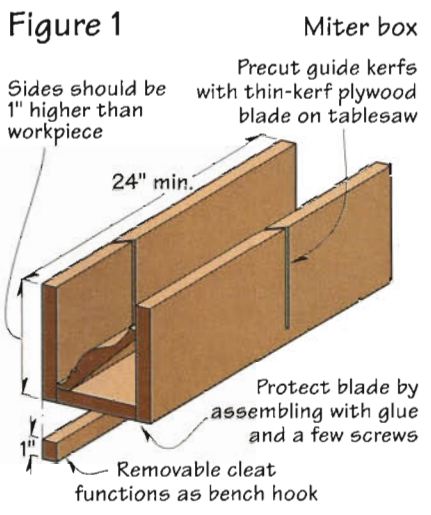
For exacting cuts, I turn to the backsaw, which has a thin, rectangular blade with 10 to 20 teeth per inch and a spine of steel or brass along the top edge (*photo C*). This spine or "back" stiffens the blade and adds weight, which makes the saw cut smoother and straighter but prevents it from making long, deep cuts. A saw with a brass back weighs slightly more (and also costs more) than one with a steel back.

When the standard 12"- to 16"-long backsaw stretches to 24" or 28" for use with a miter box, we call it a miter saw. A tenon saw, on the other hand, measures only 8" or so in length and has 15 to 20 teeth per inch. The stiff, fine-tooth blade can operate within a very tight space and works well for precise cuts on any small joinery.



Photo D: A combination square makes an expedient guide for a 90° or 45° cut. Author has found that this method neither notches the guide nor dulls the saw.

Figure 1



Give Your Backsaw Proper Guidance

Because backsaws are designed for exacting work, I rarely use one without a guide of some sort. For a narrow or shallow cut, you mainly need a guide at the start. The simplest method is to hold the saw against the blade of a combination square—this will ensure an accurate 90° or 45° angle (*photo D*). Purists might doubt the wisdom of running a steel saw *against* a steel guide, but I'm sawing *against* the guide, not *into* it. I've never found that this method notched the guide or dulled the saw blade.

If you're wary of this approach, spend 15 minutes or so and make a clamp-on wooden U-guide. I do this myself whenever I need to make repetitive cuts at an odd angle. (See the lead photo on *page 72*.)

Start with a length of $\frac{3}{4} \times 3\frac{1}{2}$ " scrap stock. Decent-quality pine from the lumberyard will suffice for a few cuts, although a dense hardwood like maple will last longer. Joint one edge to straighten it, then crosscut one end at 90° (or any other desired angle). Glue and screw a fence cut from jointed and squared 1x2" stock across this end, aligning the edges.

If you make the fence from stock that's slightly thicker than the workpiece, you can attach a second guide to the bottom face of the fence to help keep the blade vertical. Check to make sure the two fences lie parallel, then adjust if necessary by planing or sawing.

I built my guide using glue as well as screws so that it will hang together even if I decide to pull the screws and cut it down or reshape it for special duty. I use brass screws because they do much less damage to the saw should they accidentally end up in the line of cut.

Build a Better Miter Box

In the shop where I work, we use a wooden miter box when sawing metal or dense, oily wood that might damage the power machinery. On the job site, we use a miter box to cut long molding that exceeds the capacity of the power miter saw or to avoid waiting if that tool is tied up for a while.

To make a miter box, start with a base piece that's wide enough to fit most of your workpieces. (See *figure 1*.) Joint one edge, then rip the other to ensure that the edges are parallel. I like to make the box at least 24" long, which is a more useful length than the bare minimum length you get with commercial boxes.

I make the sides 1" higher than the thickest workpiece I'm likely to saw. This extra inch starts the saw straight into the stock. I also screw a removable 1"-wide cleat to the bottom edge of the front side, which serves as a bench hook when I want to keep the box aligned with the front edge of the bench.

You could make the guide kerfs by cutting carefully with a hand saw, but I flip the box over and cut them with the tablesaw, using an extra-thin-kerf plywood blade. I position the cuts slightly to the *right* of center because I usually hold down the work with my left hand and saw with my right.

A Dovetail Saw For Delicate Work

The dovetail saw has a cylindrical, pommel-style grip and a thin, fine-toothed blade with a steel or brass spine (*photo E*). The round handle doesn't allow the firm control that you get with the conventional hand saw grip. Its narrow blade and super-fine teeth, 15 to 25 points, limit this saw's use to small, shallow cuts.

Even so, I use this tool a lot around our shop because its small size lets me reach almost anywhere I need to cut. Besides cutting the occasional dovetail, I use it to form and trim tenons and other joints. It also excels at sawing veneers and delicate solid woods, leaving minimal tearout on the back face.

Japanese Saws Cut on the Pull Stroke

The typical Western crosscut saw has the top half of each tooth bent out or "set" at an 8 to 15° angle. (See *figure 2*.) This makes a kerf about twice as wide as the blade thickness, which reduces friction and creates clearance for sawdust as well as the blade. Without set, saws tend to bind and kink as you push them through the cut stroke.

Most Japanese saws are made of thin steel and given less set. Because they cut on the pull stroke, tension straightens them and eliminates kinking and binding. They cut a very narrow kerf easily and smoothly (*photo F*).

Japanese saws have two drawbacks. With certain woods, they lift and fuzz the grain along the cut line. In addition, the extreme angles and multiple facets make sharpening the teeth a job that can grind you down. (In Japan, wood-

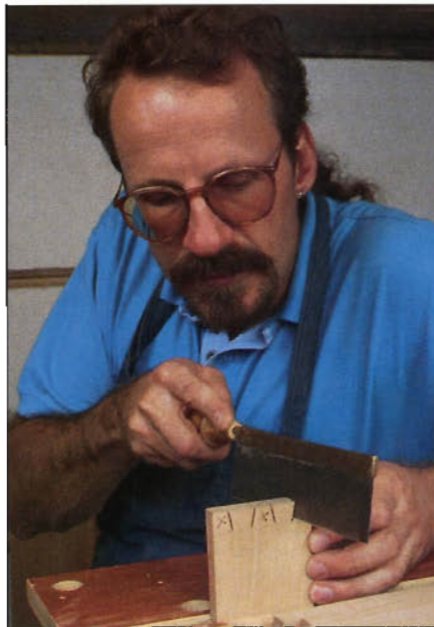


Photo E: Dovetail or "gent's" saw offers versatility in tight spaces or wherever shallow cuts are called for. It cuts dovetails and tenons without roughing up the shoulders, but also takes care of veneers and other delicate stock with minimal tearout.



Photo F: Japanese saws, made of thin steel and given less set than Western saws, cut a very narrow kerf. Because they cut on the pull stroke, tension virtually eliminates binding. This backless ryoba saw has fine crosscut teeth on one edge, rip teeth on the other.

workers return their dull saws to the manufacturer for sharpening.) If you have the patience to file at three or four different angles per face with a special feather-thin file, you can, with practice, do a respectable job.

Flush-Trim Saws Don't Leave a Scratch

Some saws have no set or are set on only one face. They enable you to trim protruding face frames, dowels, plugs, and tenons almost perfectly flush without marring the surrounding surface (*photo G*). The saw shown in the photo, which is set only on the top face, has an offset handle that can be rotated 180° for left-handed sawing.

Coping Saws Take Care Of the Details

Coping saws, like fret saws, use a frame to maintain tension in a very thin blade. Although the blade can be reversed in these tools, woodworking tension saws should always cut on the *pull* stroke. Otherwise, they tend to chatter and jump, which makes for sloppy cutting and frequent blade

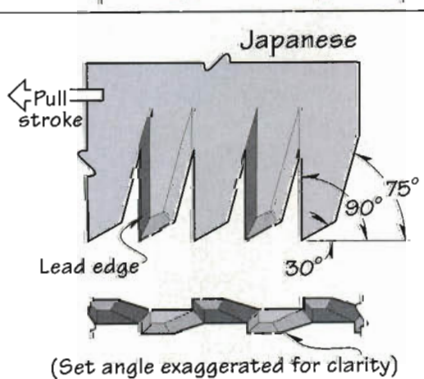
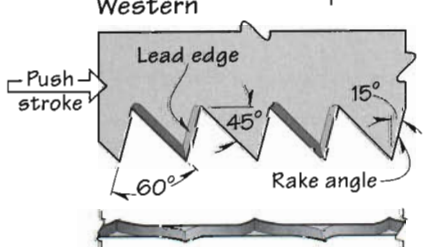
breakage. A good coping saw has a 6"-deep frame with guides that allow the blade to be pointed in any direction.

This saw derives its name from its original intended purpose—making the zigzagging cut required for "coped" molding (*photo H*). Considered the high-class way to fit inside corners, this technique produces a butt joint that looks identical to a miter. (You first miter the end of the second piece, then cope it to fit into the mold-profile of the first piece.)



Photo G: A flush-trim saw's teeth have no set or are set only on one face, which lets you trim dowels, plugs, and projecting parts nearly flush without marring the surrounding surface. The saw's back protrudes only on the off-face, and the handle rotates 180° for left-handed use.

Figure 2 Typical crosscut tooth pattern



The removable blade on a coping saw also permits starting an interior cutout from a drilled hole. For heavy-duty work, this tool can't beat an electric jigsaw. However, for curved cuts in cramped spaces or tight-radius sawing, the coping saw can often finish the job before you've installed the right blade in the power tool.

The stock blade supplied by the manufacturer usually has too few (and too large) teeth. You need at least 25 points on a coping saw blade to minimize chatter and tearout. To find the best compromise between smooth-cutting and fast-cutting blades, test several different sizes in scrap stock before you start on the workpiece. I also like to put a little extra tension in the blade by bending the frame open an extra $\frac{1}{4}$ " or so before installing it.

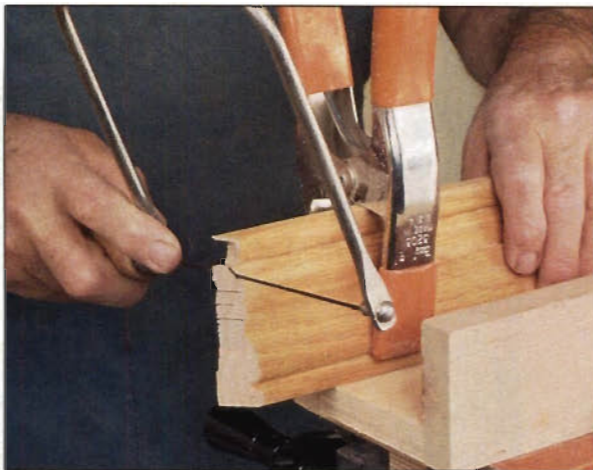


Photo H: To cope molding with a coping saw, first miter the end, then saw along the contour of the molded profile, keeping the blade perpendicular to the face of the stock.

Reconsidering the Rip Saw

Most of us hand-tool fanatics have collected a rip saw or two, but, in my opinion, they take too much time and

sweat. A tablesaw—or even a circular saw with an edge guide—cuts kerfs that require less cleanup than hand-sawn rips. A competent operator with a decent tablesaw and a quality blade can make rip cuts that are ready to join. You can't do that with a hand saw.

A number of eminent craftsmen, Tage Frid among them, disagree with me about dismissing the rip saw. Frid recommends that, at the first sharpening, you file a perpendicular rip-tooth profile on the teeth of your crosscut saw. This way, you get the best of both worlds: swift, efficient cutting from the more aggressive rip teeth along with 50 to 100 percent more teeth per inch, which makes for a smoother cut.

Continued on page 78

SHARPENING A HAND SAW

Try A Touch-up First

A 20" 10-point saw has 200 teeth. Hand-sharpening from dull to perfect takes a lot of work, so instead of filing the entire blade, I'll sometimes touch it up in just the areas where the teeth show wear. After a couple of touch-ups, however, the teeth get uneven and the saw must be jointed, filed, and reset.

Jointing

A complete sharpening begins with "jointing" the edge of the blade. In this step, an 8" or 10" mill bastard file puts the points of all teeth into the same plane (See photo below.) In just a few passes, it evens up the teeth by flattening the tops of the taller ones. A word of caution: To prolong the life of your saw, joint only when absolutely necessary, and don't remove more steel than you need to.



Setting

A blade requires some set in order to form a kerf for it to slide back and forth in without binding. Too much set, however, will give you a wide, grabby, rough cut.

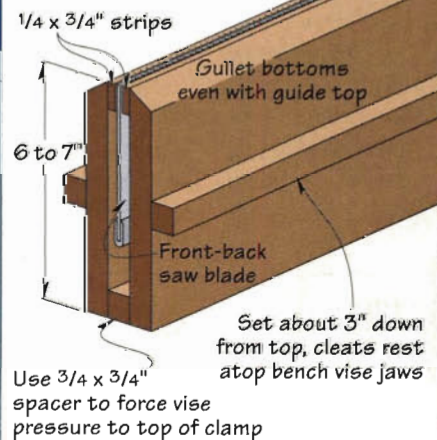
To "joint" the teeth, or bring the points into the same plane, author uses an 8" or 10" mill bastard file.

The standard set varies from 8 to 15°, with saws made for finer work leaning toward the lower end of this range. The length of the tooth adds to the final width of the set. A large-toothed rip saw cuts a kerf more than four times as wide as that made by a fine crosscut saw.

A saw set has two handles that you squeeze together to adjust the teeth. (See photo below.) As you squeeze the handle, a "hammer" pushes the teeth out against the adjustable "anvil." To get the proper set, rotate the anvil until the number matches the teeth per inch (tpi) of the saw. You work down one face of the blade set-

A saw set presses each tooth against an adjustable "anvil," bending it away from the blade axis to the correct angle (8 to 15°).

Shop-Built Sharpening Clamp



FINDING AND RESTORING HAND SAWS

New or used, a saw will cut well if it has a flat blade, sharp teeth, and a firmly affixed handle. If it has good steel, it will stay sharp until you can't remember when you last sharpened it. Auctions, garage sales, pawn shops, and flea markets often yield better-than-new tools.

If you find what appears to be a promising candidate, sight down the blade to make sure it's straight. A saw shop can remove bends by an expensive process called "hammering," but you're better off starting with a straight blade. I follow up by examining the handle. It should attach to the blade with three or four large-headed fasteners. The best of them are made of brass and stamped with the manufacturer's logo. Premium saws often have more detailed handles

made of fancier woods such as walnut.

The brand of the saw etched on the blade tells you a lot about the quality.

To clean corrosion from blade, apply either Rust Free, a water-based product (shown here), or naval jelly. After 15 minutes, scrub away residue with a purple ScotchBrite pad. Be sure to remove the handle to protect it from the cleaner.

ty. Familiar old names like Sandvik and Disston guarantee good-to-excellent steel. I've generally found that steel made in Sweden, England, or the U.S. tends to hold its sharpness. Better metal pays for itself because it takes a better edge and stays sharp longer.

It's not difficult to get a good saw at a good price. This is because better saw steel, which has more carbon, tends to corrode (and hence deteriorate in appearance) more readily than the cheap stuff. In fact, it gets ugly fast, especially when exposed to moisture.

When I've found a saw that has the potential to look great after cleanup, I remove the wood handle before cleaning the blade. This makes the job easier and protects the wood from the acid-based cleaner. If the quality of the handle warrants it, I remove any old paint, then sand and oil it. A Scotch-Brite pad polishes the fasteners.

Next, I give the blade a coat of Rust Free, a steel-cleaning product, or naval jelly. I wait 15 minutes until the corrosion dissolves, then work the surface with a Scotch-Brite pad. (See photo at *left*.) A rinse with water removes the residue, and a coat of WD-40 prevents more corrosion. If the Scotch-Brite pad doesn't give me a smooth surface, I massage the blade with a medium carborundum stone lubricated with oil, taking care to avoid the teeth.

ting the left teeth, then down the other to set the alternate (right) teeth.

My one beef with sharpening shops is their common tendency to apply too much set. When that happens, you struggle to hold the cut on the line while the saw tends to make a rough kerf and leave lots of tearout. When I drop off the saw at the shop, I check the set on the ones they're finishing up. If it looks excessive, I ask them to ease off a little.

If you get too much set, you can reduce it by clamping the teeth between two smooth, uniform strips of wood. Start with soft wood and light clamp pressure. Switch to greater pressure and harder wood only if necessary.

Filing

If you avoid sawing rocks and nails, a saw shouldn't need jointing and setting more than once every five sharpenings.

Sharpening is the easy part. Depending on use, sharpening requires only a couple of passes with the file, whereas jointing and setting require a

For touch-up sharpening, author secures blade in a shop-built jig that drops into his bench vise. Note marks on top edge of jig that show correct filing angle (35° forward of perpendicular).

good deal more work. You might consider leaving that job to a professional sharpener.

For filing the teeth, a shop-built jig, shown in the drawing *left*, secures the blade. The 8"-long jaws drop into a standard bench vise. (You'll need to move longer saws once or twice to cover their length.) Position the saw so that its lowest gullets just clear the tops of the jaws; this allows you to see when the file hits full depth. To sharpen, hold the file level at an angle 35° forward of perpendicular. (See photo *below left*.)

I file with a triangular "slim taper" file, using a 6" for 7- or 8-point saws, a 5" for 9- or 10-point saws, and a 4½" for finer teeth. I file every other tooth from one side, then file the remainder from the other side. The gullet has a 60° angle—or at any rate, it does after you sharpen it, since that's the angle of the file. The front of the tooth should have a negative rake of 15° and the back of the tooth a rake of 45°. (See the drawing on page 75.)

At the moment when the file touches the top of the jig (or .001" before, whichever is easier), you stop filing. To keep things uniform, I mark the top edges of the jig at regular intervals with the correct 35° angle. You can also find the angle used for the last sharpening by pressing the file down into the teeth with your thumb and measuring the angle to the blade. Fresh grooves help you remember which teeth you've completed.

Even with old file marks on the top of the jig, you can see and feel the file making contact with the wood. Perfectionists will plane the jig smooth before each filing and use the first pass that cuts into the wood as assurance that they've filed the tooth to full depth.



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Hand Saws

Continued from page 76

You would also enjoy another advantage with Frid's conversion. Because you file rip teeth straight across the blade, this "hybrid" is much easier to sharpen than a crosscut saw. Whether or not you decide to convert, keep in mind that a sharp saw of any tooth profile will cut better than any dull saw. **Wj**

Photographs: Sven Hanson



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Garrett Wade

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Quality saws (both Western and Japanese), sharpening tools

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800/279-4441

Quality saws (both Western and Japanese), Sharpening Supplies, Hardware.

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TOOL
REVIEW

WET-WHEEL GRINDERS

A cool way to sharpen tools and not get burned

by Bob Colpetzer

Ten years ago, we had few options when it came to motorized grinders. Today, we can choose from a wide variety of slow-speed, wet-wheel grinders that make tool-sharpening substantially easier and safer. To see how they compare, read on.

When our plane irons, chisels, knives, and turning tools need regrinding, many of us come down with “grinder panic”—and not without good cause. One slip on a high-speed grinder can instantly spoil the proper cutting angle of a tool. Also, failing to cool a tool adequately during grinding can destroy the steel’s temper before we even realize it.

Fortunately for those of us who have not developed that special touch required for high-speed grinding, there is an alternative. Slow-speed, water-cooled grinders turn their wet wheels at speeds ranging from 60 to 1200 rpm, far slower than the 3450 rpm generated by conventional grinders. This slow approach is not only safer, but gives us considerably more control over the grinding action. The water supplied to the wheel during the grinding process cools the



Grizzly G1036**Lobo BG102****Penn State
SSG-ACCU**

tool's edge and then carries away abraded steel particles.

I rounded up a dozen of these machines, representing most of the current offerings in a range of prices, and put them through their paces in my shop. For comparison's sake, I divided them into two basic groups: those with vertical wet wheels and those with horizontal wet wheels. (See the chart on *page 86* for specifications on the grinders I tested.)

Vertical-Wheel Grinders

Four of the six vertical-wheel grinders I tested use 10" 220-grit aluminum-oxide wheels that turn in water at speeds of 60 to 70 rpm. These include the Grizzly G1036, Lobo BG102, Penn State SSG-ACCU, and the Delta 23-700.

Besides their slow-speed wet wheels, these four grinders also have a smaller 100-grit dry wheel that turns at 3450 rpm. Using the dry wheel first can reduce wet-grinding time significantly, especially if you need to remove nicks, reshape an edge, or remove a lot of steel.

Three Similar Machines

The Grizzly, Lobo, and Penn State machines come from Taiwan and, except for paint color, appear nearly identical. All three required some assembly. Unfortunately, they all had poorly tapped holes that needed extra time to deburr or retap. The wheels lacked flange facings to cushion the flange against the wheel, so I had to take extra care when tightening the wheels. Also, none of the wheels on any of the three units indicated grit size or composition.

During my tests, the face of the dry wheel ran true on each of these machines, but the sides wobbled. I

eventually traced the problem to the stamped metal flanges. By rotating and repositioning the flanges before tightening the wheels, I was able to minimize, but not completely solve, this problem.

Generally, the three machines performed adequately. Suppliers price the Grizzly and Lobo between \$120 and \$130. Penn State offers the same basic machine but has equipped it with the Accu-Sharp Jig for \$159.95. (For details about this jig, see "An Improved After-Market Tool Rest" on *page 83*.)

Delta's Sturdy Tool Rest

The Delta model 23-700 was also manufactured in Taiwan but by Delta. Although it incorporates the same wet-and-dry-wheel combination, I found the tool rests more functional than those on the other machines. Delta's cast-aluminum rest for the wet wheel was sturdy, fully adjustable, and large enough to adequately support the tool being ground. It also has a milled slot that accepts a small miter gauge, which comes as standard equipment (*photo A*).

Thanks to an excellent manual with good photos and illustrations, the Delta assembled easily. Best of all, the parts fit together perfectly. Parts that require regular adjustment (tool rest, guards, etc.) come equipped with knobs or levers so you don't need to chase down a wrench or screwdriver. Both the

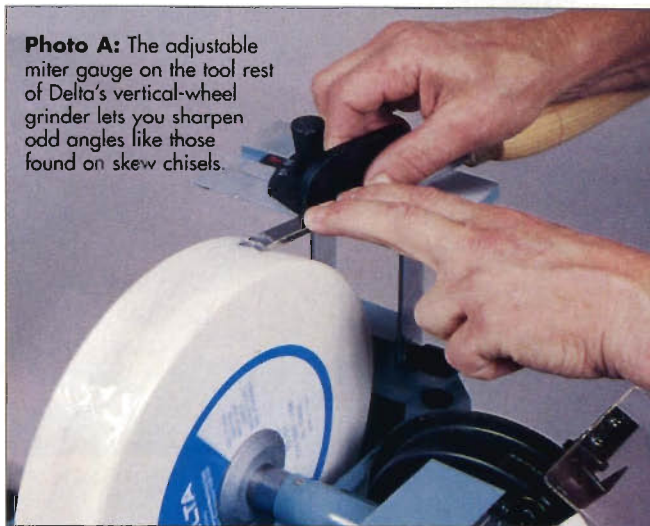
wet and dry wheels ran smoothly with no vibration. Flange facings on the wet wheel were clearly marked with the grit, abrasive, and size.

The Delta unit costs a little more than the three lookalikes—\$160 to \$210 depending on the supplier. However, if you add in the cost of an Accu-Sharp Jig to the three other imports, the Delta's price tag becomes more competitive. Add Delta's two-year warranty, network of service centers, and inventory of spare parts, and the unit becomes even more attractive.

Tormek: A Breed Apart

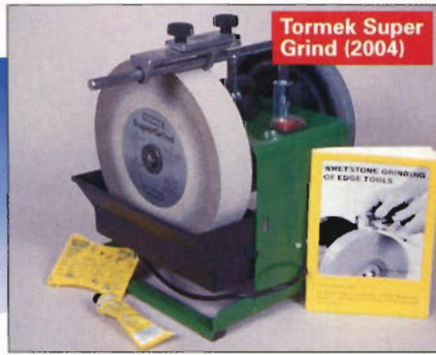
Designed to accommodate all of your sharpening needs, Tormek's Super Grind 2004 features a 10" aluminum-oxide wet wheel that's different from all the others. It's held together with a unique ceramic binder that lets you change the grit using a silicon-carbide grading stone. Press the stone's fine side against the revolving wet wheel, and it dresses the wheel to a smooth 1000-grit consistency. To restore the 220-grit sur-

Photo A: The adjustable miter gauge on the tool rest of Delta's vertical-wheel grinder lets you sharpen odd angles like those found on skew chisels.





Delta 23-700



Tormek Super Grind (2004)



Wen 2908

face, just press the coarse side of the stone into the wheel for a few revolutions. This process can be repeated an unlimited number of times.

The Tormek also incorporates a leather stropping wheel that you charge with honing compound. It quickly removes grinding burrs, honing and polishing the cutting edge to razor sharpness.

I especially liked the unit's removable water trough because it was easy to empty and clean. The trough also lowers out of the way when not in use. This way, the bottom of the wheel doesn't sit

idly in the water and become so saturated that it runs off-balance.

I had no complaints with the Tormek's tool rest. The system's "universal support" uses a 1/2" bent steel rod that forms a 90° leg. A second rod runs perpendicular to the main section and parallel to the first leg, forming an F-shaped support (photo B). The legs slip into sleeves on the grinding unit and can be locked at different heights.

All Tormek grinding jigs fasten to this tool rest. It also worked well as a support for grinding tools when



Photo B: Tormek's universal support arm accommodates all of the company's sharpening jigs.

The Great Debate: Vertical Vs. Horizontal Grinders

Before you choose either a vertical- or horizontal-wheel unit, I suggest you consider the type of grind you want, the type of work you do with your cutting tools, and the speed at which you prefer to grind.

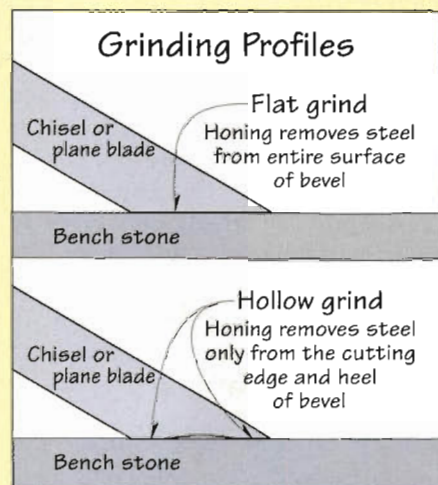
Vertical wheels produce a hollow-ground bevel. By comparison, horizontal wheels produce a flat bevel. (See the illustration right). Woodworkers disagree as to which of these two grinds work wood better. Hollow-grind advocates point to the ease of honing this type of bevel and claim that they get a sharper, more refined edge. Flat-bevel proponents claim that their favored grind can be honed just as sharp and that it holds up better under

heavy use. Carvers, generally prefer a flat bevel on their knives and gouges, as do hand-tool craftsmen who use their chisels to do a lot of heavy chopping, such as mortising requires.

Next, consider the speed of the grinding process. Vertical-wheel

units typically abrade metal faster because they use coarser wheels than you'll find on horizontal models. However, a bevel ground on most vertical wheels will need additional honing on a bench stone to make the edge razor-sharp.

Most horizontal units come with an 800- to 1000-grit wet wheel. (Makita, however, offers a selection of different grits.) This makes for slow going if you need to remove large amounts of steel, which is why many woodworkers use these machines mostly as power hones. They'll grind the edge to its basic shape on the attached dry wheel (or on a conventional bench grinder), then switch to the wet wheel for honing. Horizontal-wheel units also excel at flattening and honing the backs of chisels and plane irons, as shown in the photo at left.



Horizontal wet wheels quickly and accurately flatten the backs of chisels and plane irons.

the jigs don't suit the task. Occasionally, I wished that I'd had a third hand to hold both the angle gauge and the tool clamped in the jig while adjusting and locking the height of the tool rest. However, that was the only difficulty I encountered, and it just took a bit of practice to overcome it.

Wide Variety Of Jigs Offered

The basic Tormek machine comes with a straightedge jig for grinding chisels and plane irons, a template for setting common grinding angles, a tube of honing compound, and a 68-page manual. While the basic machine and its straightedge jig will probably take care of most of your sharpening needs, the manufacturer offers additional jigs for grinding planer and jointer knives, gouges, turning tools, axes, knives, and scissors (*photo C*). The firm's latest jig grinds turning gouges to a fingernail shape.

The Tormek was a delight to use. The parts fit precisely, and it did an excellent job of grinding. All of the jigs hold tools securely and slide effortlessly on the tool rest. While grinding, you can remove the jigs from the support to inspect the grind and then return them to the support without altering the grinding angle. The fingernail gouge jig took some getting used to, but with a little practice I was able to get excellent, repeatable results.

As you'd expect, all of this capability costs. The basic unit lists at \$389. Add a \$20 stone grader and a \$25 truing tool—accessories I consider essential—and you've passed the \$400 mark. The complete system, including all jigs, goes for nearly \$800.



Photo C: A sampling of the many Tormek sharpening jigs currently available for the grinder.

Wen's Small, Affordable Unit

The Wen 2908 was the least expensive unit I tested. This U.S.-made product lists for \$50 and comes with a two-year warranty. It ships fully assembled and has a good fit and finish.

Designed as a single-wheel unit, the Wen has a 3" 180-grit wheel that turns at 1200 rpm. A felt wiper and wick apply water from a built-in reservoir to the wheel. The tool rest, made of formed sheet steel, proved sturdy and fully adjustable. A tool-rest extension attachment snaps easily onto the standard tool rest. There's also an adjustable protractor guide for the extension to help make square or angled grinds. A small 240-grit honing stone built into the top of the machine removes grinding burrs.

The Wen performed adequately on small chisels and gouges and even better on knives and scissors. I found it more difficult (though not impossible) to use with larger chisels and plane irons. Initially, the wheel speed and water-application system concerned me, but my fears proved unfounded. The wheel receives enough water for cooling with no splash or mess. I think this small grinder best serves woodworkers who have limited and/or occasional grinding needs.

HORIZONTAL-WHEEL GRINDERS

Five of the six horizontal units I tested use an 8" wet wheel that turns at 400 to 560 rpm. These include the Garrett Wade GGM-250W, AMT 5260, Trendlines/Reliant DD-68, Delta 23-710 Sharpening Center, and the Makita 9820-2. Except for the Makita, these units also have a 3450-rpm dry wheel. The wet wheels appear to be composed of the same material as Japanese water stones, and all were 1000-grit except for the 800-grit wheel on the AMT. The sixth unit I tested, the Wen 2900, has a single 4" 180-grit aluminum-oxide wet wheel spinning at 3500 rpm.

Here's what I observed about each.

An Improved After-Market Tool Rest

Created as an after-market accessory for vertical-wheel grinders, the Accu-Sharp Jig consists of two parts shown in the photos *below*. The tool holder (the part with the two red knobs) clamps chisels and plane irons up to 2¾" wide. The second part, a 4x6" extruded-aluminum table, has a lengthwise slot to control the lateral motion of the tool holder on top. The two parts are priced and sold separately.



The Accu-Sharp tool holder and table.

The Grizzly, Lobo, and Reliant grinders require both jig parts. To install the table, drill three holes in the grinder's tool rest and attach the table with the stainless-steel screws provided. The Delta doesn't require the table because the jig fits the slot in the factory tool rest.



The tool holder rides in the groove in the table, providing complete control of the tool on the wet wheel.

The Accu-Sharp has positive 90° stops for squaring chisels and irons to the grinding wheel. A UHMW plastic slide bar rides smoothly in the table groove and buttons on the bottom of the jig prevent metal-to-metal contact. You can lift a tool, inspect the ground edge, and return it to the wheel without losing your grinding angle.

The tool holder sells for \$34.95, the table for \$12.65. You can buy them from several of the major woodworking catalogs.



Garrett Wade GGM-250W

Garrett Wade bills this machine as a combination dry grinder and water-cooled whetstone for the cost-conscious. It has a 2x5" 100-grit vertical dry wheel paired with an 8" 1000-grit wet wheel that turns at 400 rpm. Water is gravity-fed to the wheel from an overhead plastic reservoir. You control the flow by opening or closing a valve. A plastic water tray surrounds the wheel, and a drain hole in the bottom of the tray directs used water into a container by way of a plastic hose. To keep things clean, a foam ring fits into a slot on the water tray and catches water flung from the surface of the spinning wheel. A flat stamped-steel tool rest for the wet wheel mounts on the water tray.

The vertical dry wheel has a small plastic spark shield and adjustable stamped-steel tool rest. The motor mounts on a stamped-steel base, and rubber-tipped feet screw into the base and level the unit. You can also remove the motor from the base and mount it on a bench.

Assembly took longer than I expected due to poorly tapped holes, burrs on some of the parts, and a poor fit in several places. The fit on the dry wheel's tool rest made assembly with the two locking knobs impossible.

Assembling the tool rest for the wet wheel was not much easier. I had to

retap and deburr all of the mounting holes. The guide posts also needed deburring before they would fit smoothly in their mounting holes. Once I had the tool rest assembled and in place, I found the bottom of the rest made contact with the post flanges, limiting adjustment to a minimum angle of 32°. Honing any edge to a more acute angle had to be done freehand.



When I turned the unit on, it vibrated and walked all over my bench. I traced the vibration to an out-of-round dry wheel, which needed dressing before I could use the machine. The face of the wet wheel was also uneven.

Offered at \$149.95 through the Garrett Wade catalog, this grinder was the most expensive of the three Taiwanese imports I tested. The manual that came with it rated a barely passing mark, but the unit is backed by a one-year warranty.

Trendlines/Reliant DD-68

This grinder comes with an 8" 1000-grit wet wheel that turns at 400 rpm and a 3/4x6" 36-grit dry emery wheel

Photo D: The Delta Sharpening Center tool rest mounted over the wet wheel. Note the planer-knife jig secured to the tool rest.



Photo E: The Delta Sharpening Center tool rest mounted over the dry wheel.



that rotates at 3450 rpm. The water reservoir, water tray, tool rest, and splash guard look identical to those on the Garrett Wade unit, and parts appear to be interchangeable. I also encountered the same assembly problems: numerous burrs, poorly tapped holes, and a limited-angle tool rest.

This unit did, however, run vibration-free, but the wet wheel was pitted and appeared to be of low quality. The emery wheel ground a little hotter than the aluminum-oxide dry wheels on the other models. I also found the narrow emery wheel less convenient, especially when grinding wider chisels and plane irons.

Trendlines offers the DD-68 at \$99.95 with a one-year warranty. No manual came with the unit I tested, but that was a packing error.

AMT 5260

This unit comes with a 2x5" 80-grit aluminum-oxide dry wheel and an 8" 800-grit wet wheel that turns at 400 rpm. At first glance, it appears to be a carbon copy of the two previously discussed imports, although a closer look revealed subtle but important differences. The motor, gear box, base, splash guard, and water reservoir are identical to those on the other two. The water tray on this unit, however, was made from cast aluminum, and the tool rest fitted to this tray really works!

Although made of plastic, the tool rest adjusts fully for height and angle. It consists of two parts (*photo F*). The top part slides back and forth on the bottom section, so you can hold the tool in one position during grinding and honing. The top section of the rest also has magnetic strips built into the plastic and an adjustable protractor.

The dry wheel worked fine with its simple, flat tool rest. The 2" wheel width made grinding plane irons easier, and the wheel ground without burning as long as I quenched the tool regularly. The AMT assembled more easily than the other imports, thanks to a good manual and properly fitting parts. Priced at \$119.95 and backed by AMT's 10-year warranty, I consider this machine a good value.

Delta 23-710 Sharpening Center

The Delta 23-710 has a 2x5" 120-grit aluminum-oxide dry wheel that turns at 3600 rpm. Its 8" 1000-grit horizontal wet wheel revolves at 400 rpm.

Well-machined parts and a clearly illustrated manual made assembly easy. On this unit, a plastic water reservoir sits above the wet wheel, which is surrounded by a sturdy plastic tray. The two-part plastic splash guard adjusts, so you can make a gap between the two sections. This lets you grind longer knives or tools without bumping them into the guard. The motor and gear box mount on a cast-iron base that has four holes for securing the unit to a bench.

The versatility of this machine's tool

rest impressed me. Made of cast iron and machined steel parts, it provides a rock-solid platform for any tool. You can adjust it to any height and sharpening angle, and when you've finished honing your primary bevel angle, you can dial in a few degrees of change for a perfect micro-bevel. The tool rest also comes with a tool holder and built-in protractor. The holder can be removed during the sharpening process, then returned to the exact same position on the wheel. Best of all, you can mount the rest over either the wet or the dry wheel (*photos D, E*).

The dry wheel also has a standard tool rest for hollow-grinding tools on the face of the wheel. This adjustable cast-iron rest, although small, proved to be sturdy.

The wrenches and tools required to assemble and adjust the sharpening

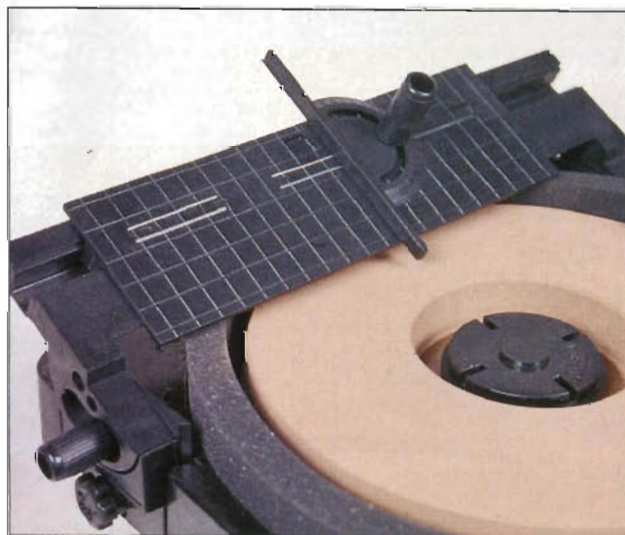


Photo F: The top part of the AMT grinder's tool rest slides back and forth on a track.

center, as well as a wheel-dressing stone, come as standard equipment. You can also buy an accessory jig that holds planer and jointer knives up to 15½" long. (See photo D.)

I found the 23-710 selling for \$169 to \$210. Delta backs it with a two-year warranty and a network of service centers. Replacement wheels, both wet and dry, are readily available. This unit provides a lot of precision, reliability, and versatility for the money and should give years of service.

Makita 9820-2

Introduced to the market about 14 years ago, the single-wheel Makita 9820-2 has proven its reliability over time. The unit's 7½" 1000-grit wet wheel turns at 560 rpm in a heavy plastic base with an adjustable plastic splash guard. A removable trough mounted above the wheel supplies the water.

The unit comes with a jig for grinding planer or jointer knives up to 16" long. This jig slides onto a cast-iron tool rest that mounts on the base and

adjusts to a full range of heights and angles. You can also clamp chisels and plane irons in an optional hand-tool jig that attaches to the tool rest in place of the planer-knife jig. All parts on this unit impressed me as top-quality. They fit together and performed flawlessly.

Unlike many of the competitive horizontal wet-wheel models, the Makita can legitimately call itself a wet-wheel grinder. The other machines offer only 800- or 1000-grit wheels, which more accurately categorizes them as honing machines. Makita also offers optional 60-, 1000-, and 6000-grit wheels. (You can also buy a green 120-grit silicon-carbide wheel for it from Highland Hardware.) This array of wheels allows you to rough-grind a wide variety of tools quickly, then switch wheels and hone them on the same machine.

You can currently buy the Makita for about \$240. The optional wheels run from \$40 to \$70 each, and the hand-tool jig costs about \$15. The unit has an excellent owner's manual and a one-year warranty.

Wen 2900

The U.S.-made Wen 2900 comes fully assembled. It has a 4" 180-grit aluminum-oxide wet wheel that turns at 3500 rpm, but doesn't have a dry wheel. A pump circulates water from a plastic reservoir to the wheel. It has a built-in scissors-sharpening guide, a drill-sharpening guide, and an adjustable tool rest. Priced at \$60 with a two-year warranty, it was the lowest-priced horizontal unit I tested.

I found that this machine sharpened knives, scissors, and drill bits well, but its high rpms, small wheel diameter, and small tool rest made grinding larger chisels and plane irons a challenge. In my opinion, the Wen is best suited to sharpening knives and scissors and producing a flat grind on small carving chisels. Because of its coarse wheel grit, tool edges ground with this unit require final honing on a bench stone.

My Recommendations

Of the six vertical units tested, the Tormek topped my list. I give it high

Continued on Page 88

Wet-Wheel Grinders

VERTICAL-WHEEL UNITS

	STREET PRICE	TYPE	WET WHEEL DIA. RPM & GRIT	WET WHEEL WIDTH/THICKNESS	DRY WHEEL DIA. RPM & GRIT	DRY WHEEL WIDTH	MOTOR HP	MOTOR AMPS	WEIGHT (LBS)	WARRANTY (YEARS)	COUNTRY OF ORIGIN	COMMENTS
GRIZZLY G1036	\$129.95	VW VD	10", 70 rpm 220-grit	2"	4½", 3450 rpm 100-grit	¾"	¾"	4.2	29	1	T	Addition of Accu-Sharp jig would improve performance
LOBO BG102	\$119.95	VW VD	10", 60 rpm 220-grit	2"	5", 3450 rpm 100-grit	¾"	¾"	4.2	29	1	T	Same as above
PENN STATE SSG-ACCU	\$159.95	VW VD	10", 60 rpm 220-grit	2"	5", 3450 rpm 100-grit	¾"	¾"	4.2	30.5	1	T	Accu-Sharp jig made this unit perform well
TORMEK SUPER GRIND (2004)	\$389	VW LW	10", 90 rpm 220/1000-grit	2"	8½" leather stropping wheel	1¼"	200 watt	1.8	32	1	S	Complete line of tool sharpening jigs available. Excellent unit
DELTA 23-700	\$159	VW VD	10", 70 rpm 220-grit	2"	5", 3450 rpm 100-grit	¾"	¾"	2	30.5	2	T	Good solid tool rest. Runs smooth
WEN 2908	\$50	VW	3", 1200 rpm 180-grit	2"	—	—	not listed	.5	6	2	U.S.	Most useful for smaller tools

HORIZONTAL-WHEEL UNITS

MAKITA 9820-2	\$239.95	HW	7½", 560 rpm 1000-grit	1"	—	—	not listed	1.1	24	1	J	60-, 120- & 6000-grit wheels available. Planer-knife jig standard
GARRETT WADE GGM-250W	\$129.95	HW VD	8", 400 rpm 1000-grit	1"	5", 3450 rpm 100-grit	2"	¾"	2.0	22	1	T	Poor tool rest
DELTA 23-710	\$179	HW VD	8", 400 rpm 1000-grit	1"	5", 3600 rpm 120-grit	2"	¾"	2.5	40	2	T	Planer/jointer knife attachment available. Versatile unit
AMT 5260	\$119.95	HW VD	8", 400 rpm 800-grit	1"	5", 3450 rpm 80-grit	2"	¾"	1.0	24	10	T	Better than average tool rest and holder
TRENDLINES/RELIANT DD-88	\$99.95	HW VD	8", 400 rpm 1000-grit	1"	8", 3450 rpm 36-grit	1½"	¾"	2.0	22	1	T	Poor tool rest
WEN 2900	\$60	HW	4", 3500 rpm 180-grit	¾"	—	—	not listed	2.0	10	2	U.S.	More suited to knives & scissors

VW= Vertical Wet
LW= Leather Stop Wheel
VD= Vertical Dry
HW= Horizontal Wet

T= Taiwan
J= Japan
S= Sweden
U.S.= United States

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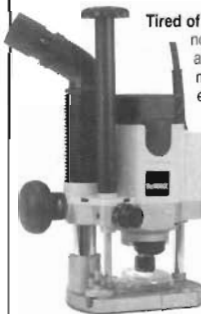
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Wet Wheel Grinders

Continued from Page 86

marks for its ability to change stone grades, its extensive complement of jigs, and the stropping wheel. Not surprisingly, it also carries the biggest price tag. Among the vertical units, it was the only machine that could grind planer and jointer knives.

For a vertical unit in the mid-priced range, I like the Delta 23-700. It offers a large, sturdy tool rest, well-machined parts, and smooth operation. Of the three imports, the Penn State SSG-ACCU (equipped with the Accu-Sharp Jig) gets my vote, although either of the other two should perform similarly if retrofitted with the Accu-Sharp.

If you have limited sharpening needs and/or a tight budget, consider the Wen 2908. However, keep in mind the size and speed limitations of this unit; it won't easily handle larger sharpening jobs.

Of the four horizontal two-wheel units, the Delta Sharpening Center gets my vote. Priced competitively with the other three units, this machine's

well-engineered tool rest, tool holder, and precision parts make it a logical choice. It's also the only two-wheel unit offering a tool-holding jig and the capacity to grind planer and jointer knives. My second choice would be the AMT 5260.

For a single-wheel wet grinder, I'd go with the Makita 9820-2. This well-built machine has earned a reputation as a solid, dependable unit. **WJ**

Photos: Kevin May, the author

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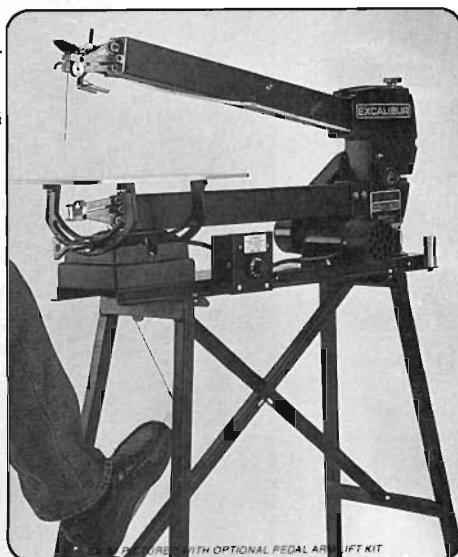
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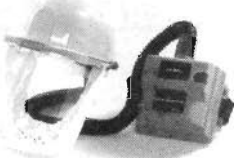
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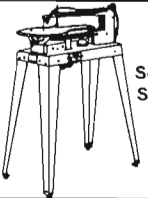
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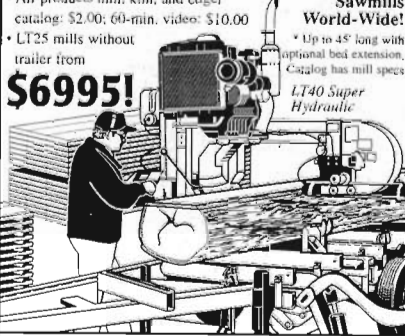
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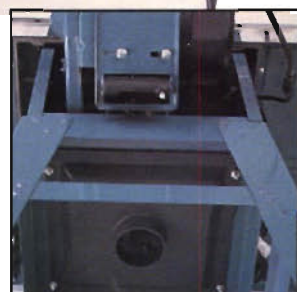
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