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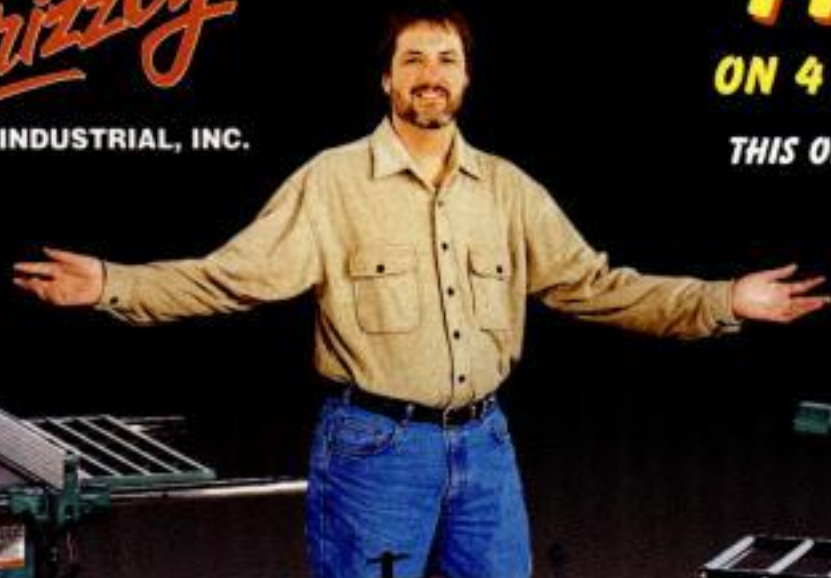
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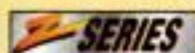
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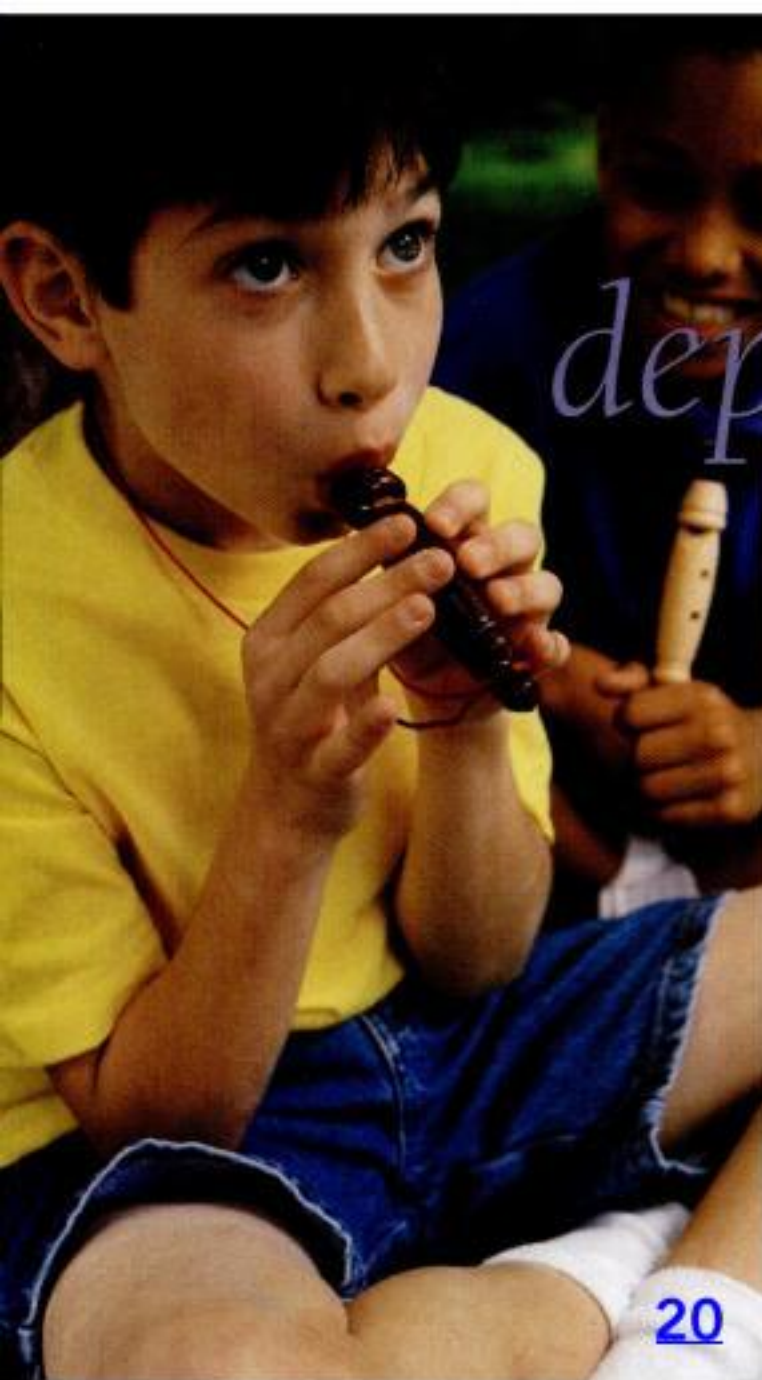


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Question & Answer



Which Sharpening Stones?

Q. I'm just starting out in woodworking and need advice on sharpening stones.

Joseph Hill, Calumet, Wash.

A. We put your question to Peter Korn at the Center for Furniture Craftsmanship and here is his response:

There are four types of sharpening stones used for woodworking tools: waterstones, oilstones, diamond stones and ceramic stones.

Each has markedly different working characteristics. Of the four, waterstones and oilstones give the best overall performance. Ceramic stones are the slowest cutting and the finest diamond stone is too coarse to create a satisfactory cutting edge.

The two components of a sharpening stone are an abrasive and a binder. Abrasives vary in sharpness and durability, binders differ in hardness. (For a more detailed explanation of sharpening stone materials, maintenance and selection refer to AW# 52 p. 33. For information on back issues and copies of articles, see p. 6.)

Waterstones are the clear choice for most sharpening applications. They give superior results with the greatest economy of effort. Waterstones are characterized by a soft binder, which allows worn abrasive particles to break

free, exposing sharp ones underneath. The good news is the stone stays sharp, the bad news is the stone tends to wear unevenly and needs to be flattened regularly. In our shop at the Center for Furniture Craftsmanship we use diamond stones to keep our waterstones flat. A 1000 grit and a 6000 grit make a complete set and cost \$50.

Oilstones are the next best choice for woodshop sharpening. They have a hard binder, which makes them slower cutting than waterstones, because the abrasive particles tend to dull and clog with use. However, the hard binder is an advantage for sharpening applications where a waterstone might be gouged or grooved, such as narrow carving tools and odd-shaped blades, such as inshaves. In terms of coarseness, a soft Arkansas and a fine India stone are roughly equivalent to an 800-grit waterstone while a hard Arkansas is closest to a 1000-grit waterstone. (Expect to pay \$55 to \$64 for a soft and a hard Arkansas.)

Is Blue-Stained Pine OK?

Q. I have some pine that was given to me. The price was right but the wood is full of blue stain. Is it safe to use this wood for painted projects or as a secondary wood?

Peter Mowatt
Vancouver, BC

A. Blue stain is a common fungus that infects the sapwood of freshly sawn boards causing a blue discoloration in pine. The infestation most often occurs during the summer months when freshly sawn boards are exposed to the open air before kiln drying. The color can range from a striking blue to a dull gray or black. We asked Harlan Petersen at the University of Minnesota Department of Wood and Paper Science about blue stain.

Mr. Petersen told us that blue stain is a non-destructive fungus that has little or no effect on the

structural integrity of the wood, so it is safe to use in terms of strength. However, because more destructive organisms thrive under the same conditions that lead to blue stain, it is advisable to inspect your boards for weakened wood fibers or punkiness.

The Western Wood Products Association encourages woodworkers not to think of blue stained pine as junk wood. Often your blue stained boards can be used like a spalted or figured wood to create dramatic effects (see photo).



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Mortise and Tenon Dimensions

Q. I would like to use mortise and tenon joinery on a project. Are there any rules of thumb for sizing mortise and tenon joints?

Michael J. Ryan
Daytona Beach, Fla.

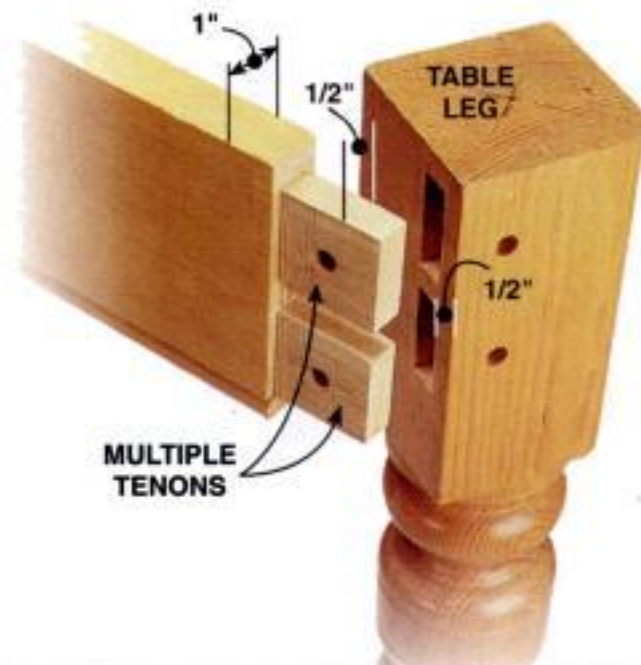
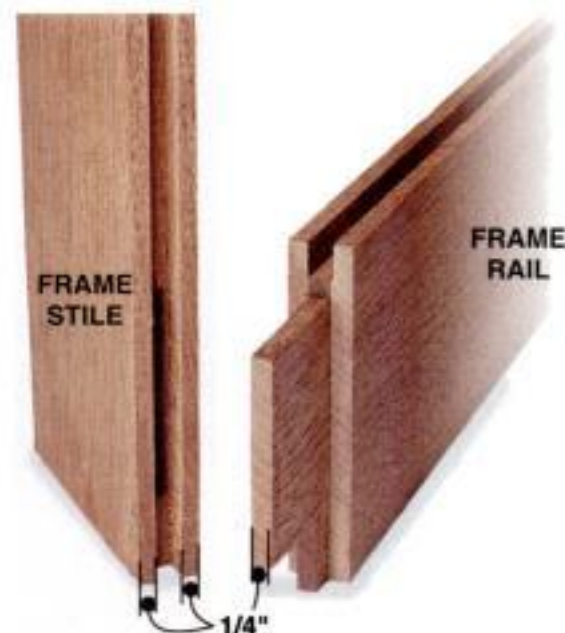
A. Here are a few good rules of thumb for designing a mortise and tenon joint:

For strength, a tenon should be at least twice as long as it is thick. Thus, a 1/4-in. thick tenon should be at least 1/2-in. long. The thickness of the tenon is dependent upon how wide the mortise can be made.

In frame construction where the stile and rail thickness is the same, the tenon

should be no more than one-third of the total thickness of the rail. Keeping the sides of the mortise at least as thick as the tenon produces the strongest possible joinery (see photo below).

If the piece into which the mortise is cut is wide enough to allow a set back, as when



a table leg is joined to an apron, then the tenon width can be increased to as much as half the thickness of the piece from which it is cut (see photo below).

The width of the tenon is largely a function of the width of the piece it is cut from. Try to maximize the width for the glue surface while leaving enough of a shoulder for mechanical strength. If the tenon is more than 3-in. wide it is best to cut multiple tenons to better accommodate the expansion and contraction of the wood across the grain (see photo below).



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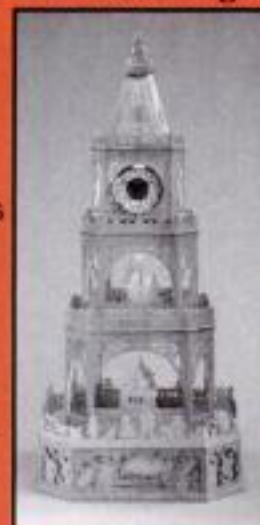
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Q. I have plans for a Queen Anne highboy in which the drawer beads are applied as separate strips to the edges of the drawer front. How is this done without creating a problem with cross grain movement?

Robert Naslund,
Poughkeepsie, N.Y.

A. Some techniques common to the 18th century, like cock-beading on drawer fronts, seem daring or even reckless to us today. But keep in mind that 18th-century furniture wasn't built with 20th-century central heating in mind. The dry air created by central heating has ruined many a fine antique. But take heart, if they could do it, you can do it too!

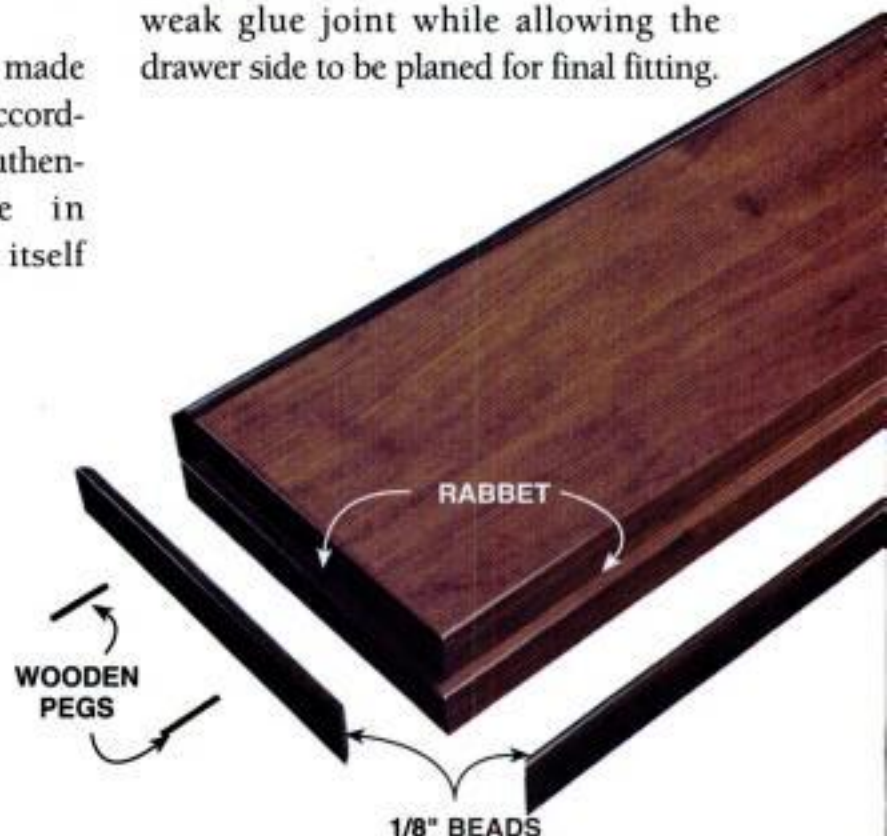
Here are some things you can do to minimize problems and still remain true to the construction techniques of the period: Select straight-grained wood for the front, back and sides of your drawers (look for rift to quartersawn boards). The deepest drawers in your highboy (7 in.) will exhibit negligible

shrinkage in quarter- or rift sawn boards. Finally, if possible, add some humidity to the air where the piece will be displayed during dry months.

Here's how cock-beading was made and applied in the 18th century, according to Gene Landon who builds authentic reproduction furniture in Motoursville, Penn.: The bead itself would have been made with a $\frac{3}{16}$ -in. side-bead plane and then cut away to yield a $\frac{1}{8}$ -in. bead. The rabbet in the drawer front was cut with a plow plane and finished with a shoulder-side rabbet plane.

The bead was then mitered to fit and glued onto the drawer. The bead on the sides of the drawer (where the end grain to long grain problem

arises) was also fastened with toothpick-size wooden pegs. The pegs help to reinforce what would otherwise be a weak glue joint while allowing the drawer side to be planed for final fitting.



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Which Glue for Bent Lamination?

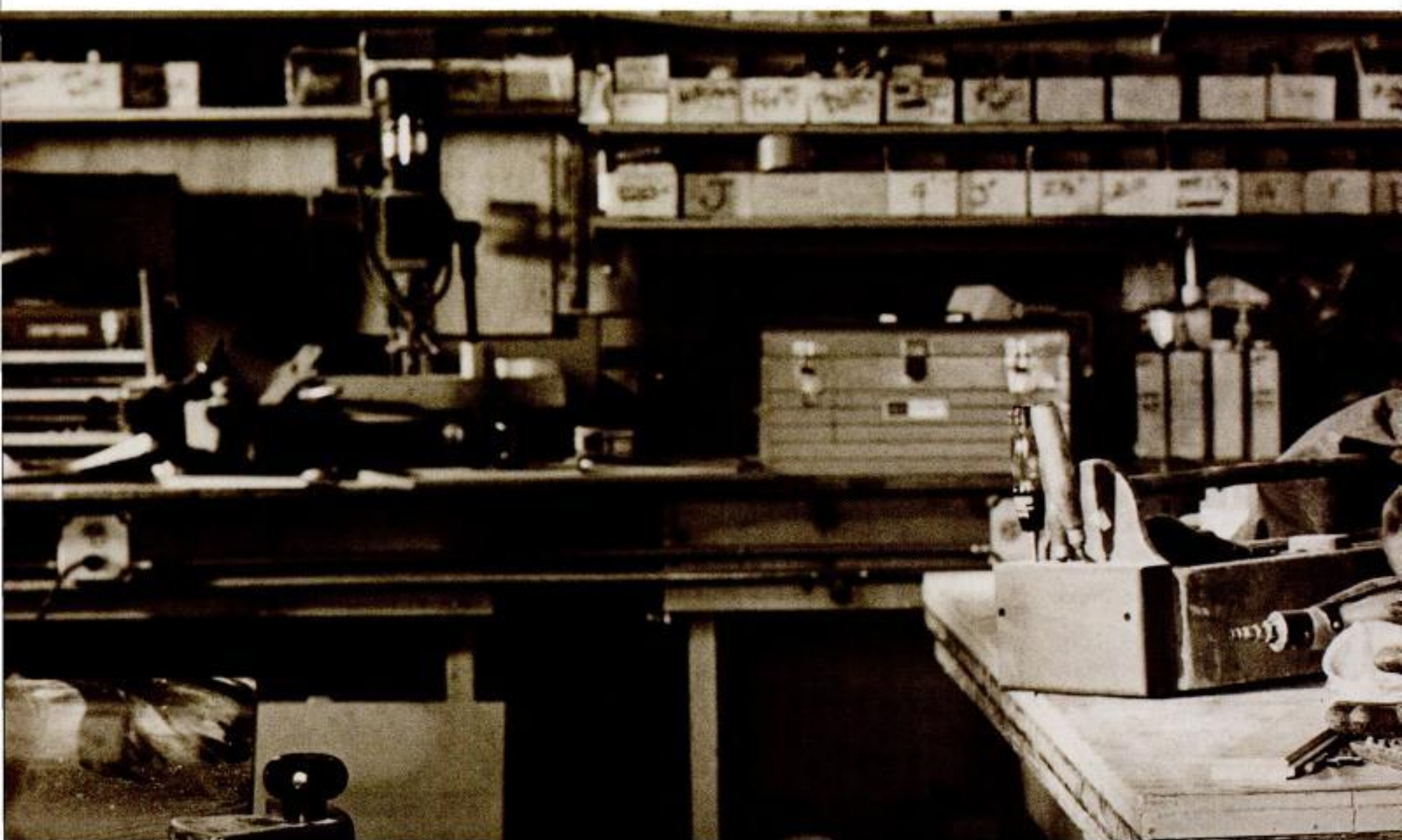
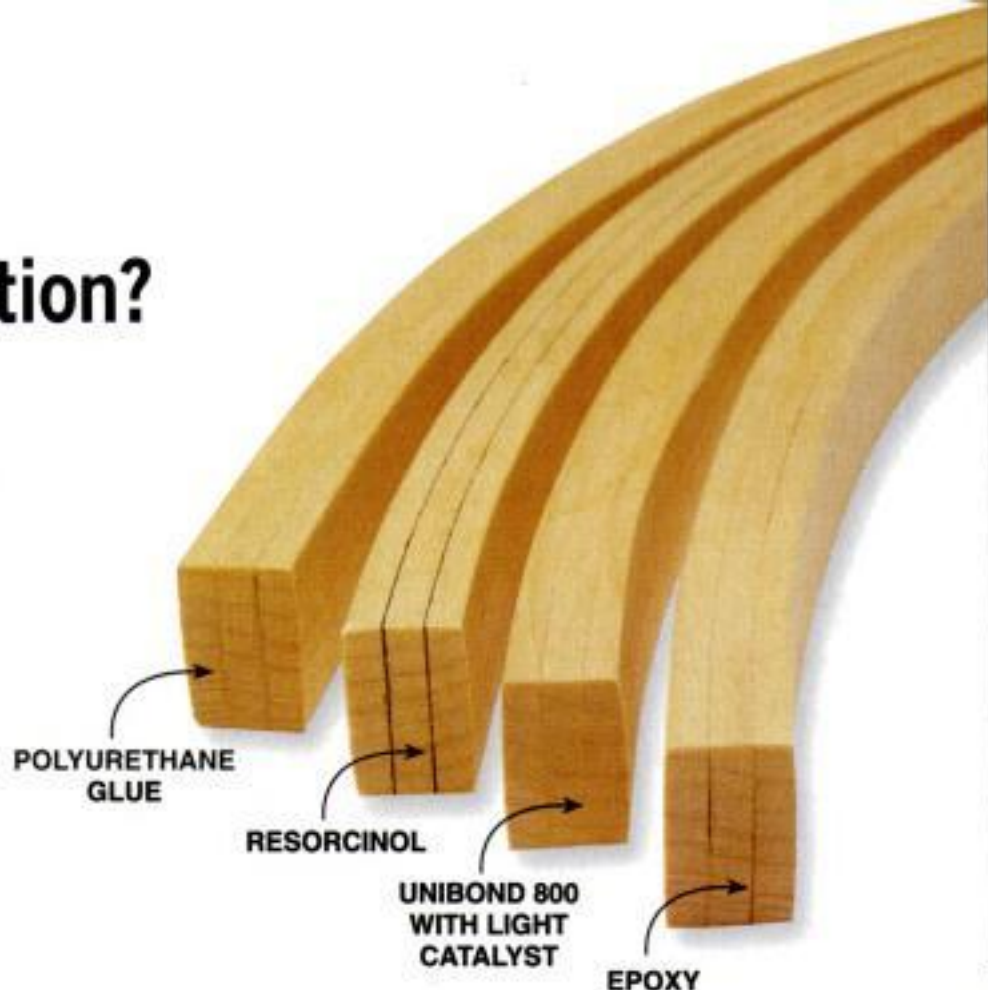
Q. A chair design I'm working on requires bent laminations for the back spindles. I'm using maple and am having a hard time keeping the glue lines from jumping out. Any suggestions?

Jack Schulte,
Decatur, Ill.

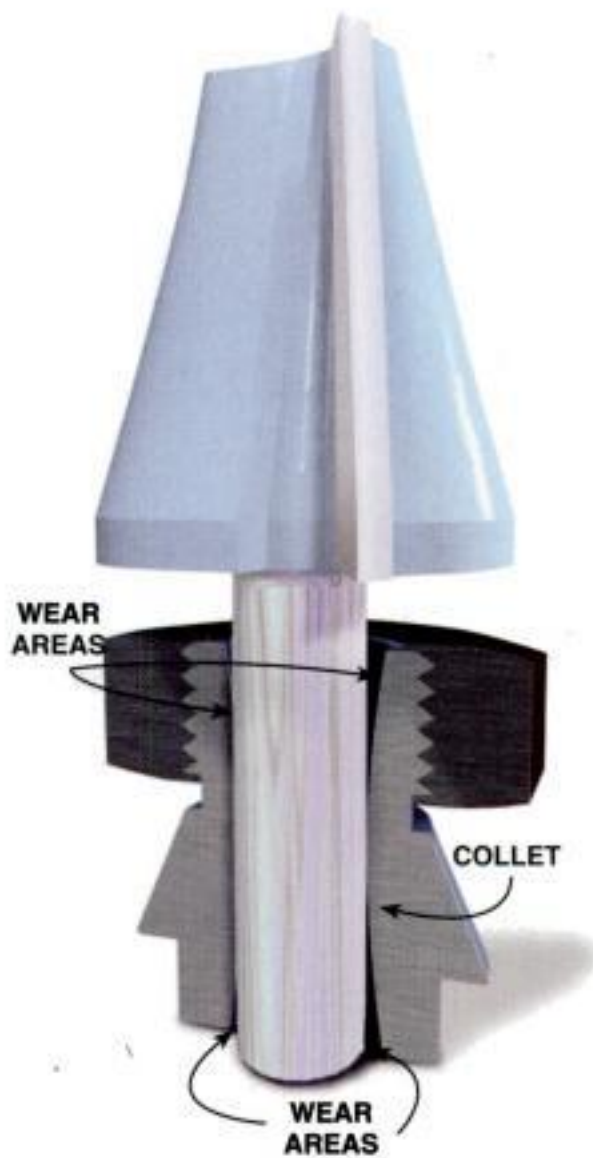
A. Because bent laminations are under constant stress, they require glue that sets hard. Epoxy, urea resin, resorcinol and polyurethane are all good choices for bent laminations. Of these four glues, urea resin and resorcinol achieve the most rigid

glue line when cured. While resorcinol has a Type I rating (a good choice for outdoor applications) its color is very dark, making it unsuitable for lighter woods like maple. Consider using a urea resin glue by the name of Unibond 800 which comes with a light catalyst specifically designed for blonde woods. (It's also available with a medium or dark catalyst. Order from Vacuum Pressing Systems; 207-725-0935; \$29/gal.)

Tip: You can also minimize glue lines by selecting straight-grained stock to cut your laminations from and assembling the laminations in their original order.



Router Bit Slipping



Q. Is there any reason why my router bits are suddenly slipping? I have had this router for years without any trouble.

Lynn Huppert
Biloxi, Miss.

A. Because you haven't had trouble with bits slipping before, the problem is probably not with your operating technique, but rather with your collet.

Check your collet for signs of wear. Over the years collets can wear out leading to the problem you describe. Try the following method to check for a worn

collet: Unplug the router and insert a long-shanked bit using finger pressure to tighten the collet. If sideways pressure at the end of the bit causes it to move at all inside the collet, then the collet is worn and should be replaced.

Also check your bit shanks for any sign of damage. This is especially true of the bits that you know have already slipped. If the shanks are marred or scratched from spinning in the collet, they should be replaced or you run the risk of scoring the gripping surface of your new collet.

Check your owner's manual for the nearest service center. They should have replacement collets for your brand of router. Generally, you can expect to pay \$10 to 15 for a new collet. **W**

A black and white photograph of a man, Pike Noyes, in a workshop. He is smiling and holding a can of Cabot's Oil-Based Wood Stain. The can is yellow with a blue label that reads "Cabot's", "PREMIUM WOODCARE", "OIL-BASED WOOD STAIN", and "SINCE 1877". In the background, there are shelves with various tools and wood pieces. A large, dark, curved object, possibly a piece of furniture, is in the foreground.

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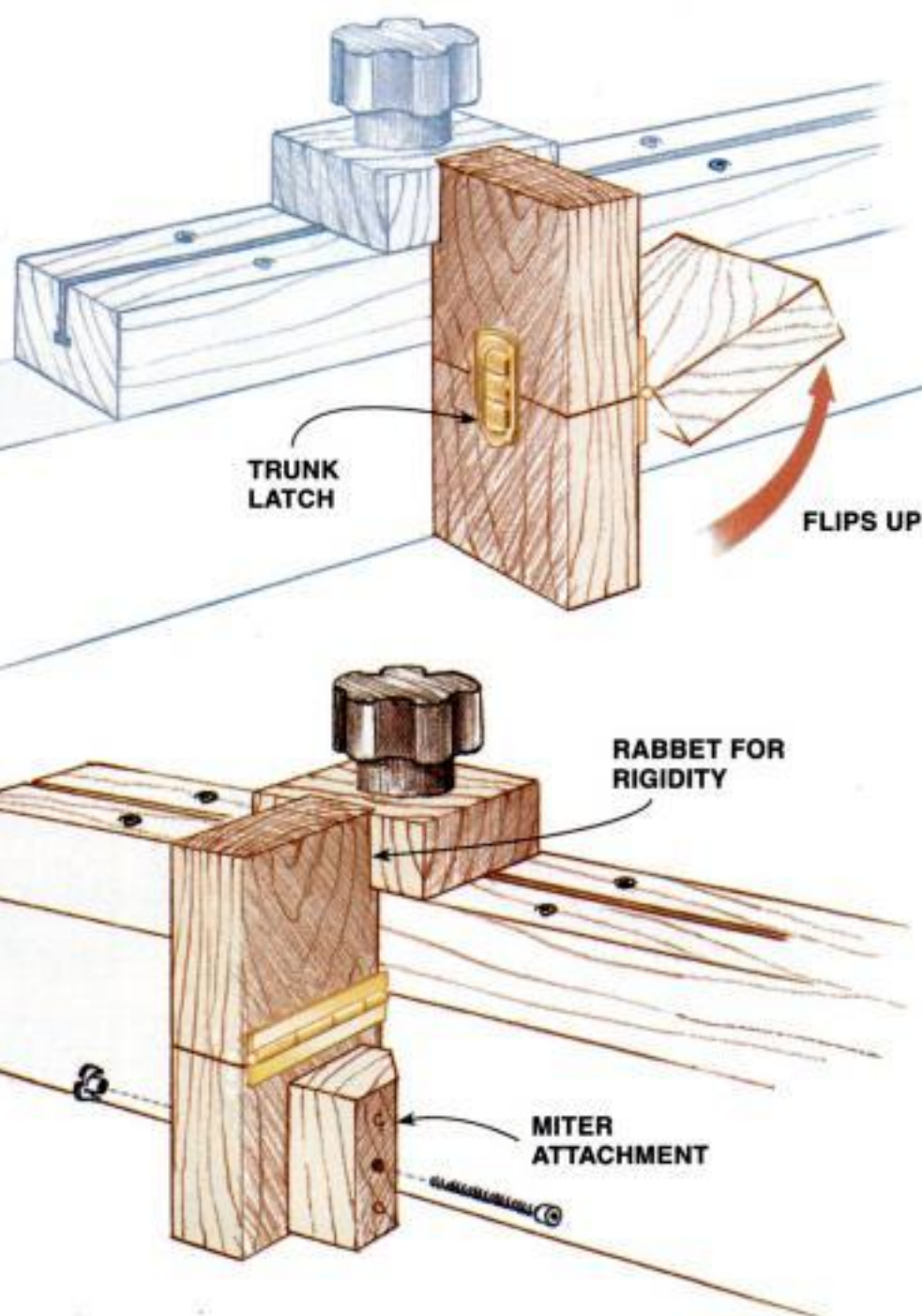
To locate the retailer nearest you, call 1-800-US-STAIN ext. 343.

WorkShop Tips

Super Chop Saw Stop

This stop slides along a rail that's screwed to the top of my chop saw fence, and I can lock it in any position. The hinged block is locked in the down position with a trunk latch. When not needed, the stop can be flipped up out of the way or removed altogether. The miter attachment is quickly installed with a single bolt and two wooden locking pins keep it from swiveling.

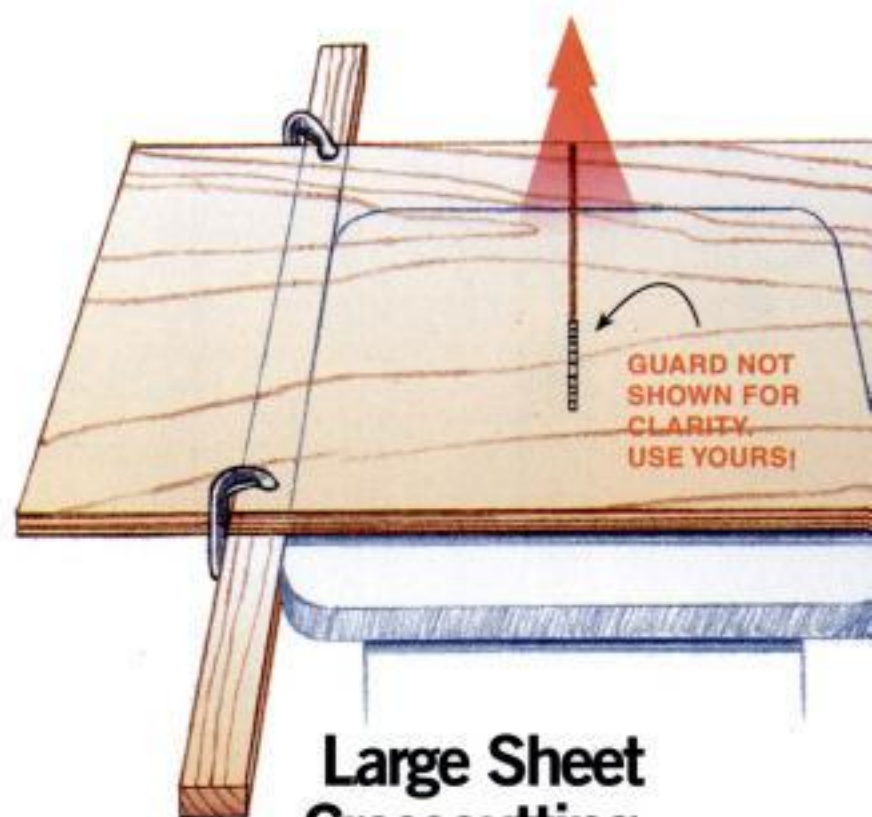
WILLIAM BOYD / SALEM, S.C.



Belt Sanding Block ▲

I do most of my sanding by hand, so I made this convenient wooden sanding block to fit 3-in. x 21-in. sanding belts. The block is split for two-thirds of its length, and the belt is tensioned with a removable dowel. A softer wood, such as poplar or white pine, gives the best results. If the belt stretches and becomes loose, insert a slightly larger dowel.

BILL MCCARTHY / RIEGELSVILLE, PENN.



Large Sheet Crosscutting

Crosscutting large sheets of plywood on the tablesaw can be difficult, and I usually end up binding the blade, burning the wood, or worse. To get around this, I clamp a board under the plywood, and use it as an auxiliary fence which rides against the left edge of the table-saw top.

AMY KENDALL / MILWAUKEE, WISC.

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Workshop Tips

Bandsaw Guide Blocks

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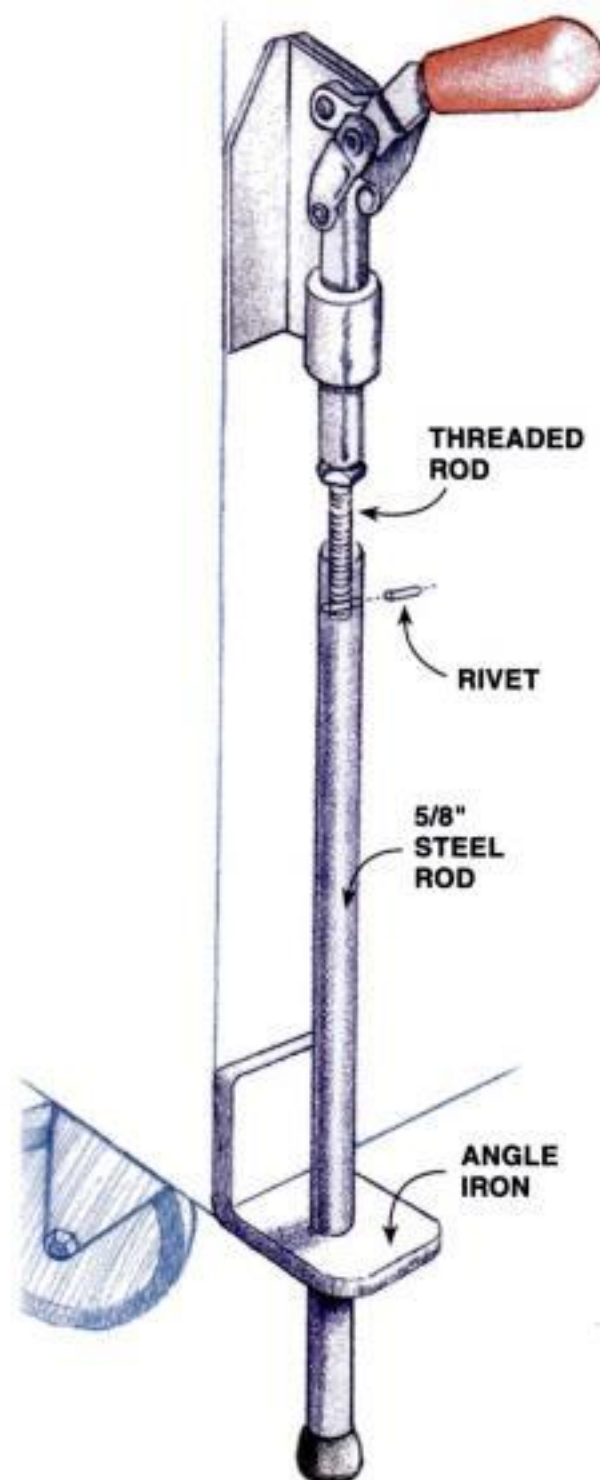
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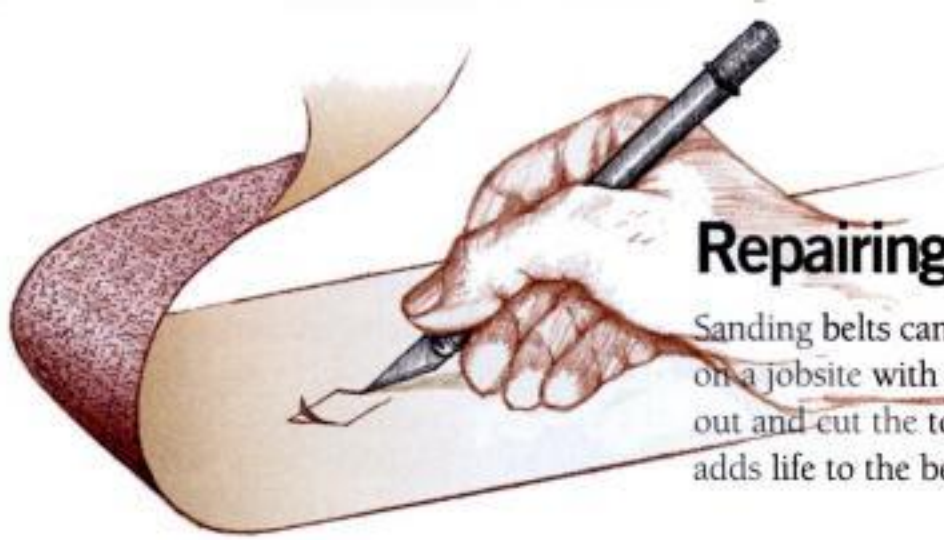


Machine Floor Locks ▲

Anyone with a machine on wheels—especially a tablesaw or planer—understands the necessity of locking it in place before using it. I use a pair of toggle clamps connected to rods. I position the machine where I want it and lock the toggle clamps down, as shown above. To keep the tool level, threaded rods adjust the clamp height so the wheels barely leave the ground.

STEVEN MURPHY / BERKELEY, CALIF.

If you have an original tip you'd like to share, send it to Workshop Tips, American Woodworker, 2915 Commers Drive, Suite 700, Eagan, MN 55121. We pay \$200 for tips we print. Original contributions become our property upon acceptance and payment. We're sorry, but tips can't be returned.



Repairing Ripped Belts

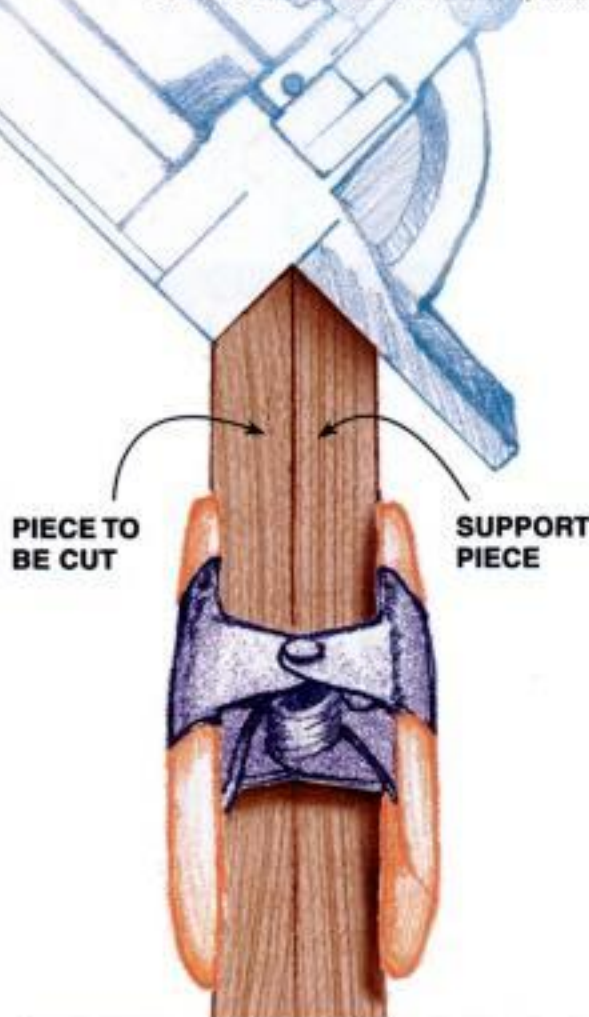
Sanding belts can rip at the worst possible moment—such as when you're out on a jobsite with no spares. When this happens I remove the belt, turn it inside out and cut the torn spot into a diamond-shaped hole with a utility knife. This adds life to the belt without affecting its performance.

RODNEY BAKER / DALTON, N.Y.

Miter Plunging Biscuit Joiner ▼

My biscuit joiner fence does not rotate to 135 degrees, and that is one of my most-often-made joints. To help hold the joiner steady, I add a second mitered piece of wood to the other side of the joint, forming a right angle. By increasing the surface for the joiner fence to rest on, the plunge is more stable.

HANK METZ / MUNDELEIN, ILL.



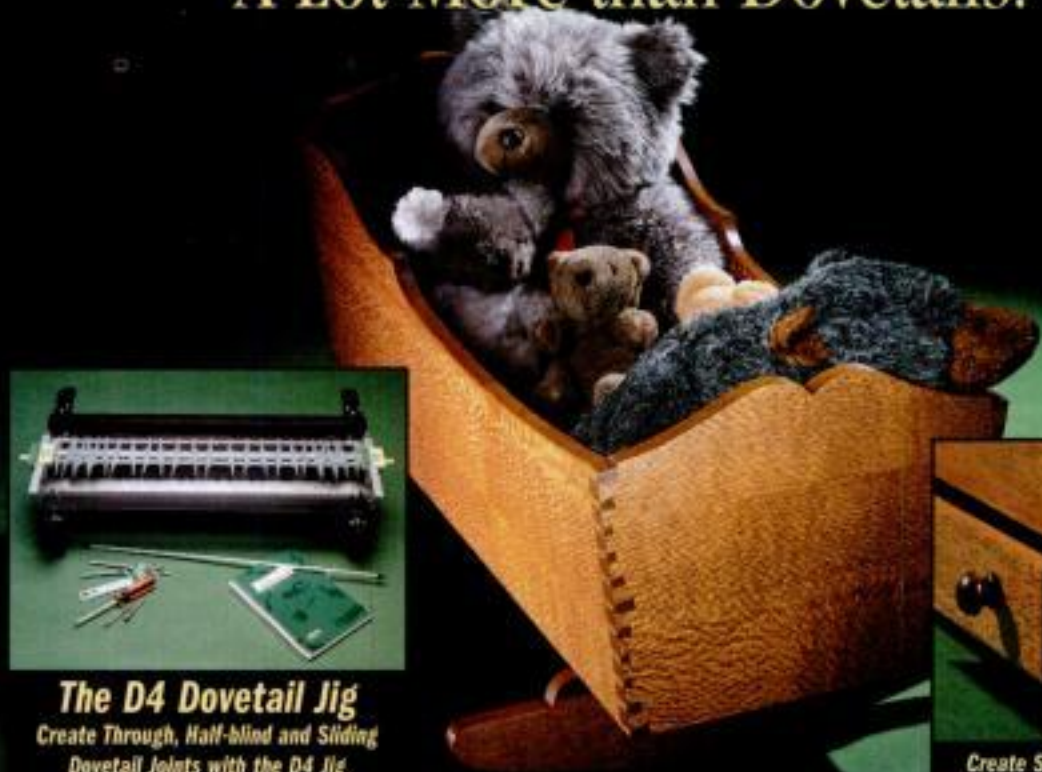
Magnetic Honing Helper

When flattening the back of a plane iron (the side opposite the bevel) I find a horseshoe magnet makes a convenient handle. I slip a piece of wax paper, or plastic wrap, between blade and magnet so it doesn't pick up metal particles.

JOHN BURKE / NORTHFIELD, N.J.

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Workshop Tips

Dovetail Marking Jig

This little jig greatly speeds the laying out and marking of dovetail pins. Make the jig so the thin piece is exactly the same size as the pin you plan to use. Then, mark a half-pin on the left side, and divide the remaining space into equal parts according to the number of pins you want to use. Mark each full pin, from left to right, ending with another half-pin.

JOHN PAPPAS / DENVER, COLO.

PIN

Bench Helper

I use this simple device when planing the edges of long boards. It's especially useful when the board is too springy to be clamped between a bench dog and a tail vise. I hold the board in the v-shaped notch with my left hand and plane with my right. Use 1/2-in. or 3/4-in. plywood so it doesn't split.

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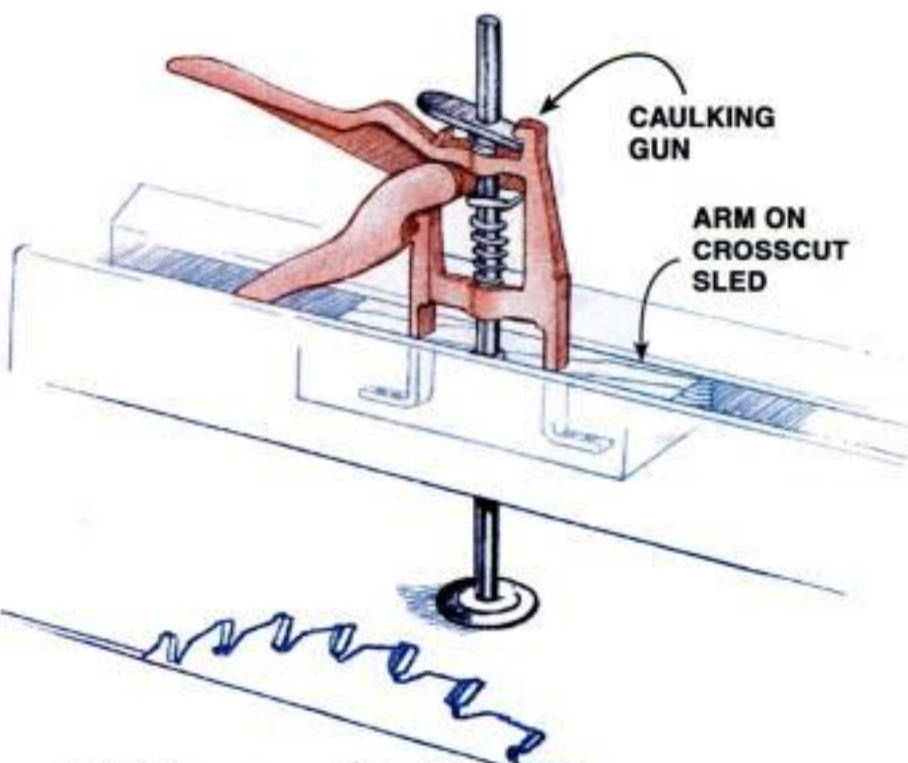
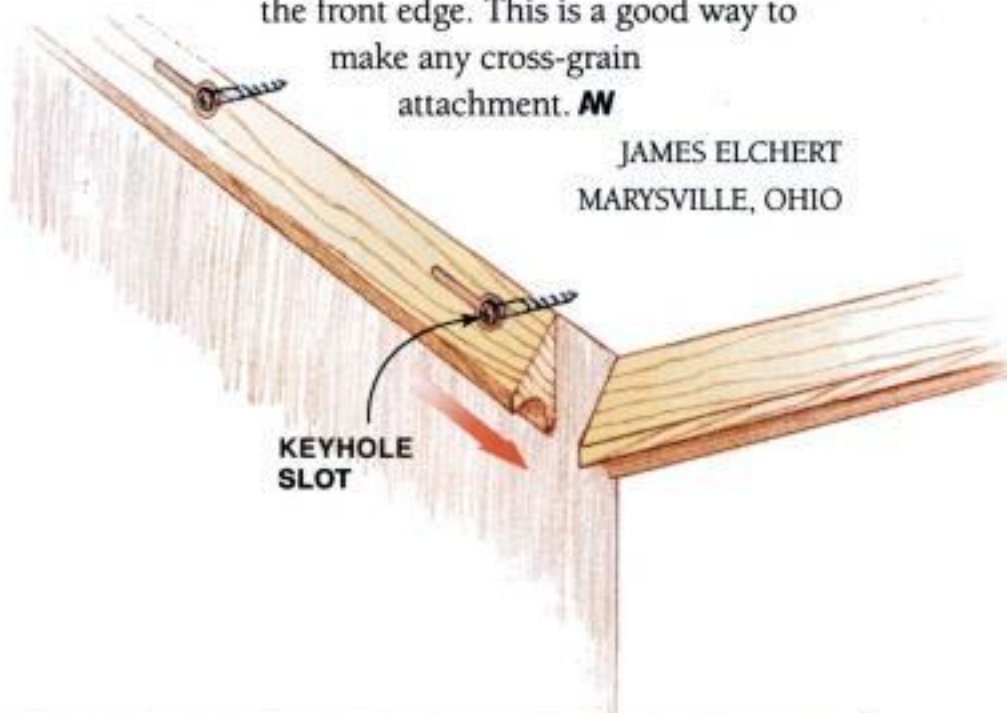
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Cross-Grain Trim

I recently needed to attach molding across the sides of some bookcases. Because the sides were solid wood, I had to allow for some seasonal movement. I used a table-mounted router with a keyhole bit and cut slots in the back of the molding, as shown below. I installed round-head screws and adjusted their height to fit snugly in the slots. Then I installed the trim and slid it forward to its final position and glued the front edge. This is a good way to make any cross-grain attachment. **AW**

JAMES ELCHERT
MARYSVILLE, OHIO



Tablesaw Jig Clamp

I added this hold-down to my tablesaw's sliding cutoff jig and find it a great convenience, because the height of the clamp is easily changed. This clamp uses a standard bar-type caulking gun, cut in half, as shown. The mounting block slides to apply clamping pressure where needed, and I covered the plunger with rubber so it wouldn't mar the workpiece. One squeeze of the handle and the work is locked in position—and all for less than \$3!

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Prepare the Blank

You can use any hardwood that cuts cleanly—I've made these whistles out of everything from maple to rosewood, and they all seem to work well. Avoid softwoods, though. They absorb moisture and that affects tone quality. These whistles are so quick to turn that I usually make them in multiples, starting by cutting a length of 1¼-in. square stock into 5-in. lengths.

Drill a ½-in. dia. hole in the end of each blank to a depth of 3¾ in. Keeping this hole precisely centered in the blank is not critical, but try to keep it close!

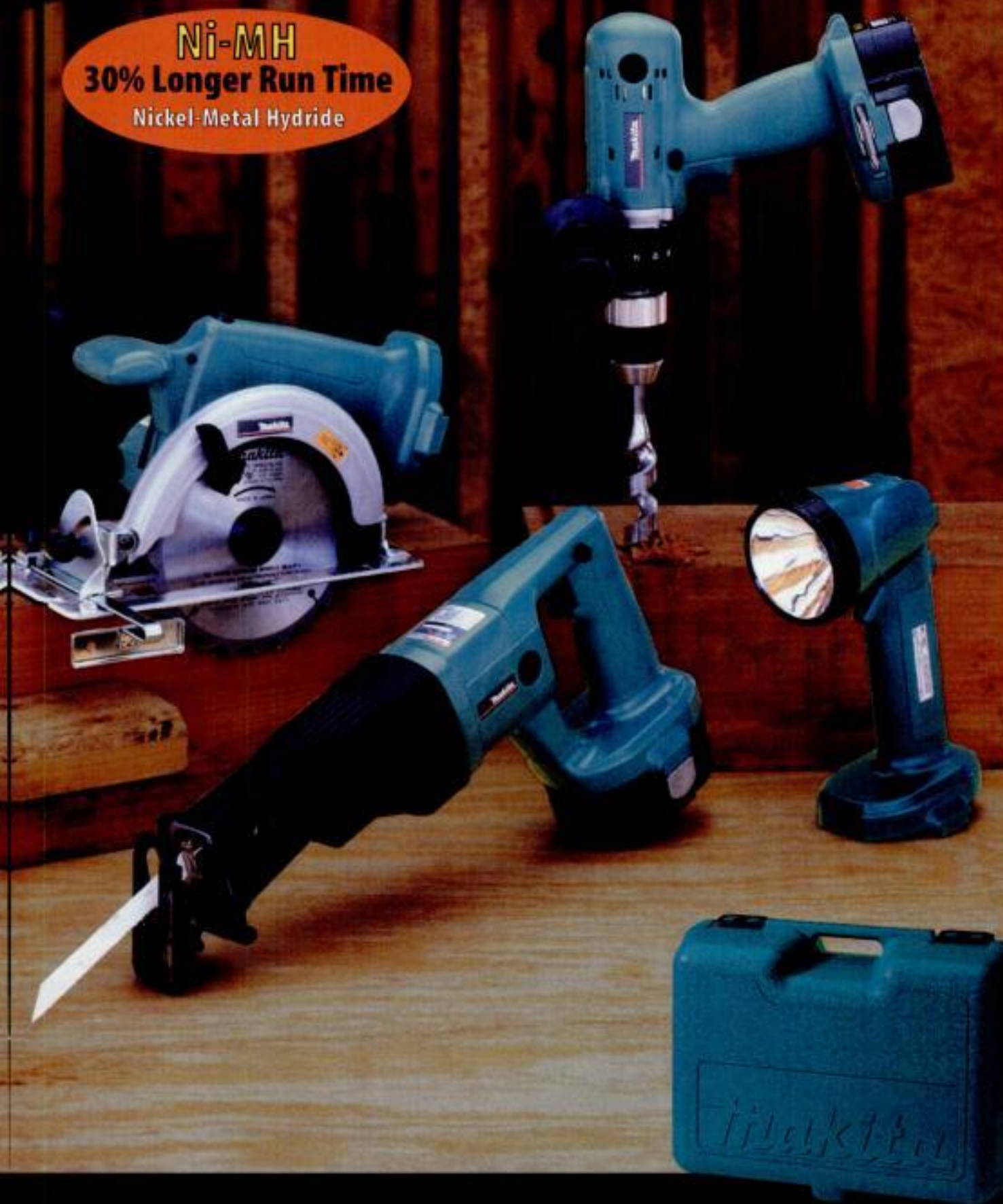
Make the Mandrels

The end-bored blank gets mounted on a wooden shaft for working. This shaft is called a mandrel. Turn your

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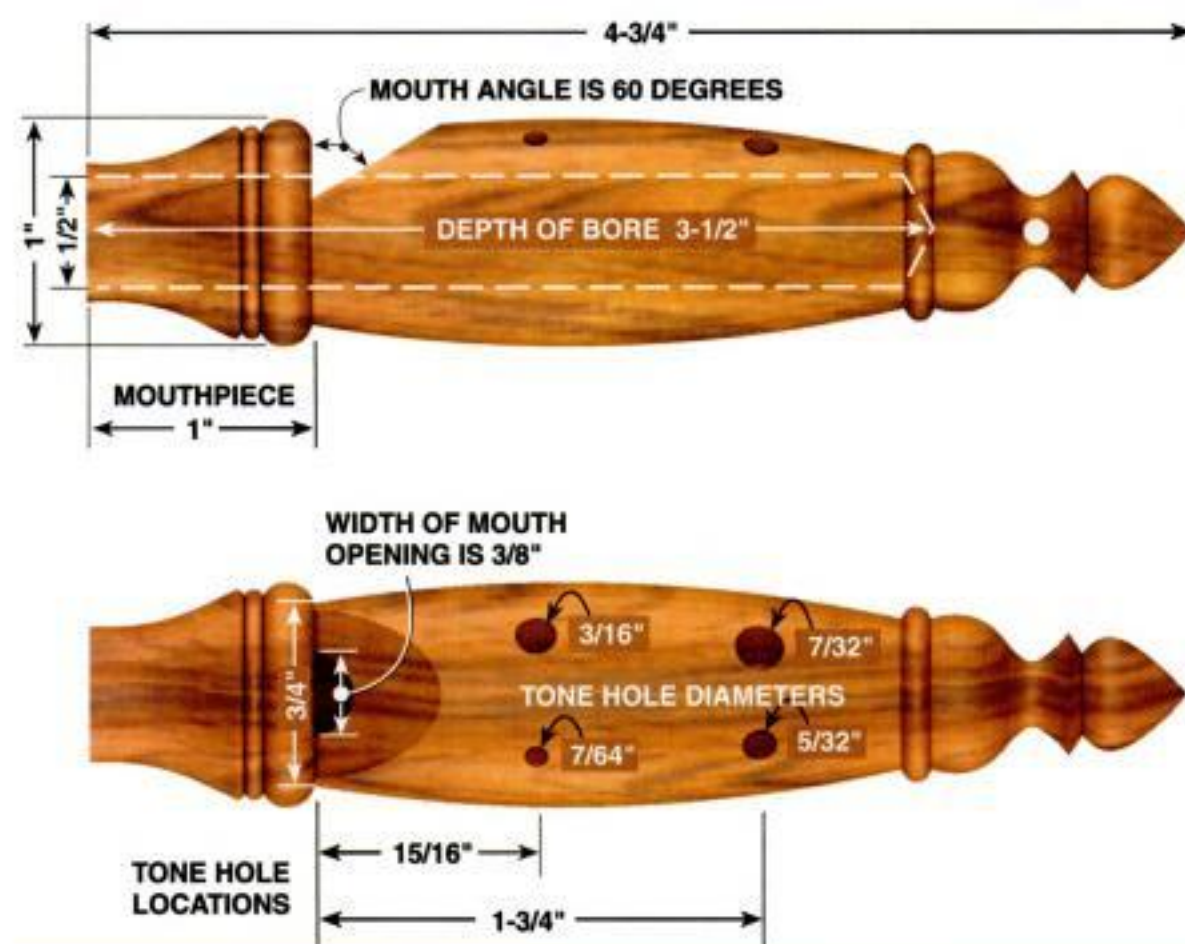
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Woodturning

FIG. A Side and Top Views

Shape the whistle's body around these important dimensions.



WARNING For safety, replace the decorative pointed end with one that's completely rounded. KEEP THIS WHISTLE AWAY FROM ANYONE UNDER THE AGE OF SIX.

own 1/2-in. dia. mandrels—about 2-in. long—from solid stock. You'll need one lathe-mounted mandrel for turning (Photo 1), and another turned on the end of a square section so you can hold the whistle level for sawing, sanding and drilling (Photo 4).

Turn the Whistle

Once the blank is mounted and turned round, the only precise lathe work is the cut that defines the whistle's mouthpiece (Fig. A). The placement and depth of this cut, 1-in. from the squared open end, to a point (not a flat) at 3/4-in. diameter affects the whistle's tuning (Photo 2).

Turn the body of the whistle as any spindle, but remember that most of it has a hollowed center. You can only make deep decorative cuts at the solid end.

Before removing the piece from the lathe, locate positions for the tone holes (Photo 3).

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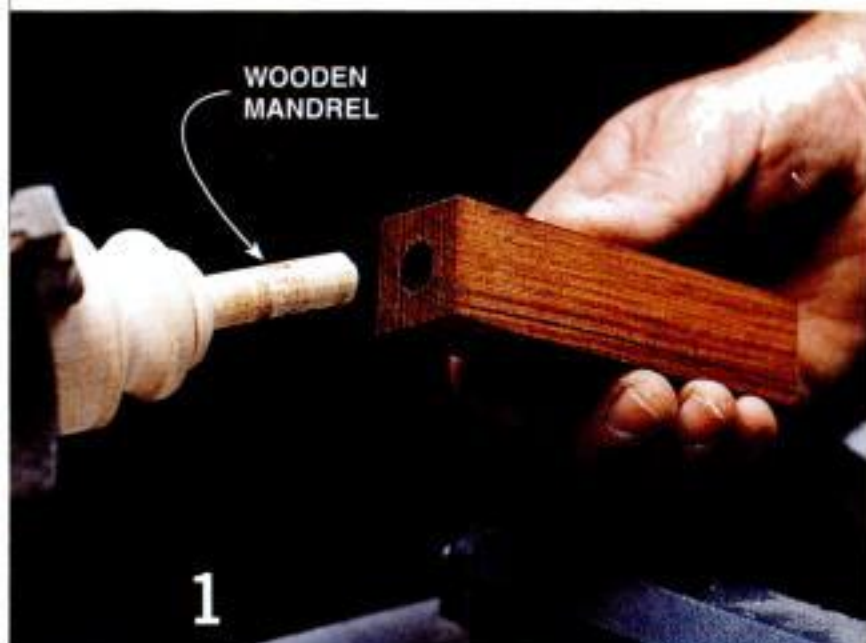
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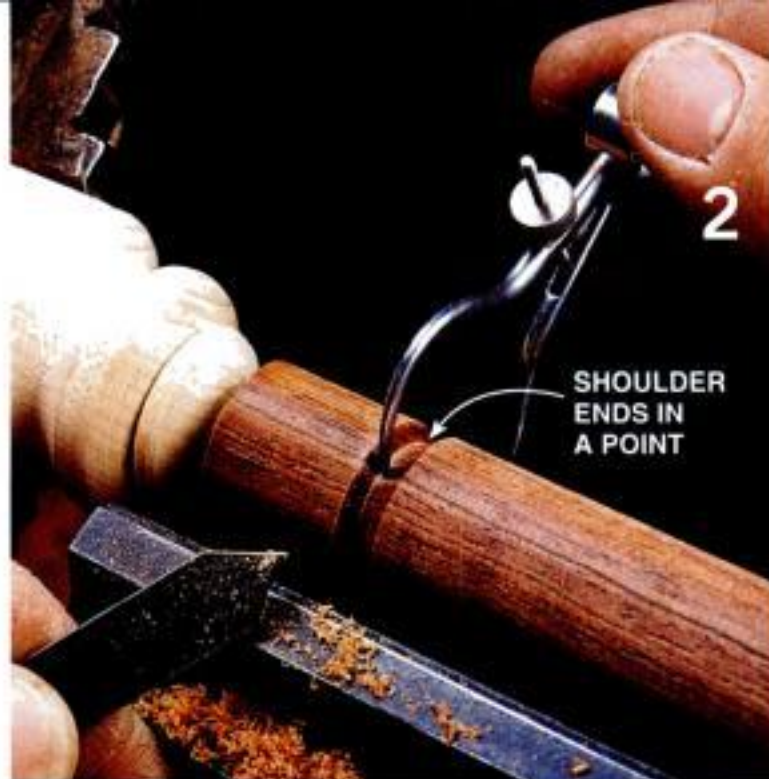
Woodturning

Turn the Whistle's Body.

Wooden mandrels hold the bored blank for turning, sawing and drilling.



SLIDE the end-bored blank onto a wooden mandrel of the same diameter, mounted on the lathe. Support the blank from the tail stock with a live center. Turn it round to about 1-in. dia., then square the bored end, leaving a bore length of 3½-in.



SHAPE the shoulder of the mouthpiece so it ends in a point (Fig. A) by cutting in with a parting tool held at an angle. Start beyond the mark that locates the end of the mouthpiece and work back to it, turning the tool inward as you define the shoulder and deepen the cut.



MARK positions for the tone holes (Fig. A) by drawing rings around the turned whistle body. Before drilling (Photo 7), mark points on these rings to locate the four holes.

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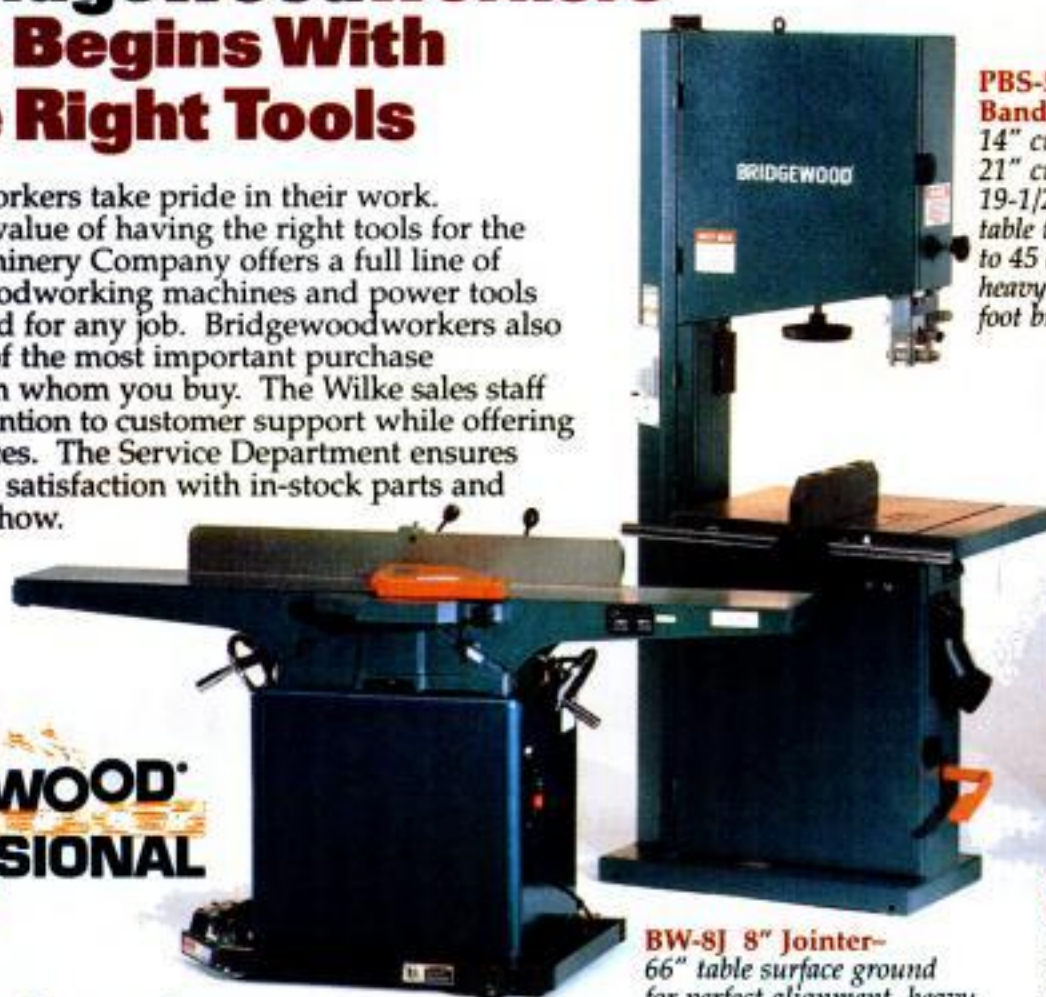
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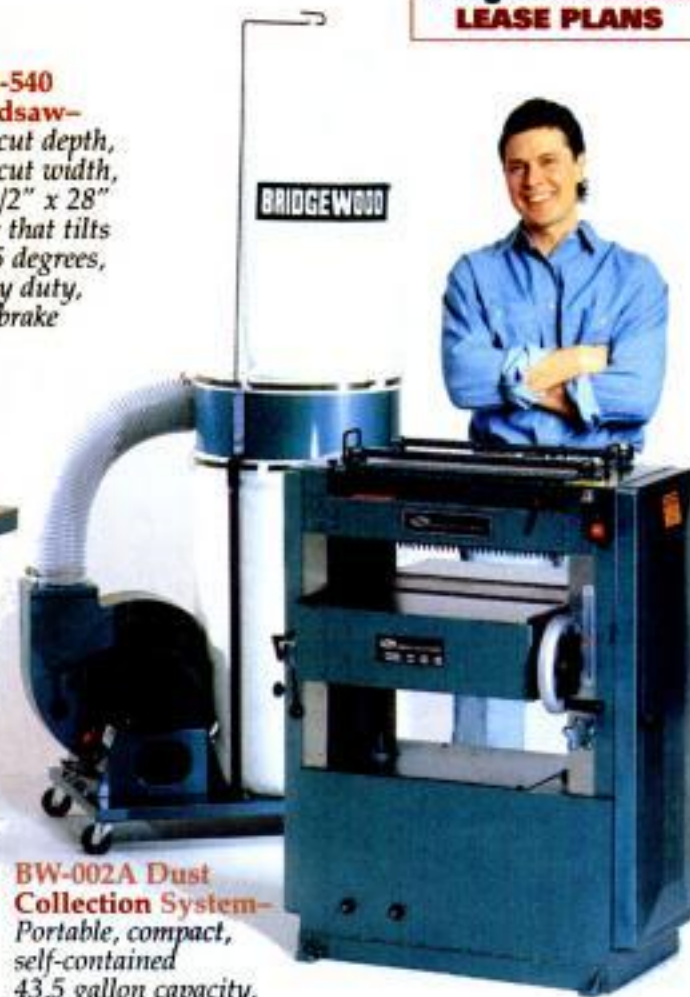
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Make the Whistle Whistle. *Make a careful cut on the whistle's body and complete the mouthpiece so it directs air across this cut.*



CUT the whistle's mouth on the bandsaw. Hold the whistle on a mandrel turned on the end of a square section. Make the first cut with the miter gauge reversed and set at 30 degrees, to give a 60-degree cut. Make this cut in the quarter-sawn grain of the whistle, starting about 1/2-in. from the mouthpiece shoulder. The second cut is at 90 degrees, right at the shoulder (Fig. A). These cuts expose the center bore.



SAND both surfaces of the whistle's mouth with sandpaper folded around a 60-degree angle block so they meet in a smooth, crisp line. The angled surface must be dead flat, so clamp the mandrel firmly on a hard surface and pull the block toward you. Don't sand back and forth. When you're finished, the exposed bore should measure 3/8 in. at its widest point.

MAKE a cedar fipple, a 1/2-in. dia. round dowel with one side sanded flat and tapered. It fits into the mouthpiece and directs the air blown into the whistle. Getting the right size and taper (Fig. B) is an inexact science, so you may have to make and test several fipples to get one that makes a clear tone. Make them long, about 1 1/4-in., so they're easy to reposition or replace.



Woodturning

Cut Out the Mouth

The whistle's mouth is a notch cut to expose the center bore at a 60-degree angle. I make this cut on the bandsaw using a 14-tpi blade with the whistle mounted on a mandrel block (Photo 4). After cutting, refine and smooth the surface with fine sandpaper glued onto an angled sanding block (Photo 5).

Make a Fipple

A fipple is a dowel with a tapered, flattened side. Position the fipple in the mouthpiece of the whistle with its flat side parallel to the mouth opening and its front edge barely protruding into it. Test the sound. You can adjust the tone by moving the fipple in or out. Once you've achieved a good clear tone, mark the block so you can accurately reposition it. Then remove it and set it aside.

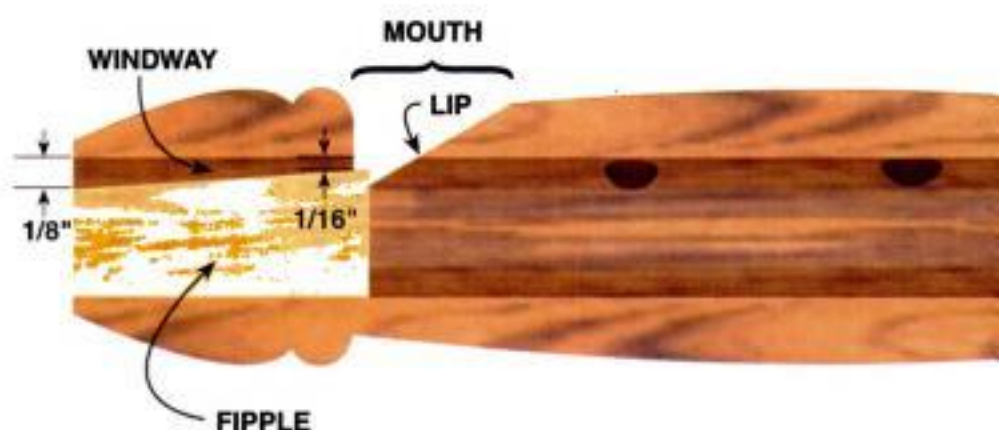
Make Some Music

This whistle has four tone holes, two on each side of its body. Each one of them has a different diameter so that when covered singly or in combination, you can play eight different notes. Locate the holes so the whistle is convenient to hold while playing (Photo 3). Drill the holes at the drill press with the whistle again mounted on the mandrel block (Photo 7). The diameters of the holes are critical to the tones, so use the correct size bits (Fig. A). Clean out any waste that is clinging to the inner bore of the whistle with sandpaper.

Remount the fipple in the mouthpiece and check the tone of each note. Making a hole slightly larger (by filing or sanding) will lower the pitch. If you need to make the hole smaller to raise the pitch, try a bit of epoxy around its edge, or plug it and redrill.

When you are satisfied with the tone, glue the fipple in place. Be sure that its flat surface is parallel to the mouth opening, and

FIG. B Fitting the Fipple



When fitted inside the whistle's mouthpiece, the flattened side of the fipple forms a windway. Air blown through it is accelerated by the narrowing passage and directed at the mouth's lip as it exits. The mouth's lip splits the blown air, directing it into the bored-out center and creating the whistle's sound. Minute adjustments to any part change the flow of the air and affect the sound.

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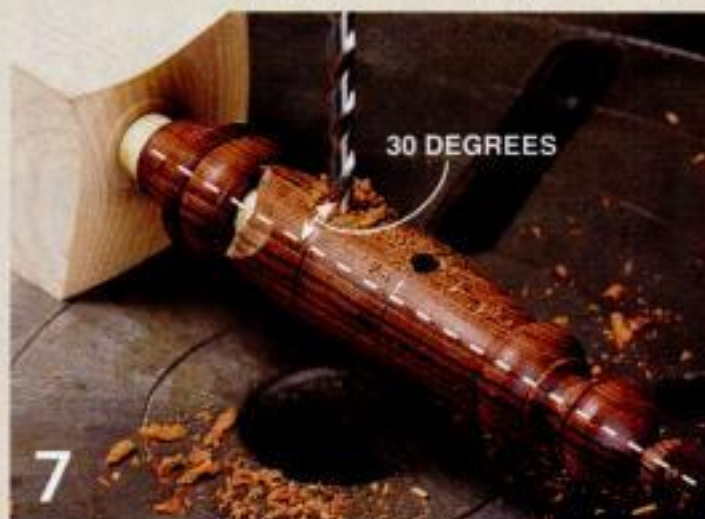
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Woodturning

Let the Whistle Sing!

Drill tone holes, glue in the fipple and practice, practice, practice.

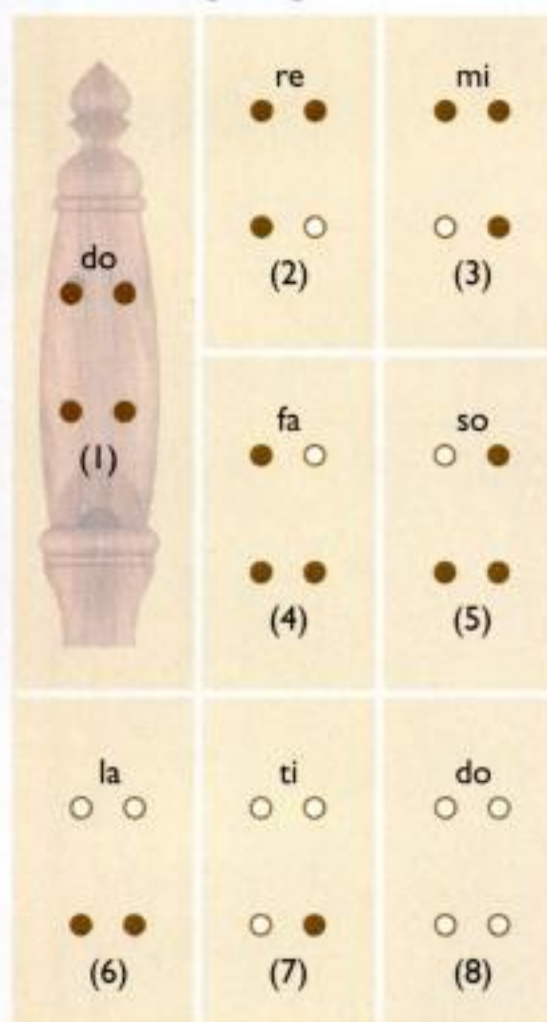


DRILL tone holes in the whistle about 30 degrees from the top of the center axis. A mandrel long enough to extend beyond the drilling points will minimize tear out on the inside. Chamfer the outer surfaces of the holes slightly to help your fingers make contact and a good seal. After drilling, sand the inside with a rolled piece of 220-grit sandpaper, but don't enlarge the bore. If you do, the fipple won't fit.



SHAPE the mouthpiece (Fig. B) after gluing the fipple in place. A sanding drum creates a concave shape that looks good and sounds good, too.

FIG. C Fingering



Here's an easy melody to try.
It will make you feel joyful!

3 3 4 5 5 4 3 2 | 1 2 3 3 2 2
3 3 4 5 5 4 3 2 | 1 2 3 2 1 1

that its front edge extends a tiny bit into the vertical cut of the mouth (Fig. B). Test the tone, again, to make sure everything is properly positioned before the glue sets.

After the glue on the fipple has set, cut off the extra length from the front of the mouthpiece and sand it smooth. Then use a sanding drum chucked in a drill press to shape the bottom of the mouthpiece (Photo 8). If you plan to drill the tail end for a string, this is the time to do it.

Finish the whistle with multiple light coats of spray lacquer. A long screw mounted through the hole for the string makes it convenient to hold the whistle while finishing. Allow the lacquer to cure fully before playing. It's hard to play sweet music on a sour-tasting instrument! Do plan on making



Whistles Steve Blerk, 1999

these little gems in batches because every time you play yours in public you will be asked to make more! **AW**



Yes, our

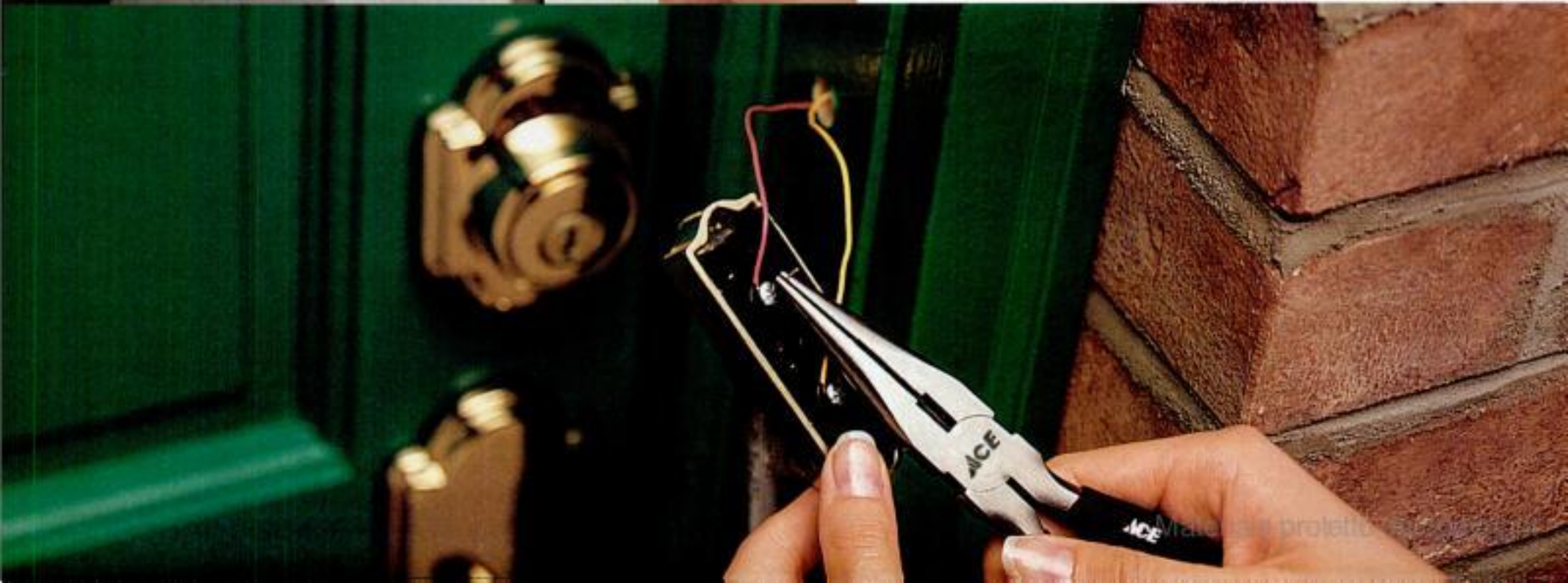
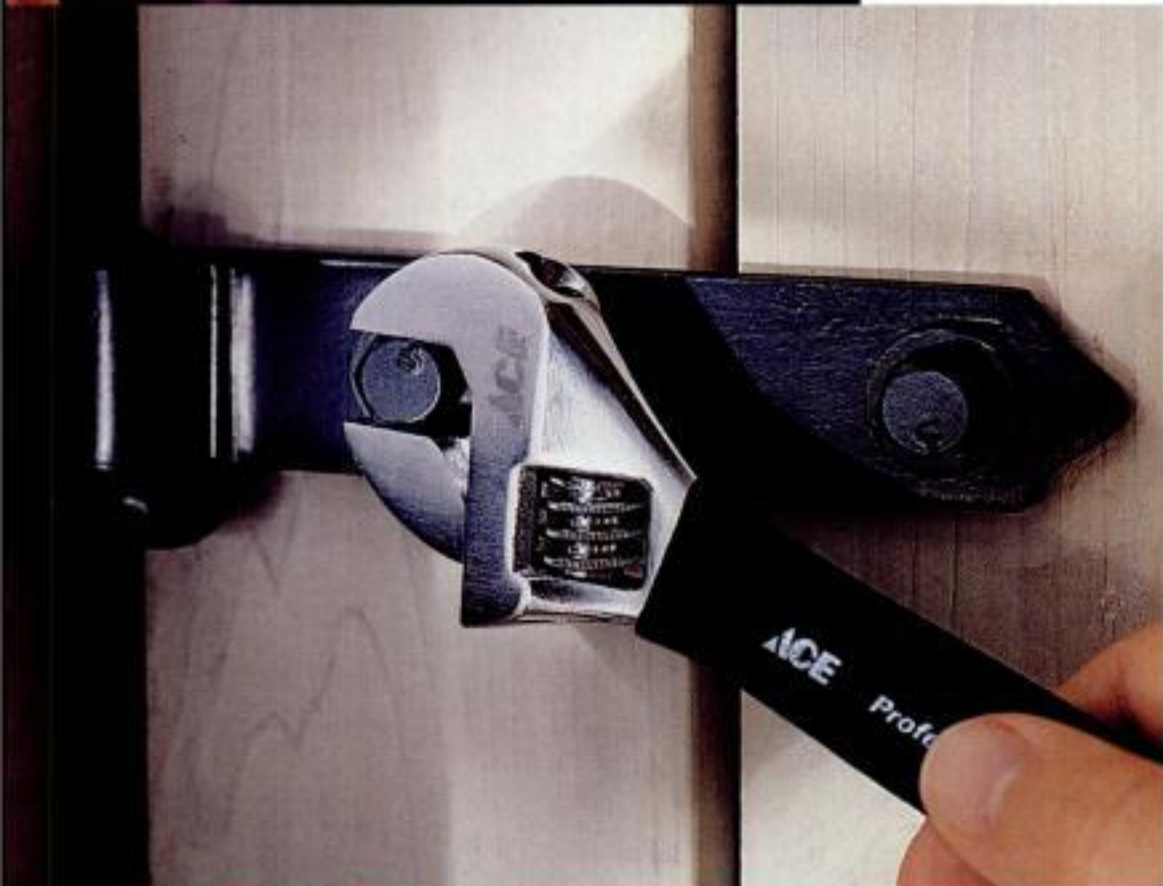
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Walnut Entertainment Center

A 19th-century wardrobe fills a 21st-century need.



*A*n antique wardrobe from a 19th-century German settlement in Iowa was the inspiration for this

piece. Its most striking element is a radiused cove that gently curves around the corners giving it an air of stately elegance. Its structure is simple yet solid and its cavernous interior can be put to many uses besides storing clothes. With an eye on the 21st century we added some modern upgrades to this timeless design so it could be used as an entertainment center. This cabinet is deep enough to house a 32-in. TV and the pocket doors slide back into the cabinet for unobstructed viewing. A plywood insert holds the electronic gear and can be altered or replaced for other uses.

Simple frame-and-panel construction and applied moldings make this wardrobe surprisingly easy to build, despite its large scale. The ability to make haunched mortise-and-tenon joints for the doors and a familiarity with Euro-style hardware is helpful in building this project. Otherwise, dadoes, rabbets and butt joints are the toughest joinery you'll encounter.

Expect to pay about \$1,200 for building materials and another \$200 for the hardware.



CHOOSING YOUR MATERIAL

We built our wardrobe from unstained walnut ordered through Hearne Hardwoods, Inc. ([see Sources, p. 37](#)) (Kiln-dried walnut is usually steamed, a process that eliminates all the wonderful color variations natural to walnut). By ordering wood from a specialty supplier like Hearne we were able to obtain wide stock (10 in. or better) that came from a single tree. The grain in a wide board runs from quarter- or rift sawn on the edges (perfect for stiles and rails), to flatsawn in the middle (ideal for panels). Wood from a single tree ensures a good color and grain match.

Be sure to sticker the wood in your shop and let it acclimate for a couple of weeks before milling. Now, spread out the lumber and begin to organize your boards. Save the best pieces for the doors which will be the central focus of the cabinet, at least while the TV is off. (We special ordered "bees-wing" walnut from Goby Walnut Products for our door panels, [see Sources, p. 37.](#)) Boards that contain any quarter- to rift sawn pieces are good for door and panel frames (Photo 1). With an eye on grain patterns and color, decide where the remaining boards will be used and mark them accordingly.



MAKING THE SIDES

The sides are simple frame-and-panel structures made with tongue-and-groove joinery. The panels fit into grooves cut into the stiles and rails with a dado blade. Set your fence so the groove is centered exactly on the edge of the frame. This is important because each stile must be flipped end-for-end to cut the deeper groove for the rails (Photo 2). The tongues on the rails are cut on a crosscut sled making multiple passes over a blade. Final fitting should be done with a rabbet plane.

Glue up and thickness plane the panel stock. Cut the panels to size allowing for adequate seasonal movement across the width (in our northern climate we allowed for 1/4 in.). Raise the panels by cutting a wide rabbet with a router and straight bit (Photo 3).

After dry fitting the side frame-and-panel assembly, disassemble and finish sand the panels and the inside edges of the frames. Pre-finish the rabbets to keep the seasonal movement of the panels from revealing any unfinished edges. Glue up the side panels and check for square.

THE CARCASS

The bottom shelf carries all the weight of the insert and its contents. That's a lot of weight for one shelf! We used a torsion box for the bottom shelf because it's both lightweight and strong (see Practical Design, p. 79). A torsion box works the same way as framing in the floor of a house. It takes advantage of the weight-carrying capacity of a board put on edge (like floor joists). The torsion box consists of two plywood shelves with vertical dividers (Fig. A). The cabinet sides, face frame and back complete the box. The upper shelf and torsion box are cut from inexpensive plywood.

Cut dados for the torsion box and the upper shelf. Dry fit the entire carcass assembly and drill countersunk pilot holes for the top shelf and the bottom portion of the torsion box where the base molding will cover the screws.

Final assembly of the carcass begins with the torsion box, which is glued and screwed together. The top shelf and the completed torsion box are joined to the cabinet sides with glue and screws. Use clamps for the top half of the torsion box.

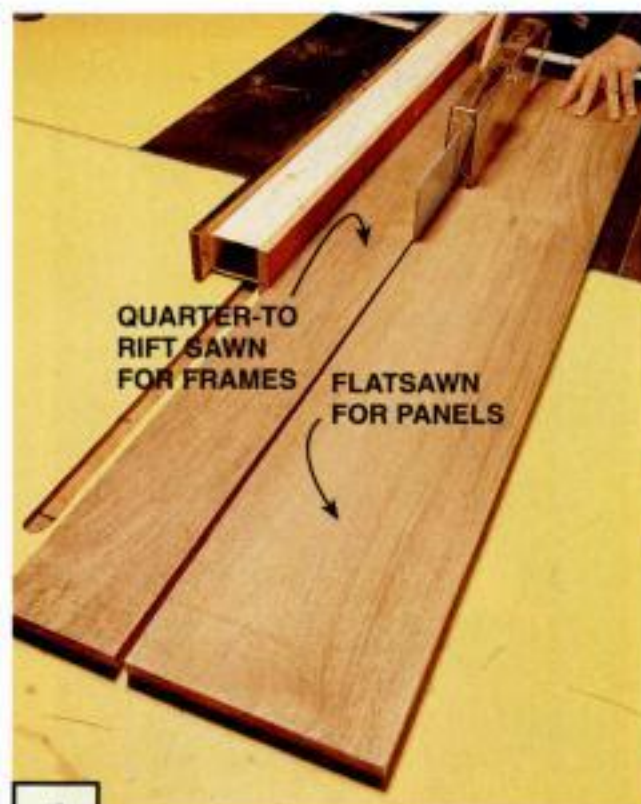
THE FACE FRAME

This cabinet depends on a face frame and a plywood back to prevent racking. The face frame is made 1/8-in. wider than the carcass and is joined with biscuits. Dry fit the assembly and make precise layout marks for the rails. Glue up the face frame, making sure it is square. Lay the glued up carcass on saw horses and attach the face frame (Photo 4). Use a flush trim bit and a router to remove the overhang on the face frame.

A pleasing design feature of the wardrobe is the stopped radius on its corners (Fig. A). With the carcass still on its back, use a 3/4-in. round-over bit taking several passes to reach the full depth of cut. Set up stop blocks to limit the cut to within 1/2 in. of the crown and base moldings.

THE DOORS

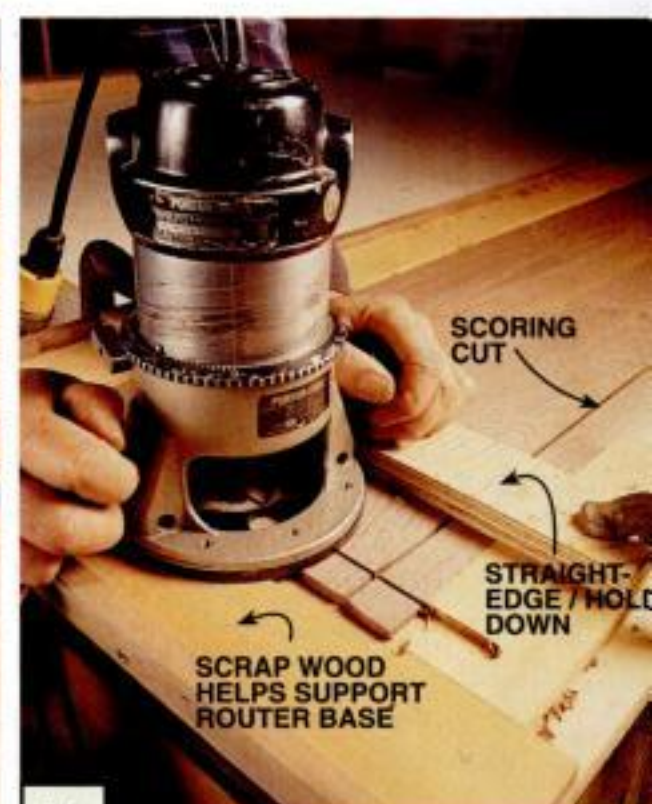
The frames are joined using haunched mortise and tenons. The panels are raised in the same way as the side panels (Photo 3). Assemble the doors and cut them to fit the openings with 3/32-in. margins on all sides.



1 RIP WIDE BOARDS for frame-and-panel parts. Use the straight-grained wood at the edges for frames and save the remaining flatsawn wood for panels.

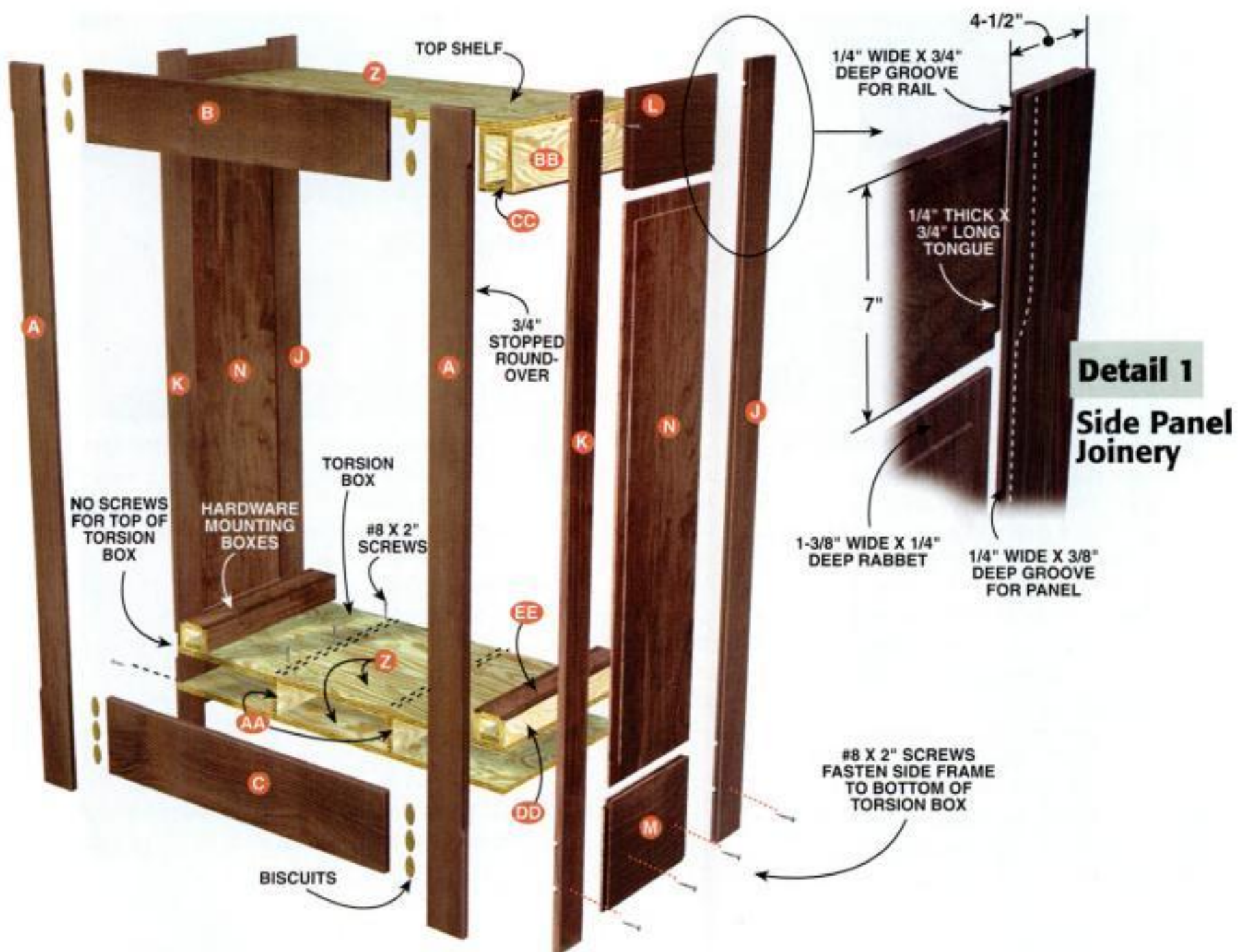


2 USE STOP BLOCKS to limit the length of the deeper grooves at each end of the stiles where the tongues of the rails will fit. Use a dado blade to cut panel grooves in the stiles and rails. Raise the blade and make the deeper grooves for the rails.



3 CUT THE WIDE RABBET on the edges of the panels with a router and a straight bit. Score the outline of the panel field on the tablesaw to prevent tear out. To support the router and secure the panel, tack pieces of wood the same thickness as the panel onto some plywood. Use straightedges as guides and hold-downs.

FIG. A Carcass Face Frame



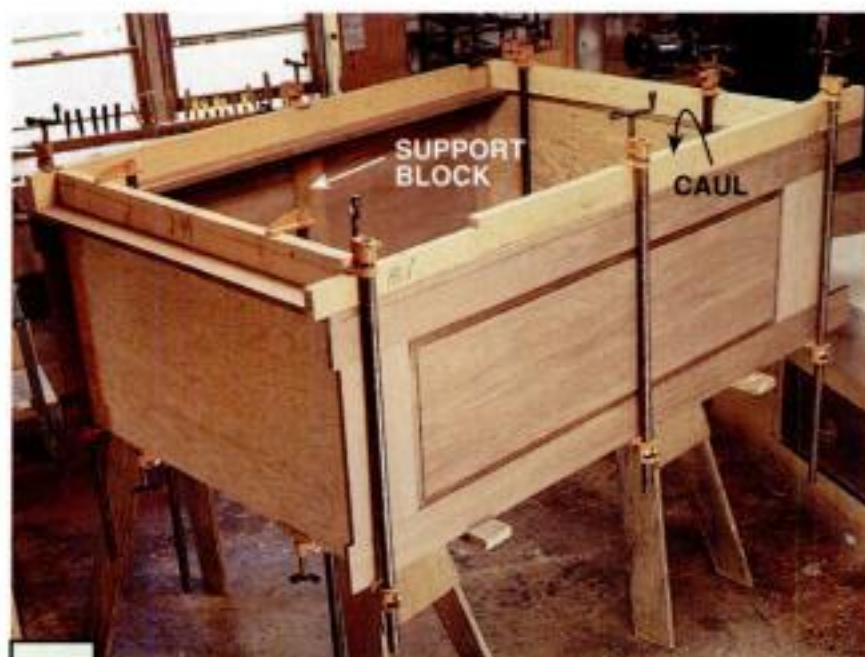
THE MOLDINGS

The applied moldings really make this piece come alive. If possible, cut each molding from a single board with the long front piece cut out of the middle and the sides cut from the ends. All the moldings use a simple butt joint at the corners.

WHERE THE FUN BEGINS: DOIN' THE COVE

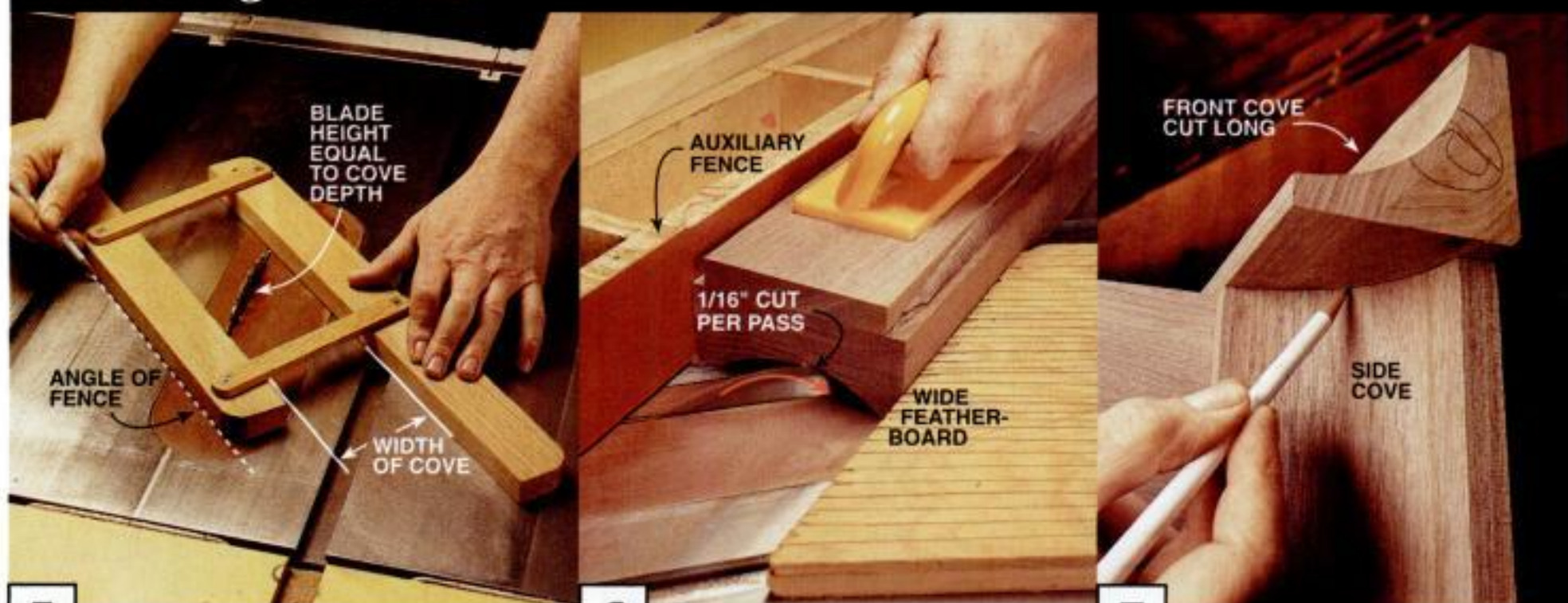
If you've never done anything like this before, glue up some stock from scrap wood to use as a trial run before you cut into that expensive walnut.

Mill cove stock from 12/4 lumber to 2 3/8 in. Rough cut the sides and front to length and width plus 1 in. Set up your tablesaw for cutting the cove (Photo 5). It is best to have the pith side of the board at the back of the cove (Fig. B). This ensures a stable molding with a straight grain pattern. That said, we found the pith side of our stock full of defects forcing us to orient the grain the opposite way. (If plan A doesn't work, switch to plan B!)



4 GLUE AND CLAMP THE FACE FRAME to the carcass using cauls to help distribute the clamping pressure. Square the cabinet to the face frame. Keep the center of the side frame from flexing under clamp pressure by mounting a support block that fits between the stiles at the mid-point of the panel. Tack the face frame down at each corner to keep it properly aligned during glue up. Place the nails where the moldings will cover them.

Creating a Cove



5 DETERMINE THE PROPER ANGLE for the auxiliary fence by using a layout jig. Set the height of the saw blade equal to the depth of the cove and open the layout jig to the width of the cove (Fig. B). Set the jig over the raised blade at an angle that just allows the blade to clear the inside edges of the jig. Scribe a reference line on your tablesaw and set the auxiliary fence parallel to that line.

6 CUT THE COVE MOLDING by passing thick stock over the saw blade at an angle (a 50-tooth combination blade works well). Use an auxiliary fence clamped to the table and take only $\frac{1}{16}$ in. at a time. Protect your fingers with a push block and use a featherboard to hold the cove against the fence. Make a very light final pass and use a slow, steady feed rate to ensure the smoothest cut possible.

7 SCRIBE THE SIDE COVE PROFILES onto the back of the front cove then remove the front cove for cutting.

Mark the top edge of each piece and always have that edge against the fence to ensure proper orientation while machining (Photo 6). Use a gooseneck scraper followed by sandpaper to remove saw marks from the cove. Rip the cove to final width, then set the saw at 45 degrees to make the back cuts (Fig. B).

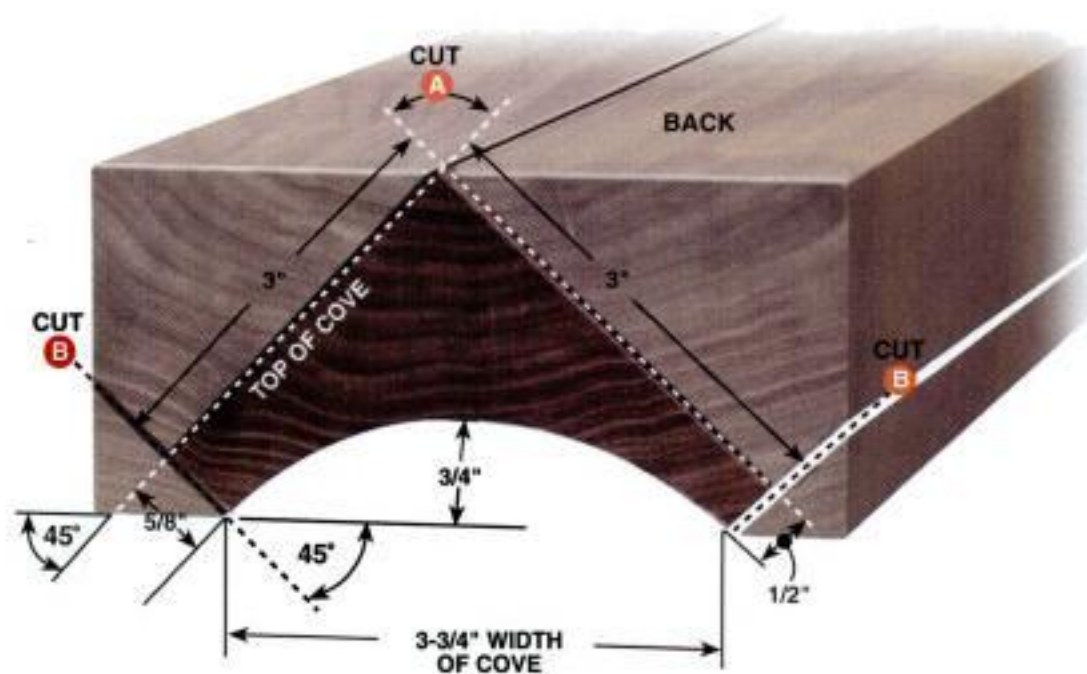
Secure the front cove with a couple screws driven in from the back of the face frame. Make clean, square end cuts on the side coves. Butt them against the front cove and secure with screws. Scribe and cut the front cove (Photos 7 and 8).

The cove's radiused corner is a dramatic element in this piece. It looks difficult to execute but in reality it's surprisingly straightforward.

Permanently attach the cove with screws and glue. Use a little epoxy mixed with very fine walnut dust at the butt joint to help stabilize the joint. With a template and router, form the convex radius on top of the cove first. This will help guide you in shaping the concave radius of the cove. To make the

FIG. B

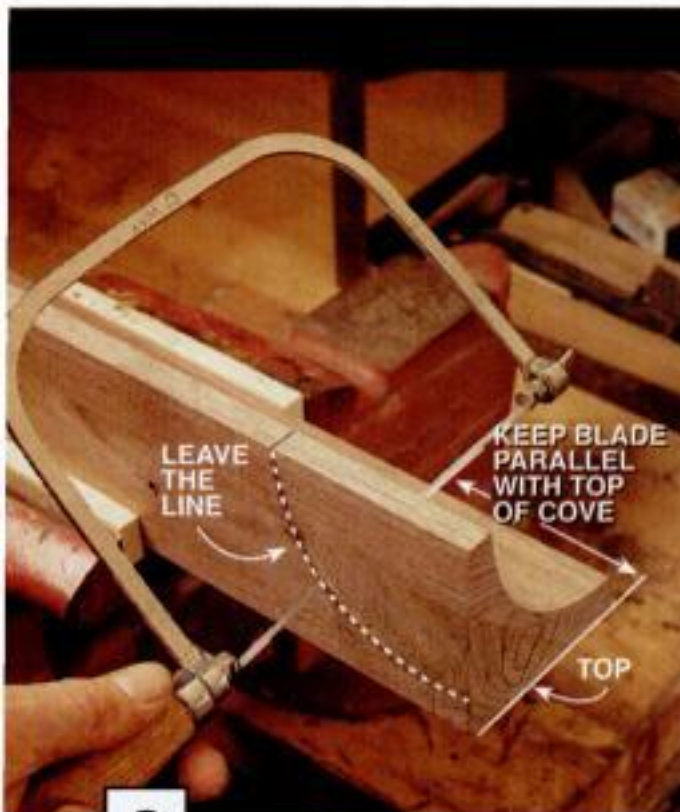
Cove Cuts Lay out the cove profile on the end grain as a guide for cutting. With the cove on its back, make cuts A. Turn the cove over to make cuts B.



template, swing a 3-in. arc on a piece of scrap that's large enough to support your router. Now cut out the profile on a bandsaw. Use the template to scribe the radius on the top of the cove. Rough-cut the outline with a jig saw or

a coping saw. Tack the template onto the top of the cove and use a router with a top bearing flush bit to finish cut the profile.

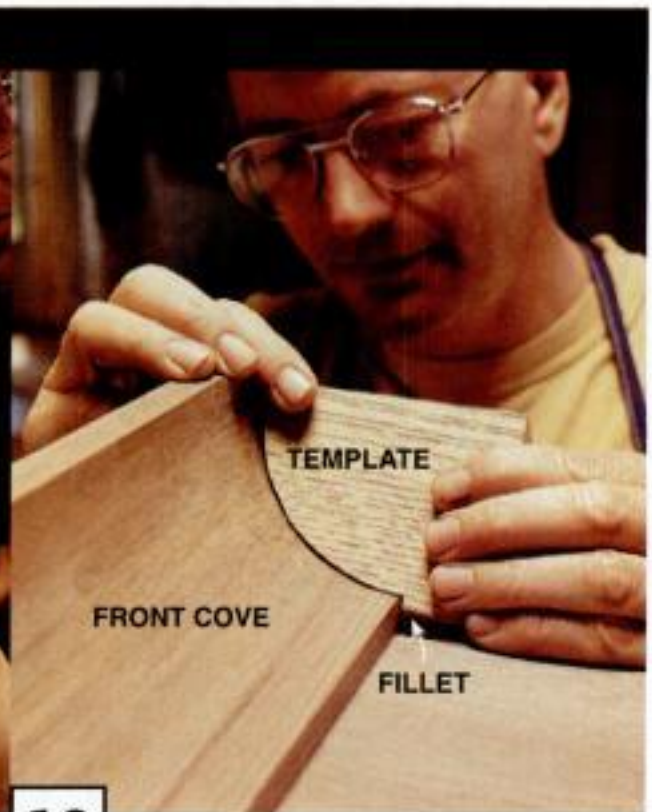
Shape the inside radius of the cove as shown in Photo 9.



8 CUT THE PROFILE IN THE FRONT COVE on the waste side of the line. Excess length will be removed during final shaping, but a cove that's cut too short can't be salvaged!



9 SHAPE THE RADIUS with a large half-round rasp to remove most of the material. The radius begins at the butt joint and wraps around the front. Switch to a finer file, scraper or sandpaper as you approach the desired shape (Photo 10).



10 USE A TEMPLATE to guide you in forming the concave radius of the cove. Make the template by tracing the cove onto a piece of scrap. Cut out the profile, leaving a small fillet as a reference point.

THE CROWNING TOUCH

The crown is made up of the cove with a cap on top and a bead below (Fig. C). Screw the cap molding onto the top of the cove. The butt joint on the cap should line up with the butt joint on the cove. Cut the radius on the cap in the same manner as the cove, using a 3 $\frac{3}{4}$ -in. template and router.

Make the bead using a $\frac{3}{16}$ -in. round-over bit and a router table. Secure to the bottom of the cove with glue and nails and shape the radius with a file. Tip: To protect the surrounding surfaces from any slips with the file, tape down some very thin pieces of scrap wood.

BASE MOLDING

Like the crown, all three pieces of the base should be cut from a single plank of walnut. Chamfer the top edges and mount to the cabinet with screws. Scribe, cut and mount the base as you did the cove. Radius the corner of the base with a $\frac{7}{8}$ -in. round-over bit using blocks of $\frac{7}{8}$ -in. wood on either side of the base for support. Use a sharp chisel and a flat file to radius the chamfer.

BRACKET FEET

Make a $\frac{1}{4}$ -in. hardboard template of the bracket feet using a compass and a straightedge. Mark the outlines from the template onto the blanks and rough-cut the feet on the band saw. Attach the template to the backside of each foot with brads or pin nails and finish the cuts on the router table with a flush-cutting bit and bearing. Fasten the feet with screws driven in from the back of the face and side frames. Radius the corner with a 1-in. round-over bit. Note: Use a variable-speed router or form by hand.

POCKET DOOR HARDWARE

On the plus side, European-style hardware is well engineered, easy to install and allows you to adjust the doors in three dimensions. On the down side it requires a mounting surface that is flush with the inside edge of the face frame. You can create this surface by building four simple boxes that are glued and screwed into the cabinet (Photo 11). Accuride's Model 1332 pocket door hardware ([see Sources, p. 37](#)) consists of

modified drawer slides mounted on these boxes (Photo 12). The door hinges are fastened to a hinge carrier, which, in turn, is fastened to the slides by an adapter plate. The set includes a pair of self-closing hinges, which mount at the top and bottom of the hinge carrier strip. Because the doors are so tall they require two additional free-swinging hinges each. Accuride provides detailed plans to make your own hinge carrier strip out of $\frac{3}{16}$ -in. aluminum bar stock. We found it easier to combine two short hinge carrier kits. The only modification required was drilling two holes in the extra adapter plate (Fig. C, Detail 1). Assemble the slides and carrier strips according to instructions and mount to the cabinet (Photo 12).

HANGING THE DOORS

Cut two extra stiles from scrap wood and use these to lay out and test the hinge spacing for each door (Photo 13). Finish installing the doors according to the instructions provided by Accuride. Attach the astragal to the right-hand door as you face the cabinet.

THE TV INSERT

Finally, we come to the insert where the 19th-century wardrobe becomes a 21st-century entertainment center. A minimum pocket of 2 in. is required for each door allowing 33 in. for our insert (plenty of room for a 32-in. TV). The insert is designed to be functional, flexible and as inexpensive as possible. We used walnut plywood with a hardwood

edge (careful of the veneer, its paper thin). The torsion box assembly is used to support the TV and also carry the VCR (or DVD depending on where you are on the technology curve). The boxes on either side of the VCR space are dimensioned so drawers can be made to hold CDs ([see photo, p. 31](#)).

Cut notches for wires in the back of the two shelves that make up the torsion box. Set the insert into the cabinet $\frac{1}{8}$ -in. in from the back edge of the face frame to allow for door bumpers. Secure the insert to the torsion box with screws.

THE BACK

Cut the back from a sheet of $\frac{1}{4}$ -in. walnut plywood. The plywood serves as a back for both the wardrobe and any insert you choose to build. It also strengthens the carcass to prevent racking. Add ventilation slots for the equipment you plan to use. Fasten the back to the carcass and the insert with screws.

THE FINISH

To highlight the luxurious grain in the door panels and bring out the rich color of the unstained walnut, we chose a multiple-step finish. To "pop" the grain we began with a wash coat of Solar Lux NGR Dye (medium brown walnut) diluted 12:1 with Solar Lux Reducer. (If you plan to brush on the dye, replace 10 percent of the reducer with Solar Lux Retarder.) To bring out the richness of the walnut, follow the dye with Watco Natural Danish Oil. After the oil has dried, spray on a 1-lb. cut of orange shellac to highlight the colors and build the finish. Add depth and luster to the finish by spraying on two to three coats of Behlen's Qualalacq 755. ([See Sources, p. 37 for all finishing products.](#)) Sand the finish with 400-grit paper to remove imperfections before the final coat.

Now sit back and enjoy your favorite show or listen to some music knowing that when you're done, all that cold glass and plastic will be enclosed in rich, warm walnut. For once, maybe it's what's on the outside that counts. **AW**



11

FASTEN the partially assembled hardware mounting boxes to the upper and lower corners inside the carcass. Complete the boxes by running a small bead of glue on the exposed plywood edges and nailing on the face piece.



12

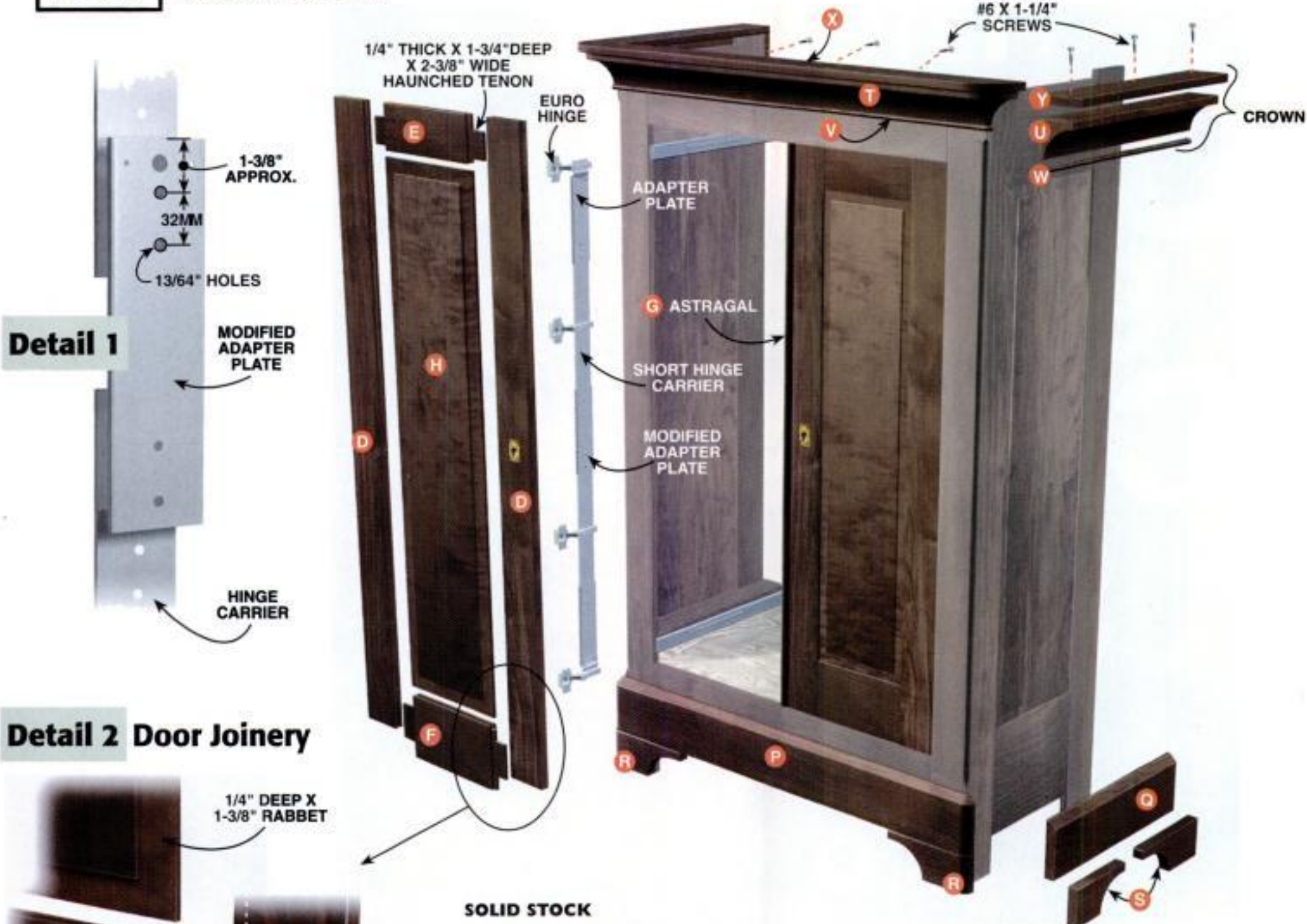
TO ENSURE PROPER PLACEMENT of the hinges cut a piece of scrap to the exact size of the door stile and hold it in the opening with shims. Mark the centerlines of the hinge baseplates onto the scrap and drill for hinge cups. Test fit a practice stile for each door before transferring the hinge placements from the test pieces to the doors.



13

USE SCRAP WOOD to hold the completed pocket door hardware assembly a minimum of $\frac{3}{4}$ -in. off the bottom of the cabinet.

FIG. C Doors and Trim



Detail 1

Detail 2 Door Joinery



SOLID STOCK

Ref.	Part	Qty	Dimensions
Face frame:			
A	Stiles	2	4 1/2 in. x 76 3/4 in.
B	Top Rail	1	7 in. x 37 1/8 in.
C	Bottom Rail	1	8 1/2 in. x 37 1/8 in.
Doors:			
D	Stiles	4	4 in. x 57 3/4 in.
E	Top Rails	2	4 in. x 14 1/4 in.
F	Bottom Rails	2	6 in. x 14 1/4 in.
G	Astragal	1	3 1/8 in. x 7 1/8 in. x 57 3/4 in.
Door Panels:			
H		2	11 1/2 in. x 48 3/4 in.
Side Frames:			
J	Back Stiles	2	4 1/2 in. x 76 3/4 in.
K	Front Stiles	2	3 3/4 in. x 76 3/4 in.
L	Rails, top	2	7 in. x 17 in.
M	Rails, bottom	2	8 1/2 in. x 17 in.
Side Frame Panels:			
N		2	16 1/4 in. x 54 3/4 in.
Base:			
P	Front	1	7 1/8 in. x 6 in. x 48 in.
Q	Sides	2	7 1/8 in. x 6 in. x 24 1/2 in.
Feet:			
R	Front	2	1 in. x 4 in. x 10 in.
S	Sides	4	1 in. x 4 in. x 9 in.
Cove:			
T	Front	1	2 5/8 in. x 5 5/8 in. x 54 in.
U	Sides	2	2 5/8 in. x 5 5/8 in. x 24 1/2 in.
Crown Bead:			
V	Front	1	7/16 in. x 7/16 in. x 48 in.
W	Sides	2	7/16 in. x 7/16 in. x 24 1/2 in.
Crown Cap:			
X	Front	1	3/4 in. x 3 1/2 in. x 55 in.
Y	Sides	2	3/4 in. x 3 1/2 in. x 24 1/2 in.

SHEET STOCK

Ref.	Part	Qty	Dimensions
Fixed Shelves/Torsion Box:			
Z	Shelves	3	23 1/2 in. x 45 in.
AA	Dividers	2	23 1/2 in. x 4 5/8 in.
Upper Mounting Boxes for Pocket Door Slides:			
(Sides with 5/16 in. hardwood edging)			
BB		4	6 in. x 23 1/2 in.
CC	Top & Bottom	4	2 1/8 in. x 23 1/2 in.
Lower Mounting Boxes:			
(Sides with 5/16 in. hardwood edging)			
DD		4	3 in. x 23 1/2 in.
EE		4	2 1/8 in. x 23 1/2 in.

SOURCES

Walnut
Hearne Hardwoods, Inc.; (888) 814-0007
Figured Walnut
Goby Walnut Products; (541) 926-1079
Hardware
Rockler Hardware; (800) 279-4441
Finishing Supplies
Woodworker's Supply; (800) 645-9292

MATERIALS LIST

Lumber and Plywood
24 board feet 12/4 walnut
15 board feet 5/4 walnut
100 board feet 4/4 walnut
2 sheets 3/4 in. x 4 in. x 8 in. walnut veneer plywood
2 sheets 3/4 in. x 4 in. x 8 in. inexpensive plywood
1 sheet 1/4 in. x 4 in. x 8 in. walnut veneer plywood

HARDWARE

2 24-in. Accuride Model 1332 Flipper door slide with European Hinges (Rockler # 89830)
4 hinges/carrier strips (Rockler # 40379)
2 rectangular flush ring (Rockler #69278)

by Travis Larson

The Ultimate Shop-Built Crosscut Sled

ART DIRECTION: JOEL SPIES • PHOTOGRAPHY: BILL ZUEHLKE • ILLUSTRATION: FRANK ROHRBACH

PERMANENT, FINGER-
SAVING BLADE GUARD

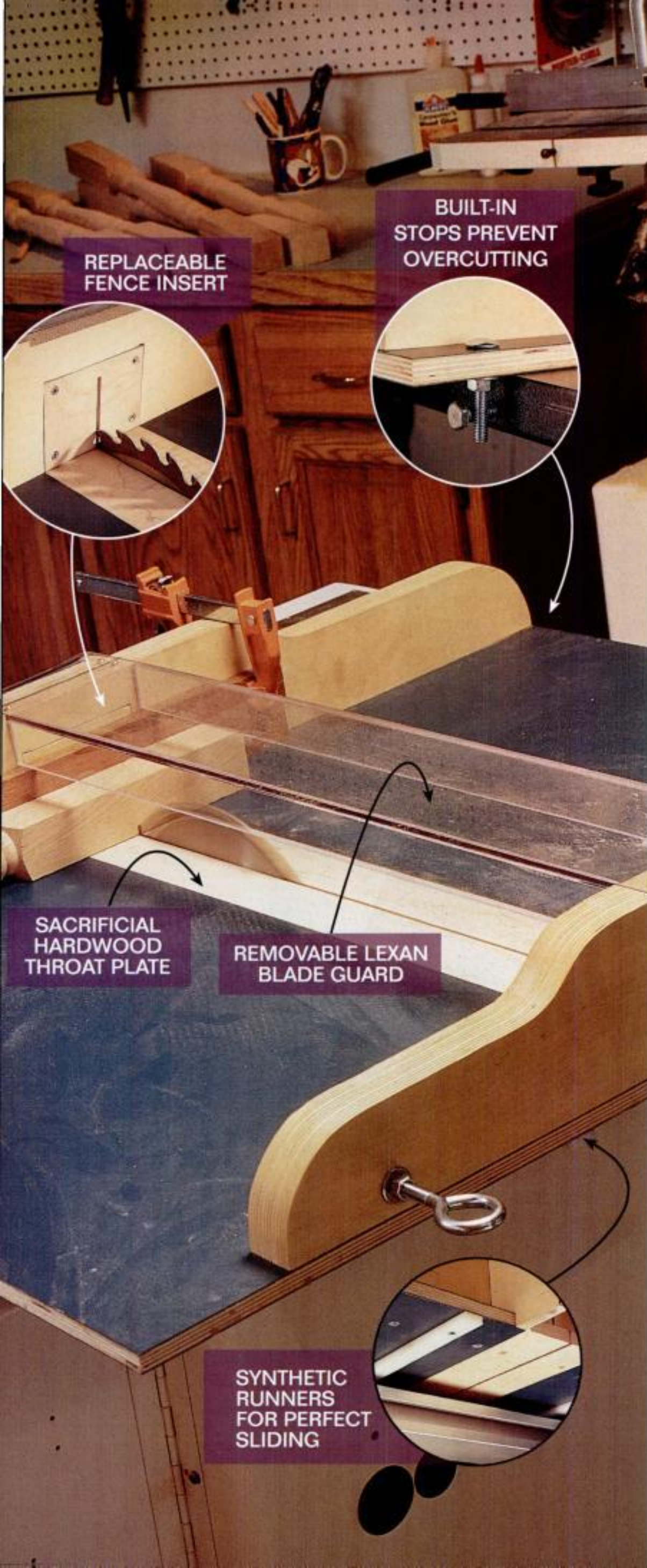
LAMINATE TOP AND
BOTTOM SURFACES

OUTFEED SUPPORT
FOR LONG STOCK

It's safe, it slides like a dream and a replaceable throat plate makes it last forever!

A good tablesaw sled makes perfect crosscuts easy, accurate and very safe. In addition, a well-designed sled can be used for bevel cuts, dadoes and with a few shop-made jigs, you can make tenons or repeated miter cuts at any angle.

I used to handle crosscuts with my sliding miter saw (with inevitable tear out). For wider stock, I employed the miter gauge on my tablesaw and sometimes fit it with all sorts of Rube Goldberg-style contraptions to handle various specialty cuts. But I always felt a little queasy with these devices because they put expensive stock (not to mention my fingers) in serious jeopardy. This sled is a much better way to crosscut.

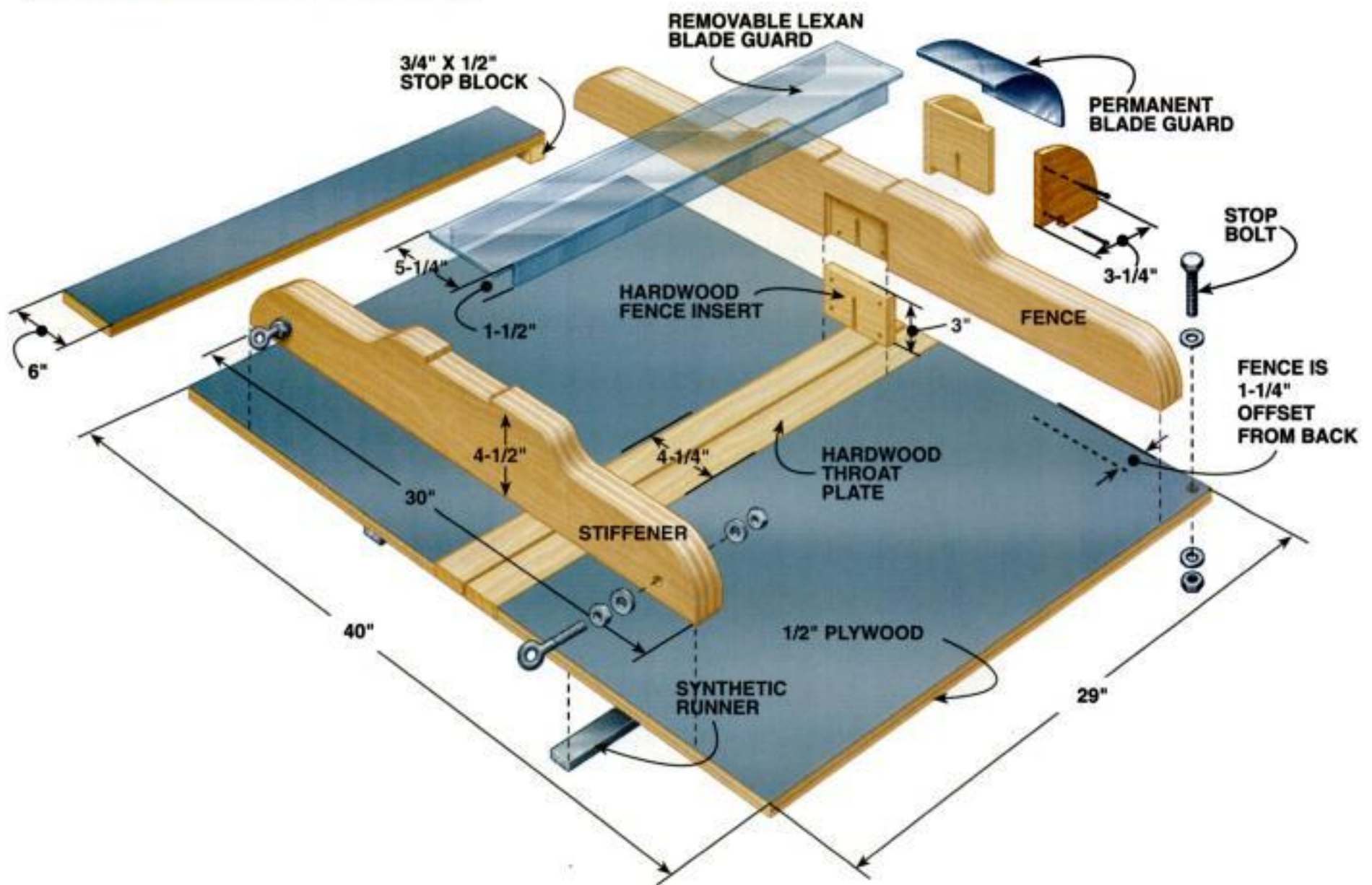


CLAMP A 45-DEGREE (or any other angle you need) jig to the fence to use the sled for cutting miters.



CUT TALL STOCK by removing the top guard for clearance and using a stop block on the saw fence to prevent kickbacks.

FIG. A EXPLODED VIEW



MATERIALS NEEDED

For this sled you'll need Baltic birch plywood (one 5x5 sheet), plastic laminate (one 4x8 sheet), plastic runner and guard material, and fasteners—all of which will cost under \$100. An equivalent-sized factory-built model sells for about \$350 but isn't designed to handle dados or bevel cuts without wrecking the table and fences. Without any mistakes, you should have enough material left over for a miniature sled for lighter, smaller crosscut work.



1 COVER PLYWOOD WITH PLASTIC LAMINATE for the base and two slightly larger squares of laminate for the top and bottom. Glue the laminate onto both sides with contact cement, roll it down and trim off the excess with a flush-trim router bit. Rip a 6-in. strip off the width for the outfeed support and glue and nail on a stop block (see Fig. A).

TAILOR THE SLED TO SUIT YOUR WORK

The sled shown in this story handles material up to 24-in. wide, such as cabinet sides and most furniture parts. I

haven't seen many larger sleds, but some people *prefer* smaller ones. Size your sled wide enough to handle the work you usually do. Some woodworkers use larger sleds for wide work and lighter, smaller, more portable ones for narrow cuts.

TWO SLEDs FROM ONE SHEET OF PLYWOOD

Six hours of shop time will produce this sled. We used a sheet of Baltic birch plywood, and had enough to make a sled for



2 FIT THE PLASTIC RUNNERS. They should slide easily in the miter gauge slots without any binding or slop. Cut them to the sled table width.



3 PRE-DRILL AND COUNTERSINK five evenly spaced holes for $\frac{3}{4}$ -in. No. 6 wood screws in both runners. Mount only the first one to the bottom of the sled using a carpenter's square with a metal straightedge to hold the runner straight and square. Drill the holes for the screws slightly larger than the shafts ($\frac{9}{64}$ -in. for No. 6 screws) or the plastic will bulge and cause binding in the slots.



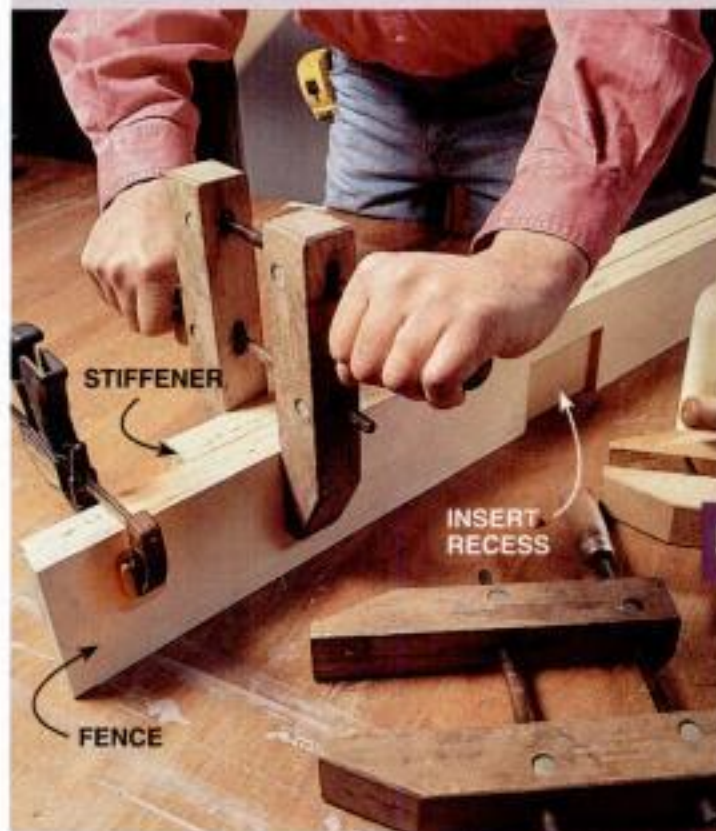
4 ATTACH THE SECOND RUNNER with double-sided tape. Align the rear edge of the runner with the back edge of the saw table. Slip the sled's attached runner into the miter slot keeping the end of the runner flush with the rear edge of the table and lower the sled onto the taped runner. Carefully lift off the sled, pre-drill through the runner holes into the sled bottom and screw the runner to the bottom of the sled

with five evenly spaced screws. Test fit on the saw table for easy, no-play movement. If the runners are binding, lift off the sled and inspect the runners for darker areas where they rub on the miter slot edges (usually bulges around the screws). Remove the runners and shave those areas with a block plane.

small tasks and the larger model shown here. You can use any $\frac{1}{2}$ -in.- or $\frac{3}{4}$ -in.-thick, cabinet-grade plywood—as long as it's flat.

The runners are made of ultra-high molecular weight plastic ($\frac{1}{2}$ -in. x 4-ft. x 4-in. sheets run about \$20; [see Sources, p. 43](#)). Slop-free sizing of the runners is crucial for an accurate sled. They should be the same length as the sled table, just under $\frac{3}{8}$ -in. thick (so they won't bottom out in the miter slot) and should slide in the slots easily with no side-to-side movement.

Centering the blade in the table allows for the necessary 2-in. overhang for the stop (Photo 13) on the left side of the saw table and access to the adjusting screw for the fence. Check your saw to confirm that the dimensions of this sled (built to fit a Delta Unisaw) will allow enough overhang. If not, either make the table wider or offset everything so the sled has at least 2-in. overhang over the left side of the saw.



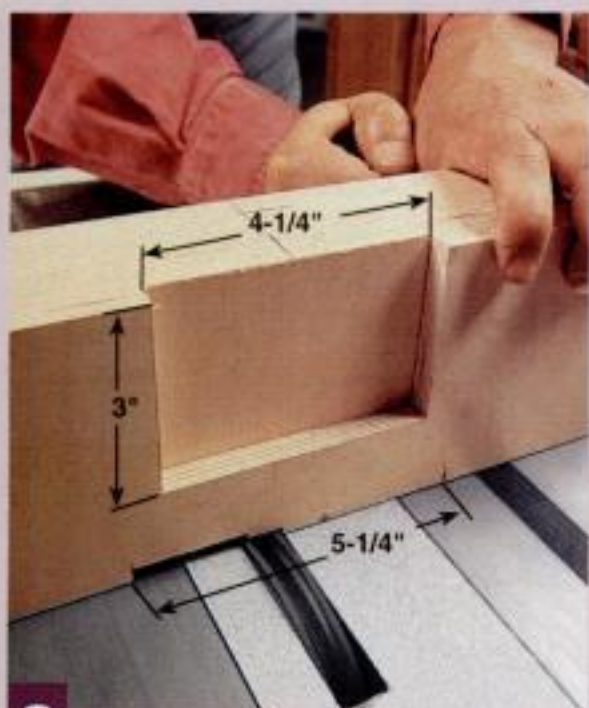
FRONT STIFFENER AND FENCE

Shape the stiffener and fence contours however you wish, but leave at least $4\frac{1}{2}$ in. about 5-in. away from the left and right sides of the saw blade. The stiffener and fence are all that's holding the right and left halves of the table together after cutting through the sled

5 GLUE TOGETHER two sets of plywood strips for the fence and stiffener blanks. Make the fence blank about 42-in. long (use a jigsaw to cut the fence throat plate recess in one of the fence strips before gluing) and the stiffener blank about 32-in. long. Joint one edge, rip to final width, cut to length and shape the curved edges.

table, so they need to be stout and stable. To size the shorter left- and right-hand areas, I tested various heights and found that a 3-in. height was comfortable for my fingers to wrap over the fence and easily hold $\frac{3}{4}$ -in. material. Ease or round over the sharp edges.

Don't be overly fussy about mounting



6 CUT DADOES into the centers of the two fence blanks to receive the blade guard. (This step is optional. You can also surface mount the guards.) Use a band saw or jigsaw to cut contours on the fence and stiffener and ease the edges with sandpaper. Attach the stiffener flush with the edge of the sled with six evenly spaced 3-in. countersunk drywall screws. Keep all screws 2½ in. away from the center of the table for cutting the throat plate slot.



7 ATTACH THE FENCE at the right side of the table with a countersunk screw and attach the left side using a screw in a router-cut slot. This allows for squaring adjustment. Raise the saw blade to full height and make a pass through the stiffener and base, stopping the cut at the fence.



8 MAKE A TEST CUT on a straight-edged scrap of plywood. Flip the left half of the plywood over to see if the cut is square. Loosen the alignment screw and tap the fence to adjust. Re-tighten the screw and make another test cut. When you achieve a perfectly square cut, flip over the table and install the rest of the fence screws.



9 CUT THE THROAT AND FENCE PLATES, fit them to the recesses and fasten with four 1¼-in. countersunk drywall screws.

the front stiffener. Clamp it flush with the rear edge of the table and fasten it with countersunk 2½-in. drywall screws spaced about every 3 in. Keep all screws outside the area where the 4½-in.-wide throat plate will be. Proper, square placement of the rear fence is the key to a successful sled (Photos 7 and 8).

Seal all exposed wood surfaces with a coat of polyurethane if you like smoother, stay-clean surfaces. Waxing the saw table also helps smooth operations. We installed a couple of eye hooks in the stiffener for stowing the sled on the wall.

REPLACEABLE THROAT PLATES AND CLEAR, PLASTIC SAW GUARDS

Impact-resistant polycarbonate plastic (see [Sources, p. 43](#)) is best suited for guards and can be machined with woodworking techniques and tools (Lexan and Cyrolon are two common brands), but bending and burnishing edges requires either a heat gun or propane torch and a bit of patience.

If you want smooth, clear edges on plastic, joint or sand off saw marks and run a torch over the edge to get slightly rounded, translucent edges (a "flame finish"). Practice on a piece of scrap before bending or softening the edges on



10 ATTACH TWO ROUNDED BLOCKS to a nailing block with glue and nails. Cut two notched, rounded blocks (a 3-lb. coffee can is a good curve pattern). Fasten a nailing block to the back side of the fence and glue and nail on the curved blocks.



11 BEND PLASTIC around the blocks the fence and stiffener with $\frac{3}{4}$ -in. pan head screws. Bend the curve with a heat gun or torch and apply pressure to mold the plastic over the blocks. Use a handsaw to cut off the excess flush with the bottom of the blocks. Pre-drill screw holes at all four corners of the curved part of the guard. Remove the guard and use the sled to cut off the curved portion and re-install both guards on the sled.



12 WELD THE SIDES to the underside of the guard with polycarbonate cement.

your guard to get the feel for using the torch or heat gun without damaging the surface.

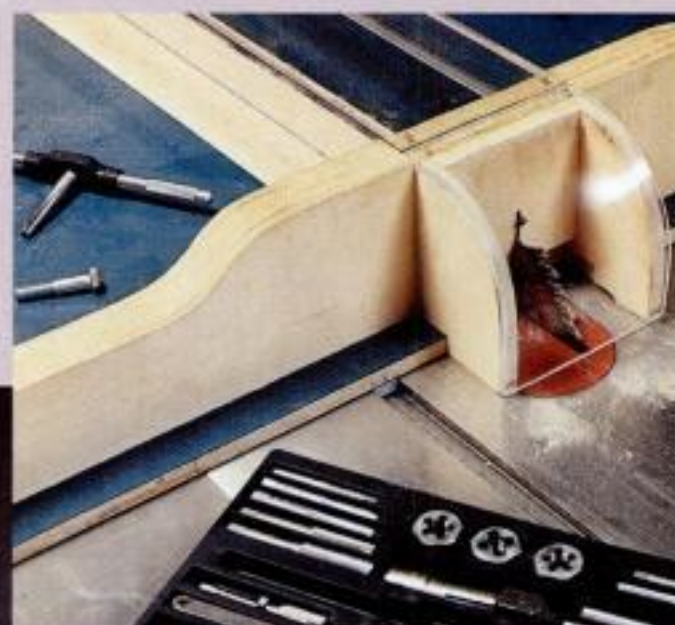
After you get the plastic parts cut, polished and clamped, weld the sides on with polycarbonate cement (Photo 12) using a gluing syringe, eye dropper or a "worm blower" (available at fishing tackle shops).

You'll find that a well-made tablesaw sled, like a lead sled dog, is dependable, solid and holds up over the long haul. *Mush! AW*

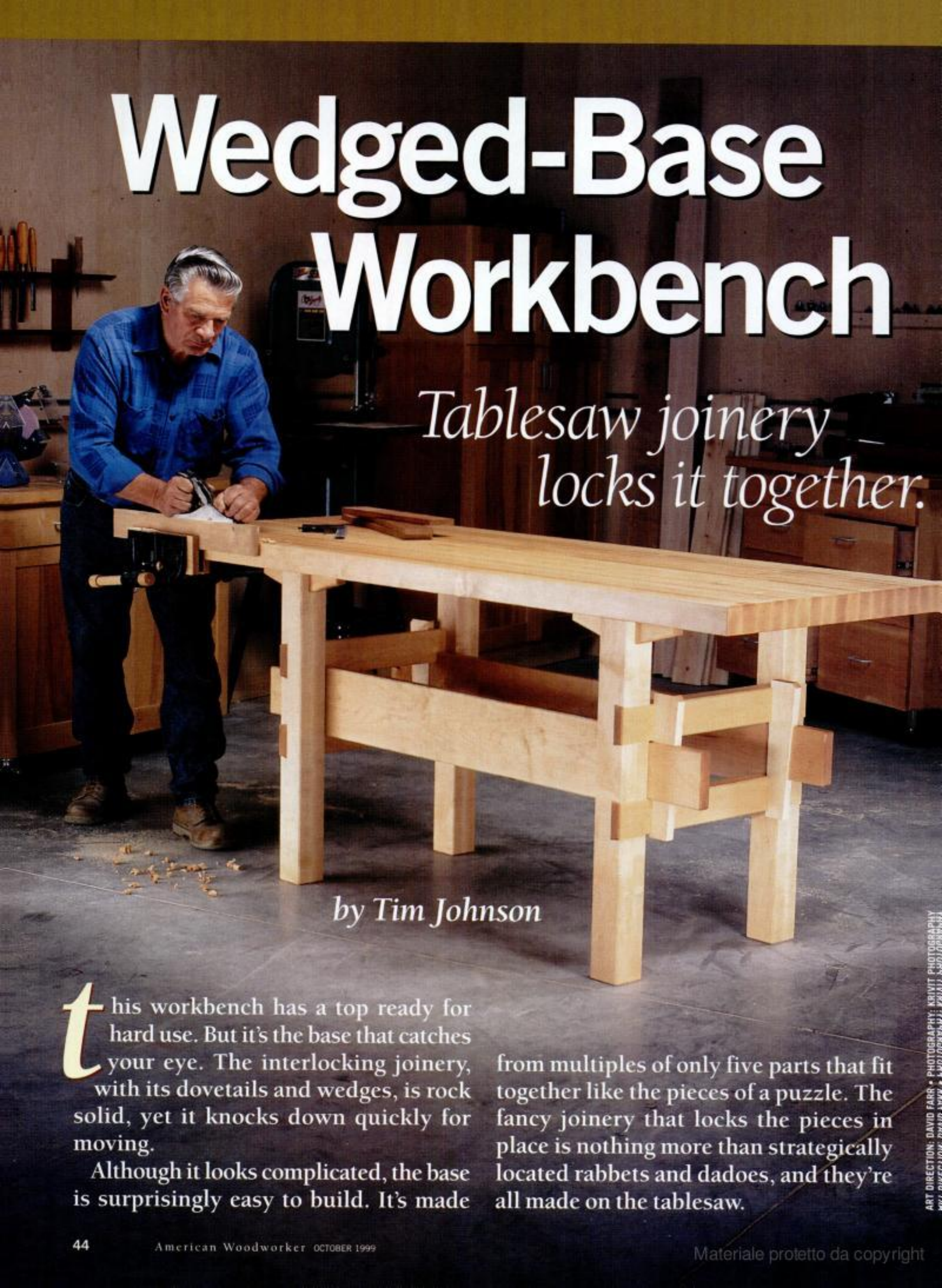
Sources

Plastic runner material: Woodcraft, 210 Wood County Industrial Park, P.O. Box 1686, Parkersburg, WV 26102; (800) 225-1153; www.woodcraft.com

Polycarbonate guard material and welding cement: Plastics To Go, (612) 551-1140; www.plasticstogo.com



13 INSTALL ONE STOP in the side of the tablesaw table and another in the left rear corner of the sled table. (Depending on your fence guide, you may have to go with a shorter bolt for clearance). Raise the blade to maximum height and make a pass through the throat plate and rear fence stopping the saw $\frac{1}{2}$ -in. short of the rear plastic blade guard. Clamp the sled to the saw table. Center punch, drill and tap a hole for the saw table stop bolt.



Wedged-Base Workbench

Tablesaw joinery locks it together.

by Tim Johnson

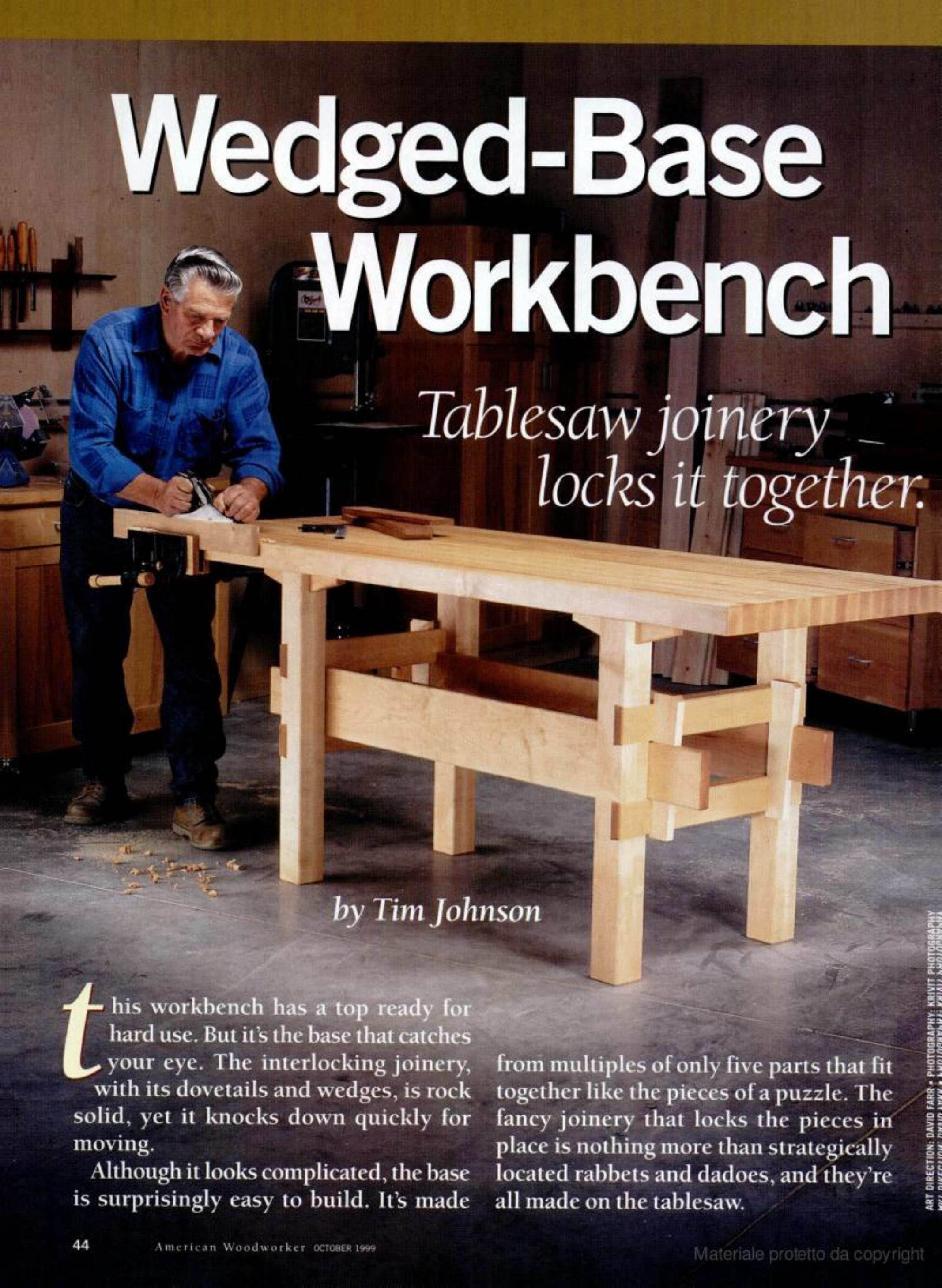
this workbench has a top ready for hard use. But it's the base that catches your eye. The interlocking joinery, with its dovetails and wedges, is rock solid, yet it knocks down quickly for moving.

Although it looks complicated, the base is surprisingly easy to build. It's made from multiples of only five parts that fit together like the pieces of a puzzle. The fancy joinery that locks the pieces in place is nothing more than strategically located rabbets and dadoes, and they're all made on the tablesaw.

44 American Woodworker OCTOBER 1999

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ART DIRECTION: DAVID FARR • PHOTOGRAPHY: KRIVIT PHOTOGRAPHY
 STYLING: JESSICA HARRIS • PROP STYLING: JESSICA HARRIS • MAKEUP: JESSICA HARRIS

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A man with grey hair, wearing a blue button-down shirt and dark pants, is working on a large, light-colored wooden workbench. He is using a hand plane on a piece of wood clamped to the left side of the bench. The workbench has a thick top and a base made of several vertical and horizontal wooden beams connected by complex interlocking joints, including dovetails and wedges. The background shows a workshop with various tools and wood pieces. The overall lighting is warm and focused on the workbench.

Wedged-Base Workbench

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by Tim Johnson

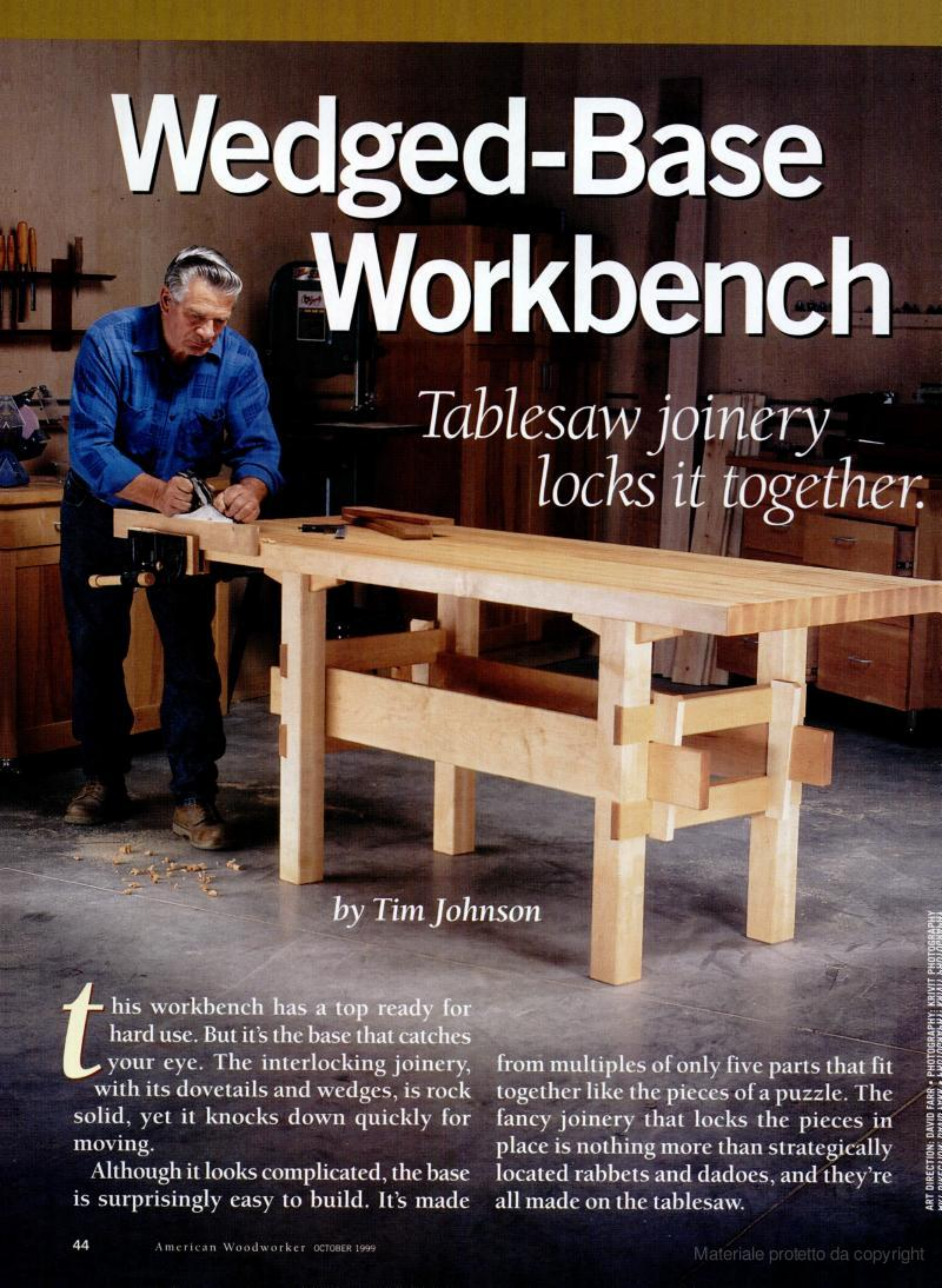
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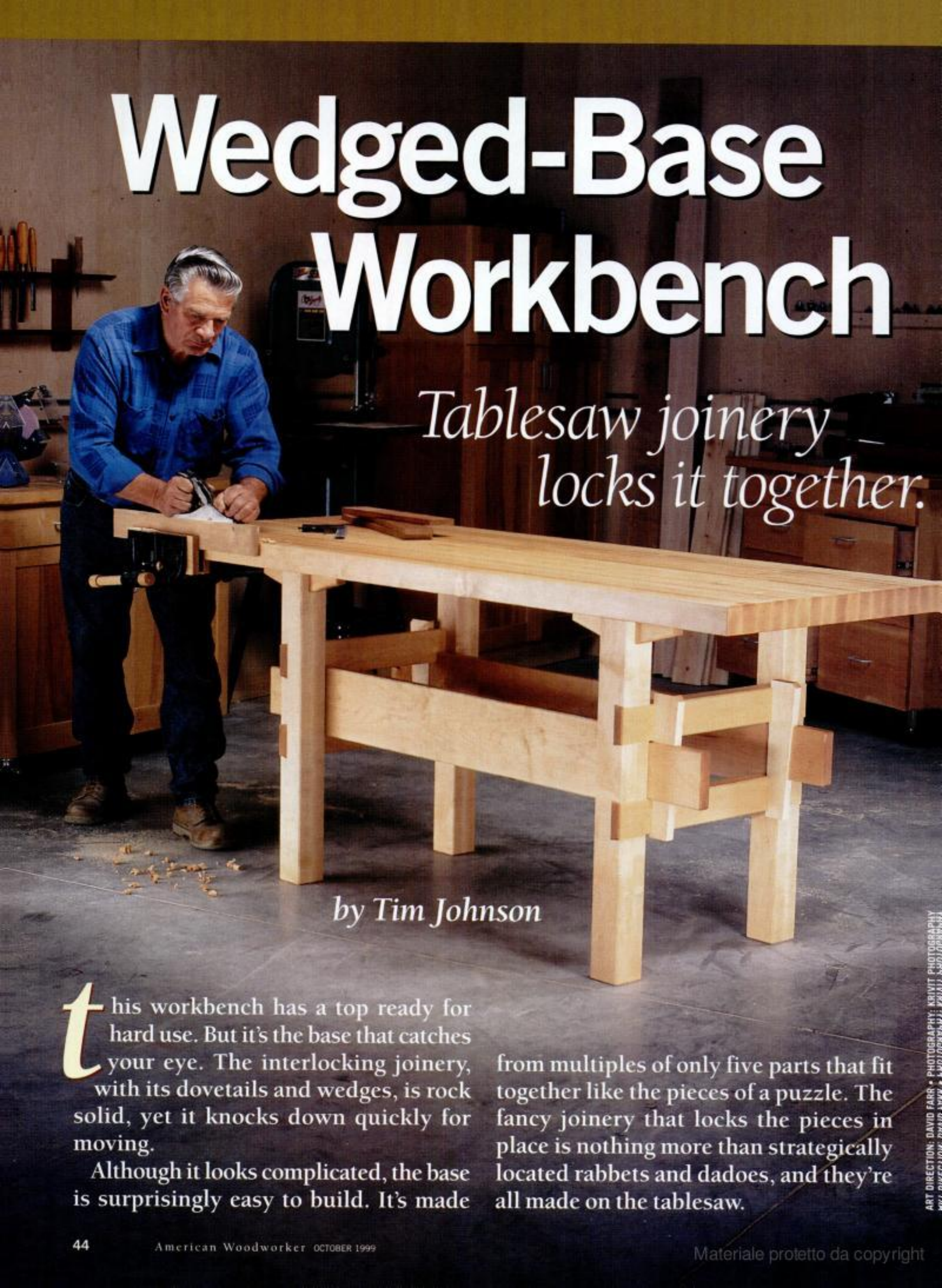
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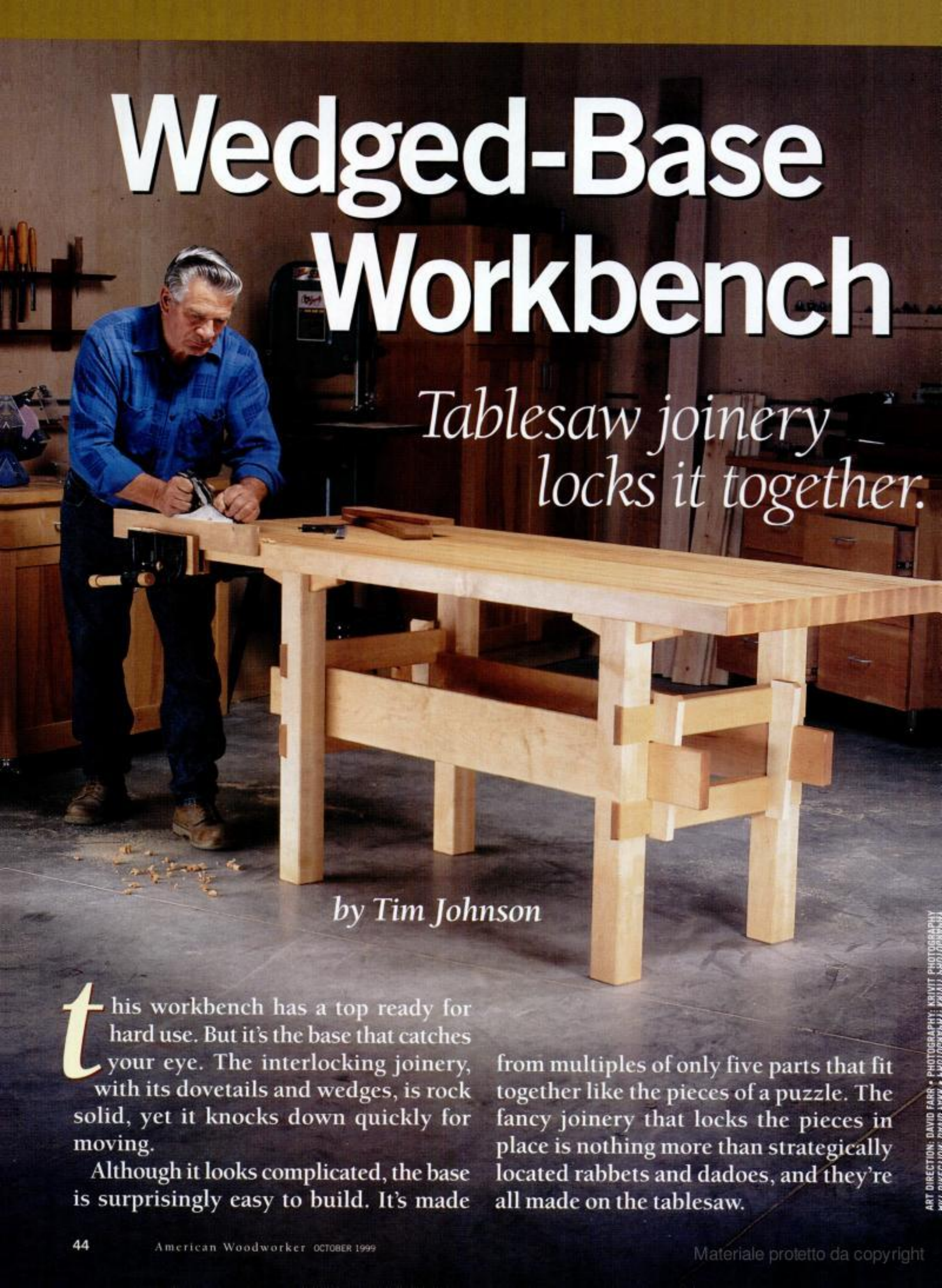
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Make the Top Bracket

The top is screwed to brackets held in place on top of the legs with a shouldered slip joint. Make this joint by cutting a slot in the leg (Photo 1) and two dados in the bracket (Photo 2). After dadoing, drill holes for screws—oversized to allow wood movement—and cut tapers on the bottom of each bracket.



BLADE GUARD GHOSTED FOR CLARITY. USE YOURS!

CUT DADOES on both sides of each top bracket so they can slip into the dados in the leg tops (Step B). Stop blocks at each end of the miter fence control the width of the cut.



CUT SLOTS centered in the top of each leg for the brackets that hold the top (Step A). To keep the leg steady, attach a tall auxiliary fence to your saw's rip fence and clamp the leg to a good-sized rectangular block. Use a featherboard and make the cut in several shallow passes until you reach the maximum depth your dado set allows (2 1/8-in., in this case).

Unlock the Joinery

The key to successfully building this base is knowing the sequence of the saw cuts, shown here as lettered steps. If you approach building it one cut at a time, following the steps, you'll have it assembled before you know it.

First, fit the brackets to the tops of the legs with slots and dados (Steps A and B). Set the brackets aside.

Next, fit the end rails to the legs with half-lap, dado and bevel cuts (Steps C - F). Before gluing them together, make dados in the end rails to house the side rails (Step G).

After the end assemblies are glued, cut the tenons on the side rails so they fit between the end rails (Step H). Then cut dados in the end assemblies (Step J) for the wedges.

Make the End Assemblies

The end rails lock to the legs with dovetailed half-lap joints. When assembled, the faces of the end rails and legs are flush and the dovetail pin ends of the end rails protrude $\frac{1}{4}$ -in. beyond the legs.

First, cut half-lap joints on the backs of the end rails (Step C). The tongues remaining on each end become large dovetail pins. Next, lay out the locations of the tails on each pair of legs and cut dados in them as deep as the pin blanks are thick (Step D). Don't make these dados too large—their purpose is to establish a flat bottom and remove most of the waste. These preliminary cuts allow the angled cuts for the dovetail pins (Photo 3) and tails (Photo 4) to be made at once.

STEP F

ANGLED TAILS

10-3/4"
TO TOP
OF LEG

5-1/16"

STEP D

DADOES

REFERENCE
POINTS

3-1/4"

1-1/8"

LEG

STEP E

9-DEGREE
BEVEL CUT

END RAILS

3/8"

1-1/2"

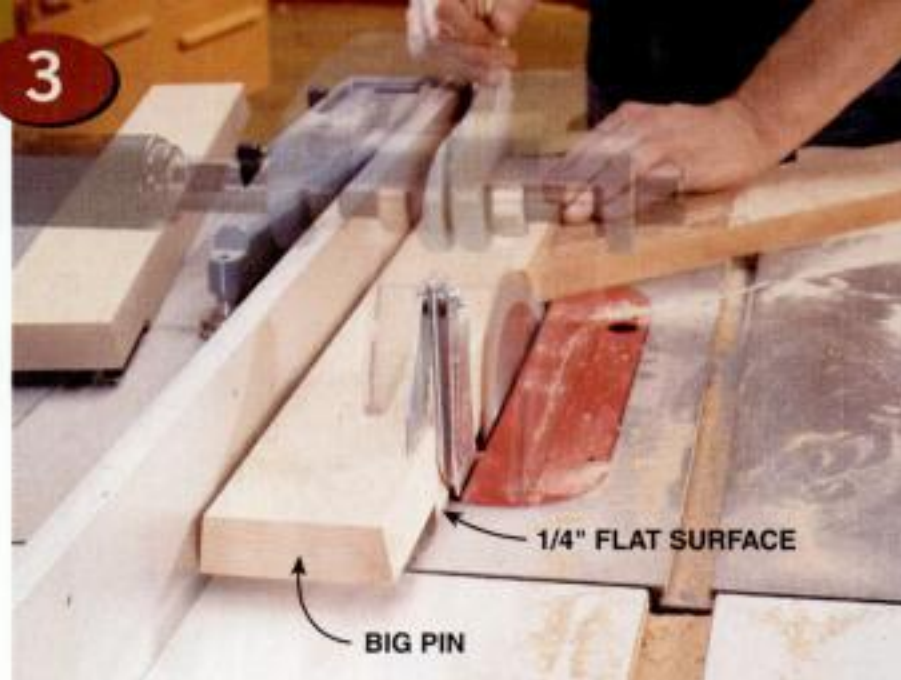
3-1/2"

STEP C

HALF-LAP

1-1/8"

3



BEVEL THE EDGES of each end rail at a 9-degree angle (Step E). These cuts turn the tongues into big dovetail pins. Leave a $\frac{1}{4}$ -in. wide flat on the back edge of the rail to ride against the fence.

4



MAKE ANGLED CUTS at the reference points, turning the leg dados into tails (Step F). Then nibble away the remaining waste. After cutting the angle on one side of each dado, flip the leg over and stand the end rail on the leg. Align the pin with the unfinished tail, and mark the leg for the remaining angled cut. (Inset) **SET THE HEIGHT** of the blade for cutting the dovetail corners by raising it so that its teeth barely nick the top of the dado.

5

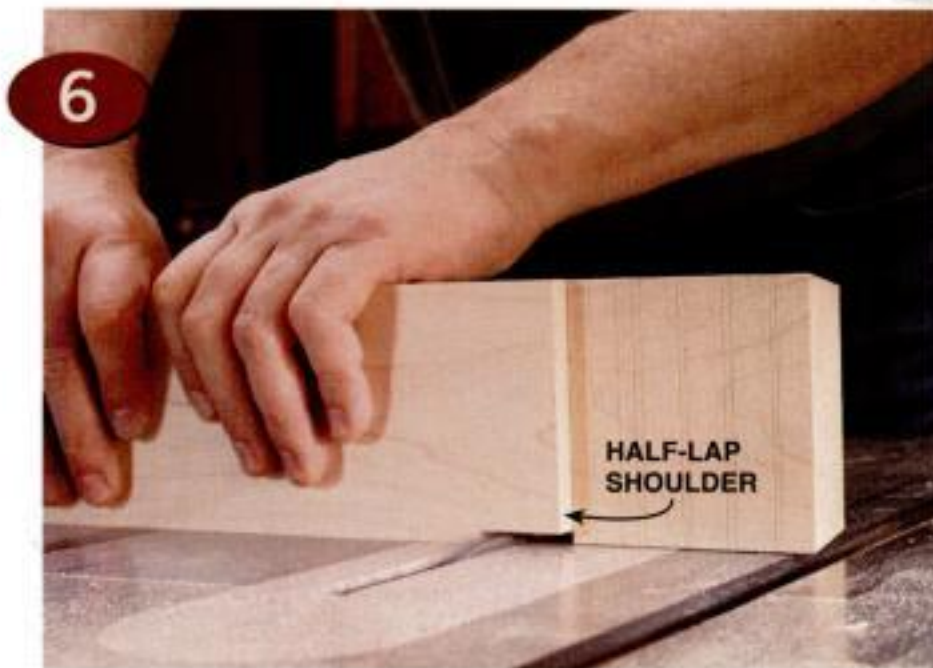


PAIRE THE WASTE from the angled saw cuts with a sharp, wide chisel to finish the corner.

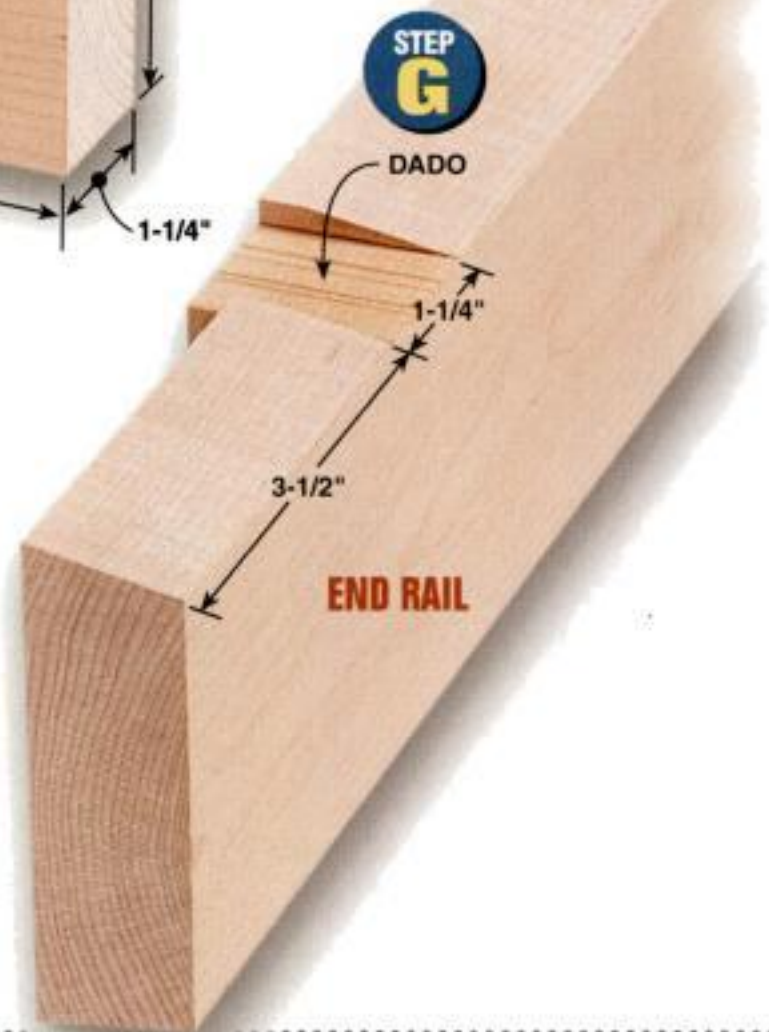


House the Side Rail

The side rail ends in a long tenon that slides through the end assembly. Shallow dadoes in the end rails, above and below, guide it and hold it in position against the leg (Step G). Cut these dadoes first (Photo 6), and then glue the end rails and legs together into the end assemblies. Make the tenons on the side rails last, so they fit properly (Step H).



CUT A DADO (Step G) in each end rail, starting from the shoulder of the half-lap. Make it wide enough to house the side rail.



Make the wedges (Step K) and then lay out and cut the angled dadoes on the side rails that hold them (Steps L and M). Assemble the base, lock it together by tapping the wedge home (Step N) and slide the top brackets in place.

In hard maple, the base costs about \$250. You'll need 25 board feet of 8/4 and 15 board feet of 6/4 stock. Additional 6/4 and 8/4 scrap stock in any wood is helpful for test cuts. Your shop needs to be equipped with a well-adjusted jointer, planer and tablesaw. You'll also need an accurate, adjustable try square. For layout work you'll need a stack dado set that cuts flat bottoms, a tapering jig for the wedges and brackets, a sharp chisel and a router and chamfering bit.

Make or Buy the Top

When it comes to the top, you have two choices. You can buy one ready-made ([see Sources, p. 49](#)), or make your own.

Manufactured workbench tops are hard to find, come in limited sizes and are expensive to ship. Butcherblock countertops are widely available, but are always only 1 1/2-in. thick and often include short butt-joined pieces.

Making your own top is a lot of work and you won't save yourself much money. Satisfaction, quality control and choosing specific dimensions, especially the thickness, are good reasons to do it.

I made this one from plainsawn 8/4 boards, all 8-ft. long and about 6-in. wide (72 board ft.; \$450) I milled them to 1 3/4-in. thickness and ripped them in half. After jointing the edges, I ripped the boards to a consistent width, as wide as the narrowest piece. Then I glued them together face to face, quartersawn edges up, in three sections, each about 10 1/2-in. wide. I ran these sections through the planer to make them smooth and of uniform thickness. Then I jointed the edges

7

Final Assembly

A wedge draws the side rail tight against the end assembly. Dadoes in the end assembly hold the wedge and a tapered dado in the side rail makes it work.

First cut dadoes in the end assemblies (Step J). Next make the wedges (Step K, p. 49). Then cut the dado in the side rail (Steps L and M), using the end assembly dado you've just cut, to locate it (Photos 7 - 9).

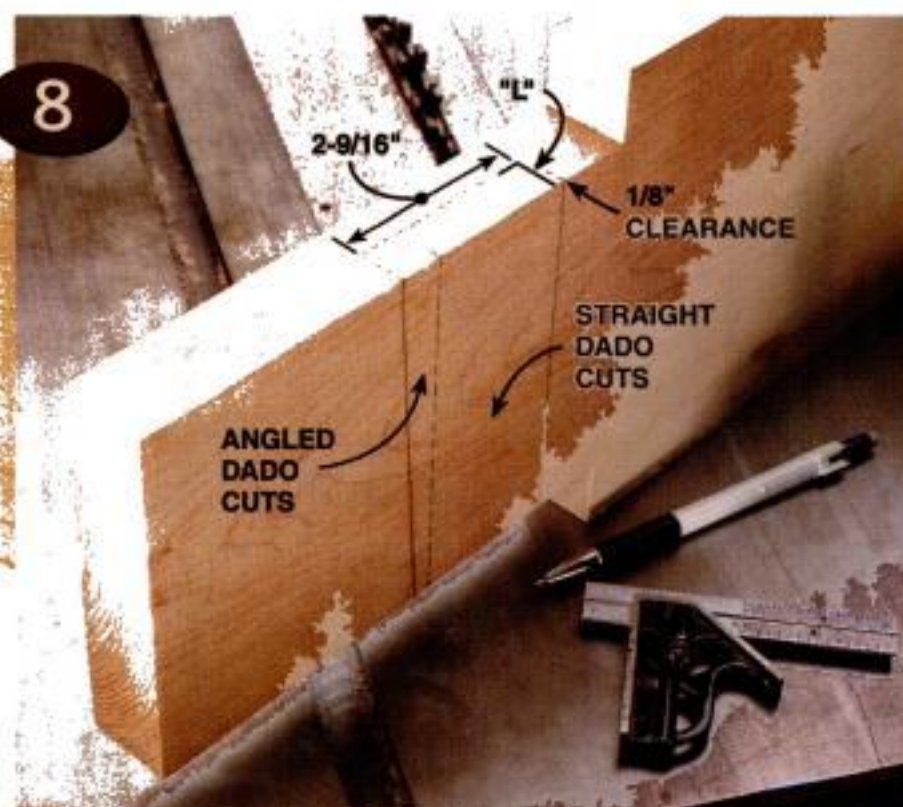
END ASSEMBLY



SIDE RAIL

MARK THE LOCATION of the angled dado in the side rail that will hold the wedge. Slide the side rail into position and use the end assembly dado for reference.

8

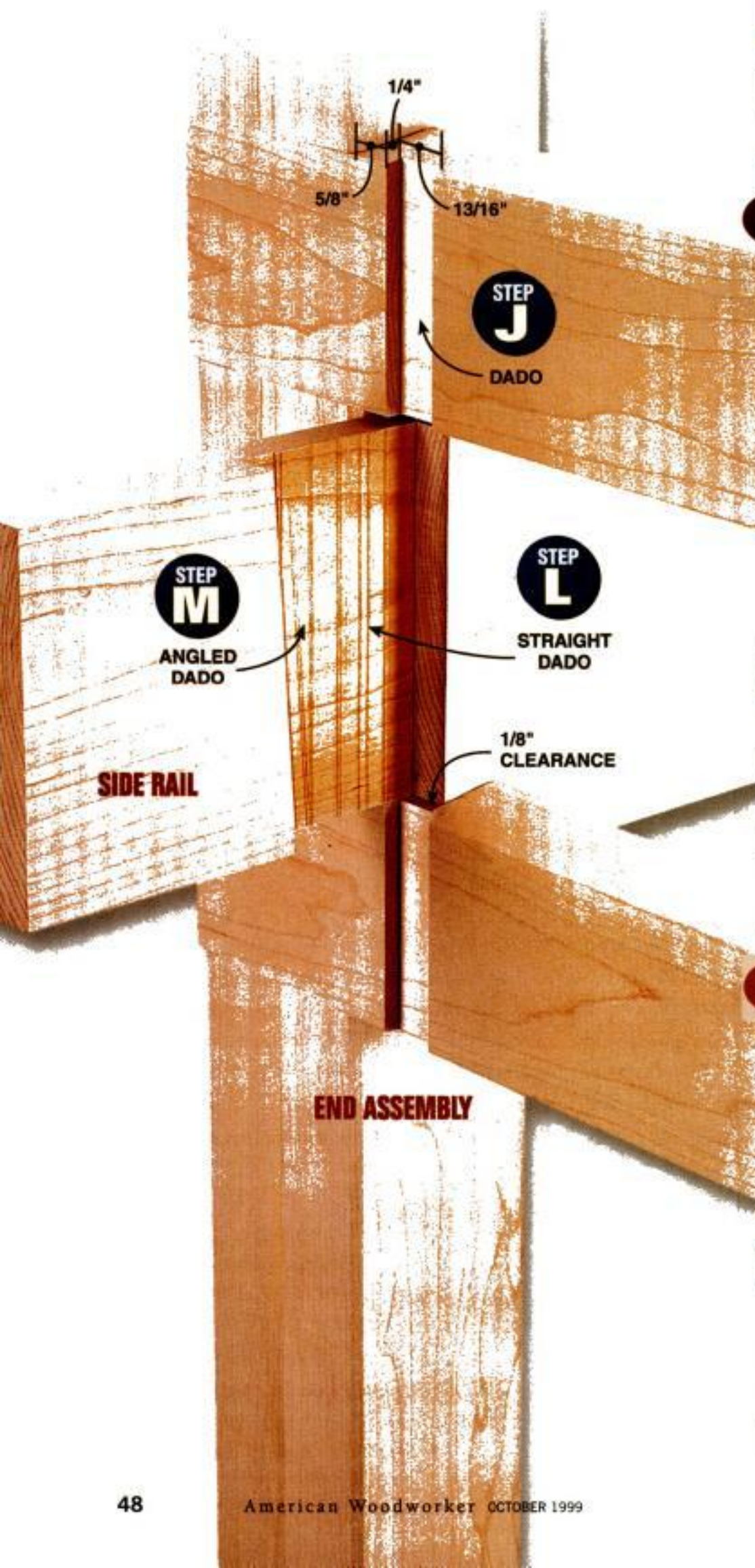


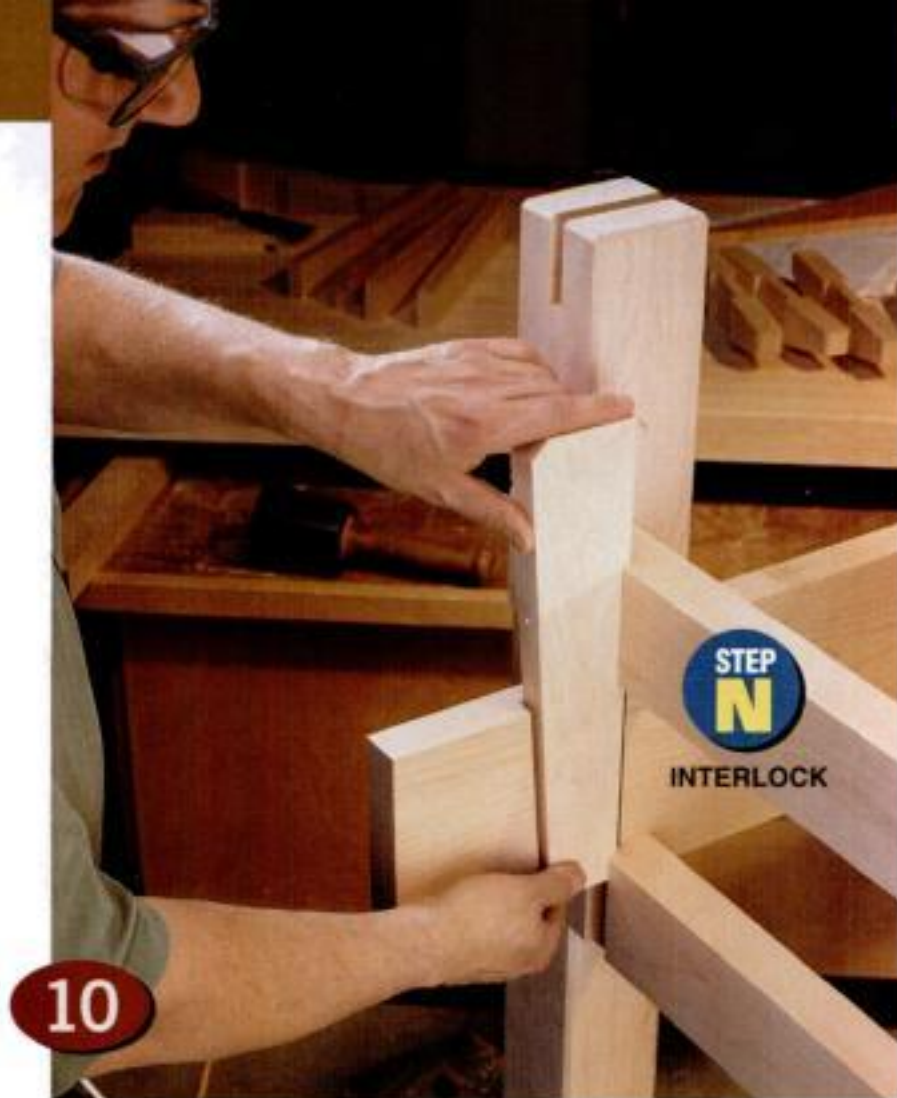
LAY OUT the side rail wedge dado from the L-shaped mark you've just made (Photo 7). Its leg gives you the depth and its stem marks the back of the wedge. Extend the dado a bit behind this line for clearance. Draw the angled front using one of your wedges held tight against a try square. You can remove most of the waste from this dado with straight, 90-degree cuts (Step L).

9



MAKE THE FINAL angled cuts in the side rail (Step M). Use one of the wedges clamped between the rail and the miter gauge to guarantee that the angle of the dado and the wedge match perfectly.





SLIDE THE WEDGE home (Step N). Once it has engaged the dado in the lower end rail, tap it securely into place.

and carefully glued these sections together to make the top. I cut the ends square with a straightedge-guided saw.

Other Possibilities

Upon seeing it, one of my friends said, "That's not a workbench, it's a table." He's right—half right, anyway. The bench could also be used as a kitchen or gardening work table. And with minor modification it would make a great dining or coffee table. Just imagine the base under a glass top. But be prepared to keep the glass clean of nose prints from guests seeking a closer look at your exquisite joinery! **AW**

Bench Dimensions

This bench sits 34½-in. tall, so it matches other shop tool table heights. The top is 84-in. L x 30-in. W x 2½-in. T. The base, measured from the outsides of the legs, is 48-in. L x 24-in. W. All sharp edges are chamfered.

Cutting List for Base

Legs (4)	Side Rails (2)
31¾" x 3¼" x 3¼"	60" x 7" x 1¼"
Top Brackets (4)	Wedges (4)
12" x 2⅜" x 1¼"	12¾" x 2⅞" x 1⅜"
End Rails (4)	
24½" x 3½" x 1½"	



The Wedge

These wedges taper ½-in. over 7-in.—flat enough so they'll work themselves tight as you use the bench. Make the wedges long and trim them to final length after all the joinery is done.

SOURCES

Workbench Tops
Woodcraft Supply
(800) 225-1153
www.woodcraft.com

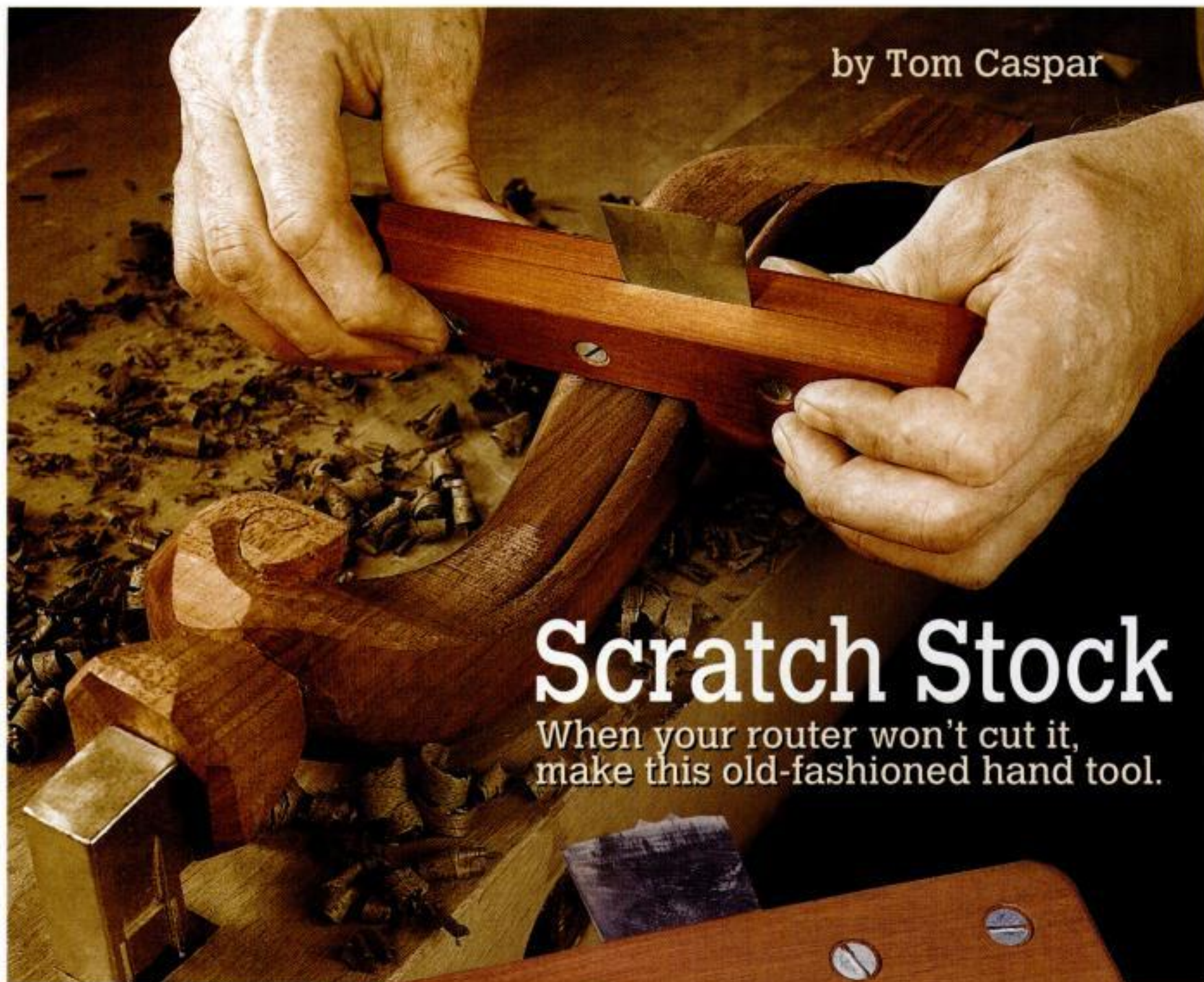
Kitchen Countertops
Your local home
center or lumberyard



by Tom Caspar

Scratch Stock

When your router won't cut it,
make this old-fashioned hand tool.



Need a molding your router can't make? Get out your hacksaw, find an old handsaw, and make a scratch stock.

A scratch stock is simply a scraper with a handle. You can make your own cutters from a variety of materials you've probably got kicking around the shop. The body can be made from any hardwood, using basic tools, and should take no more than an hour to complete.

You can also buy a new scratch stock [instead of making one \(see Commercial Scratch Stocks, p. 53\)](#). Blank cutters are

available, as well as sets of shaped cutters that are difficult to make in your shop.

With a scratch stock as part of your tool kit you can reproduce almost any molding profile. Your work won't be limited by the shapes of modern router bits. And you can shape compound-curved furniture parts that a router can't manage, like the cabriole leg above.

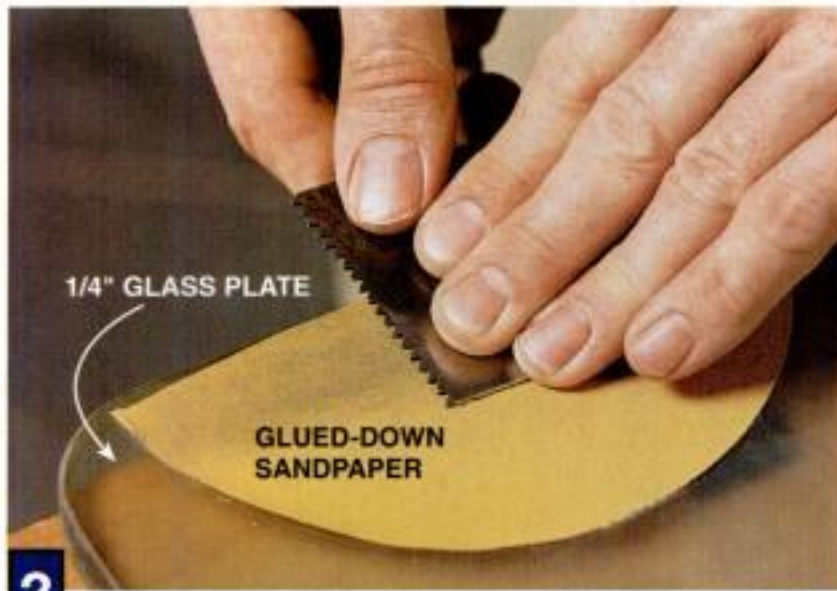
You'll find a lot of uses for your scratch stock. You can flute a tapered leg, bead a drawer edge, or cut a groove for

inlay. Because it's so versatile, the scratch stock is an indispensable tool for anyone repairing old furniture.

However, a scratch stock does have limitations. Using it is hard work. This is not the tool for making long runs of molding. It doesn't cut well in softer woods, like pine. And the small waves it creates leave behind a tell-tale handmade look to a molding. But that might be just what you're looking for.



1 **SAW A CUTTER BLANK** from an old handsaw blade using a good-quality, 32-tpi hacksaw blade. Clamp the handsaw down to the benchtop so the blade doesn't vibrate when you cut it. You can make a cutter from other material, such as a reciprocating saw blade, but the steel may be so hard that you'll have to cut and shape it with a grinder.



2 **POLISH THE BLANK** on fine sandpaper the same way you would lap the back of a new chisel. Start with 120 grit and finish with 220 grit. Sand until the metal is completely smooth. Then draw a profile on the blank with a soft lead pencil.

Making the Body

There are two types of scratch stock bodies. One is a solid block of wood with a saw kerf down the middle that holds the cutter. The second kind (shown in these photos) is made of two blocks of wood, and is easier to build.

Choose any wood that suits your fancy to make the body. It doesn't have to be as hard as maple. After all, the only wear surface on a scratch stock is the end grain in the notch of the tool.

Make your scratch stock any size that is comfortable to hold. Ours is

made from two pieces of mahogany $\frac{1}{2}$ -in. thick by $2\frac{1}{2}$ -in. wide by 8-in. long. The notch is $1\frac{1}{4}$ -in. wide by 5-in. long.

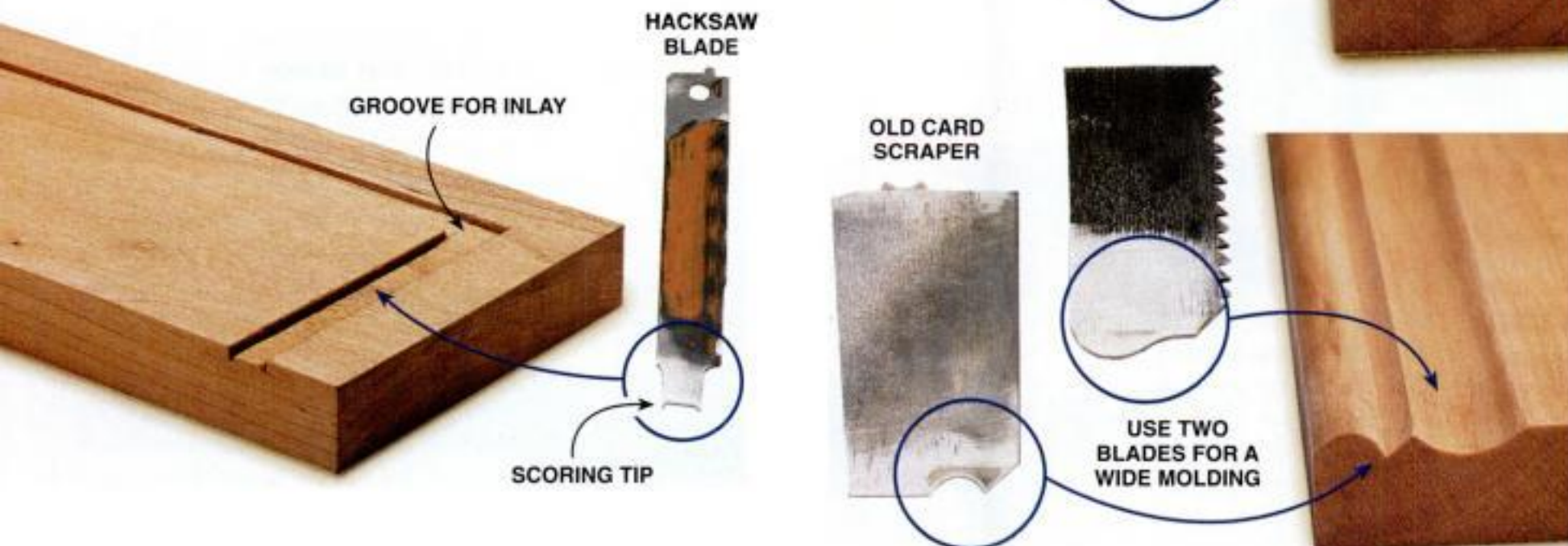
Our scratch stock uses machine screws and nuts to clamp the body around the cutter. (A simpler scratch stock would use wood screws, but they eventually strip out.) To fit the nuts into the body, drill shallow $\frac{3}{8}$ -in.-dia. holes. Then drill the rest of the way through with a $\frac{3}{16}$ -in. bit. Thread one of the nuts onto the end of a screw. Seat the nut into its hole by hitting the head of the screw with a hammer.

Bolt the two halves together, then cut the notch and round all the edges so your tool is comfortable to hold. You must also round over the entire bottom side of the arm, in order to properly control your scratch stock (see Photo 4).

Material for Cutters

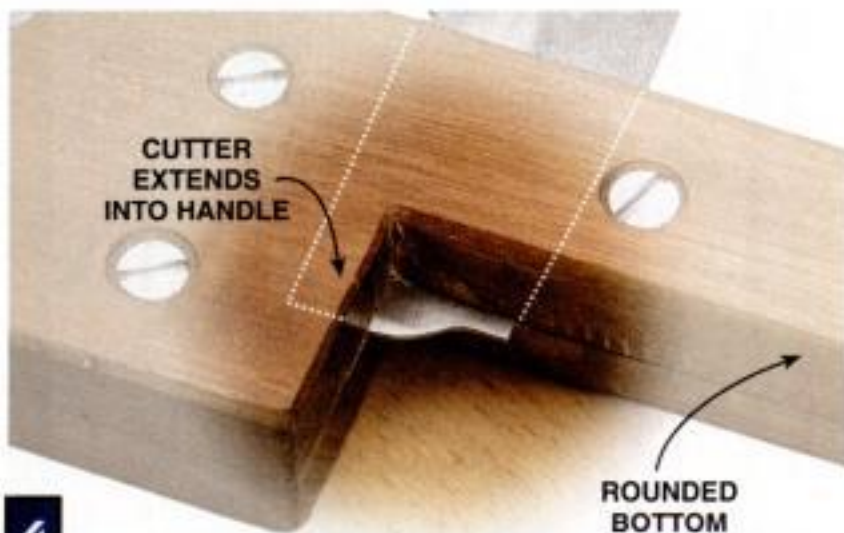
The traditional source for scratch stock cutters (and scrapers in general) is the blade of an old handsaw. You can easily

FIG. A **SCRAPE ANY SHAPE** you want with a scratch stock. You'll use a lot of elbow grease, but it's a quick way to reproduce a short length of molding. Use two small cutters instead of one large cutter to make a wide molding. Make a straight cutter for a piece of inlay that isn't a standard width. File scoring tips at the corners for a clean cut across the grain. Where grooves meet, chisel the corners square and flatten the bottom with a router.

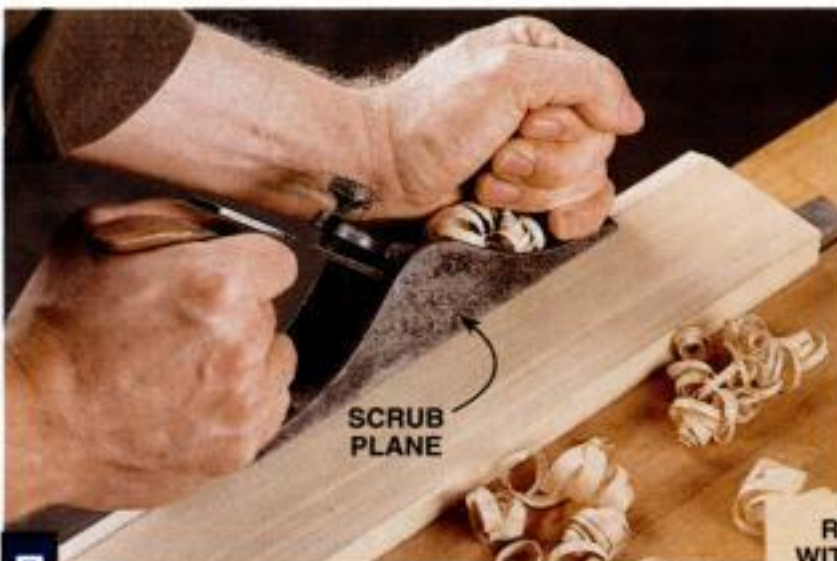




3 FILE THE PROFILE with sharp, new files. Hold the file at 90 degrees to the face of the blank. Use a fine chain saw file for round sections. Push the file across the cutter for initial shaping, then move the file along the cutter to polish the edge. This is called drawfiling. Remove the burr with sandpaper.



4 INSTALL THE CUTTER in the scratch stock body. The blade should extend a bit farther than the depth of the molding profile. For deep molding shapes, like this one, the cutter should be wide enough to extend into the handle. This cuts down on chatter.



5 REMOVE MOST OF THE WASTE before using a scratch stock. Draw the molding profile on the end of the board and shade in a triangle of waste. Then extend pencil lines from the triangle's corners down the length of the board. Cut to the lines with a scrub plane or smooth plane.



find one at a yard sale or antique store. It's okay if the saw is bent or slightly rusted. Look for a saw with good-quality steel, like a Disston. You'll get at least a dozen cutters and some large pieces for hand scrapers from one saw blade.

However, any piece of steel that can hold an edge will make a good cutter for a scratch stock—an old hacksaw blade, scraper blade, bandsaw blade, or a reciprocating saw blade. Most of this steel is so hard that it can't be cut with a hacksaw or worked with files. Hacksaw blades, for example, must be broken off in a vise and shaped with a bench grinder or small rotary grinder, like a Dremel.

It's a good idea to make a cutter that's wider than the profile of your molding. If you're making a deep molding, the cutter should be wide enough to extend sideways into the handle of the tool. This prevents the cutter from chattering.

Making the Cutter

Clamp your old handsaw down to a bench and cut it with a hacksaw (Photo 1). You should use a brand-new, good-quality, 32-tpi hacksaw blade. If your hacksaw blade doesn't work, try a carbide-grit blade made for cutting tile.

Lap both faces of the cutter blank. Rub them back and forth on sandpaper glued to glass to remove rust pits and milling marks (Photo 2). Scrapers should have smooth faces, with no visible scratches.

Draw a profile on the cutter with a soft lead pencil, or coat the cutter with layout fluid or marker ink and scratch in the profile. If you have a grinder, belt sander, or disc sander, use it to remove most of the waste.

Cut to the line with a sharp file. Keep the edge square to the face. A scratch stock is one of the few woodworking tools with a 90-degree cutting edge, or arris. An 8- or 10-in. single-cut, smooth mill file works well. (The shorter the file, the finer the teeth. See Sources p. 53 for an 8-in. file.) Use chain saw files for the curves. If you're making a beading cutter in soft steel, drill a series of holes and cut across their centers.

The smoother the edge, the better the cutter will work. Finish up the edge by drawfiling (Photo 3). Diamond hones make the edge smoother yet. Remove the burr by sanding both faces again. You can burnish a hook on your cutter, the same way as you would sharpen a card scraper, but most users don't bother.

Using Your Scratch Stock

Loosen all the screws of the scratch stock to install the cutter. Wiggle it into the right position. Extend the cutter down a bit farther than the depth of the molding profile (Photo 4). Tighten up all the screws starting with the ones farthest away from the cutter.

Using a scratch stock is harder work than planing. Planes slice through wood fibers. Scratch stocks, with their upright cutting angle, push wood fibers apart. Pushing takes more effort. Remove most of the waste with a plane or router before using the scratch stock (Photo 5).



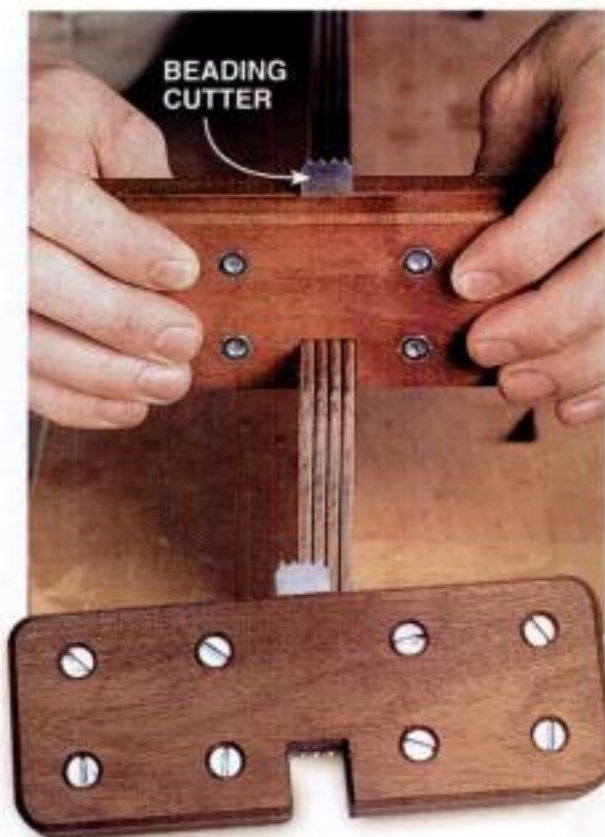
6 **PUSH OR PULL THE SCRATCH STOCK**—it cuts in either direction. Push the fence hard against the edge of the board. Lean the tool in the direction of the cut. Clean out crumbs that accumulate at the base of the cutter after a few strokes. It's hard to control a scratch stock at the ends of a board. The best strategy is to cut your board a few inches too long, start and stop the scratched molding 1-in. in from each end, then cut the board to length.

A scratch stock cuts forward or backward—you can push or pull it. That's why the edge is sharpened at 90-degrees. You have to lean the tool in the direction of the cut, so there's clearance behind the blade (Photo 6). That's why the underside of the arm is rounded. The scratch stock won't cut if it's held upright.

Inevitably your scratch stock will chatter a bit here and there, leaving a surface that looks like a washboard road. Use light (instead of heavy) pressure to smooth out the ripples. This might not work, but you could end up liking the uneven surface. It's the handmade look. You can hand sand your molding with a contoured sanding block if you want to level all the ripples.

When your cutter gets dull, you can sharpen it in one of two ways—file the edge or lap both faces on sandpaper. Simple shapes are best sharpened with a file. Complicated or precise shapes, like beading cutters, are best sharpened by lapping the faces.

Scratch stocks are venerable tools. They've been made and used by woodworkers for centuries. Now you can join their ranks. **AW**



7 **PREVENT WANDERING** of a scratch stock by making a body that surrounds the work. The notch should fit loosely around the edge of the board. This beading cutter is available from Lie-Nielsen (see Sources, below).

Sources

Lie-Nielsen Toolworks, (800) 327-2520, or visit www.lie-nielsen.com

Lee Valley Tools, (800) 871-8158, or visit www.leevalley.com
8-in. mill file, 62W16.02, \$4.50, plus \$4 S&H.

Commercial Scratch Stocks

New scratch stocks are called beading tools. The bronze Lie-Nielsen below (\$145 plus S&H) is an improved version of the old Stanley No. 66.



The $\frac{5}{8}$ -in.-wide cutter leans forward, so the tool cuts in only one direction. You can tell when you've reached the full depth of a cut when the tool rides on its flat sole. Reaching full depth is a guess with any handmade wooden scratch stock.

The cutter is held in a groove and cannot be shifted out of square to fine-tune a profile, unlike our handmade model. On the other hand, the groove locks a beading cutter precisely upright.

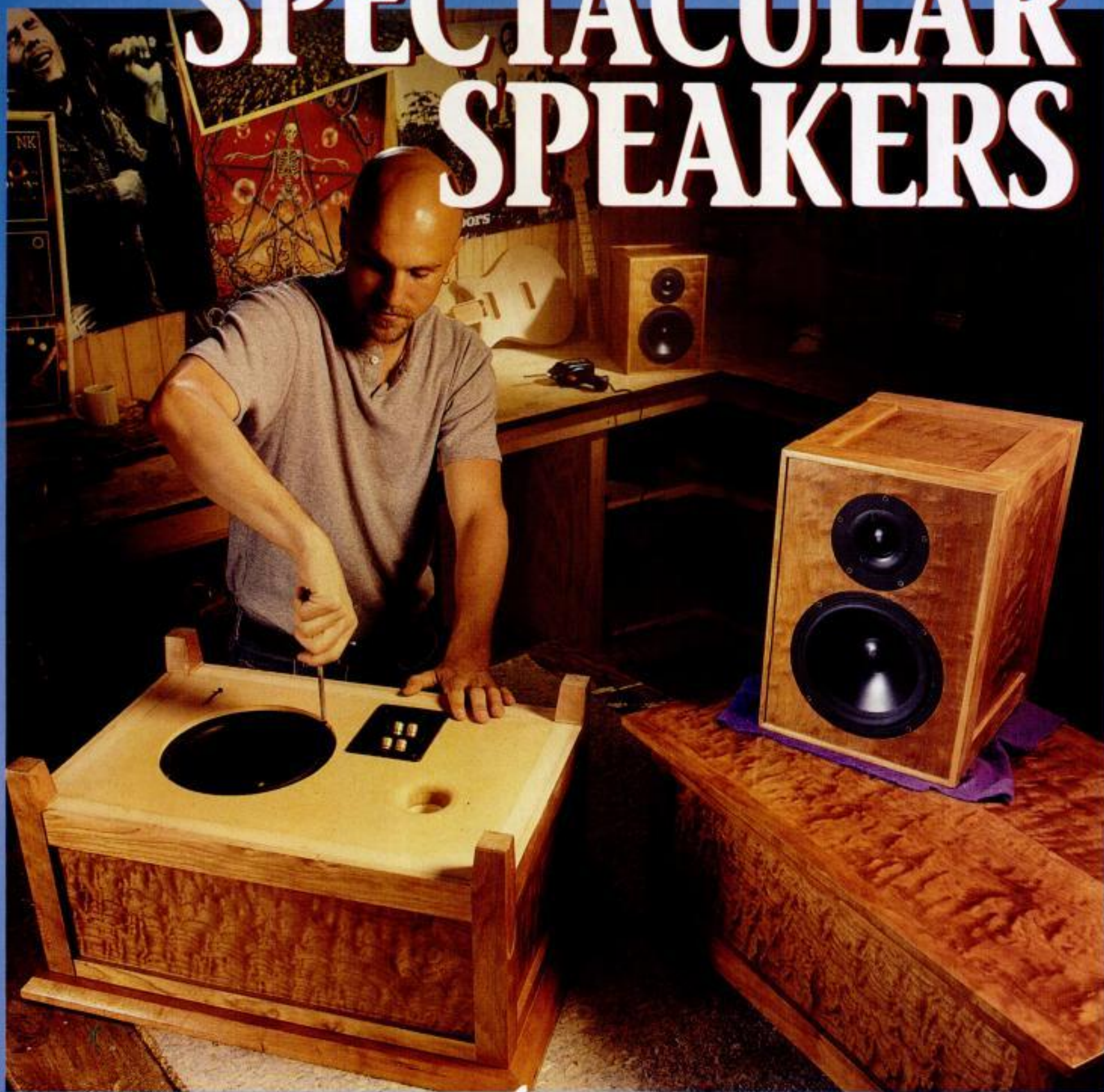
The Lie-Nielsen Beading Tool (not shown) comes with two fences. One is curved for following the inside radius of a top or leg. Both fences are adjustable to the left or right of the blade. Seven different shaped cutters to make coves and beads are included. A blade set alone is \$40, and a set of blanks is \$7.



The Veritas Beading Tool above is from Lee Valley Tools (05P04.01 \$33.75 plus S&H). The fence adjusts by sliding the arm in and out of the handle. This tool comes with one $\frac{5}{8}$ -in. wide, single-point cutter and five blanks. Sets of fluting, beading, and reeding cutters are also available.

The cutters are clamped by screws and nuts. There is no groove to lock the cutter in place. The tool will hold home-made cutters up to $\frac{3}{4}$ -in. wide.

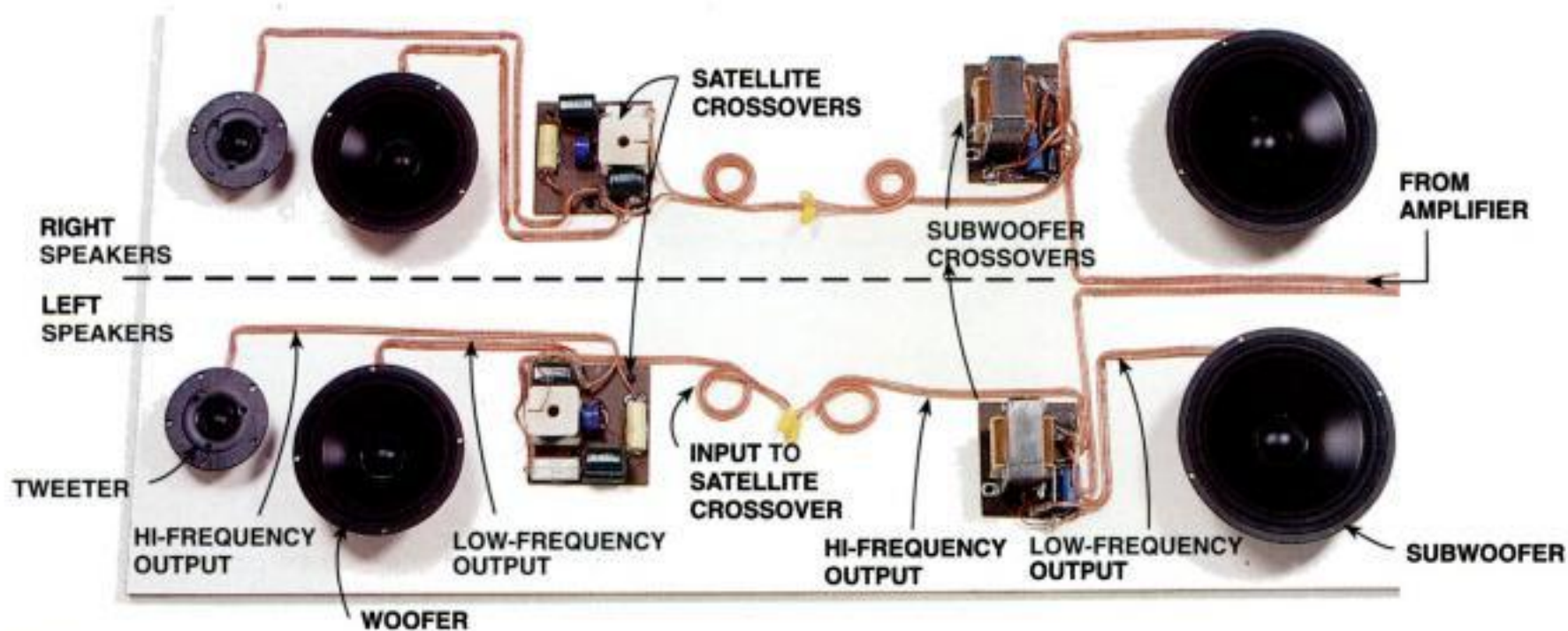
SPECTACULAR SPEAKERS



*Fine furniture
with sensational
sound.*

by Bob Wayland

The beauty of these speakers is not just skin deep—they really perform. They cost \$500 to \$600 to build, but will perform as well as a \$2,500 store-bought set. The allure of this system is that you can show off your woodworking prowess and end up with a speaker system that looks great—and sounds great! (Editor's Note: Nousaine Communications, an independent audio testing laboratory, tested these speakers and supports this performance claim.)



- 1 TEST the components by temporarily connecting the crossover wires to the drivers and amplifier, and run the amplifier at low volume. The sound will be tinny, but you should be able to hear music from each of the speakers.

This speaker system includes a pair of satellite speakers and a pair of subwoofers, and can be used with any stereo amplifier ranging from 5 to 100 watts per channel. Each satellite speaker contains two drivers: a 3-in.-dia. tweeter for high-frequency sound and a 5-in.-dia. woofer for midrange and low frequencies. Each subwoofer uses an 8-in.-dia. driver, and enhances ultra-low frequency sound.

The drivers and other audio components will cost about \$425 for the complete set, and are available as a kit ([see Sources, p. 58](#)).

Tools and Skills

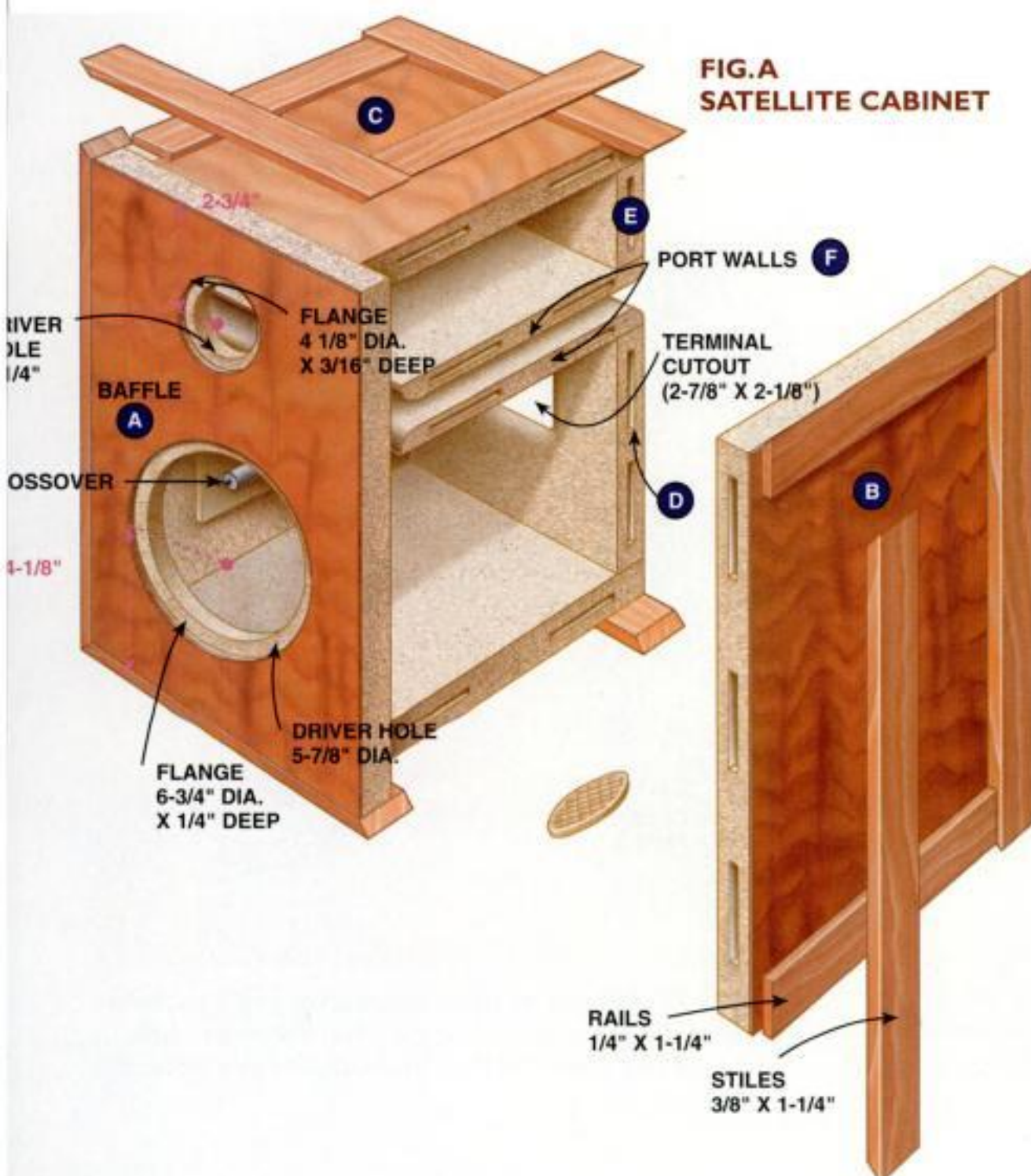
Aside from common woodworking tools, you need a 1¼-in. Forstner bit, ½-in. and ¾-in. round-over router bits, a top-bearing pattern bit, a soldering iron, yellow glue, polyurethane glue, two-part epoxy, and silicone caulk. You also need a router trammel that you can make with a scrap of plywood or plexiglas (Photo 2). Secure the trammel to your router base and slowly plunge the router bit through the trammel's base, creating a zero-clearance hole. To locate your trammel points, use a good-quality drafting compass and scribe the distances from the far edge of the zero-clearance hole.

This project involves a lot of biscuit joinery and veneering and you'll have to align butt-joint and T-joint biscuit slots. If you haven't veneered panels before, see AW #42, pp. 66 - 71 for the how-to. (See p. 6 for information on ordering back issues and copies of articles.)

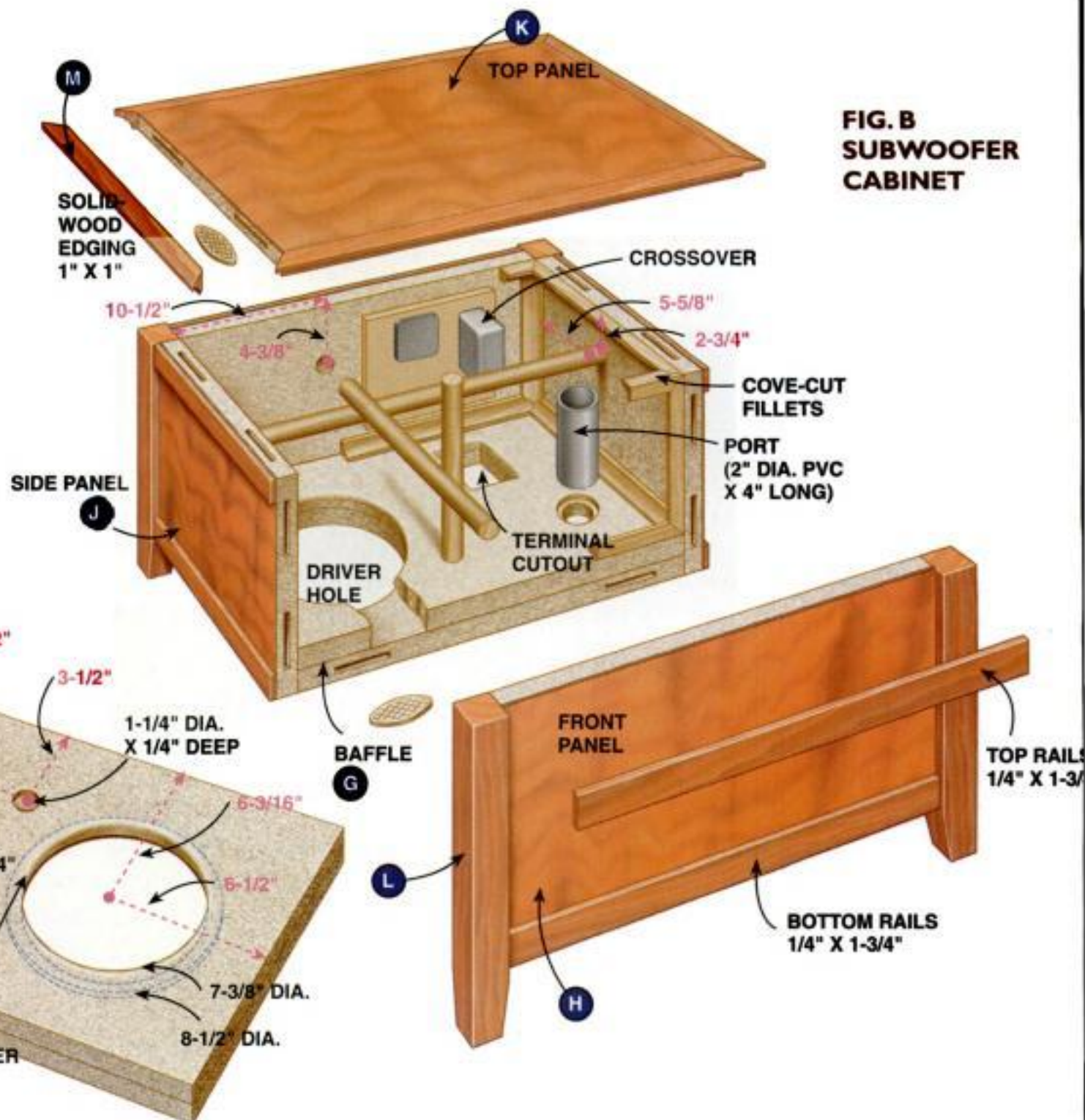
Cutting the Parts

Before beginning any work on the speakers, test all of the speaker components (Photo 1). You don't want to find out that something isn't working when you're ready to install it.

Cut all of the parts for the satellite and subwoofer cabinets. One-inch medium-density fiberboard (MDF) weighs nearly 130 lbs. per sheet, so get some assistance with the first cut. Begin by ripping the sheet so it's more manageable (see Fig. E). Cut all of the parts to size except the four pieces that



make up the subwoofer baffles. After the parts for the 2-in.-thick subwoofer baffles are glued together, trim them to size. Apply veneer to the cabinet part faces, being careful to have the grain direction going the right way. Notice that not all the parts are veneered.



Cutting the Driver and Terminal Holes

Get yourself psyched up for the mountains of sawdust you are about to create, and definitely wear a dust mask. By the time I finished routing the driver holes, there was a 1/4-in.-deep coating of dust across my assembly table, and small tools were nowhere to be found.

Route the driver holes (six total) in each of the satellite and subwoofer baffles with the router trammel to guide the cut (see Figs. A and C; Photo 2). Route the flange recess first. To reduce the chances of chipping the veneer on the satellite baffles, don't use an up-spiral router bit, and run the router trammel counterclockwise. Test fit the driver flange in the recess to ensure a snug fit, then reset the trammel distance, and rout the rest of the hole. The center of each hole and the main workpiece are securely screwed down to a piece of scrap so you don't lose your trammel point when the cut is finished. Rout a 3/4-in. roundover on the inside of the subwoofer driver holes.

Drill and saw the 2 7/8-in. by 2 1/8-in. terminal cutouts in the lower back wall of each satellite cabinet, as shown in Fig. A. Smooth the cutout faces with a file, and rout a 1/2-in. roundover on the inside edges. Then drill and saw the 3-in. by 3 3/4-in. cutout in the subwoofer baffle as shown in Fig. C, and round over the inside edge with a 3/4-in. round-over bit.



2

ROUT holes for the speakers using a trammel. Before cutting all the way through, screw down the center blank (the trammel point) and the main workpiece to a piece of scrap plywood.

SPEAKER BASICS

What makes these speakers perform so well is the overall design coupled with the rigidity of the construction. The theory behind high-quality sound reproduction is that the drivers should be creating 100 percent of the sound, and the cabinet makes no contribution. This means that the enclosure should be rigid and free from vibration. Bracing is used on larger enclosures to prevent the ultra-low frequency vibration of subwoofer drivers from vibrating the enclosure. Small air leaks in the cabinet can result in a whistling effect, which is why all possible areas are sealed with silicone caulk. What may seem like overkill for general woodworking is a necessity for speaker enclosures.

For further information on speaker design, read "Designing, Building, and Testing Your Own Speaker System," 4th ed., by David B. Weems, 1997, McGraw-Hill, \$19.95, (800) 352-3566.

Constructing the Satellites

Before the satellite cabinets can be assembled, the port walls need to be machined and biscuit slots cut (Photo 3). Begin by rounding over the front and back edges of the port walls with a 1/2-in. roundover bit. Then resaw the 1-in. thick MDF to 1/2-in. thickness and sand smooth. Paint the faces of the port walls flat black. (The back of the cabinet is painted black for aesthetics later on, but the interior port walls will be inaccessible.)

Cut all of the biscuit slots for the satellite cabinets. Begin the assembly by gluing the port walls, cabinet backs, and the top and bottom pieces into U-shaped assemblies (Photo 4). After the glue is dry, run a bead of silicone caulk along the glued joints on the inside to seal against air leaks.

Install the crossover components to the side wall of each satellite cabinet. Run a bead of silicone caulk around the back of each crossover, covering the edges and center, and screw the crossover down. The silicone should squeeze out when the crossover is screwed down to ensure everything is secure.

Glue the two U-shaped port assemblies to the side walls. When the glue is

dry, seal all joints with a bead of silicone caulk. Paint the back of the satellite with flat-black paint. Trim the crossover input wires to length, connect them to the terminal block, and install the [terminal blocks in their openings](#) (see [Basic Electrical Soldering, p. 58](#)). Cover the terminal block (the inside face) with a two-part epoxy to prevent sound waves from escaping through the thin plastic.

Before the front baffle is glued into place, lightly stuff the inside of the enclosure with dampening wool, supplied in the speaker kit (Photo 5). Don't overstuff them. Pull the crossover wires through their appropriate driver holes, and glue the front baffle in place.

Trim the outside of the speakers with the details of your choice, or duplicate those shown here. After you have applied your favorite finish to the cabinets, you can install the tweeter and midrange speakers, using the supplied gaskets.

These speakers will perform with or without the subwoofers and you'd like to try them out right now, right? Go ahead. Use 12-gauge speaker wire for runs up to 30 feet and 10-gauge wire for longer runs.



3

PLUNGE the biscuit slots for the port walls. Clamp the port walls down and use them to guide the vertical plunge. Next plunge horizontally into the edge of the port wall.

Making the Grille (optional)

Serious audiophiles don't use grilles on speaker cabinets because they create minor sound diffraction. But for cosmetics and protection, you may want to install them.

Make the grilles as shown in Fig. D from 1/2-in.-thick MDF. The first step is to make a template for routing the grille cutout. Use this template, with a pattern bit and a round-over bit, to create the cutout and profile of the grille.

To install the grille fasteners that

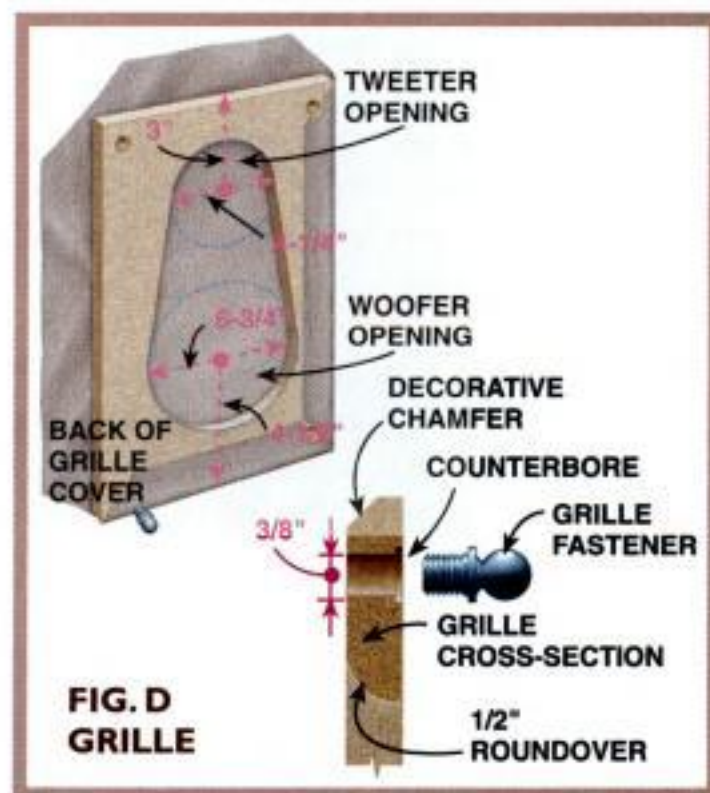
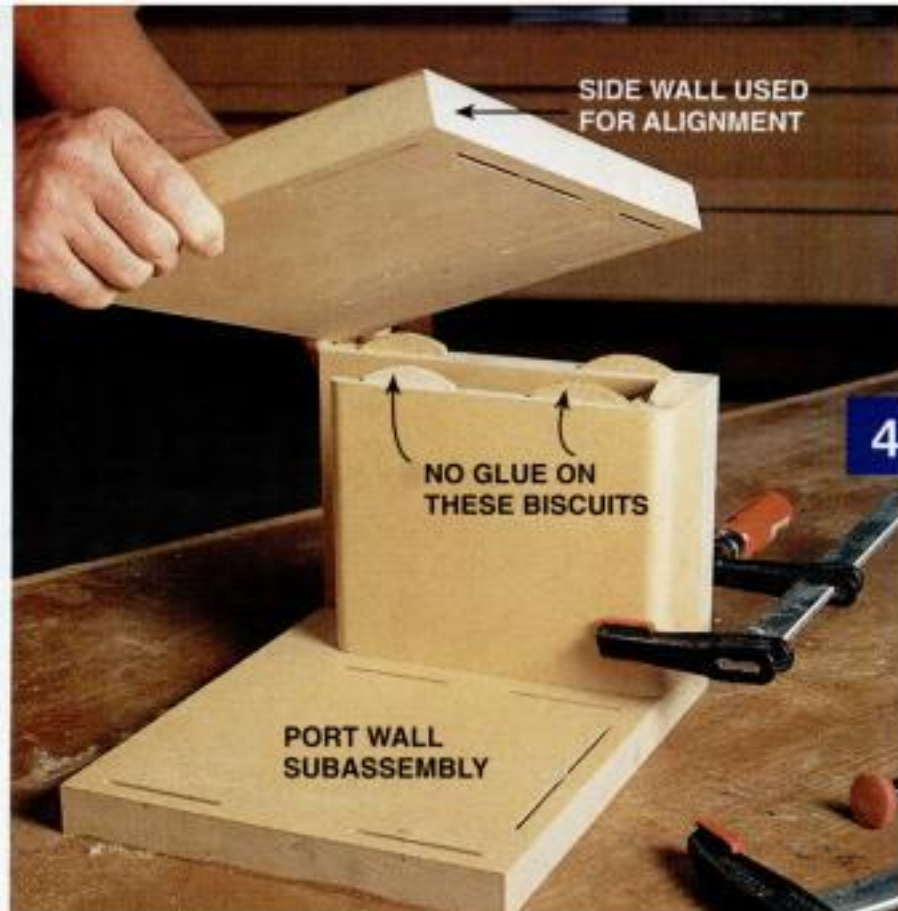


FIG. D
GRILLE



4

GLUE and CLAMP the port wall sub-assemblies. Use the side walls with dry-fit-biscuits for alignment.

BASIC ELECTRICAL SOLDERING

You may feel at home buried up to your ankles in sawdust, but many woodworkers are intimidated by wiring. The soldering for this project is not too difficult if you follow these tips:

For all electrical connections in this project, use either rosin-core solder, or a separate flux and solid-core solder. Do not use an acid-core solder for any of the connections. If you have not soldered before, the separate flux with solid-core solder is easier to work with.

Begin by stripping no more than 1/2-in. of insulation from the ends of each wire, and wrap the exposed copper strands around the terminal (or through the hole in the terminal, if available). Smear a small amount of flux on the connection, and begin heating with a soldering iron. Any soldering iron between 15 and 100 watts will work fine. Smaller soldering irons (15 watt) take more time to heat the connection. If you have a larger soldering iron, in the 100-watt range, be careful not to melt the surrounding insulation.

After heating the connection for a second or two, touch the solder to the connection near, but not directly on, the tip of the soldering iron. Continue heating until the solder flows into the connection without balling up on the surface. Remove the soldering iron and let the connection cool, but do not allow the wire to move until the solder is hard (about 2 seconds).

Soldering irons, solder, and flux can be obtained at home centers or Radio Shack (see Sources, below).

Sources

Curly Cherry Veneer:

Constantine's (800) 223-8087

Speaker component kits:

Speaker City USA, 115 S. Victory Blvd., Burbank, CA 91502; (818) 846-9921.

Satellite Kit: Part No. AM6.1

Subwoofer Kit: Part No. AM8.1

Sorbothane mounts:

Edmunds Scientific (609) 573-6250, Part No. H35264. (Set of 8, \$30.50)

For the nearest Radio Shack location or to request a catalog, call (800) 843-7422.

come with the kit, drill the counter-bored holes for the male half of each fastener in the grille, and the mating counterbored holes for the female half, in the cabinet face.

Before installing the fasteners, paint the grille panel the same color as your grille cloth. (Radio Shack sells grille cloth, but any thin, loosely woven fabric will work.) Cut the cloth about 2-in. bigger than the frame in each dimension. Apply a thin film of spray adhesive to the grille face, and lightly stretch the fabric over it. Trim off the corners of the fabric, wrap the overhanging flaps tightly around the panel, and glue them to the back. Then glue the fasteners into their holes with polyurethane glue.

Making the Subwoofers

With the driver and terminal cutout holes completed, the PVC port holes need to be routed. Because the diameter of the PVC port cutout is too small for a trammel, a top-bearing pattern router bit works best. Make a 2-in.-dia. and a 2 1/4-in.-dia. hole template using an adjustable hole cutter. After routing the 2-in.-dia. through hole, carefully center the 2 1/4-in.-dia. template over the hole, and rout the stepped flange. With a 3/4-in. round-over bit, round over the exterior edge of the port cutout.

With all of the baffle cutouts complete, it's time to cut a slew of biscuit

slots. After determining the best aesthetic layout of the veneered panels, number each of the joints for re-assembly. To ensure that all of the biscuits are placed correctly, you may find it easiest to dry fit all of the parts, and mark them in place. Now, start cutting.

Two weeks later (just kidding), with the biscuits complete, bore the 1 1/4-in. dia. by 1/4-in.-deep holes for the bracing dowels in each of the components.

The first assembly step is to glue the legs to the front and back panels. After constructing these assemblies, secure the crossovers to the rear cabinet wall in the same way you did for the satellite speakers, and glue the PVC port to the baffle with polyurethane glue. Glue the two side walls to the baffle, and glue the brace (dowel) in place. Use polyurethane glue to secure the bracing into the holes. Use the front and rear assemblies as alignment jigs when clamping the side walls, as shown in Photo 6. With the side walls installed, reattach the front and rear assemblies with yellow glue.

Fit and install the fillet strips (Fig. B) to all interior corners. Apply a bead of silicone caulk to all of the joints and smooth it out with your finger.

Trim the crossover wires to length, and connect the input wires to one set of lugs on the terminal block. Connect the high-frequency output wires from the crossover to the other set of terminal lugs. (If your terminal block



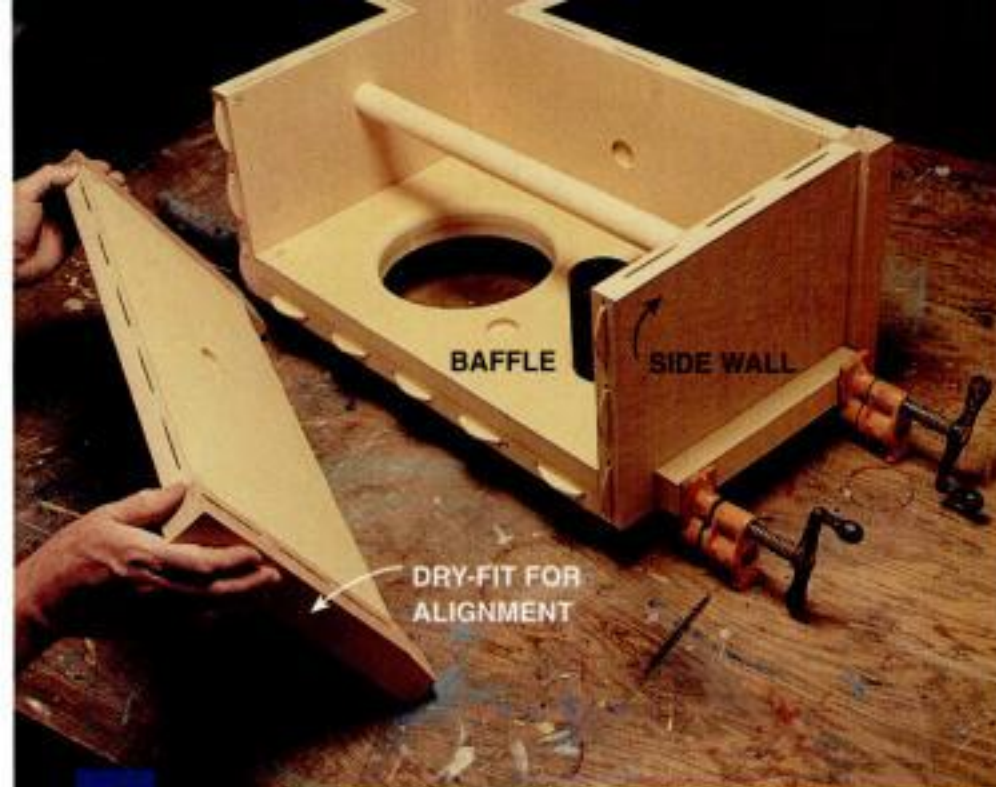
5 **STUFF** dampening wool into the satellite speakers. Use about 1/3 lb. of wool per speaker, and tear it into manageable pieces. Make sure the wool is not obstructing the port opening or touching the driver cone.

came with a set of gold jumper straps, remove them.) Install the terminal block, and fill the space around it with two-part epoxy.

Using the remaining wool, lightly stuff each subwoofer. Again, don't obstruct the port or touch the driver cone.

Apply external trim and moldings of your choice to the cabinet, and apply a finish. Connect the crossover wires to the driver, and mount it in its hole. Run speaker wire from your amplifier to each subwoofer input terminal, and from the subwoofer output terminal to the satellites.

Final note: If your subwoofers will sit on an uncarpeted floor, attach Sorbothane mounts ([see Sources, p. 58](#)) to the bottoms of the legs with polyurethane glue. They'll prevent the speakers from rattling on the floor. Trim the sides of the mounts to fit the shape of the feet. Now let the concert begin! **AW**



6 **THE SUBWOOFERS** are also assembled with biscuits. Here the side panel is being glued to the baffle. The front and rear assemblies are dry clamped in place to aid alignment. The bracing dowel and PVC port (painted black for photo) are glued in place with polyurethane glue.

FIG. E
MDF CUTTING DIAGRAM

Rip the sheet of MDF in half to make it more manageable.

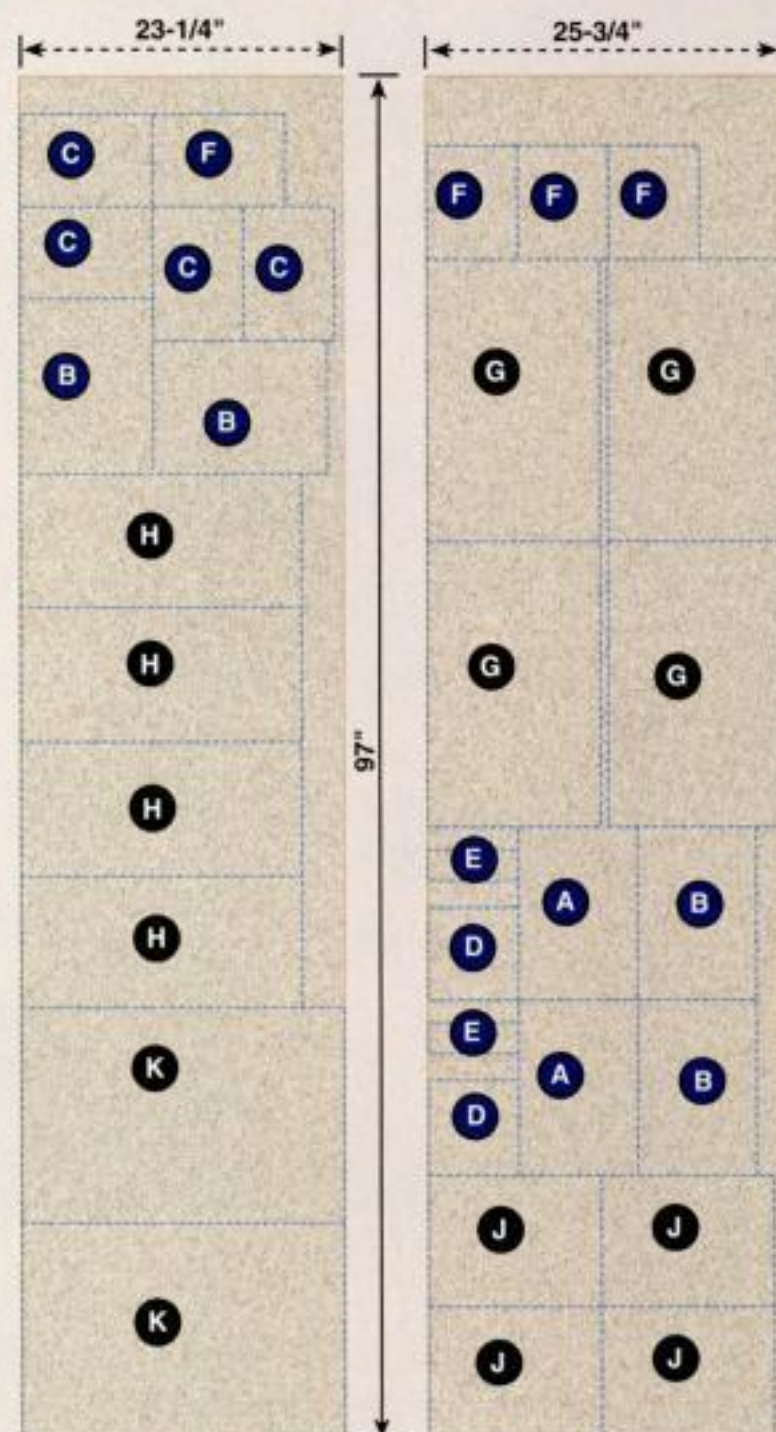
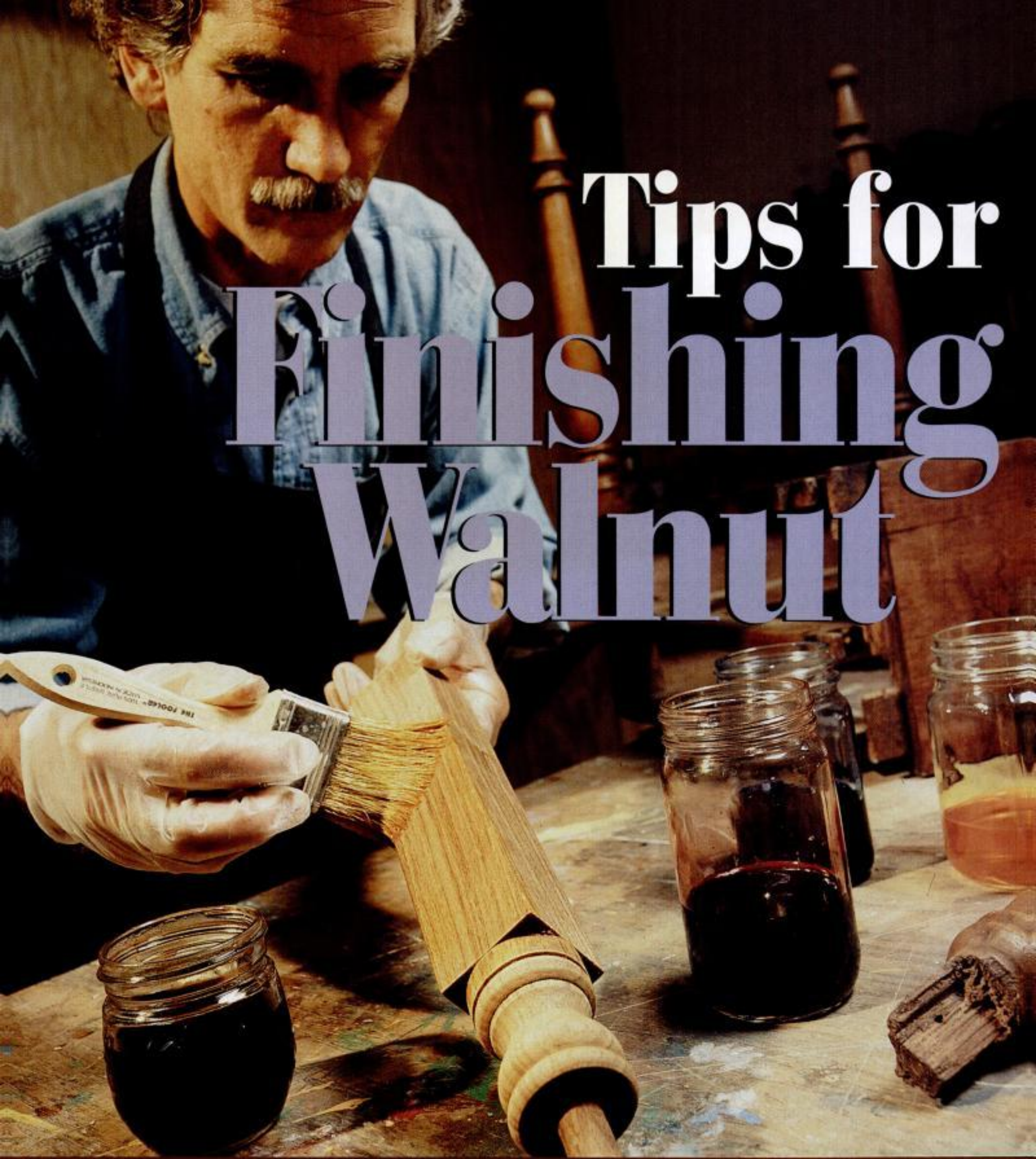


FIG. F
CUTTING LIST

Part No.	Name	Material	Qty	Size
A	Baffle (Sat.)	Veneered MDF	2	12 1/2 x 8 1/2
B	Side (Sat.)	Veneered MDF	4	12 1/2 x 9 1/2
C	Top/Bot. (Sat.)	Veneered MDF	4	9 1/2 x 6 1/2
D	Lower Back (Sat.)	MDF	2	6 1/4 x 6 1/2
E	Upper Back (Sat.)	MDF	2	2 1/4 x 6 1/2
F	Port Wall (Sat.)	MDF	4	8 x 6 1/2
G	Baffle (Sub.)	MDF	4	20 1/2 x 12 1/2
H	Front/Back (Sub.)	Veneered MDF	4	20 1/2 x 9 1/2
J	Side (Sub.)	Veneered MDF	4	12 1/2 x 9 1/2
K	Top (Sub.)	Veneered MDF	2	23 1/2 x 15 1/2
L	Legs (Sub.)	Cherry	8	1 1/2 x 1 1/2 x 11 1/2
M	Top edging (Sub.)	Cherry	15 lin. ft.	1 x 1 (size to fit)
N	Brace	Dowel	8 lin. ft.	1 1/4-dia. (size to fit)
P	Fillets	Poplar (or similar)	30 lin. ft.	3/4 x 3/4 (size to fit)



Tips for Finishing Walnut

THERE'S NO DENYING that most walnut looks great with nothing more than a few coats of oil. Here we'll show you some tricks to make your walnut projects look even better.

by Jeff Gorton

Make Sapwood Disappear

EVEN SELECT WALNUT BOARDS are likely to contain an occasional streak of light-colored sapwood. Some projects benefit from the contrast provided by skillfully placed sapwood, but in most cases it's merely a distraction. If you can't afford the luxury of avoiding all sapwood, we'll show you how to make it less conspicuous. Even though the initial investment for dye, shellac and glaze materials will set you back about \$100, most of these products are highly concentrated and should last you many years.

Dyeing sapwood looks paint-by-number simple but there are a few tricks. The key to the process is getting the dye color to match the heartwood color. Don't bother with dyes labeled "walnut." Buy red, blue, yellow and black water-soluble dye powder and custom mix a sapwood dye according to the recipe on p. 62. We gradually adjusted the color of the dye by adding drops of blue and black to reach the purplish gray hue of kiln-dried walnut. An eye-dropper works great for this. Air-dried walnut has more red. Adjust your dye accordingly using the Color Mixing Chart on p. 62 as a guide.

We're using water-soluble dye because it resists fading in sunlight better than alcohol-soluble dye and is easy to apply without leaving lap marks. One drawback, however, is its tendency to raise wood grain. Minimize grain raising by wetting the wood, letting it dry, and sanding off the raised grain with 220-grit sandpaper before applying the dye.

Don't sand too much or you'll expose new wood and negate the effect.

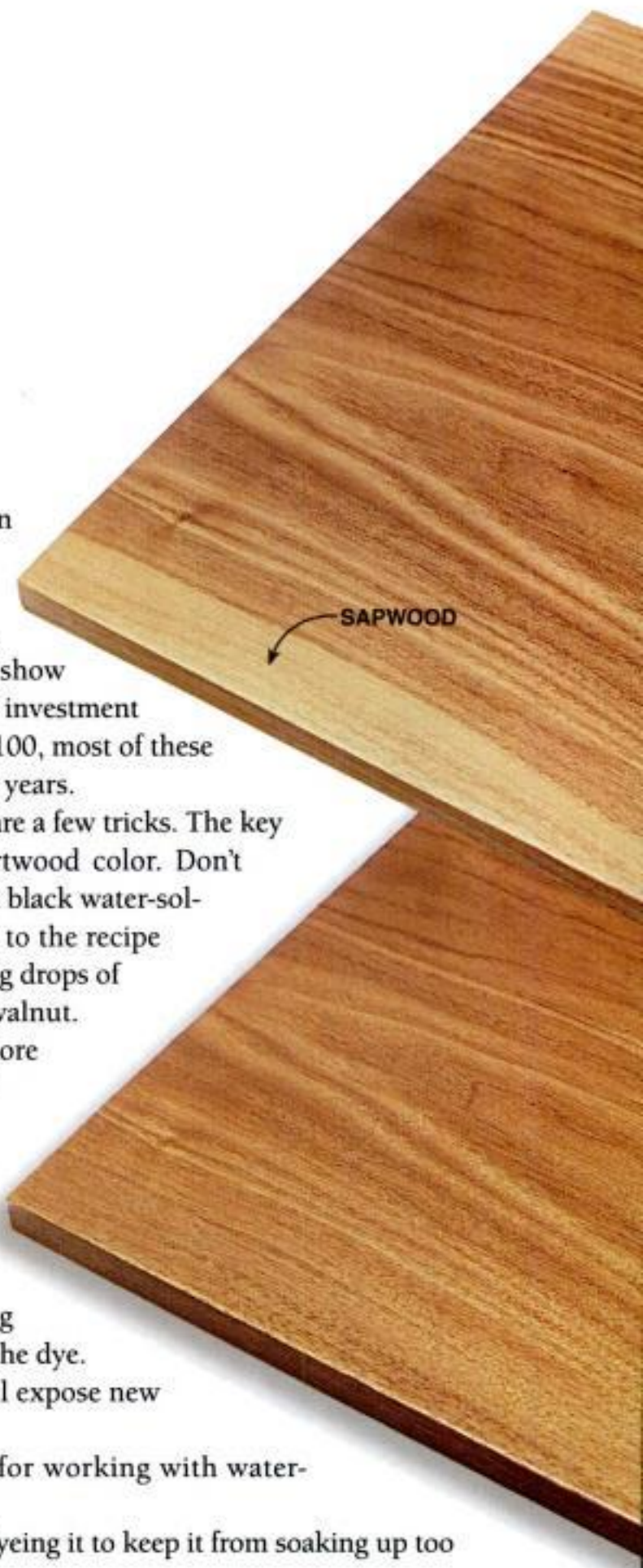
Here are a few more tips for working with water-soluble dye:

- Wet the end grain before dyeing it to keep it from soaking up too much dye.
- Start with a diluted dye; you can always increase the intensity of the color by adding a "layer" of more concentrated dye.
- Adjust the color by adding another layer (refer to the Color Mixing Chart, p. 62). Wipe on green dye to decrease red, for example.
- The color you see when you apply the dye to the wood is close to the color you'll end up with. The wood will look dull when the dye dries, but the "wet" color will return when the finish is applied.
- Lighten dyed wood by wiping off some dye with a damp rag. If you really goof, use household chlorine bleach to remove almost all of the dye.

Allow the dyed wood to dry completely, usually overnight. Then seal the entire surface with a thin coat of brushed on shellac (about a 2-lb. cut of super-blond or other dewaxed shellac). Allow the sealer to dry and sand it lightly with 320-grit sandpaper. If you're happy with the way the sapwood blends after the sealer is applied you can move on to applying the final coats of finish. To blend the dyed sapwood more completely,



USE A SMALL ARTIST'S PAINT BRUSH to carefully dye the sapwood, following along the grain line. Blend the edge of the dye into the heartwood with the corner of a damp rag. Dampen the wood before applying the dye.





APPLY THE GLAZE with a rag or brush. Remove the excess, leaving a thin layer. Then use a good-quality paint brush with soft bristles to manipulate the glaze, adding or subtracting as needed to blend the dyed sapwood into the heartwood.

and add greater depth and richer color, apply a thin layer of glaze before applying the final coats of finish.

Glaze is essentially thinned paint that's layered over a sealed surface. Commercially prepared glazes are available, or you can make your own. Mix up an oil glaze by combining artist's oil paint (available at art supply stores) with a glazing medium consisting of three parts boiled linseed oil, two parts mineral spirits and 1 part Japan drier, to the consistency of heavy cream. We chose the "burnt umber" color and it looked great. Pick up the following colors as a starter set for blending your own custom colors; burnt umber, raw umber, burnt sienna, raw sienna, Vandyke brown, yellow ochre, black and blue.

Complete the process of blending the sapwood by applying a layer of glaze, as shown in Photo 2. Keep the brush

Color Mixing Chart

Red + Blue = Violet

Red + Yellow = Orange

Blue + Yellow = Green

Red + Yellow + Blue = Brown

To decrease Red add Green

To decrease Orange add Blue

To decrease Yellow add Violet

To darken a color add Black

"dry" by removing excess glaze from the bristles with a rag. To add glaze in one section, "stipple" it on with the tips of the bristles and then smooth it. If you make a mistake, remove the glaze using a rag dampened with mineral spirits.

Allow the glaze to dry completely, a minimum of 24 hours, before applying the final coats of finish. Check by running your hand across the surface. If glaze rubs off, it's not dry.

SAPWOOD DYE RECIPE

Start by mixing each of the powdered dyes with hot distilled water or rainwater in its own glass or plastic container according to the instructions on the label. Then combine the liquid dyes in the proportions listed below to create the sapwood dye color.

1 part red

1 part blue

2 parts yellow

1½ parts black

Transfer a small amount of this dye to another container and dilute with up to 4 parts water.

Check the intensity and hue on a scrap of walnut sapwood.



UNSEALED END GRAIN WITH OIL FINISH

SEALED END GRAIN WITH OIL FINISH

End Grain can Be Beautiful

End grain reveals much about a board's history and provides an attractive detail in many woodworking projects. But too often the end grain soaks up so much finish that the detail gets lost in a dark, muddy cloud of oil or stain. To bring out the full potential of the end grain detail in your

next project, seal it with a thin coat of ½-lb. cut shellac before you apply the stain or oil. Sand the face with 320-grit sandpaper after you seal the end grain to remove any sealer that may have lapped onto it. Then lightly sand the end before you apply the oil or stain.



REPLACEMENT
PART

REPLACEMENT parts made of new walnut must be artificially aged to match antique walnut.

Matching Old Walnut

BROKEN
ORIGINAL

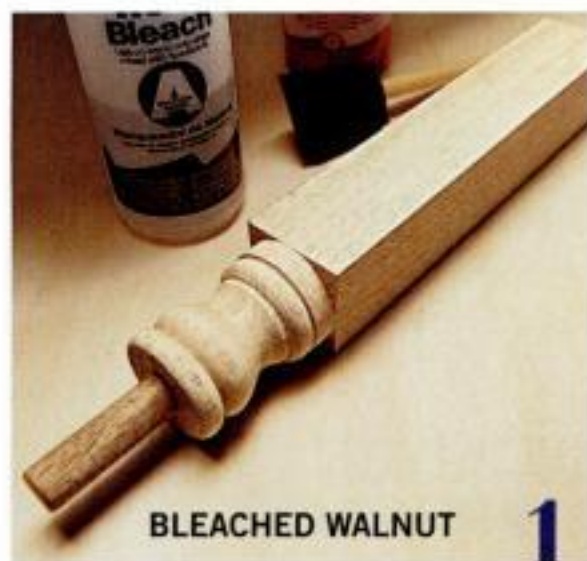
As walnut ages its color changes. Matching the cool, charcoal-gray color of new kiln-dried walnut to the mellow mahogany red or amber gold of aged walnut is a challenge faced by anyone who repairs old furniture.

In most cases the new walnut will have to be lightened before adding color with dye. Use two-part wood bleach, available at most hardware and paint stores. This bleach will lighten the walnut without removing all of the reddish tones. Mix and apply the bleach according to the instructions on the containers. Allow it to dry. Then lightly sand the surface with 220-grit sandpaper.

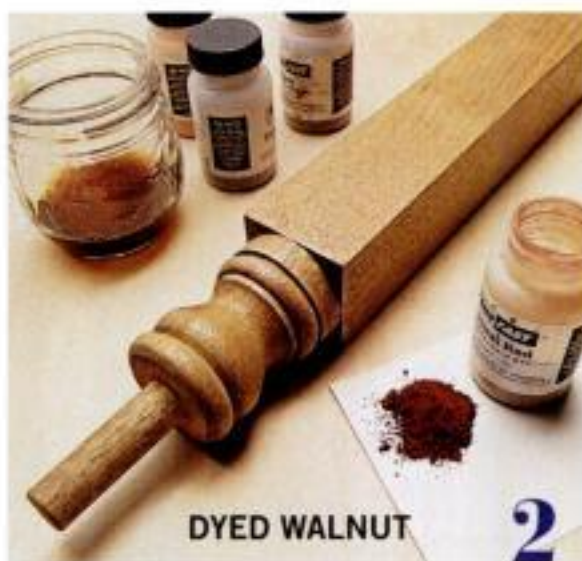
Once the wood has been lightened with bleach, mix dye to match the lightest, most prevalent color of the wood. If you're matching reddish walnut like ours, use our aged walnut recipe (at right) to mix the dye and then adjust the color to match your project. The process of dyeing and glazing is the same as that for blending sapwood. We left extra glaze in the recesses around the turnings to duplicate the aged finish on the other legs.

AGED WALNUT RECIPE

1 part red
2 parts yellow
1/2 part black



BLEACHED WALNUT



DYED WALNUT



GLAZED WALNUT

BLEACH your replacement part by mixing two-part wood bleach according to the directions on the label and immediately applying it to the new walnut. Disposable sponge brushes work well for applying bleach. Allow the bleach to dry and lightly sand the surface.

DYE the bleached wood to approximate the color of the aged walnut. Err on the light side. Allow the dye to dry. Then seal with a coat of 1-lb. cut shellac, allow to dry and sand with 320-grit sandpaper.

BRUSH or WIPE a thin layer of glaze over the dyed walnut. Remove the excess glaze with a rag or dry brush, leaving enough to match the color of the new piece to the aged walnut. Let the glaze dry before applying the final coats of finish.

COMPLETED REPAIR





Warming Up Colorless Finishes

Water-borne varnishes and lacquer are often used on light-colored wood like maple to avoid the "yellowing" that occurs with traditional shellac and varnish finishes. Darker woods like walnut, on the other hand, look better with a "warmer" finish that brings out the rich, dark color.

If you plan on using a water-borne varnish or lacquer finish, consider warming up the walnut first with a coat of dye. We used the aged walnut recipe diluted three parts to one. Allow the dye to dry. Then brush on a sealer coat of a 2-lb. cut of dewaxed shellac to keep the water-borne finish from dissolving the dye. Dewaxed shellac makes an excellent undercoat for most water-borne and lacquer finishes, but check the label to be sure.

Coloring Mismatched Walnut

The intensity and hue of walnut often varies from one board to another or between plywood veneer and solid lumber. These color differences can detract from the appearance of your finished project. Give your project a more cohesive look by dyeing the lighter wood and applying a glaze to even out the color differences. Use the same procedure we explained in "Make Sapwood Disappear," p. 61.

If you don't discover the mismatch until



after you have applied a coat of oil or other finish, skip the dyeing step and blend the colors with glaze as we've done on the bookcase in these photos. **AW**

SUPPLIES & SOURCES

SUPPLIES

- 1 oz. bottles of yellow, red, blue and black water-soluble dye powder
- 1 lb. container super-blond shellac flakes
- 1 qt. Behkol proprietary shellac solvent
- 1 oz. tube of burnt umber artist's oil
- 1 qt. mineral spirits
- 1 qt. boiled linseed oil
- 1 pt. Japan drier
- 2-part wood bleach
- 150-, 220-, 320-grit white aluminum-oxide non-loading sandpaper
- Tack cloths
- Small artist's brush
- 1½ in. disposable, pure-bristle brushes
- 1½ in. premium-quality natural-bristle brushes
- Lots of white cotton rags

SOURCES

- Woodworker's Supply, Inc.
1108 North Glenn Rd.
Casper, Wyoming 82601
(800) 645-9292
- Woodcraft
210 Wood Cnty. Industrial Park
P.O. Box 1686
Parkersburg, WV 26102-1686
(800) 225-1153
www.woodcraft.com
- Constantine's
2050 Eastchester Rd.
Bronx, NY 10461
(800) 223-8087
www.constantines.com

FOR MORE INFORMATION

"The New Woodfinishing Book," by Michael Dresdner. The Taunton Press, 1999, revised ed.; (800) 888-8286; prod. #070429.

"Hand Applied Finishes," by Jeff Jewitt. The Taunton Press, 1997; (800) 888-8286; prod. #070282.

"Bleaching Wood," AW #72, p. 34. "Shellac," AW #60, p. 78. "Dye Stains," AW #57, p. 40.

For information on how to order back issues and copies of articles, see p. 6.

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#1335 Wedge\$29.00

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#1305 3/4" lrg. dia, 3/8" sm. dia.\$17.00

4 LOCK MITRE BIT

#1433 2" Dia., For 1/2"-3/4" Stock\$37.50

5 RABBETING KIT

4 depth of cuts: 3/8", 7/16", 5/16", 1/4". Set: 1/4" shank rabbeting bit, 4 bearings & hex key.

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6 BRASS PILOTED BIT SET

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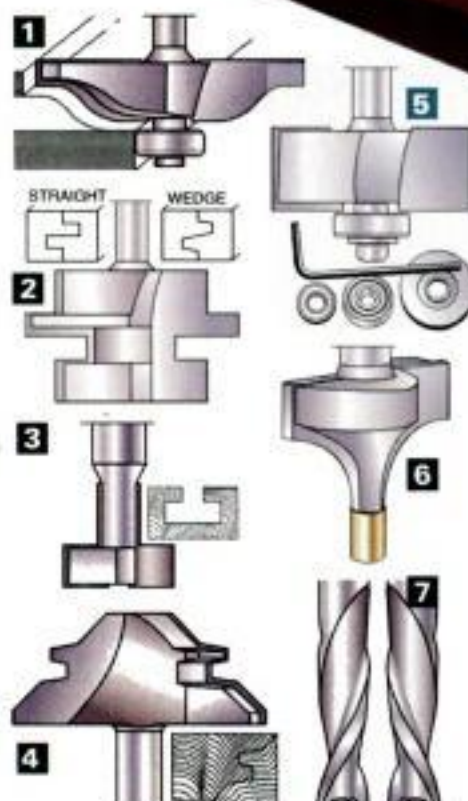
#1441 1/8", 1/4", 3/8" Round Over\$44.95

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Upcut spiral ideal for mortise and tenon joints. Downcut will plunge cut and plane edges.

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ITEM #1418

REG. \$141.20SALE \$43⁹⁵

Round Over-Beading Bit Set

1/4" shank, Carbide Tipped, 4 Round Over Bits with 1/2" OD bearing: (1/8", 1/4", 3/8", 1/2"), plus 3/8" OD bearing and allen wrench.



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SHOPTEST Random

Most woodworkers have a random orbit sander in their shop or wish they did. Whether you are ready to buy your first or replace a relic, this tool test will help you make an informed choice. After testing 33 random orbit sanders we're ready to give you the lowdown—first the basics, then the nitty gritty.

The Basics

Random orbit sanders remove material rapidly, yet leave a very smooth finish. This combination results from their "dual action," sanding pad that has two distinct motions—an orbital motion and a rotational motion.

There are four basic types of random orbit sanders—right-angle, pistol grip, palm grip, and pneumatic palm grip (see chart on opposite page). Each of these designs has its own purpose. The design that's right for you depends on the type of work you do.

Three Features

In choosing a random orbit sander, there are several features to consider:

Abrasive disks You have to choose between PSA (pressure sensitive adhesive) and H&L (hook-and-loop) disks. The PSA disks are less expensive but are one-time use only. H&L disks can be changed easily and reused repeatedly, but heavy sanding can cause the pads to heat up, and the plastic hooks can get distorted.



Dust collection Many random orbit sanders have self-contained dust collection using paper bags, cloth bags or plastic canisters. Paper bags have the convenience of being disposable, but can easily tear. Plastic canisters are very easy to empty, but they tend to allow fine dust to escape through the pores and collect on the outside of the canister. We prefer the cloth bags due to their flexibility and relative ease to empty.

Variable speed For the majority of sanding work, this feature isn't needed, but it is handy when working in tight areas, where more control is needed.

What Makes One Sander Better Than Another

Sanders do their work by scratching the wood surface, yet the goal of sanding is to eliminate visible scratches. Conflicting goals?—You bet!

Scratches from a random orbit sander are most visible when they form

loops or swirls. The smaller these loops are, the better the finish will look. Here are some factors that determine loop and swirl size:

Orbit size The easiest way to reduce the size of the sanding swirls, and their visibility is to reduce the orbit diameter. Sanders with a smaller orbit diameter will have a cleaner finish. Sanders with larger orbit diameters cut faster but leave more visible scratches. Random orbit sanders have the sanding pad slightly off-center from the motor shaft—like the pedal on a bicycle. Most sanders have an orbit diameter between $\frac{3}{32}$ -in. and $\frac{7}{32}$ -in.

Pad brakes This feature is relatively new and can be found on the majority of electric sanders (they aren't necessary on pneumatic sanders). Pad brakes control "freewheeling" (high-speed rotation) of the sanding pad when the sander is not touching the wood. This

Orbit Sanders



Right-angle sanders:

- electric
- heavy duty
- remove material very aggressively
- do not provide a smooth sanded finish
- portable
- these are not normally considered finish sanders, so they are not include in this test

Pneumatic palm-grip sanders:

- considered production tools; designed to operate for extended periods
- highest quality; machined-steel construction
- most versatile
- small size
- lots of power
- excellent finishing results
- requires at least a 50 gal., 5-hp compressor to operate (\$500 and up)
- not very portable

Pistol-grip sanders:

- electric
- larger than palm grips
- best suited to larger work pieces
- portable
- can be used with one hand, but best suited for two-handed operation
- can do limited detail work
- most have a removable front handle to get into tight places
- tend to provide smoother finishes than palm grips because of higher-quality construction

Palm-grip sanders:

- electric
- designed to be operated with one hand and get into tight spaces
- generally less expensive
- generally lower construction quality

allows the operator to lift the sander from the work surface and reposition it while it is running without gouging the wood.

In our testing, we found that pad brakes reduced the overall finish quality. After removing the pad brakes from each of the sanders, the number of visible scratches left behind was reduced (Fig. A). The tools with pad brakes that were most effective in controlling freewheeling had the greatest improvement in finish quality when the brakes were removed.

Some woodworkers find pad brakes indispensable. Our conclusion is that pad brakes only serve a purpose for the short time between turning the tool on and placing it on the wood, or while repositioning the sander. Without them, you'll get a better overall finish.

Smooth operation Anything that causes a random orbit sander to jump, stutter or wobble results in an increase in visible

How We Tested

We assembled a panel of six woodworkers to examine the subjective (opinion-based) qualities of the sanders. They examined such things as comfort, vibration, dust collection and overall ergonomics. After the test, we asked the panel members to choose their favorites.

Finally, each tool was disassembled to examine the design and construction. The primary focus was to look for parts and designs that could shorten the tool's life and contribute to runout.

scratches. The number one cause of these problems is runout. Runout is any type of wobble in a rotating part, a bent motor shaft, for example. The higher the precision in the components' machining and fit, the lower the chances for runout. We dissected and examined the general quality of the machining and the design to compare which sanders were likely to have runout.

The most common causes we found for runout were associated with the aluminum eccentric flywheel and the pad bearing (see anatomy photos on pp. 66 and 67). In some cases we found

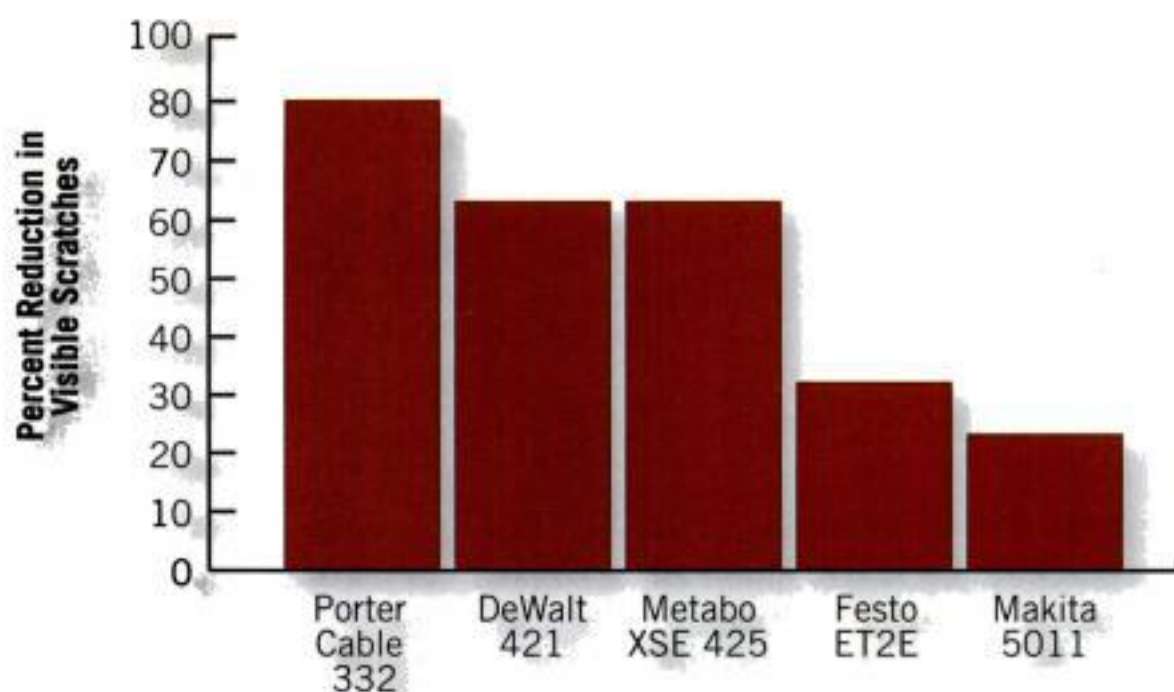
the flywheel was not true to the motor shaft. In other cases we found bearings that were ill-fitting and not true to the flywheel and sanding pad. Read the tool summaries for in-depth discussion of the machining and design quality for each tool.

There are some factors that contribute to runout that you can observe before you buy, without even plugging in the tool. When you're at the store:

1. Rock the sanding pad side to side. If the pad feels loose, the sander will be jittery when you change sanding directions.
2. Slowly rotate the sanding pad. If the pad appears to move in and out from the sander's housing, either the sanding pad is bent or the eccentric bearing mount is out of true. This will result in a slow-speed wobble in the sanding motion.
3. A third cause for runout is not as easy to detect without disassembling the tool. However, if the salesperson permits you to remove the sanding pad (this shouldn't void any warranties because it is part of the maintenance procedure for replacing pad brakes and worn H&L pads) you can see the eccentric flywheel. Slowly rotate the flywheel and look for a wobble that will result in sharp jumps and stutters in the sanding motion. **AW**

FIG. A Pad Brakes: Convenience vs. Performance

We tested these five sanders with their pad brakes installed, and again after removing the pad brake, to see if there was a change in sanding performance. Each of the sanders left fewer scratches when their pad brakes were removed.



The Best of the Best

We awarded the Dynabrade 57135 pneumatic sander our Editor's Choice for Best Overall Sander. When we asked our panel of testers which sander they would use if they could have any of them regardless of cost or design, the response was almost unanimously the Dynabrade 57135. This sander is compact, powerful, comfortable and very well built. (\$160 street price, \$210 with vacuum option)



The Best Palm Grip

There was a tie for Best Palm-Grip Sander—the Makita B05010 and Bosch 1295DH. The Bosch was the best-built palm grip sander, but the Makita had very smooth operation.

The pad brake on the Makita was the best of any sander, giving a good mix between effectiveness, and natural motion while sanding. (Makita B05010 \$75, Bosch 1295DH \$85 street price)



The Best Pistol Grip

We awarded the Makita B05021 our Editor's Choice Award for Best Pistol Grip Electric Sander. Our testers found this sander's compact design comfortable to operate, easy to handle, and it gave one of the smoothest finishes. (\$95 street price)



RANDOM ORBIT SANDERS RUNDOWN

ARO RS25A

Features: Pneumatic palm grip, low profile, light weight with plastic body, optional dust collection, powerful motor, lacks variable speed.



Construction: Single-piece motor shaft and eccentric bearing-mount minimize the chances for runout.

Ergonomics: Comfortable with a small grip and palm-activated "ON" lever.

Street Price: \$160

Source: Ingersoll Rand (615) 672-0321

Black & Decker R0100

Features: Palm grip with dust collection bag. The 3/16-in. orbit makes the sander aggressive, but doesn't provide as clean a finish.



Construction: The parts are tight fitting, but there is noticeable play between the pad and the motor.

Ergonomics: Comfortable grip and well placed power switch.

Street Price: \$45

Source: B&D (800) 762-6672

Bosch 1295DH

(Editor's Choice Palm Grip)

Features: 2-speed (low and high), large dust collection canister, rubber coated grip.

Construction: Extremely well built. Uses double-stacked bearing for pad, and



machined aluminum flywheel, making it very stable.

Ergonomics: Very comfortable grip, but the lower edge of the rubber grip is slightly sharp. The power switch is slightly difficult to operate.

Street Price: \$85

Source: S-B Power Tools (800)301-8255

Bosch 3725 DVS

Features: Pistol grip with top rubber grip for one-handed operation, removable front handle, variable speed, cloth dust bag.



Construction: Extremely well built. Aluminum lower shroud, tight fitting parts.

Ergonomics: Very comfortable and can easily be used one-handed or two.

Street Price: \$145

Source: S-B Power Tools (800)301-8255

Craftsman 11621

Features: Palm-grip sander with felt sanding pad so paper-backed PSA disks won't stick so hard that they tear on removal.

Construction: Uses a plastic eccentric bearing pocket that may introduce runout with heat and wear. There was some play



between the sanding pad and the flywheel.

Ergonomics: Very comfortable to operate, and the switch is well placed and easy to use.

Street Price: \$40

Source: See your local Sears store

Craftsman 27717

Features: Pistol-grip sander with a screened dust collection box. Removable front handle.

Construction: For a low-cost tool, this is well built and operated smoother than some higher-priced tools. The bearing flange is machined aluminum and tight fitting. The pad brake is too aggressive and interferes with natural pad motion, but should last for a long time.

Ergonomics: Moderately comfortable, but does not have a single-handed top grip as



some others do.

Street Price: \$60

Source: See your local Sears store

DeWalt DW420, DW421, DW423

Features: All three models are the same with slightly different features. The DW420 is the basic random orbit sander without dust collection. The DW421 comes with a dust collection bag. The DW423 has dust collection, variable speed control and a rubber-coated palm grip.

Construction: The internal fit and finish of all models we examined was loose, with non-machined aluminum components, and may have been the cause for the jittery motion we observed. The sanding pads could be rocked side to side by hand



pressure. The coil-supported dust collection bags were effective.

Ergonomics: These sanders were generally comfortable to operate, but some of our testers felt the flat-topped grips on the DW420 and DW421 models were not as comfortable as the domed top of the DW423.

Street Price: DW420 \$70, DW421 \$80, DW423 \$95

Source: DeWalt (800) 433-9258

Dynabrade 57135

(Editor's Choice Best Overall Sander)

Features: Pneumatic palm grip with palm-activated power lever. Low profile, and infinite variable-speed control. Dust collection is optional.

Construction: The internal construction of the sander is very precise, with machine-ground steel components. The motor shaft and eccentric bearing pocket are



milled from a single piece of steel. This leads to very high stability.

Ergonomics: Our panel members voted this sander tops for feel, operation and size.

Street Price: \$160

Source: Dynabrade U.S. (800) 828-7333; Canada (800) 344-1488

Festo ET2E

Features: Pistol-grip sander with variable speed and large paper dust collection bag.

Construction: This is one of the best machined electric sanders we tested. The aluminum flywheel casting had a machined steel insert to house the eccentric bearing.

Ergonomics: All of our testers said the tool was very comfortable to operate, but



the dust collection bag would be better if it was smaller and not made out of paper. The sander operated fairly smoothly, but had a slight oscillation in the motion, possibly due to an imbalance in the pad or flywheel.

Street Price: \$270

Source: Toolguide (805) 565-4675

Jepson

Features: Palm-grip sander with a small, rear-mounted dust collection bag.

Construction: The machining quality of the Jepson sander was good, with the bearing, flywheel and motor shaft fitting snugly. The quality of the construction is contradictory to the performance we



observed. This sander uses the same design as the Milwaukee 6018 and 6019 sanders, and all three of these similarly built units we tested had noticeable runout in the pads.

Ergonomics: The palm-grip handle was comfortable and the power switch was easy to use.

Street Price: \$75

Source: Jepson (310) 320-3890

Makita B05010 and B05011

(Editor's Choice Palm Grip)

Features: The B05010 uses H&L disks and the B05011 uses PSA disks. Otherwise these sanders are the same. The dust collection port can be rotated to any position to suite the users needs and the power switch is easily operated.

Construction: The pad-bearing's socket is machined aluminum with a snug fit to the bearing and motor shaft. The pad brake

RANDOM ORBIT SANDERS RUNDOWN (CONTINUED)



system on the Makita sanders seems to be the best mix between too much braking and not enough. The brake slows the pad down when removed from the surface, yet did not interfere with the natural motion of the pad.

Ergonomics: Our testers found this series of tools easy to use and comfortable.

Street Price: \$75

Source: Makita (800) 462-5482

Makita B05021

(Editor's Choice Pistol Grip)

Features: This is a new model from Makita, with variable speed, one or two-hand operation and a removable front handle for getting into tight places.

Construction: Good construction with well-fitting components. The B05021 uses the same pad brake design as the B05010 and B05011.



Ergonomics: Very comfortable with minimal vibration. The variable-speed control is under the user's thumb for easy access.

Street Price: \$95

Source: Makita (800) 462-5482

Master Power MP 4400-5 and MP4403-5

Features: The Master Power pneumatic sanders ranked very high in terms of comfort, operation and construction. They were the lightest sanders we tested, and came with three interchangeable grips to accommodate small, medium and large hands. The MP4400-5 has a $\frac{3}{16}$ -in. orbit, and the MP4403-5 has a $\frac{1}{2}$ -in. orbit. Both sanders have a variable speed control and are available with dust collection.

Construction: Master Power sanders have evolved from Dynabrade sanders and



have similar design and construction, with a one-piece motor shaft and eccentric bearing pocket.

Ergonomics: Very comfortable to operate.

Street Price: \$150, \$170 with vacuum option

Source: Master Power (800) 466-7263

Metabo SXE425 and SXE425 XL

Features: The SXE425 (5-in. disk) and SXE425 XL (6-in. disk) sanders have variable speed and $\frac{3}{16}$ -in. orbit paths, which makes these sanders fairly aggressive, yet the quality of the construction keeps the scratches to a minimum.

Construction: Very well built and worth the price. Tight-fitting components result



in smooth operation and excellent sanding finish.

Ergonomics: Very comfortable handles, with a rubber-coated top grip for one-handed operation. The only drawback our testers observed was the large, paper dust collection bag.

Street Price: SXE425 \$150, SXE425 XL \$160

Source: Metabo (800) 638-2261

Metabo SXE450 Duo

Features: This sander has the unique feature of easily switching between a $\frac{3}{16}$ -in. and a $\frac{1}{2}$ -in. orbit diameter, plus it has variable speed. The sander removes material aggressively, yet leaves a smooth finish. Even though this sander has the large paper dust collection bag, we felt the fea-



tures and performance outweigh this drawback.

Construction: Very well built and worth the price. Tight-fitting components result in smooth operation and excellent sanding finish.

Ergonomics: Very comfortable for one- or two-handed operation.

Street Price: \$195

Source: Metabo (800) 638-2261

Milwaukee 6018 and 6019

Features: Palm-grip sander with a small, rear-mounted dust collection bag. The

6018 uses PSA disks and the 6019 uses H&L disks.

Construction: The machining quality of the sanders was good, with the bearing, flywheel and motor shaft fitting snugly



together. The quality of the construction is contradictory to the performance we observed. These sanders use the same design as the Japson sander, and all three of these similarly built units we tested had noticeable runout in the pads.

Ergonomics: The palm-grip handle was comfortable and the power switch was easy to use.

Street Price: \$75

Source: Milwaukee (800) 414-6527

Milwaukee 6020-2

Features: Variable speed, 6-in. pad, with large cloth bag for dust collection.

Construction: This tool has very good construction. The pad is screwed down to a machined-steel flange that houses a



double set of bearings. The eccentric shaft that passes through these double bearings is machined from a single piece of steel, and has two bearings supporting it from the top side. The chances for runout on this tool are low. The pad brake is too effective.

Ergonomics: The tool seems cumbersome and the front handle is very low. The dust collection port sticks out from the side and may interfere with close-in work.

Street Price: \$160

Source: Milwaukee (800) 414-6527

Porter Cable PC332, PC333, PC333VS, PC334, and PC335

Features: These sanders are all the same design, but vary by feature. The basic sander has PSA disks without dust collection and the higher end sander has H&L disks with dust collection and variable speed. The PC 335 is the 6-in. version.

The models with dust collection use a canister that can be swiveled to suit your needs.

Construction: The internal construction of these sanders is good, with well-fitting components, giving them smooth operation. The pad braking system uses a plastic O-ring around the pad-mount and a fixed stud in the tool's base. These are the only sanders with this type of braking system. Our tests indicate that this system provides too much braking and interferes with the natural motion of the pad while sanding.



Ergonomics: The Porter Cable sanders were comfortable to operate and were relatively smooth. Rigid dust collection canisters are off to the side, and easy to empty. Our testers found the power switch to be small and slightly difficult to operate.

Street Price: \$60 to \$90 depending on features

Source: Porter Cable (800) 487-8665

Ryobi RS200

Features: Pistol-grip sander with a screened dust collection box, removable front handle and variable speed.

Construction: For a low-cost tool, this is well built and operated smoother than some higher-priced tools. The bearing flange is machined aluminum and tight fitting. The pad brake is too aggressive and interferes with natural pad motion, but should last for a long time.



Ergonomics: Moderately comfortable, but does not have a single-handed top grip.

Street Price: \$60

Source: Ryobi (800) 525-2579

Ryobi RS240

Features: Palm-grip sander. With the felt pad, paper-backed PSA disks won't stick so hard that they tear on removal.

Construction: The flywheel was glued to the motor shaft for greater stability and showed no signs of runout. Uses a plastic eccentric bearing pocket that may introduce runout with heat and wear. There was some flex between the flywheel and the sanding pad.

Model	Street Price	Disk Type	Orbit Size	Dust Collection	Ergonomics*	Construction Quality*	Type
Black & Decker	\$45	5" 8 hole, H&L	3/32	cloth bag	9	5	Palm Grip
Bosch 1295 DH	\$85	5" 8 hole, H&L	1/8	canister	9	7	Palm Grip
Craftsman 11621	\$40	5" 8 hole, PSA	3/32	cloth bag	8	6	Palm Grip
DeWalt 420	\$70	5" no hole, H&L	3/16	none	8	6	Palm Grip
DeWalt 421	\$80	5" 8 hole, H&L	3/16	cloth bag	8	6	Palm Grip
DeWalt 423	\$95	5" 8 hole, H&L	3/16	cloth bag	8	6	Palm Grip
Jepson 5173	\$75	5" 8 hole, H&L	3/32	cloth bag	8	6	Palm Grip
Makita B05010	\$75	5" 8 hole, H&L	3/32	cloth bag	9	8	Palm Grip
Makita B05011	\$75	5" 8 hole, PSA	3/32	cloth bag	9	8	Palm Grip
Milwaukee 6018	\$75	5" 8 hole, PSA	3/32	cloth bag	8	6	Palm Grip
Milwaukee 6019	\$75	5" 8 hole, H&L	3/32	cloth bag	8	6	Palm Grip
Porter Cable 332	\$65	5" no hole, PSA	3/32	none	9	8	Palm Grip
Porter Cable 333	\$65	5" 5 hole, H&L	3/32	canister	9	8	Palm Grip
Porter Cable 333 VS	\$85	5" 5 hole, H&L	3/32	canister	9	8	Palm Grip
Porter Cable 334	\$70	5" 5 hole, H&L	3/32	canister	9	8	Palm Grip
Porter Cable 335	\$90	6" 6 hole, PSA/H&L	3/32	canister	9	8	Palm Grip
Ryobi RS240	\$45	5" 8 hole PSA/H&L	3/32	cloth bag	9	5	Palm Grip
Bosch 3725 DVS	\$145	5" 8 hole, H&L	3/16	cloth bag	9	8	Pistol grip
Craftsman 27717	\$60	5" 8 hole, PSA	5/32	box	7	4	Pistol grip
Festo ET2E Plus	\$270	6" 8 hole, H&L	1/8	paper bag	9	10	Pistol grip
Makita B05021	\$95	5" 8 hole, H&L	3/32	cloth bag	9	8	Pistol grip
Metabo SXE 425	\$150	5" 8 hole, H&L	3/16	paper bag	8	9	Pistol grip
Metabo SXE 425 XL	\$160	6" 6 hole, H&L	3/16	paper bag	8	9	Pistol grip
Metabo SXE 450 Duo	\$195	6" 6 hole, H&L	3/16-3/32	paper bag	8	9	Pistol grip
Milwaukee 6020-02	\$160	6" 8 hole, H&L	3/16	cloth bag	7	7	Pistol grip
Ryobi RS200	\$55	5" 8 hole PSA/H&L	5/32	box	8	4	Pistol grip
ARO RS25A	\$160	5" No hole	3/32	optional	9	9	Pneumatic
Dynabrade	\$160	5" no hole, PSA	3/32	optional	10	10	Pneumatic
Master Power 4400-5	\$150	5" no hole, PSA	3/16	optional	10	9	Pneumatic
Master Power 4403-5	\$150	5" no hole, PSA	3/32	optional	10	9	Pneumatic
Sioux 690	\$155	5" no hole, PSA	3/32	optional	8	9	Pneumatic
Sioux 790	\$140	5" no hole, PSA	3/32	optional	8	9	Pneumatic
Sioux 890	\$140	5" no hole, PSA	3/32	optional	9	9	Pneumatic

* Scale of 1 to 10. Ten is best.



Ergonomics: The power switch is well placed and easy to operate, but the handle is not very comfortable. The motor cooling slots in the top of the sander had sharp edges which can dig into your hand.

Street Price: \$40

Source: Ryobi (800) 525-2579

Sioux 690 and 790

Features: These sanders have an aluminum body, are very rugged and slightly larger than the typical pneumatic sanders we examined. The aluminum body is durable, but adds extra weight.



Construction: These sanders are very well built with one-piece motor shaft and eccentric bearing pocket. For stability in the pad, these sanders use a single-roller bearing plus a smaller-needle bearing to support the sanding pad's shaft.

Ergonomics: These sanders are comfortable to operate and are smaller than any of the electric palm-grip sanders, however, they are larger than the other pneumatic sanders we examined.

Street Price: 690 \$155, 790 \$140

Source: Sioux Tools (800) 722-7290

Sioux 890

Features: Low-profile and light-weight pneumatic sander. Optional dust collec-



tion. Similar design to the ARO RS25A.

Construction: Well built, with one-piece motor shaft and eccentric bearing pocket, which reduces the chances for runout.

Ergonomics: Fairly comfortable with palm activated "ON" lever.

Street Price: \$140, \$160 with vacuum

Source: Sioux Tools (800) 722-7290

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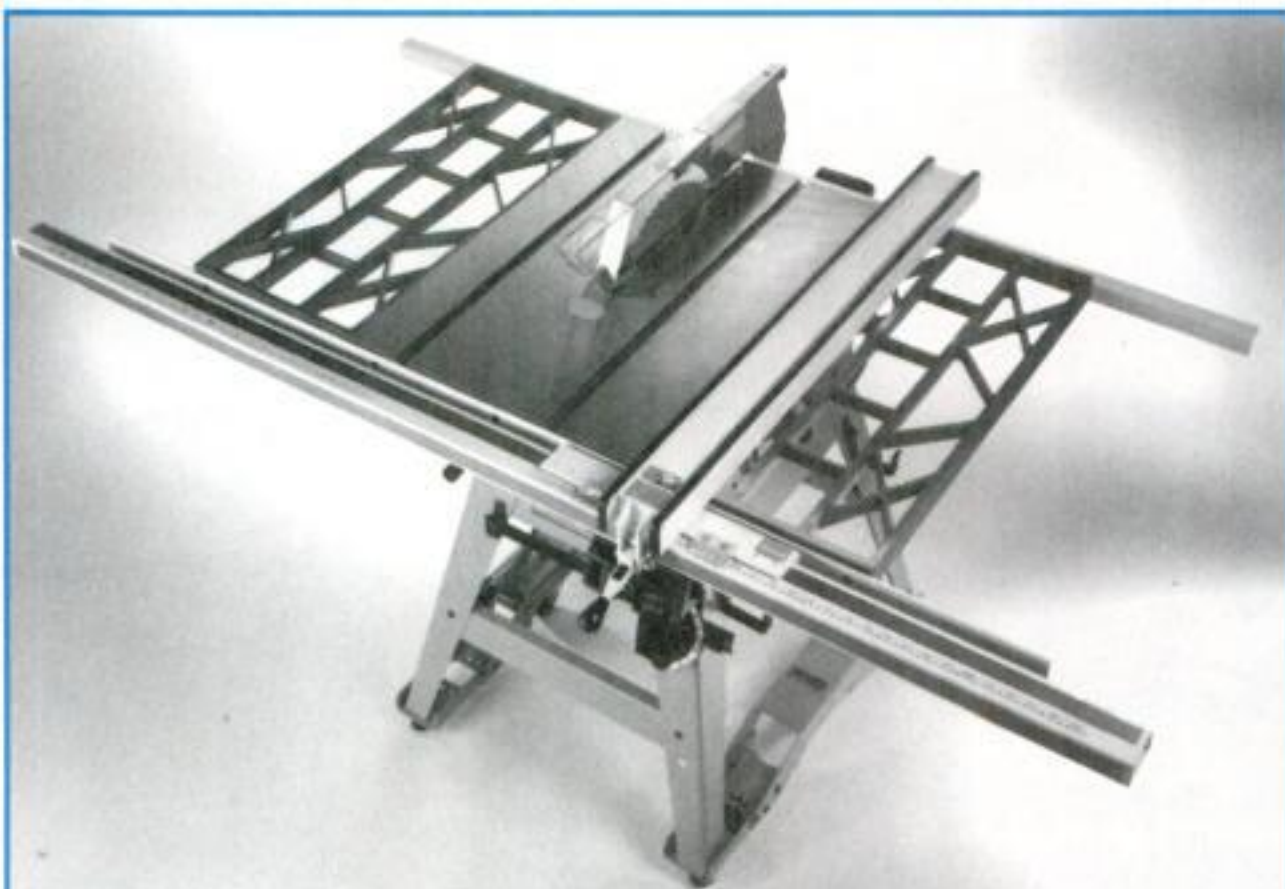
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Stronger Shelves

Designing sag-proof shelves.

Have you ever heard a shelf groan? Well, maybe not, but some shelves look like they would if they could. So much stuff gets piled on them that they end up sagging like a limp noodle. It's not a pretty sight. A span that holds up weight should look strong and sturdy.

Even a slight sag sends an unappealing visual message.

A shelf sags in two stages. There's a small sag when you first put weight on the shelf. This sag, or deflection, increases as more stuff is loaded on the shelf over the years. The shelf keeps

on sagging, a little more each year, because wood slowly but surely changes shape under a load. This characteristic of wood is called "creep."

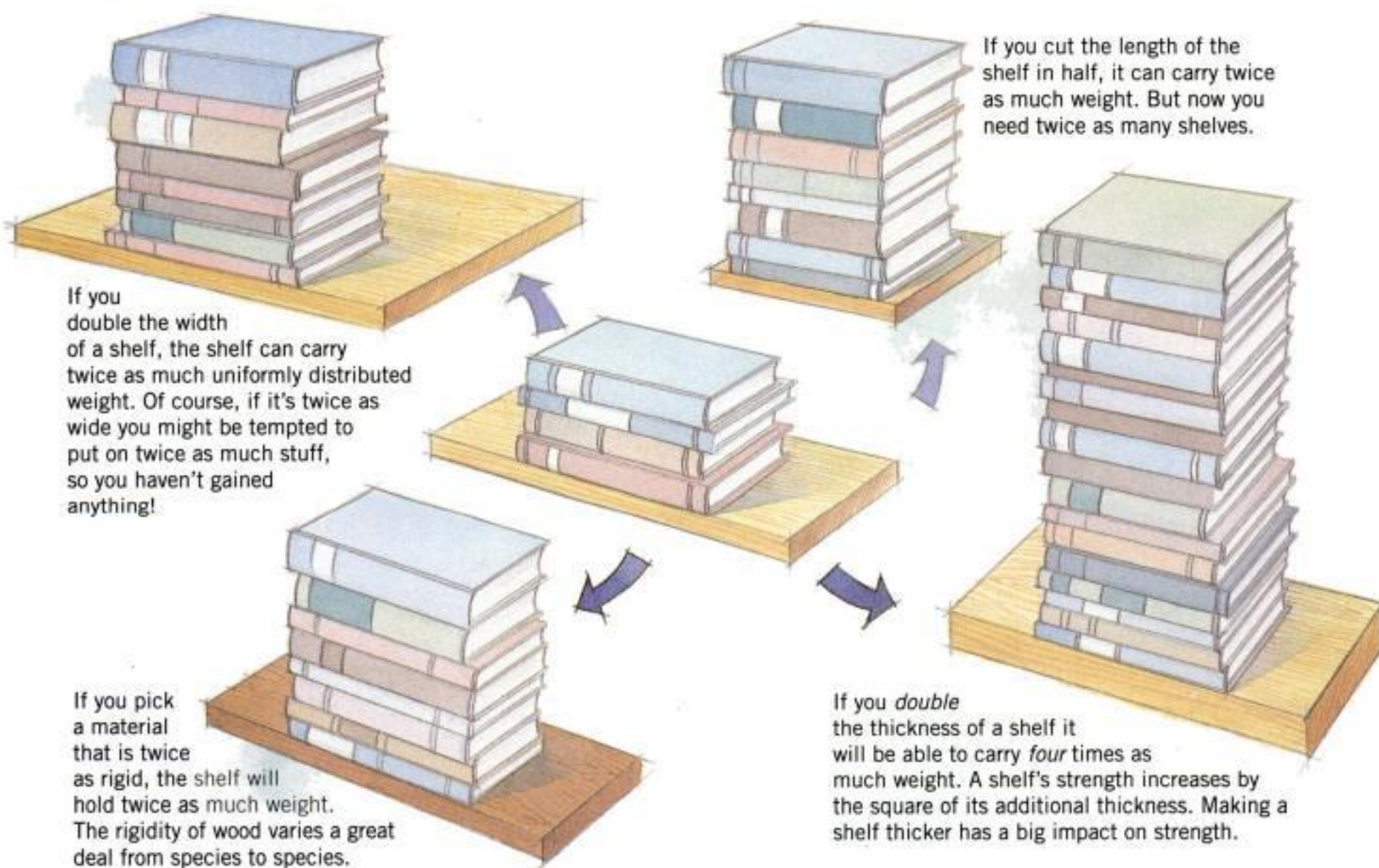
Arm yourself for the fight against creep with common sense engineering knowledge about how each dimension of a shelf affects its strength, or rigidity (Fig. A).

The most important dimensional factor is a shelf's thickness. The effect of the other two dimensions, width and length, is straightforward; add 10 percent to the width of a shelf, and it's 10-percent more rigid; add 10 percent to the length, and it's 10-percent less rigid. However, add 10 percent to the thickness of a shelf and it's 21-percent stronger! Strength increases at an exponential rate as you add thickness. That's why wooden joists and steel beams stand on edge. A shelf that's $\frac{7}{8}$ -in. thick is about

(continued on p. 79)

FIG. A The ABCs of Holding Up Weight

Changing any dimension affects the rigidity of a shelf. The biggest returns come with adding thickness and choosing a strong material. These two factors are the foundation of sag-proof shelf design.



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Learn how to work with shellac and custom stains, and how to "dry brush". Take home a picture frame that you finish. Capacity: 24. Cost including all materials: \$65.

Build a Whittled Peg Rack

George Vondriska

Fri., 9:00-11:00 am; Sat., 9:00-11:00 am
Sun., 11:30-1:30 pm

This butternut wall-hung coat rack appeared in AW issue, #73. Make one at the show and use it to hang your favorite fedora. Capacity: 12. Cost including all materials: \$75.

Make a Hinge Mortising Jig

Carol Reed

Fri., 9:00-11:00 am; Sun., 11:30-1:30

Make and keep a great jig for routing hinge mortises in your boxes and cabinets. You will also get a set of hinges and learn to install them using the jig. Capacity: 20. Cost including all materials: \$60.

Construct a Pair of Cam Clamps

Fred Matlack

Fri., 2:00-4:00 pm; Sat., 9:00-11:00 am
Sun., 2:00-4:00 pm

Handmade from wood and aluminum, it will last forever. Take the pair home to use on your next project. Capacity: 20. Cost including all materials: \$60.

Make a Mahogany Jewelry Box

Frank Klausz

Fri. & Sun., 2:00-4:00 pm

Learn to layout and cut dovetails by hand. Use tools sharpened by Frank, and then complete the jewelry box at home. Capacity: 12. Cost including all materials: \$75.

Make the Jig that Makes Jigs

Carol Reed

Sat., 2:00-4:00 pm

Customize a plastic marking gauge to suit your router. Then, take the gauge home and use it in your shop to make other new, very accurate woodworking jigs. Capacity: 20. Cost including all materials: \$65.

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Learn how to properly sharpen and burnish a cabinet scraper, and how to use it for smoothing woods. Take home the scraper and burnisher. Capacity: 15. Cost including all materials: \$60.

Sharpening

Paul Anthony

Sun., 11:30-1:30 pm

Learn how to put a truly keen edge on your chisels and plane irons. Bring a couple of your favorite tools for a serious tune-up. Take home a sharpening aid. Capacity: 12. Cost including all materials: \$60.

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Woodworking Fundamentals

Frank Klausz

Fri., 11:30 am-1:00 pm; Sat., 1:30-3:00 pm

Learn how to select and understand tools, machines and materials. Choose projects and joinery you can handle. Allow for wood movement. Use the proper glue.

Tablesaw Basics, Fred Matlack

Fri., 11:30-1:00 pm; Sat. 3:30-5:00 pm

Learn how to use it safely and efficiently for ripping, crosscutting, dadoing, and other essential woodworking operations.

Making and Fitting Cabinet Doors

Paul Anthony

Fri. & Sat., 1:30-3:00 pm

There's nothing more important to the look of a cabinet than its doors. This design tour of cabinet door styles will include a demonstration of construction and installation techniques.

Getting Started with your Router

Carol Reed

Fri., 1:30-3 pm; Sat. 11:30-1:00 pm

For anyone new to routing. Learn how to rout safely and successfully. Discover which routers, bits, and aftermarket jigs and fixtures will work best for you.

Finishing Secrets

Michael Dresdner

Fri., 3:30-5:00 pm; Sat., 3:30-5:00 pm

Learn how to select the best finish for the job. Understand wood stains and use them correctly. From surface preparation to final polish, you'll know what it takes to get a professional finish.

Tablesaw Tips and Tricks

Andy Rae

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(continued from p. 75)

36-percent stronger than a $\frac{3}{4}$ -in. thick shelf. If you're careful, you should be able to get $\frac{7}{8}$ -in. thick boards from $\frac{4}{4}$ lumber. With such a substantial increase in rigidity, it's definitely worth the effort.

Shelving Standards

Let's put our common sense engineering to the test. How wide or long does a cherry shelf have to be to hold up, say, a set of encyclopedias? We can use standard dimensions that have proven themselves reliable over the years to answer this question (Fig. B).

Encyclopedias are large books, so we need a shelf that's at least 12-in. deep. (Books look best when they sit 1-in. or so back from the front edge of a shelf.) How heavy are they? It wouldn't be a bad idea to place them on a bathroom scale and find out. Books and magazines can be surprisingly heavy. These standards suggest they'll weigh up to 50 lbs. per running foot.

How long should a $\frac{3}{4}$ -in. cherry shelf be to hold up these books? The standards tell us that a wide hardwood shelf that carries a heavy load should be no more than 36-in. long. But this doesn't tell us the whole story, and that's why we have to look at one more variable before we can build this shelf with confidence.

How Strong is the Wood?

Some species of wood are much more rigid than others. In terms of deflection under a load, hickory is about twice as strong as butternut. If we make similar shelves out of hickory and butternut, and apply the same load, the butternut shelf will sag twice as much. If we cut the butternut shelf in half, it will sag the same amount as the hickory shelf.

The shelving standards are based on averages. Is our cherry encyclopedia shelf average? No, cherry is more than 10 percent weaker than an average wood like walnut or soft maple (Fig. C). Thus, the shelf has to be shorter or thicker.

Plywood and Composite Woods

Manufactured wood products are not as strong as solid wood. Plywood is only about half as rigid as the average hard-

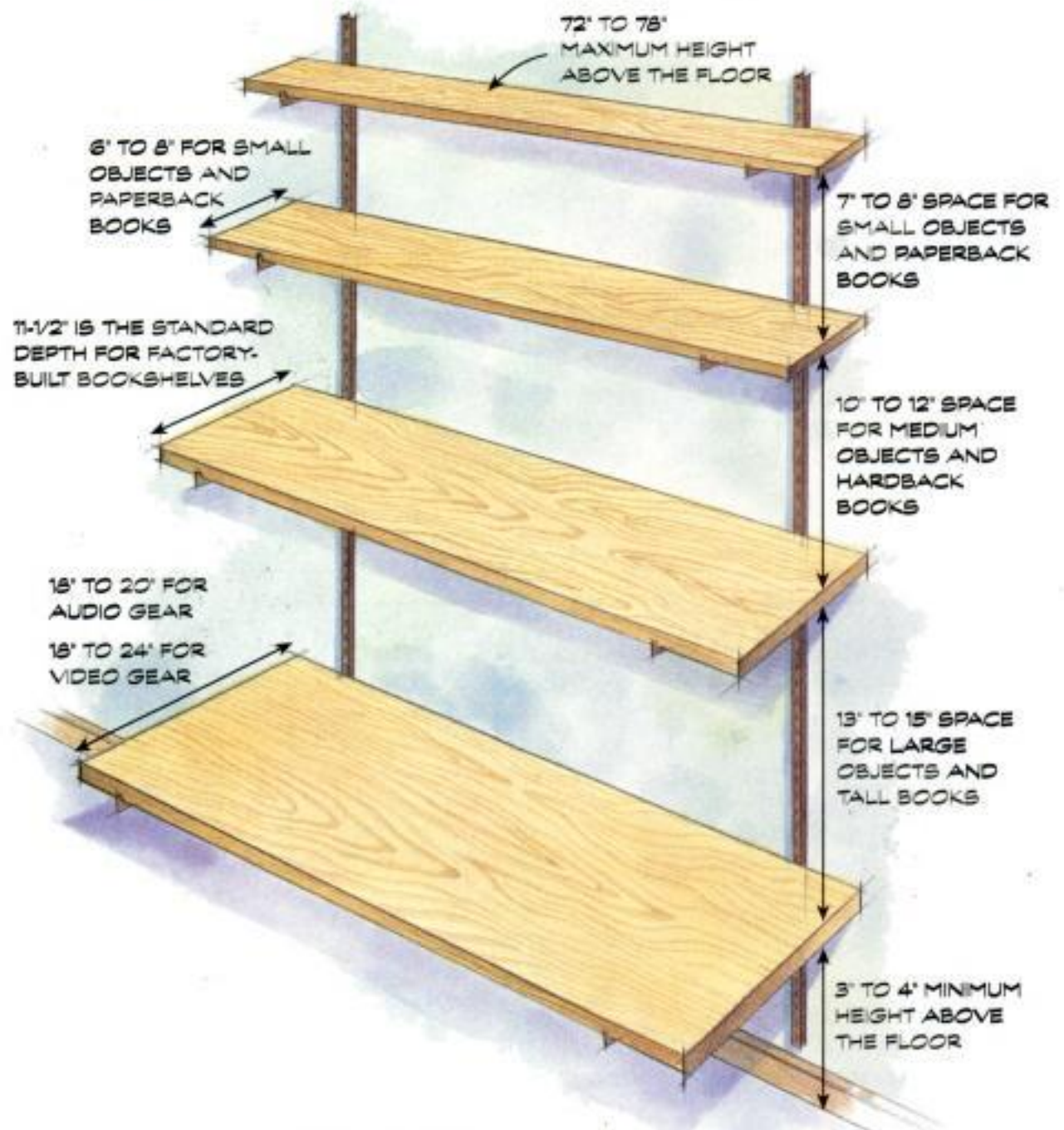
wood because it's made of alternating layers of thick veneer. Wood is not as rigid across the grain as along the grain. In a shelf, the grain of some of the veneer layers runs the long way, but

almost half runs the short way.

Particleboard and MDF (medium density fiberboard), collectively called composite woods, do not have the grain structure of solid wood or of plywood

FIG. B
Standard Shelving Dimensions

Here are some guidelines for sizing shelves that are supported at the ends by brackets. The maximum length of a shelf increases when you use thicker stock and stronger material.



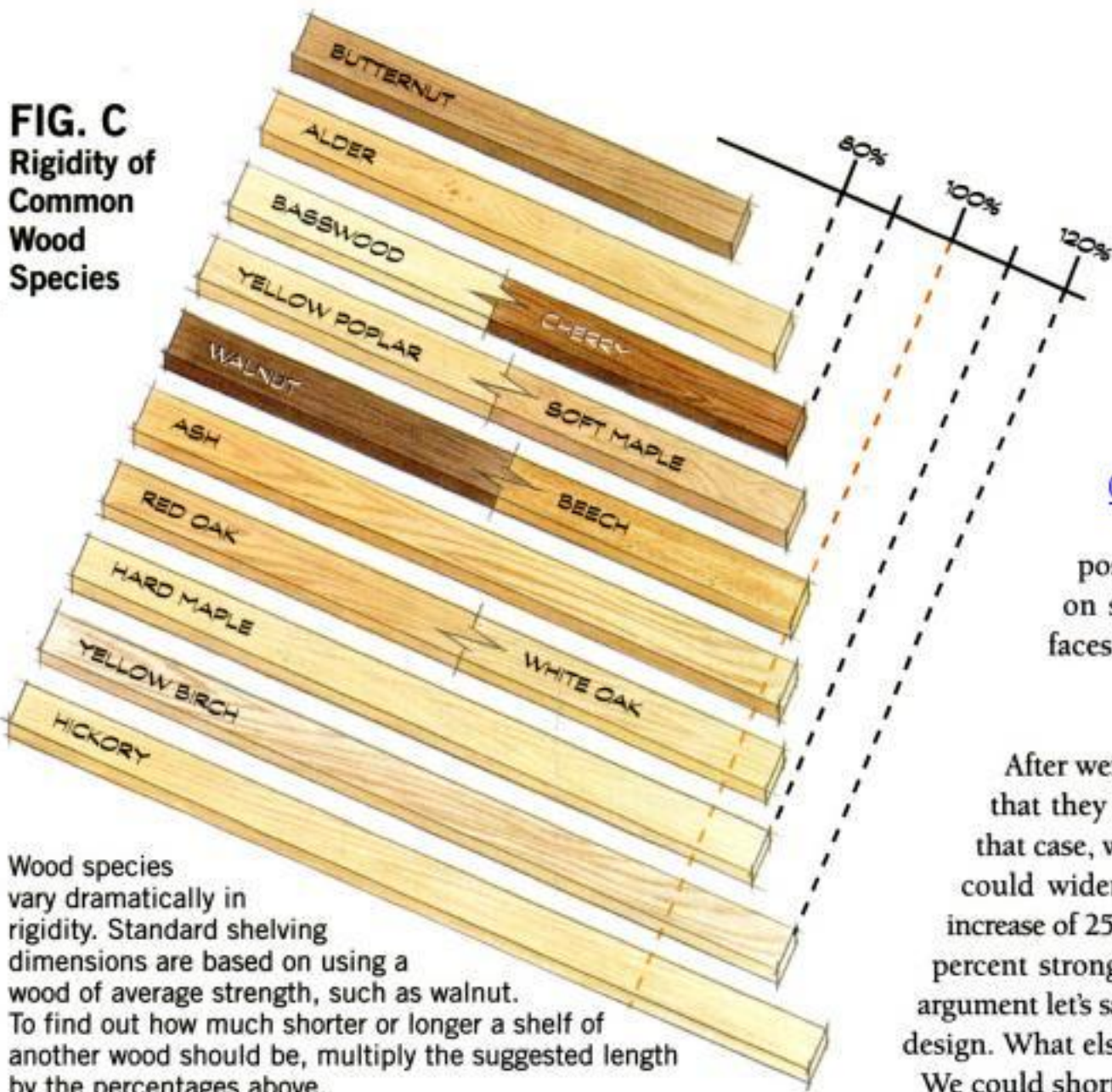
Maximum length between supports for a moderate load (25 lbs. per running foot) on a narrow shelf (for paperback books and small objects):

$\frac{3}{4}$ "	particleboard	24"
$\frac{3}{4}$ "	mdf	28"
$\frac{3}{4}$ "	plywood	32"
$\frac{3}{4}$ "	softwood	36"
1"	softwood	48"
$\frac{3}{4}$ "	hardwood	48"
1"	hardwood	54"
1 $\frac{1}{2}$ "	softwood	66"
1 $\frac{1}{2}$ "	hardwood	78"

Maximum length between supports for a heavy load of 40 to 50 lbs. per running foot on a wider shelf (for large objects, hardback books, and American Woodworker magazines):

$\frac{3}{4}$ "	particleboard	20"
$\frac{3}{4}$ "	mdf	22"
$\frac{3}{4}$ "	plywood	30"
$\frac{3}{4}$ "	softwood	28"
1"	softwood	36"
$\frac{3}{4}$ "	hardwood	36"
1"	hardwood	40"
1 $\frac{1}{2}$ "	softwood	50"
1 $\frac{1}{2}$ "	hardwood	55"

FIG. C
Rigidity of
Common
Wood
Species



veneers. These products have a hard time holding up their own weight. They have about one-quarter of the strength of an average wood. Nevertheless, composite wood is widely used for shelving. Comprehensive information on sizing composite wood shelves is available from an industry trade association ([see For More Information, p. 83](#)).

The rigidity of plywood and composite wood can be improved by gluing on solid wood edges or plastic laminate faces (Fig. D.)

How to Strengthen a Shelf

After weighing the encyclopedias, you may find that they exceed the limits of the standards. In that case, we need to make a more rigid shelf. We could widen the shelf from 12-in. to 16-in., an increase of 25 percent. That would make the shelf 25-percent stronger. It's an option, but for the sake of argument let's say that a 16-in. shelf is too deep for our design. What else could we do?

We could shorten the shelf. Like width, it's a straight

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percentage reduction. A shelf that is 25 percent shorter will also hold up 25 percent more weight.

A shorter shelf for our encyclopedias isn't going to work, however. With all the supplements added to it, there's more than three feet of books! How about making the shelf thicker? If we've already purchased 3/4-in. stock, this option is out.

It's time to be creative about building a shelf that will be stronger than just one solid board. The simplest solution is to add a lip or two to the shelf. Rip some of the 3/4-in. stock into 1 1/2-in. wide strips, turn them on edge, and glue them onto the front and back edges of the shelf (Fig. E). If you need considerably more strength, make the rear strip several inches deep.

Another way to add thickness to a shelf without using expensive thick lumber is to make a hollow shelf 1- to 1 1/2-in. thick from thin

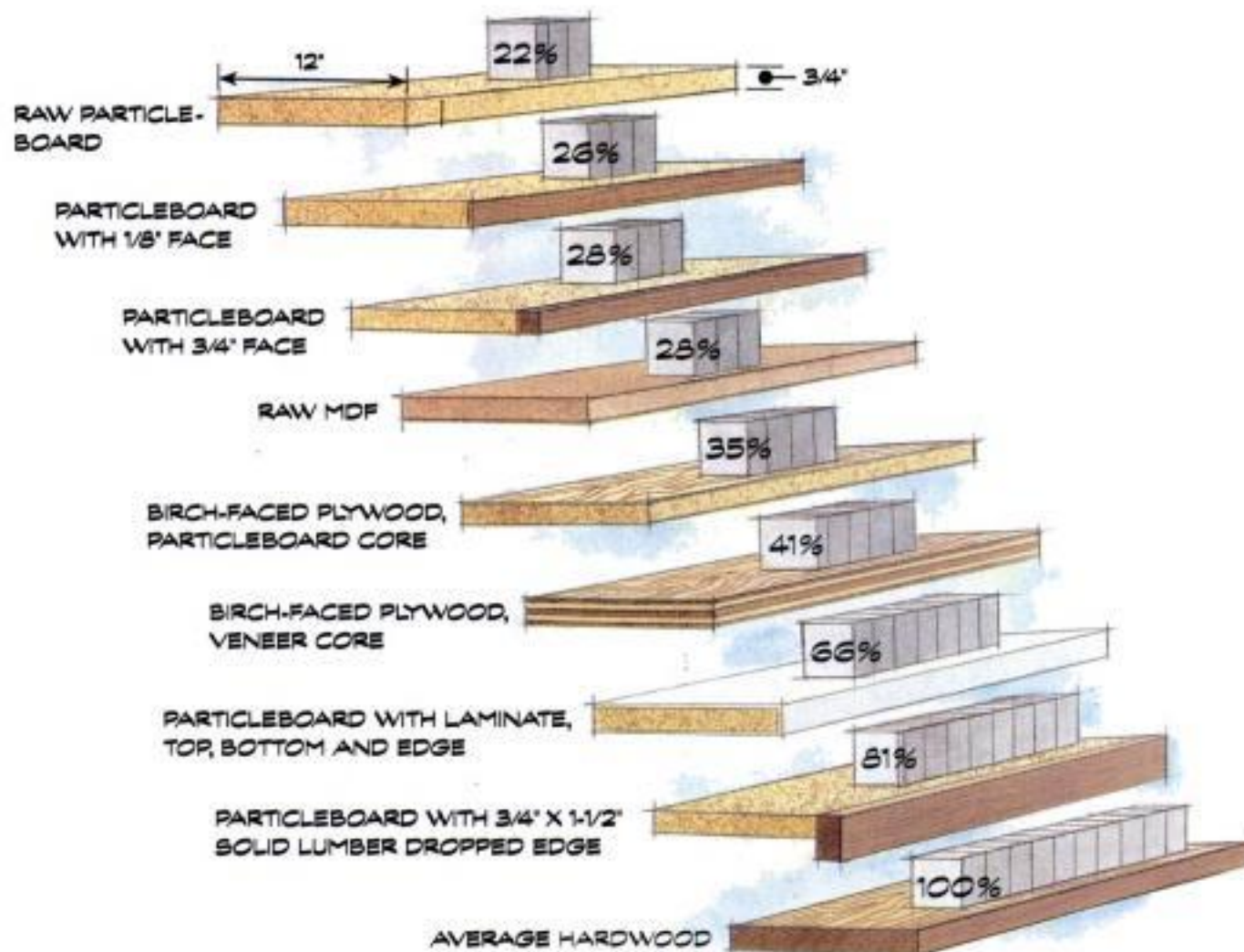
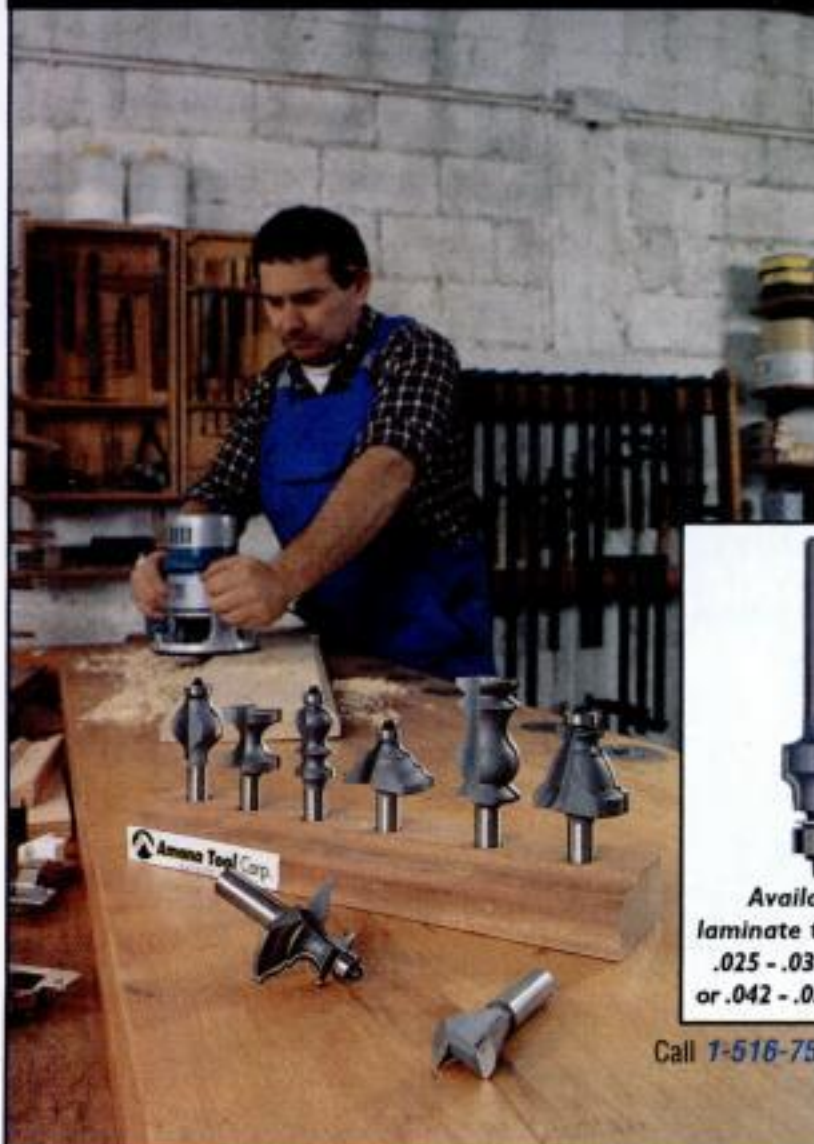


FIG. D
Strengthening Plywood and Composite Shelves

Each of these shelves is the same thickness, length and width. The solid wood shelf holds up four times the weight of the plain particleboard shelf. If the shelves were narrower, adding solid wood and laminate would help even more.

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FIG. E

Add a lip to take advantage of the thickness multiplier effect. If the shelf is made of relatively weak wood, consider using stronger wood for a back lip.

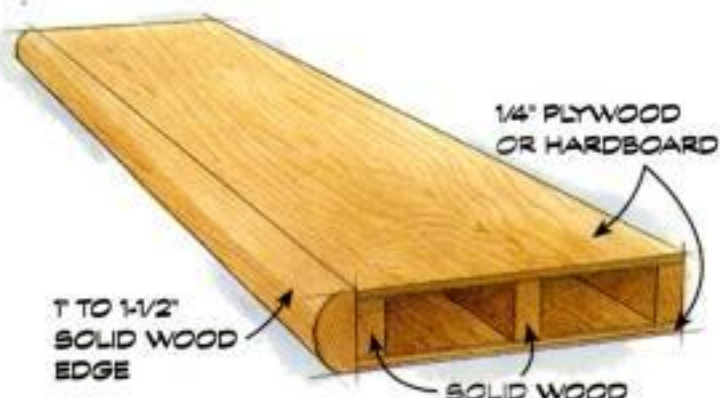
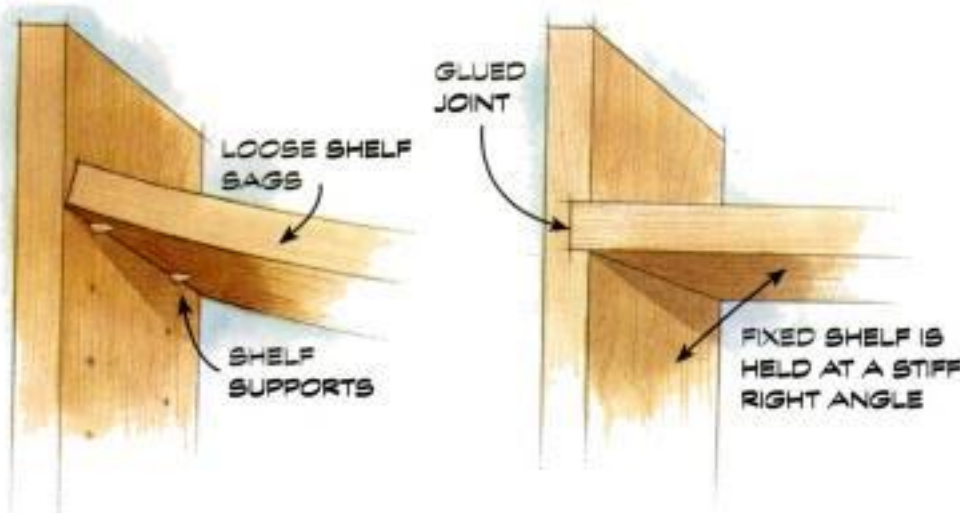


FIG. F

Build a torsion-box shelf for lightweight rigidity. All the parts are glued together. It will almost be as rigid as if it were built of solid wood of the same thickness.

FIG. G

House a shelf to take advantage of the strength of a glued joint. The sides of a case hold a fixed shelf at a rigid right angle. Fasten a fixed shelf to the case's back for even more rigidity.



plywood and strips of solid wood (Fig. F). This type of shelf is based on the engineering principles of a torsion box. It's light in weight but very strong. Use it to carry very heavy loads.

Housing a shelf into the sides of a case will enable the shelf to carry more weight. A fixed shelf is more rigid than a loose shelf because its ends are joined to the sides at a stiff right angle (Fig. G). Some joints are stronger than others, so choosing one kind over another can also effect the strength of a shelf. A plain dado works fine, but a sliding dovetail is stronger because it has more mechanical strength and a larger glue surface area.

Supporting a shelf in the middle strengthens a shelf more than you might think (Fig. H). Weight on one side of a middle support helps hold up weight on the other side, like kids on a see-saw. The net effect is that one long shelf with a center support can hold up more weight than two shorter shelves. **AW**

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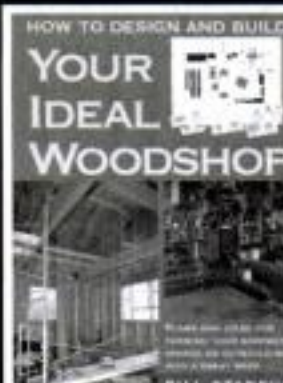
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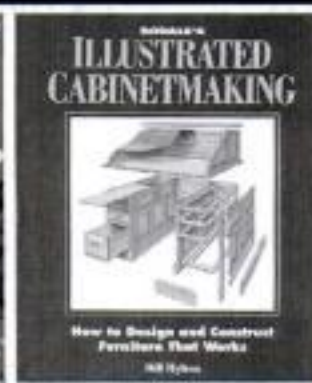
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6 Tips for Stronger Shelves

- Widen the shelf.
- Shorten the shelf.
- Use a stronger material.
- Add thickness.
- Add a lip.
- House the shelf ends.

For More Information

On dimensions for composite woods:
Particleboard and MDF For Shelving
Technical Bulletin
Composite Panel Association
18928 Premiere Court,
Gaithersburg, MD 20879;
(301) 670-0604; www.pbmdf.com

On wood's strength:

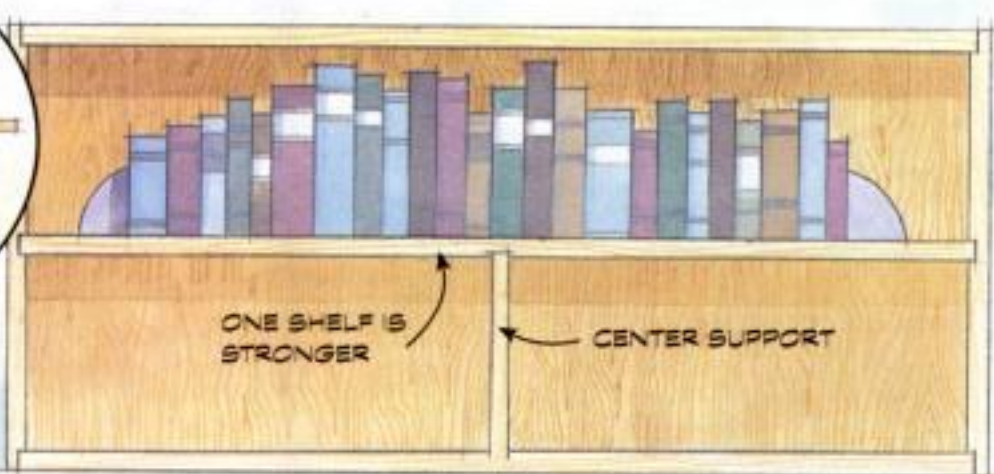
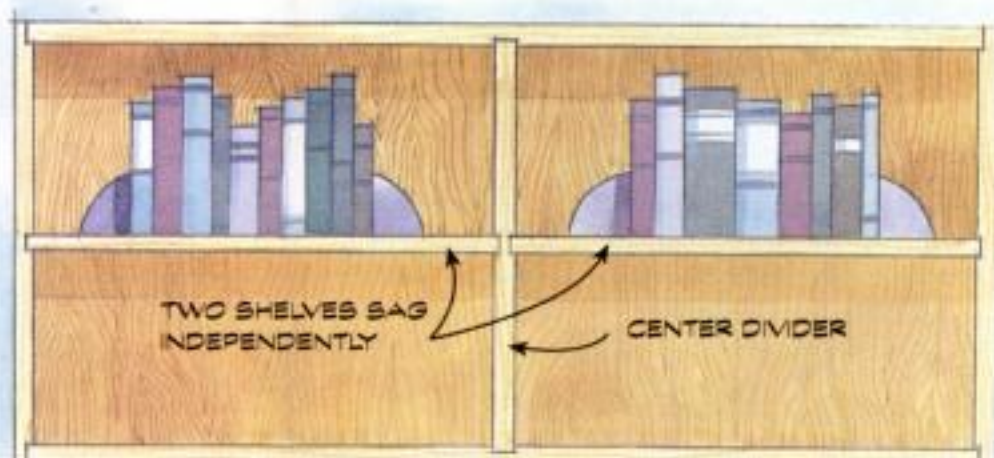
The Wood Handbook
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FIG. H

Multiply strength by adding a center support. The shelf can then hold up more than twice the weight of two shorter shelves.



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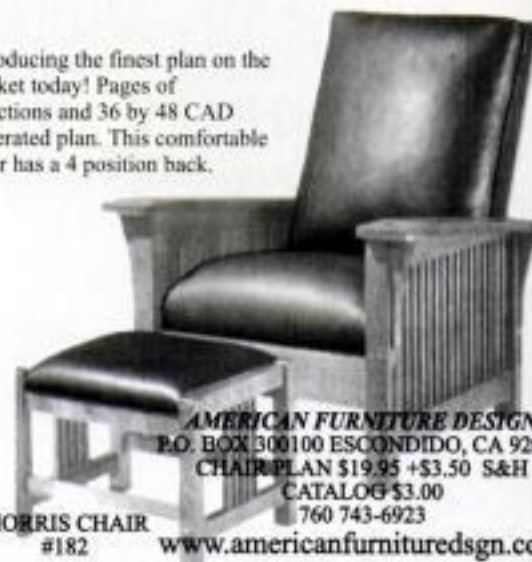
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by George Vondriska

Product Reviews

Performax 16-32 Drum Sander

Anyone who's slaved away with belt and orbital sanders has drooled over those big, wide drum sanders. I know I have, so I checked out models for the home shop. Ryobi makes a popular one that sells for about \$600 and Woodmaster (800-821-6651) makes a larger and more expensive one. I decided to look at the Performax 16-32 drum sander. It's been on the market for a while and I've always wanted to know more about it.

What'll it do?

The 16-32 has a 16-in. wide head, but will sand up to 32-in. wide. More on how that works later. Using a 24-grit belt, you can do abrasive planing, actually surfacing rough lumber. With a 220-grit belt, you're finish sanding. So you can smooth out rough-sawn lumber and get parts ready for finish, all with one tool. You can send through material as thin as $\frac{1}{16}$ in. and up to 3-in. thick.

Does it replace a planer?

Only for small or delicate work. The conveyor is variable speed, and feeds material from 0 to 10 ft. per minute. Lots of planers run at around 16 fpm. With a 24-grit belt in place, I removed about $\frac{1}{64}$ in. per pass in 6-in. wide hard maple. Most planers can hog off more than that. For wider boards it would be

very slow going!

Another thing planers can do is cause "chip out." That ain't gonna happen with abrasive planing—no matter how gnarly the grain. You can even run sheet goods through the sander (a big no-no with planers) and sand down to $\frac{1}{16}$ -in. thick.

How do I sand 32-in. wide stock?

The sanding head is supported on the drive end and open on the other. The cantilever design allows material over 16-in. wide to be handled in two passes (Photo 1). To prevent a sanding ridge on wide material, the head gets tipped up slightly on the outboard side. It's easy to do and is covered well in the owner's manual.

The big question here is rigidity. Will the open-ended design make the head flex up with sanding pressure? The answer is no. Once set, the drum did a great job of holding its position relative to the conveyor.

The extra-wide capacity is a great way to level face frames, frame-and-panel doors, tabletops—any of that big stuff that can be hard to work with a portable sander.

What about abrasives?

Performax recommends using an aluminum oxide or ceramic abrasive with

The 16-32 handles material wider than its 16-in. head. This requires two passes. The conveyor feeds material automatically.

at least an X weight paper back. The paper has to be cut at just the right taper and to the correct length to fit on the sander. You can shop around for rolls of 3-in. wide paper, or buy strips that are pre-cut for the sander. Performax's "Ready to Wrap" paper is available perfectly pre-cut. A box of 4 rolls



Three-in. wide abrasive strips are wrapped around the drum. The end of the strip must be cut at an angle to fit on the drum.



Product Reviews



3

When sanding material wider than the drum, the outboard side must be raised a few thousandths of an inch to prevent a ridge. This results in a slight crown in the material.

for the 16-32 is \$25, and is available in grits ranging from 24 to 220.

You can also buy "Ready to Cut" rolls. These are marked with color-coded lines showing you where to cut the correct taper for any model of Performax sander. They run around \$80 per box. One box will give you 19 applications for the 16-32. This is the way I'd buy sandpaper for this machine.

Once you have the correct taper and length, it's easy to wrap the paper on the drum (Photo 2). Spring-loaded clips hold the ends and apply pressure to take up any stretch you get in the paper. As the abrasive starts to wear, remove it, and wrap it back on in the opposite direction. This will give it added life.

How does it feed material?

Performax uses an abrasive belt to drive material under the sanding head. When you look at the sander, it looks like it sands both sides at once. As good as this tool is, it isn't that good.

The conveyor feeds the material without any slippage. On earlier Performax models, tracking the conveyor was a touchy thing. It was done with bolts on either side of the belt. It's made a lot easier now with ceramic guides that hold the conveyor in place.

Pressure rollers on both the infeed and outfeed side can be fine tuned to prevent snipe and slippage. This adjustment allows you to tweak the

sander for optimum performance.

The sander's DC motor controls the conveyor speed, allowing you to vary the feed rate. The conveyor motor is switched separately from the sanding head. This makes it very easy to set the sander for your first pass, as outlined in the owner's manual.

Is it a pain to set up?

Assembly was straightforward and I have to compliment Performax on their owner's manual. Pictures and descriptions are good and there's tons of great information on how to use the machine.

How's the dust?

This machine will keep your dust centralized, something that's hard to do with portable sanders. Performax recommends 400 to 600 cfm for dust collection. I found dust collection effective even with just a shop vacuum.

So what's it cost?

Start saving your pennies.

Here's the breakdown:

Sander and conveyor only	\$900
Add the stand	\$100
Add the casters	\$80
Add the infeed/outfeed tables	\$80
As shown here	\$1160

This is an expensive addition to your shop. I like the infeed and outfeed tables, but if you bought the basic unit and built it into a bench you could go without them. If you want portability, go for the whole package.

Bottom line: It is a real treat having project parts sanded prior to assembly and being able to level doors and face frames. Not only is it faster than using a finish sander, I like having all my dust centralized. The surface finish this sander left was great! You need to be a little careful with feed rate and material removal, but the 1-hp motor provides enough power. When it comes to surfacing, planers are faster and cheaper. But for light-duty applications, this sander will work as a planer.

Pros:

- variable feed rate
- easy to replace abrasive
- enough power to do the job
- easy to move around the shop
- 32-in. width capacity
- centralized dust

Cons:

- slower than a planer
- cost

Call Performax at (800) 334-4910 for a distributor near you.



Good Scrollsaw, Low Bucks

Scrollsaws are all over the map when it comes to price. For one that performs without emptying your wallet, try Makita's SJ401. \$180 gets you a parallel arm mechanism, 16-in. throat, variable speed (400 to 1,600 strokes per minute), and the ability to use plain or pin-ended blades. When using pin-ended blades, no tools are needed to change blades—a feature I like. Use an Allen wrench to change pinless blades. The table tilts 45-degrees left, and 15-degrees right. Lots of saws in this price range tilt only one way.

The cast iron base absorbs lots of vibration, but needs to be bolted down to hold the saw completely steady. Rubber feet on the base would be a good addition to this saw.

Call Makita at (800) 4-Makita.

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- **ISO 9002 Certification** represents Freud's continuous commitment to quality products.

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The 9301 is available in even lengths from 12 in. to 36 in., 48-in., and 60-in. long. Prices range from \$47 to \$213 per pair.

Available through Accuride distributors.



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Countersink Anything

Product Reviews

If you're looking for a countersink that works on wood, wood products, and even tough stuff like acrylic, try The Beal Tool Company. They've got one that works great in *all* of these materials, even acrylic. The cutting flute didn't clog and the surface finish was excellent. Not only that, its diameter is big enough to put an 82-degree chamfer on holes up to 1-in. dia. The 3/8-in. shank fits most hand drills, but the performance was best when used in my drill press.

Cost \$25; The Beal Tool Company; (800) 331-4718.

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Nobody likes rust on their tools, so why not put a bullfrog in your toolbox? Not just any bull frog, but a Bull Frog VCI emitter. The emitter is a device that contains vapor corrosion inhibitors (VCIs). The VCIs form a layer that



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6 3-in. strips \$7

1 Cup \$7

1 10-in. shield \$10

Call Bull Frog at (800) 854-3146.

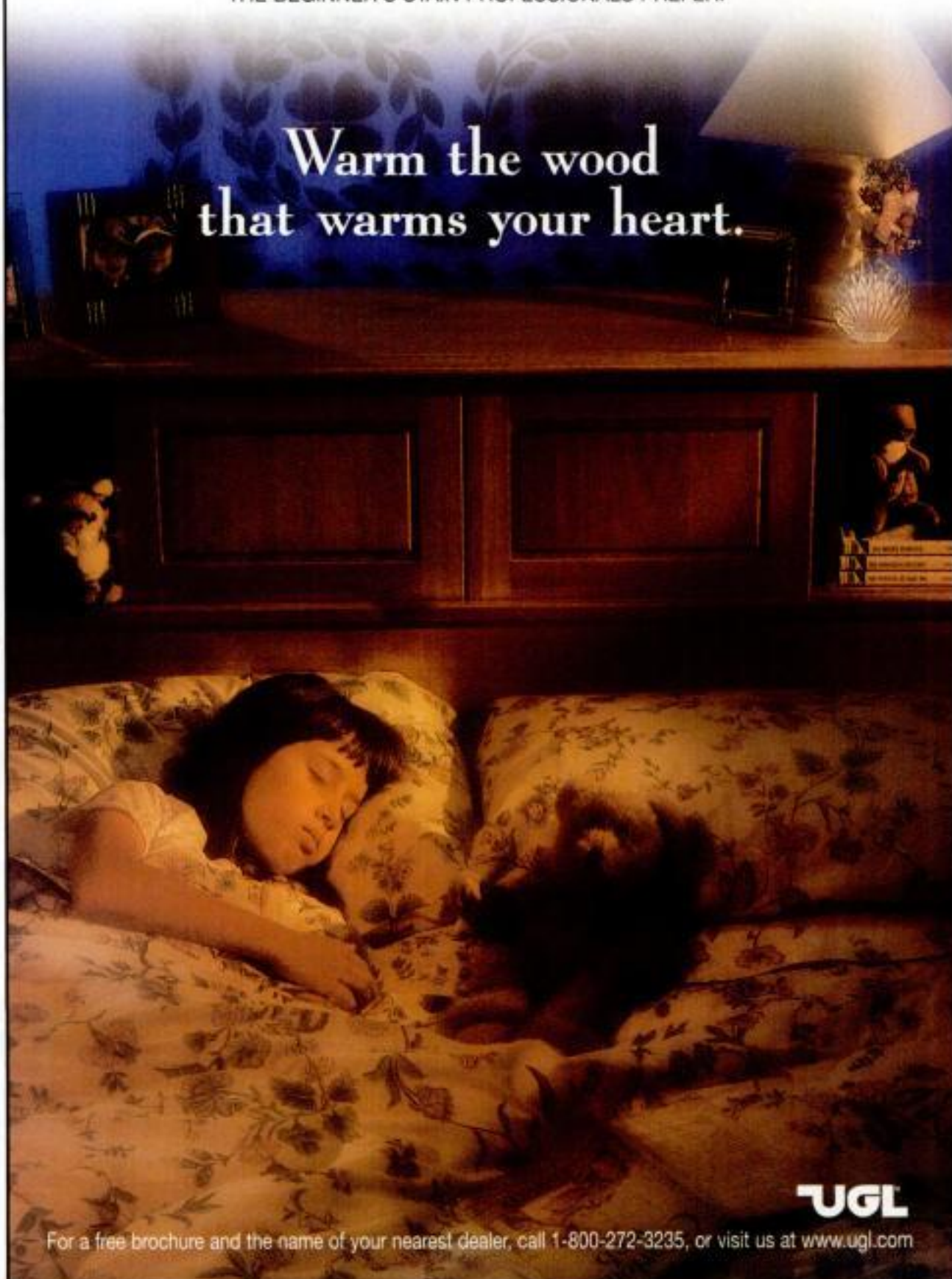
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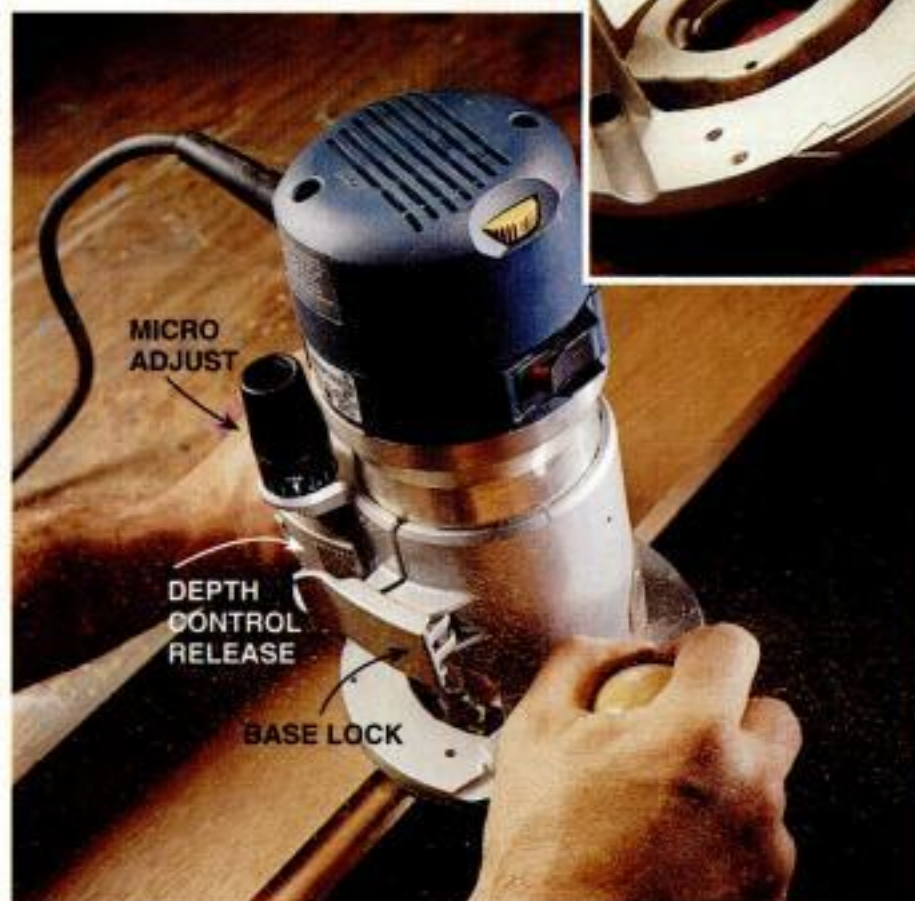
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Product Reviews

One Great Router

PHOTOGRAPHY: BILL ZUEHLKE PHOTOGRAPHY



SPRING LEVER FOR GUIDE BUSHINGS

Bosch's 1617 EVS router has been out for a while, which gave me a chance to put it through its paces. It's now become one of my favorites. It's light in weight, partly due to the magnesium base. The 2-hp motor has a soft start and is variable speed, ranging from 8,000 to 25,000 rpm.

Two things made me truly love this router. Bosch has made it easy to change the depth of cut and the guide bushings.

To change depth, release the clamp that holds the base to the motor and dial the micro adjust. If you want to make big adjustments, a quick release lets you advance the router in bigger increments. The quick release also made it easy to remove the motor from the base to change bits. This is one of the all-around best routers I've put in a router table.

A spring-loaded clip holds guide bushings (an optional accessory) in place. To change or remove them, simply slide the retainer out of the way and out pops the bushing. I had no trouble with guide bushings staying in place under a load.

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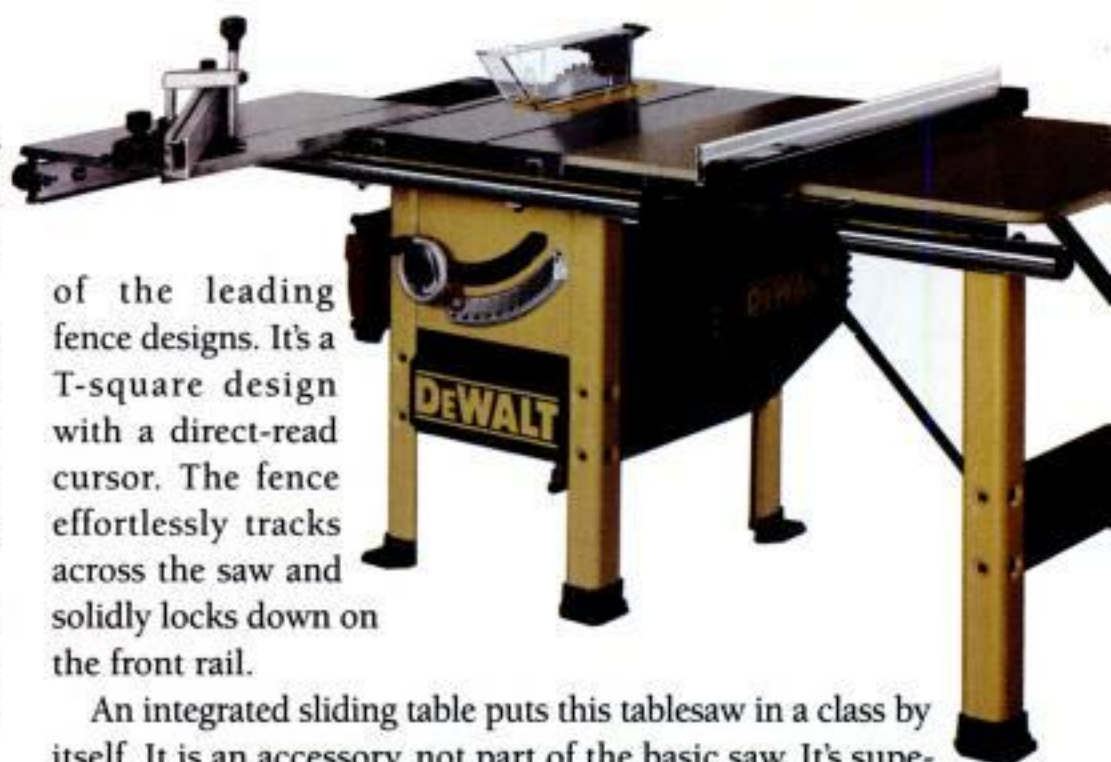
Innovative DeWalt Tablesaw

If you're in the market for a stationary tablesaw, consider DeWalt's innovative new entry. Although it won't be available until December 1999 at the earliest, we're already impressed, especially with the accessory sliding table.

The DW746 outperforms a standard contractor's saw yet is less expensive than a cabinet saw. It is driven by a 110-volt, 1 3/4 hp motor mounted inside the saw. (Contractor's saws generally have 1 1/2 horsepower motors mounted outside the saw.) The arbor is driven by a single belt and is mounted on robust trunnions to reduce vibration.

This saw takes up less space than a contractor's saw. The motor doesn't hang off the back side, so you can tuck the saw up against a wall. The rails are shorter, too, but you can still rip wood up to 30-in. wide.

Here are several other user-friendly features: The blade tilts to the left, away from the fence, which reduces the danger of kickback when making bevel cuts. The power switch is large and easy to turn off with a bump of your knee. (However, it is not a magnetic switch.) Dust collection is enhanced by a shroud that completely encloses the saw blade. There is a 2 1/2-in. dia. port on the shroud for hooking up your dust collector hose. DeWalt's new rip fence combines the best features



of the leading fence designs. It's a T-square design with a direct-read cursor. The fence effortlessly tracks across the saw and solidly locks down on the front rail.

An integrated sliding table puts this tablesaw in a class by itself. It is an accessory, not part of the basic saw. It's superior to a home-made crosscut sled, because you can easily cut panels at any angle, not just 90 degrees. The sliding table is made of cast iron, has its own miter slot, rides on two ball-bearing slides and offers 30-in. of cross-cut capacity.

Street price for a basic saw is expected to be around \$1,000. Other accessories include a 52-in. rail system, cast iron extension wings, outfeed table and a mobile base.

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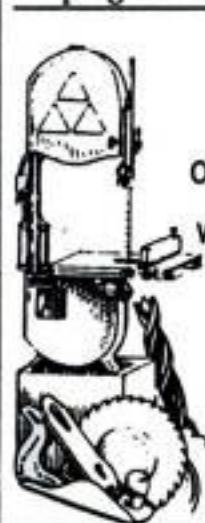
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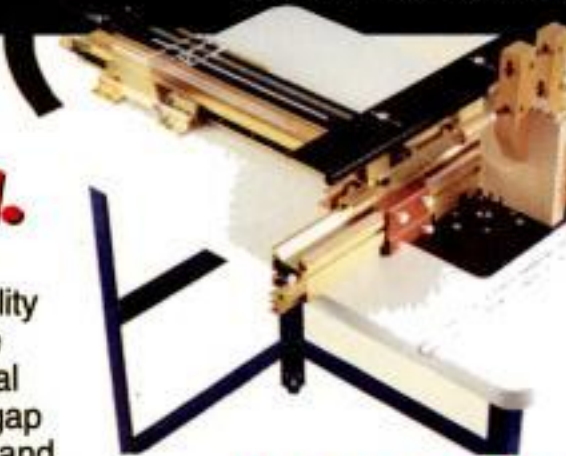
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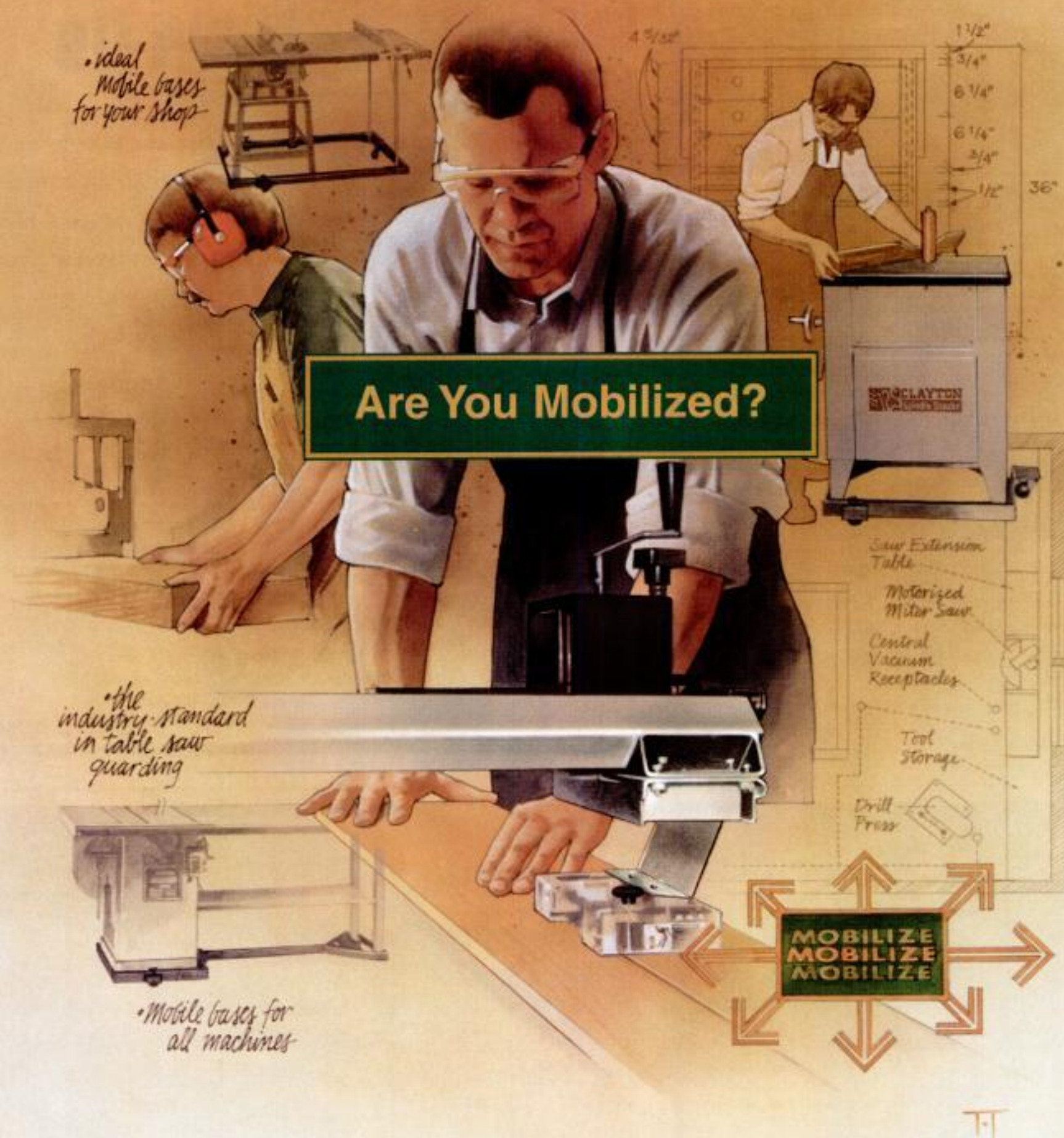
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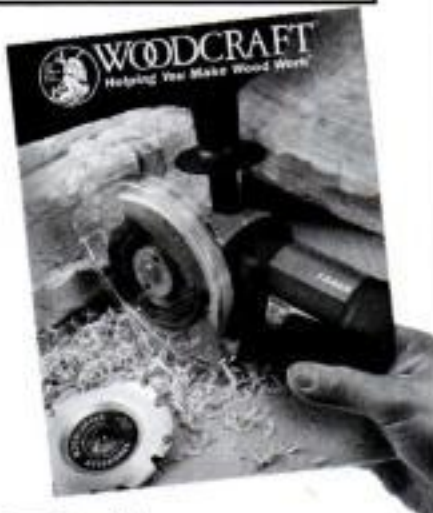
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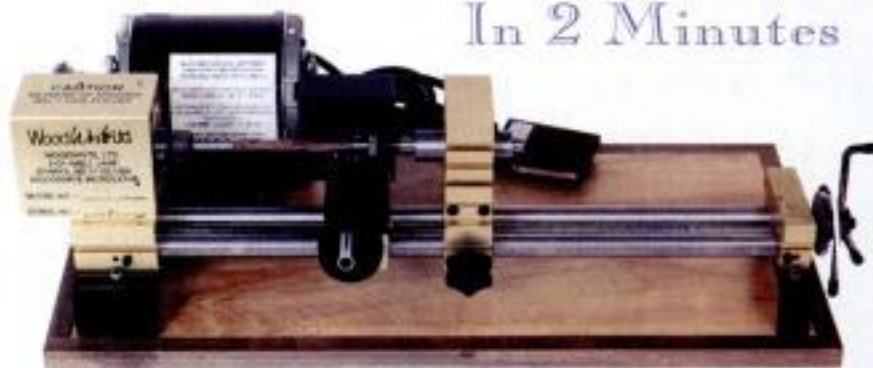


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~~\$129.99~~ **\$119.99**

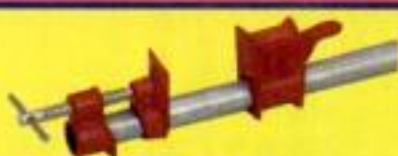
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1/2" CLAMP
1-3/8" throat depth

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- 1725 RPM disc speed

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- 12" crosscut capacity at 90°
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- 13.0 amps, 4000 RPM
- Includes 60 tooth carbide blade & blade wrench
- 0-48° bevel capacity
- Factory reconditioned, factory perfect

Capacity: 5-1/4" crown moulding vertically; 5-1/4" base moulding vertically; 4-1/2" x 12" @ 90° miter; 4 x 8 @ 45° miter

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7-1/4" 32T CIRCULAR SAW BLADES

Durable steel blades for general purpose wood cutting.

- Maximum RPM: 7000
- 5/8" arbor
- Diamond knockout

SET OF 10

Get 10 blades now and save!

~~\$9.99~~ **\$7.99**

ITEM 39804-1KEA

ONE BLADE

ITEM 39805-1KEA

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4 SPEED ROTARY TOOL KIT

Versatile tool is ideal for shaping, sanding, deburring, grinding and polishing. Includes 30 pc. accessories packed neatly in a blow mold case.

Motor: 120V, 60 Hz, direct drive; 4 step speeds: 6500, 10,700, 14,000 and 22,000 RPM; Collet sizes: 1/8" and 3/32" diameter

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16 PC. SET

- 16 sizes from 1/4" to 2-1/8" by 8ths

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ITEM 39812-1KEA

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- 20 sizes from 1/4" to 3/4" by 16ths, 7/8", 15/16", 1" to 2" by 8ths

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ITEM 39813-1KEA

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- 5/8"-11 spindle with 7/8" arbor adapter
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- Heavy duty Johnson's motor
- 6 torque clutch settings
- Includes charger, 18V battery & carrying case, 6 pc. screwdriver bit set, 6 pc. drill bit set

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18V REPLACEMENT BATTERY

ITEM
37145-4KEA

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HEAVY DUTY 16 GAUGE BRAD TACKER

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ITEM
33075-3KEA

DELTA® 12-1/2" PORTABLE PLANER

Factory reconditioned, factory perfect
Capacities: 12-1/2" width, 6" thick, 1/8" maximum depth of cut; Table size with extensions: 12-1/2" x 23-5/8"

ITEM
51706-2KEA

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ITEM
39917-1KEA

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Electric Power Tools

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- Preset depth stops: 0, 10, and 20
- Includes 4" carbide tipped blade, dust bag, high impact base and fence, carbon brush set, 4mm hex wrench, arbor wrench, glue bottle, assorted biscuits (10 each of 0, 10, and 20 gauge)
- 4" blade diameter
- Tool weight: 6-1/2 lbs.
- 115V, 6.4 amps, 10,000 RPM, 60 Hz, single phase

ITEM
38437-2KEA

CARBIDE TIP PLATE JOINER REPLACEMENT BLADE

- Blade teeth: 6 carbide tip teeth
- Blade diameter: 4"
- Maximum RPM: 12,000

ITEM 38840-0KEA

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DOVETAIL MACHINE

Just place stock and pull the cam handles to positively lock material in place. Allows cutting tails, pins, half blind, and standard dovetails. Accepts stock up to 12" wide and 1-1/4" thick. Includes 1/2" template.

ITEM 34102-8KEA

~~\$48.99~~ **\$39.99**

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10" INDUSTRIAL TABLE SAW

Die cast aluminum table 26" x 16", has adjustable 17-7/8" x 2" rip fence and inch/metric scale for precise cutting.

- Maximum depth of cut at 90°: 3-1/8"; at 45°: 2-1/2"
- Motor: 2 HP, 115V, 60 Hz, 10 amp, 4500 RPM
- Blade capacity: 10" with 5/8" arbor
- Miter gauge adjusts 0° - 60° left and right
- Blade & stand sold separately
- Shipping wt.: 36 lbs.

ITEM 38533-1KEA

10" 40 TOOTH CARBIDE TIP SAW BLADE

Molybdenum carbide
M2 tips; 5/8" arbor

ITEM 00529-4KEA

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Five speeds: 620, 1100, 1720, 2340 and 3100 RPM; 2" spindle stroke, 8-1/4" swing. Column diameter: 1-13/16"; Table dimensions: 6-1/2" x 6-5/8"; Tilts 45° left and right; Base dimensions: 11-1/2" L x 7-1/2" W x 1-5/8" H; Height: 22-1/2"

ITEM 34231-6KEA

5 SPEED BENCH DRILL PRESS WITH KEYED CHUCK

- 620 to 3100 RPM • 1/2" chuck
- 1/3 HP, 2" spindle stroke, 8-1/4" swing
- 6-1/4" square table • 22-1/2" height
- 8-1/4" max. distance spindle to table

ITEM 01844-2KEA

~~\$59.99~~ **\$48.99**

CENTRAL MACHINERY®

DRILL 1/4", 3/8", AND 1/2" SQUARE HOLES

MORTISING MACHINE

Make a square hole in the fraction of the time it takes by hand! Easier layout for professional mortise and tenon joints in furniture, cabinets, and restoration projects. Fence with hold down clamp keeps workpieces from lifting off the table. Large capacity - up to 5" maximum height. Includes fence, workpiece clamp, and 1/4", 3/8", and 1/2" mortising chisels and bits.

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ITEM 35570-5KEA

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LIMITED QUANTITIES

7-1/4" CIRCULAR SAW

- Factory reconditioned, factory perfect
- Handy scales and cutting guide
- 10 amps, 2-1/3 HP, 4600 RPM
- Maximum cut @ 90° 2-7/16", @ 45° 1-15/16"

ITEM 06188-4KEA

MOLY CARB® CIRCULAR SAW BLADE

Precision ground M2 molybdenum tips for a sharp cutting edge

ITEM 38534-0KEA

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DELTA TOOLS	
Model	Description
31-750	New Bench Random Orbit Sander
28-150	NEW 9" Bench Band Saw
50-860	850 CFM Air Cleaner
31-695	6" Belt/9" Disc Sander
23-710	Sharpening Center
31-460	4" Belt/Disc Sander
40-560	16" 2 speed Scroll Saw
40-540	16" variable speed Scroll Saw
11-990	12" Bench Drill Press
11-990	32" Radial Bench Drill Press
43-505	1/2" Bench Router/Shaper
22-540	12" Bench Top Planer
22-560	12-1/2" Planer w/ extra knives
36-865	Versa Feeder Stock Feeder
36-220	10" Compound Miter Saw
37-070	6" w/spd Bench Jointer
14-650	Hollow Chisel Mortiser with chisels and bits
17-900	16-1/2" Floor Drill Press
17-920	Mortise Chisel Kit
36-285	8-1/4" Builders Saw w/ stand
34-555	Sliding Table
36-250	10" Slide Compound Saw
31-780	Oscillating Spindle Sander
46-700	12" Wood Lathe
40-650	Q3 18" Scroll Saw
36-905	30" Unifence
36-905	50" Unifence
36-444	10" Contractors Table Saw
33-330	10" Radial Arm Saw
37-285	NEW 6" Jointer w/ stand
37-380	NEW 8" Professional Jointer
Single Stage Dust Collectors	
50-550	1-1/2 HP, 1200 CFM
50-851	2 HP, 1500 CFM

The following tools have a \$50.00 rebate! Price shown is before rebate.

36-475	10" Platinum Edition Contractors Table Saw w/ 30" unfence, cast iron wing, table board & carbide blade	849
22-675	DC380 15" Planer	1175
28-275	14" Band Saw 3/4 HP	595
28-280	14" Band Saw 1 HP motor with enclosed stand	739
28-255	14" Platinum Edition Band Saw - 1 HP w/ mobile base, 18" rip fence, & 3/8" blade	849
31-280	Sanding Center w/ stand	789
37-190	6" Deluxe Jointer	603
37-195	6" Professional Jointer	625

MILWAUKEE TOOLS

6527-6	Sawzall with case	343
6537-226527	quick lok blade change	224
0407-2212V	Drill w/keys chuck&2 batt	380
0224-1	3/8" Drill 4.5 amp magnum	236
0234-6	1/2" Drill 4.5A mag 0-850 rpm	255
0235-6	1/2" Drill w/keyless chuck	255
0244-1	1/2" Drill 4.5A mag 0-600 rpm	255
0222-1	3/8" Drill 3.5 amp 0-1000 rpm	128
0228-6	3/8" Drill 3.5 amp 0-1000 rpm	207
0375-6	3/8" close quarter drill	255
0379-1	1/2" close quarter drill	288
0546-6	Screwdriver 200 & 400 rpm	150
0547-6	6546-6 w/bits, 1/4" chuck & c/s185	112
5399	1/2" D-handle Hammer Drill Kit	356
5397-6	3/8" w/spd Hammer Drill Kit	275
5371-6	1/2" w/spd Hammer Drill Kit	360
6142	4-1/2" Grinder w/cse & acc.	224
6494-6	10" Compound Miter Saw	585
6266-6	Top Handle Jig Saw	315

FREUD CARBIDE TIPPED SAW BLADES 5/8" Bore - Industrial Grade

Item	Description	Teeth	List Sale
L72M010	Gen Pur. A.T.B. 10"	69	42
L82M010	Cut-off 10"	60	32
L84M011	Comb 10"	50	78
L85R010	Super Cut-off 10"	80	115
LM72M010	Ripping 10"	24	69
L73M010	Cut off 10"	60	84
L87R010	Thin Kerf 10"	24	72
L88R010	Thin Kerf 10"	60	88
L99R010	Ultimate 10"	80	128
F19M010	Compound Miter 10"	60	88
F410	Quiet Blade 10"	40	95
SD308	8" Dado - Carbide	230	119
SD508	8" carbide w/case & shims	344	172
FB100	16 piece Forstner Bit Set	338	194
94-100	5 pc. Router Bit Door System	320	169
FT2000E	Plunge Router		185

HITACHI TOOLS

C8FB2	8-1/2" Slide Compound Saw	1169
C10FS	10" Slide Compound Saw	1627
C15FB	15" Miter Saw	1346
C10FCD	NEW 10" dual bevel Compound Miter Saw	550
NV45AB	Cool Roofing Nailer	935
NT50AE	New Pinner 3/4" - 2"	379

MAKITA TOOLS

Model	Description	List Sale
50900D	3-3/8" Saw Kit 9.6 volt	280 139
DA391D	3/8 angle Drill 9.6V	166 95
DA391DW	3/8 angle Drill Kit 9.6V	341 139
6095DWE	9.6 volt Drill Kit w/2 batt	125
6095DWE2	6095DWE w/flashlight	139
632007-4	9.6 volt Battery	47 30
632002-4	7.2 volt Battery	39 28
NEW 18 VOLT MAKITA TOOLS		
6343DWA	1/2" Drill Kit	255
5620DWA	6-1/2" Circular Saw Kit	255
DK1016	1/2" Drill & 6-1/2" Saw combo kit	389
CORDLESS DRILLS		
WITH 2.0 AMP HIGH CAPACITY BATTERIES		
6213DWA	12V 3/8" Drill Kit	325 169
6233DWA	14.4V 3/8" Drill Kit	358 205

9900B	3"x21" Belt Sander w/bag	347 165
99240B	3"x24" Belt Sander w/bag	360 175
N1900B	3-1/4" Planer with case	263 142
1912B	4-3/8" Planer	352 205
N5514B	4" Disc Grinder 4.5 amp	118 65
DA3000R3/8"	Angle Drill	355 185
2708W	8-1/4" Table Saw	637 295
6405	3/8" Drill Rev. 0-2100 rpm	115 65
6013BR	1/2" Drill Rev. 6 amp	270 149
9401	4" x 24" Belt Sander w/bag	458 219
5007NBK7-1/4"	Circ Saw w/ case	250 125
LS1011	10" Slide Compound Saw	995 429
LS1211	12" Slide Compound Saw	1620 695
3901	Plate Joiner Kit	376 159
3612C	3 HP Plunge Router	492 265
LS1040	10" Compound Miter Saw	460 259
LS1013	10" Dual Compound Slide Miter Saw	1088 599
BO5010	5" Random Orbit Sander	142 69
LS1220	12" Compound Miter Saw	379
9227C	7/9" Polisher	350 195
SJ401	16" Bench Scroll Saw	300 175
2702	8-1/4" Table Saw	592 299
2703	10" Table Saw	592 309

SENCO AIR NAILERS

SNF1+	Finishing Nailer 1" - 2" w/ cs	448 299
SN545	Stapler 7/16" crown, 1" - 2"	540 365
SLP20	Pinner w/cs 5/8" - 1-5/8"	422 205
SKS	Stapler 5/8" - 1-1/2"	390 269
SN70	Framing - Clip Hd 2 - 3-1/2"	725 449
SN65	Framing - Full Hd 2 - 3-1/2"	709 369
SN600	NEW Framing 2 - 3-1/2"	699 369
SNF40	Finish Nailer 1-1/4" - 2-1/2"	569 349

BOSTITCH AIR NAILERS

Model	Description	List Sale
N80S-1	Stick Nailer	325
RM45	Coil Roof Nailer 3/4" - 1-3/4"	845 349
N60FN-2K	Finishing Nailer w/ case	557 269
BT35-2K	Brad Tacker 5/8" - 1-3/8" w/ case, oil, & brads	279 125
MMFIS	Flooring Stapler 15 gauge	902 539
S32SX-1K	Finish Stapler 1-1/2" - 1-3/8" w/ case & oil	269 135

JORGENSEN ADJUSTABLE HANDSCREWS

Item#	Length	Capacity	List Sale of 6
#0	8"	4-1/2"	20.35 12.50 69.95
#1	10"	6"	23.30 13.50 73.95
#2	12"	8-1/2"	26.75 15.75 88.95
#3	14"	10"	33.85 19.35 109.95

PONY CLAMP FIXTURES

Model	Description	List Sale of 12
50	3/4" Black Pipe	15.45 8.50 94.00
52	1/2" Black Pipe	12.65 6.95 79.00

PANASONIC CORDLESS

EY6431NQKW	NEW 1/2" 15.6V drill kit with two 3 amp-hr Ni-Mh batteries, 45 minute charger, & case	369 205
EY6431FQKW	NEW 1/2" 15.6V drill kit with two 2 amp-hr Ni-Cad batteries, 30 minute charger, & case	339 189
EY6407NQKW	NEW 1/2" 12V drill kit with two 3 amp-hr Ni-Mh batteries, 45 minute charger, & case	339 189
EY6406FQKW	NEW 3/8" 12V drill kit with two 2 amp-hr Ni-Cad batteries, 30 minute charger, & case	305 169
EY3503FQKW	5-3/8" 12V Wood Cutting Circular Saw Kit	500 259

BIESEMEYER FENCES

B-50	50" Commer. Saw	443 325
T-SQUARE 52	52" Homeshop	360 275
T-SQUARE 40	40" Homeshop	335 255
T-SQUARE 28	28" Homeshop	325 245

AIRY AIR NAILERS

Model	Description	List Sale
02415K	Brad Nailer 3/8" - 1-9/16"	180 96
0626SK	1/4" Crown Stapler 3/8" - 1-1/4"	194 89

STABILA LEVELS

25010	10' die cast Torpedo Level	19.95
24640	24' Level w/ hand holes	62.20 47
24670	48' Level w/ hand holes	79.70 59
24632	NEW "Jambor Set" designed for setting door jambs. Includes 78" level and 32" level	129

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DEWALT TOOLS

Model	Description	List Sale
DW134K	1/2" right angle Drill	590 329
DW321K	Top Handle Jigsaw Kit	300 164
DW364	7-1/4" Circ. Saw w/bake	294 155
DW610	1-1/2 HP 2 handle Router	266 149
DW411K	1/4 sheet Palm Sander w/ case	88 58
DW682K	Biscuit Joiner with case	448 169
DW705	12" Compound Miter Saw	734 359
DW621	2 HP Plunge Router	400 199
DW675K	3-1/8" Planer with case	292 164
DW431	3 x 21 w/spd Belt Sander	338 188
DW421	5" Palm Ran. Orb Sander	144 74
DW423	Palmgrip Random Orbit Sander - variable speed	170 89
DW421 & DW423	come with Free DW4317 case!	
DW272	Drywall Gun, 0-4000, 6.3 amp	160 95
DW276	Drywall Gun, 0-2500, 6.5 amp	160 95

DEWALT CORDLESS DRILLS

DW972K-2	3/8" variable speed w/ two 12V XR batteries	362 184
DW991K-2	3/8" variable speed w/ two 14.4V XR batteries	415 209
Above drill kits come w/ charger & steel case!		
DW991KS-2	DW991K drill, DW935 trim saw, 2 XR batteries & case	345
DW911	NEW jobsite Radio & Charger	149

DEWALT 18 VOLT CORDLESS TOOLS

DW933K	Jigsaw Kit	468 269
DW938K	Recipro Saw Kit	520 269
DW995K-2	1/2" Drill Kit w/ 2 batt.	250
DW997K	1/2" Drill/Hammer Drill Kit	454 249
DW936K	5-3/8" Saw Kit	458 249
DW995KS-2	DW995K Drill, DW936 Saw and case	385
DW995KC-2	DW995K 18V drill kit, DW938 18V reciproc. saw, & case	395

DEWALT BENCH TOP TOOLS

DW708	12" Slide Miter Saw	546
DW788	20" Scroll Saw	546
DW733	12" Planer w/ extra blades	399
DW744	10" Portable Table Saw	549
DW756	6" Bench Grinder	164 75
DW758	8" Bench Grinder	184 115

DAVID WHITE INSTRUMENTS

Model	Description	List Sale
LP6-20A	Sight Level package-20x	329 239
LP6-20XLA	LP6-20A with 9056 tripod and 7620 rod	409 269
LT8-300	Level Transit - 26x	739 539
LT8-300P	above Level with optical plumb	869 629
LT8-900	Level Transit - 20x	419 299
LT8P-900	Above level with tripod and rod	615 395
AL76-900	Automatic Level - Transit - 18x	666 479
AL76-900	above Level with tripod & rod	799 549
AL8-225	Automatic Level - 22x	583 289
AL8P-22	Above level with tripod & rod	584 349
AL8-265	Automatic Level - 26x	854 325
AL8P-26	Above level with tripod & rod	854 380

BOSCH

Model	Description	List Sale
1587VS	Top Handle "CLIC" Jig Saw	292 139
1587AVSC	1587VS Saw Kit with case and New Progressor blades	155

1584VS or 1587VS with steel case and 30 Bosch blades

1295DH	5" Random Orb Palm Sndr	145 89
1274DVS	3"x21" w/spd Belt Sander	301 175
1278VSK	1-1/2"x12" Belt Sander	218 129
1276DVS	3"x24" v/s Belt Sndr	379 219
1276DVS	4"x24" v/s Belt Sndr	408 229
194VSRK	1/2" w/spd Drill w/ case	303 159
1613EVS	2HP v/s Plunge Router	369 199
1634VSK	Recip Saw 10.5 amp	335 185
3315K	12V T-handle Drill Kit	345 159
3618K	14.4V Drill Kit	354 174
3107DVS	5" Random Orbit Sander	165 98
3107DVS	3107DVS with case	195 118
3725DVS	5" Random Orbit Sander	256 145
3727DVS	6" Random Orbit Sander	266 148
3915	10" Slide Compound Saw	1050 499
3912	NEW 12" Cmpnd Mitr Saw	638 299
11224VSR	7/8" SDS Rotary Drill	404 229
1374AES	5" Grinder - 8.5 amp	245 145
1347AK	4-1/2" Grinder with case	159 92
1638K	Drywall Cut-out Unit	165 105
1617	1-3/4 HP Router - 2 handle	159
1617EVS	2 HP Router w/ variable speed - 2 handle	189
1618	1-3/4 HP Router - "D" handle	179
1640VS	NEW Power Tenon Saw	200 129
1640VSK	NEW Power Tenon Saw Kit	229
3850	18V cordless Drill Kit	269

JDS AIRTECH AIR CLEANERS

Model	Description	List Sale
750	12"x24"x28" 1/4 hp	
	200 CFM - 750 CFM	249
8-12	20"x24"x44" 1/3 hp	
	800 & 1200 CFM	479

RYOBI SPECIALS

RE600	3 HP Plunge Router w/spd.	500 239
WDS1600	16" x 32" Drum Sander	980 569
Above sander comes with stand		
JM80K	Plate Joiner with case	218 105

JET TOOLS

JJ60S	6" Jointer - open stand	429
JJ6CSXW	6" Jointer - closed stand and extra knives	499
JJ8CS	8" Jointer - closed stand	519
JJ8CS	8" Jointer - closed stand	1189

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Portable Shaving Horse



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Often these craftspeople brought their shaving horse into the woods, rather than hauling the heavy, green timber back to their shop.

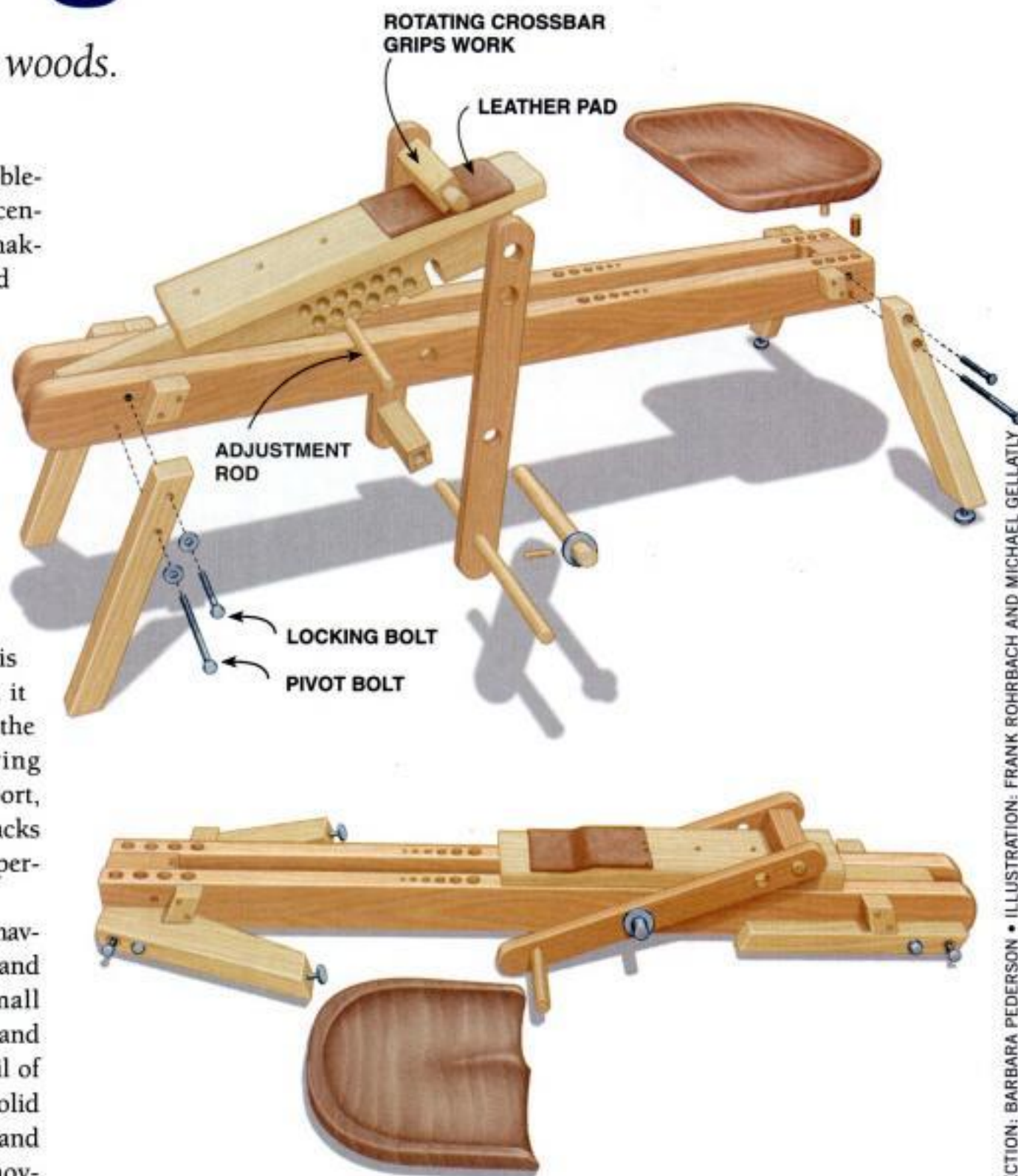
For today's woodworker this is less of a necessity, but many find it refreshing to occasionally work in the woods or backyard. Most shaving horses are cumbersome to transport, but this horse knocks down and packs flat, yet it is still rigid enough to perform admirably.

The most notable feature of this shaving horse is that the legs, bridge and yoke fold up into a package small enough to tuck under your arm and store against the wall. The split rail of the main bench is as strong as a solid plank without the added weight, and the seat is both adjustable and removable. The adjustable bridge height and seat position make it a breeze to work on both long and short stock without awkwardness.

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This unique shaving horse design was submitted by Russ Filbeck, San Diego, Calif.



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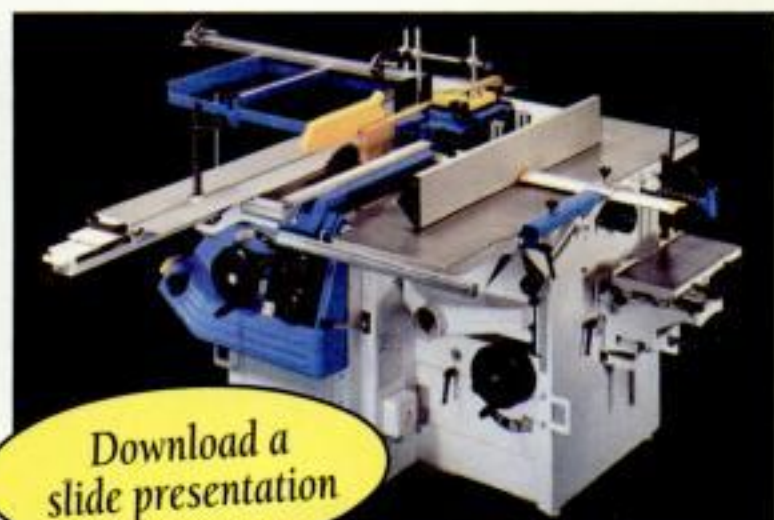


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