TAUNTON'S
Fine WoodWorking

October 1996, No. 120
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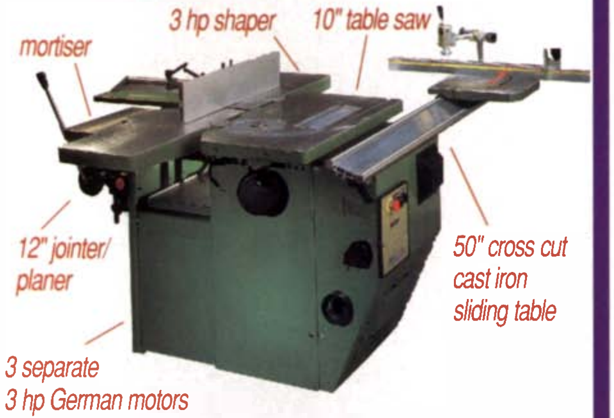
Tablesaw blades

Making an end table

Aged paint finish

Supporting shelves

Making Full-Sized Doors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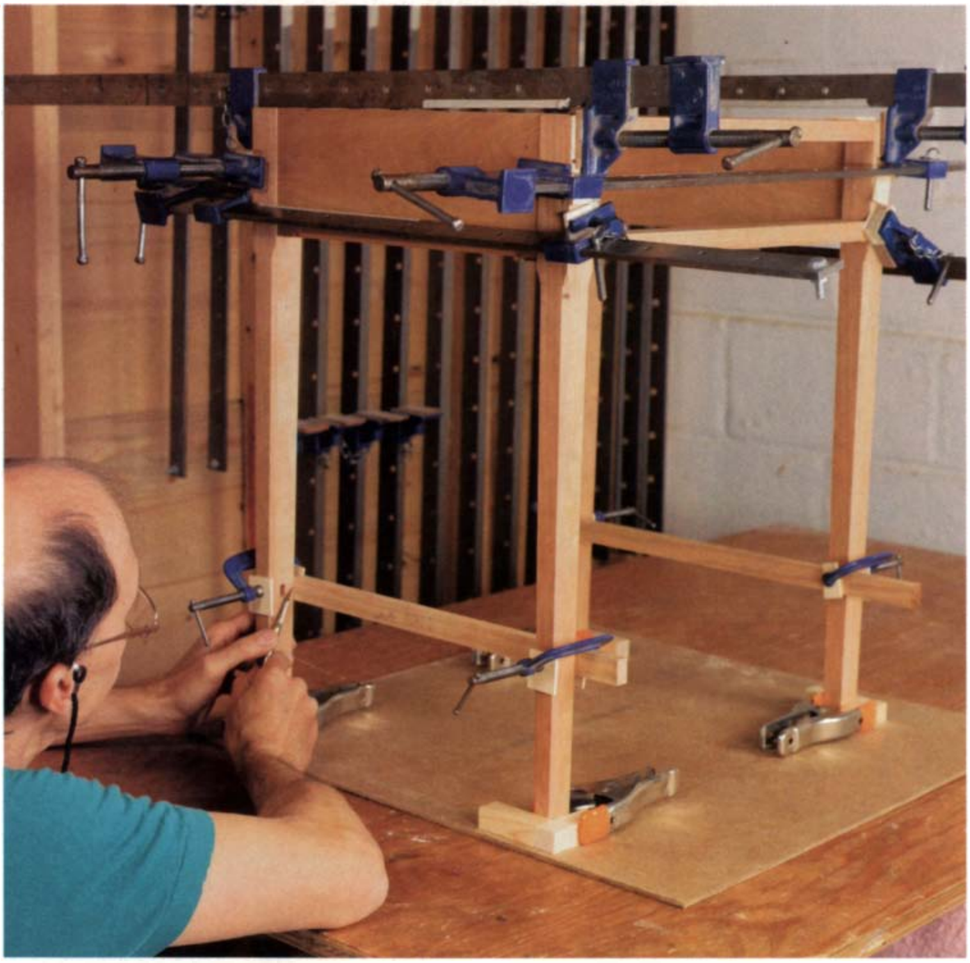
DEPARTMENTS

On the Cover:
Joseph Beals checks for twist in a door frame by sighting a line between two winding sticks. He explains how he makes traditional frame-and-panel doors beginning on p. 58. Photo: William Duckworth



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Chisel handles to order, p. 44

Machine dovetails, p. 54

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Antique painted finish, p. 64

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Tropical hardwoods revisited—I have been a designer and builder of fine furniture for 26 years. Seven years ago, I became concerned about the decimation of our tropical rain forests and stopped working with those woods. Some of your articles in the past have bothered me when you reported on the use of endangered material in furniture pieces. Now this final outrage: In your June issue, you have begun to promote the logging of the rain forest (*FWW* #118, pp. 62-68). I believe this to be criminal. I wish to cancel my subscription to your magazine, and I will try to persuade others to do the same.—*Robert Johnson, Carbondale, Colo.*

SCOTT LANDIS AND JASON GRANT REPLY: We're afraid you missed the central point of our articles, which is that the use of lesser-known woods from well-managed forests can help protect and sustain those forests. Boycotting tropical woods is a principled position that's not likely to help much. For the people who live in the tropics and the communities and countries in which they dwell, the issue boils down to survival. You cannot build a wall high enough to prevent rain forests from being cleared if local people are hungry and see those forests as an obstacle to their next meal. Most troubling is your apparent assumption that *tropical* is synonymous with *endangered* and that tropical woods are bad and temperate woods are good. Good and bad forestry can happen anywhere, and the wood you buy supports one or the other.

I read with interest the articles on tropical hardwoods, especially the references about chechen (*Metopium brownei*). This wood has a lovely figure with silver highlights. Another name for this wood, which grows throughout the Caribbean and Central America, is poisonwood. Its leaves and bark offer an extremely potent poison, and the sapwood is extremely toxic.

Years ago, I acquired some 4/4 planks of chechen that had come from Belize. Most of the planks had some whitish sapwood on them. I put the lumber through my thickness planer. I was wearing shorts and a short-sleeved shirt and was perspiring a good deal on that hot day. My eyes, face and arms were very badly affected for at least a week, all puffed up and swollen.

Some years ago, I read of an American couple touring the Yucatán, complete with chainsaw. They came upon a nice-looking stump by the side of the road and decided to take it home for woodturning. The couple found themselves on a plane to the hospital in the States. When they cut the stump, they got the fresh chips and milky sap all over themselves.

I'd advise your readers to stay away from any chechen that has sapwood in it, and let the poor Central American loggers have the pleasure of cutting this tree down. I do not think that the air-dried heartwood is toxic. —*Charles Goodfellow, West Palm Beach, Fla.*

Leave magazine content as it is—David Michael Powell pines for detailed, lead-us-by-the-hand articles (*FWW* #119, p. 8). Does he also need someone to tell him which end of the saw to hold? I say, don't mess with success. There is an abundance of publications that show every step and process. Each article reads much the same as the one last month. *Fine Woodworking* exists to showcase the quality work that can be achieved by anyone willing to try, with the added bonus of hearing how craftsmen solve tricky details. I have three suggestions for Powell: Take a class at a local community college, contact area woodworking clubs or subscribe to *Woodsmith*, a bimonthly that abounds in details and frequently presents quality projects.

—*Ed Hilton, San Antonio, Texas*

Finding value in advertisements—I must respond to V. Wayne Batton's letter (*FWW* #119, p. 10) in which he complained of too many advertisements in *Fine Woodworking*. The ads are just as important to me as the articles. They give me sources for tools and materials. In fact, the main bragging point of one woodworking magazine that regularly

Writing an article

Fine Woodworking is a reader-written magazine. We welcome proposals, manuscripts, photographs and ideas from our readers, amateur or professional. We'll acknowledge all submissions and return those we can't publish. Send your contributions to *Fine Woodworking*, PO Box 5506, Newtown, CT 06470-5506.

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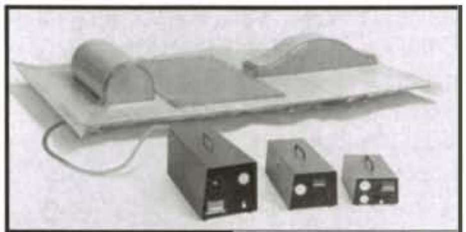

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solicits my subscription is that it doesn't carry any ads. I have told them on several occasions that if the magazine doesn't have ads, I don't want it.

—Hilliard Stone, Irving, Texas

Performax has sanders, too—After reading about the Ryobi 1600 drum sander in "Tool Forum" (*FWW* #119, pp. 88, 90), I feel compelled to correct an omission. The writer implies that the only other thickness sanders available cost $8,000 to $10,000. Evidently, he has not seen the advertisements in *Fine Woodworking* nor taken the time to research the product category.

We at Performax Products, Inc. find this especially upsetting because we are the originators of the product featured. We introduced our 16-32, the made in the U.S.A. original of the Ryobi, in August 1993. I must add that Performax offers nine drum sander models. Prices range from $350 to $5,000. *—Donna Green, vice president, Performax*

Using a belt sander to sharpen safely—In regard to the letter of John McInerney (*FWW* #119, p. 8), there is one other way to sharpen a chisel using a belt sander. He appropriately rejects holding the chisel pointing into the oncoming belt for safety reasons, but the way he has chosen (holding the sharp edge pointing in the direction of the belt's movement) also has a drawback. It causes the buildup of an excessively heavy burr at the chisel's edge. Therefore, I suggest holding the chisel with the handle at a right angle to the belt while sharpening. This is safer than the first method and eliminates the burr buildup of the second.

—Ted Fink, Shelburne, Vt.

The problem with waterborne finishes—Waterborne finishes have become our Holy Grail—great results are very much desired but thus far are unattainable. Besides their touchiness in spraying, drying and cleaning, these finishes often have a bland appearance in the color and grain departments.

I have experimented with oil as a first coat because that solves the problem of appearance. However, spraying waterborne finishes over an oil finish is inviting trouble. With proper curing time (24 hours minimum, more is better), certain waterborne varnishes will develop excellent adhesion. But several weeks later, small spots of white haze can appear on the wood.

This only occurs on a small percentage of the chairs we make, but, of course, one problem is too many. These spots have excellent adhesion but seem to be a reaction between the finishes. As much as we would like to, we do not use waterborne finishes for that reason.

—Greg Aänes, Bellingham, Wash.

The truth about horsepower ratings—As Dennis Preston wrote in the June issue (*FWW* #118, p. 28), horsepower is a function of current and voltage but only in direct-current motors. In alternating-current motors, an additional factor is involved: the power factor. The reason for this is the current and voltage in a motor are not in phase. In some motors, this power factor is 0.80, which means that the horsepower is voltage times current times the power factor.

There is a slight heat loss due to the resistance in the wiring supplying the motor and in the motor itself. This is usually not significant if the wiring is adequate. The conception that horsepower relies on current and voltage alone is a common misconception.

—Leon B. Davis, professional engineer, Grants Pass. Ore.

Many power tools and appliances are advertised as "developing" a certain horsepower. You'll always find that if volts and amps are given, the developed horsepower is considerably more than the standard calculation would indicate. That's because developed horsepower is the instantaneous power developed when the motor is brought up to speed and stopped suddenly by what's known as a pony brake. In this use, the pony brake measures the instantaneous torque produced by the motor during the sudden stop from full speed. It has nothing to do with the operating horsepower calculated from volts and amps, even without the application of an efficiency factor.

Developed horsepower is one of the small frauds we live with. I steer clear of any tool or appliance that's so advertised. If buying from a catalog that does not specify operating, running or delivered horsepower, call and insist on a disclosure of whether the advertised horsepower is the true operating horsepower at full load or is the so-called developed horsepower. You can't run a saw or dust collector or anything else on developed horsepower. It lasts for only milliseconds. *—Burton Mobley, Erie, Colo.*

Verre Eglomisé for clockmakers—A spectacular back cover on the May/June issue of *Fine Woodworking*. Gold leaf, especially Verre Eglomisé, has much to

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offer the serious woodworker, and I think the back cover proves it.

The description of the process, however, is puzzling. There are a number of people doing excellent Verre Eglomisé today, almost all for clocks or mirrors. To my knowledge, all these people (and their predecessors) put the gold leaf on first, floating it on a thin layer of water containing a small quantity of dissolved gelatin. The water evaporates, leaving the gold adhered to the glass by a minute film of gelatin.

The design is then scratched into the gold leaf, allowing a much finer line than could be obtained by pen and ink or paint on glass. The gold is then painted black to turn all the etching black, when viewed from the front of the glass. The field color or a painted sky or water (or both) is then applied.

—Edward H. Stone, Bowie, Maryland

On photographing your own work— Thanks to Susan Kahn for her fine article (*FWW* #119, pp. 64-67). Based on the overall accuracy and quality of her advice, I suspect that a few miscues were really just oversights.

Tungsten and daylight films are balanced as indicated in the article, but unfortunately, the article implies that tungsten-balanced print films are readily available. Actually, they will be almost impossible to find in 35mm format. Your readers will be unable to shoot prints indoors with constant lighting and get anything near a natural balance unless they use daylight bulbs. These bulbs are blue and have a color temperature of about 3,200° to 3,400° K. Alternately, although not as good an option, a blue filter can be used over the lens.

If your readers want to use standard (not blue) tungsten lights and are shooting slides, the only film they are likely to find is Ektachrome tungsten in ISO 64 or 160.

Ms. Kahn suggests 35mm, 28mm or 20mm wide-angle lenses for some work but, perhaps, meant to say 24mm as the last choice. A 20mm lens is not commonly available, and the focal length is too short for furniture photography.

Finally, Ms. Kahn suggests slower films give better color renditions, which is incorrect. Color quality results from three factors: the quality of the film, the quality of the light and the quality of film processing.

—Jim Hall, Photosource, Spring, Texas

Ms. Kahn's article did not mention a method used by many professional photographers—taking a time exposure and painting in the picture with a light bulb in a hand-held reflector. The technique is simple, fast and uses a minimum of equipment.

The camera must be mounted on a tripod and equipped with a cable release. A small lens aperture such as f/16 is used. A 100-watt light with a 10-in. reflector is turned on, the shutter opened and the light moved so it covers all parts of the object from different directions.

You have to learn by experience. I have found that when using ISO 200 color negative film, a 3- to 5-second exposure at f/16 allows me to get good, shadow-free pictures. The exposure time has a wide latitude.

—Howard C. Lawrence, Cherry Hill, N.J.

Scribing with a belt sander—I am a countertop installer and have worked at the trade for more than 20 years. Like Sven Hanson, I have used my belt sander almost every single day when installing countertops (see *FWW* #119, pp. 59-63). But I rarely use my sander as he does. As the photo on p. 63 shows, the laminate has a tendency to curl along the top edge when a belt sander is used.

I first cut the scribed edge with a circular saw with a 60-tooth, narrow-kerf, carbide-tipped blade. I hold the saw on an angle and cut to within 1⁄16 in. of the scribed pencil line.

Then I clean up the cut with my belt sander, holding the sander in a vertical position. This pulls the laminate toward itself and keeps the sawdust from kicking up into my face.

Our shop uses a piece of particleboard under the scribed edge, fastened with hot-melt glue or contact cement. That way, there are no nails or staples to come into contact with the sawblade or the belt sander. Cutting with the saw at an angle means the belt sander only needs to remove a small amount of material to bring edging to the scribed line.

—Harold Stewart, Oxnard, Calif.

Abrasive grading systems are different—The grit grading system used by Klingspor Sanding Products is different from that used in this country. They use the FEPA system, most common in Europe. Everyone in this country uses CAMI. This would not be a problem if we were informed about these differences. However, when we don't know it, we have problems.

I called one of Klingspor's experts who confirmed the differences between the two systems. Assuming that I should have known this all along, I consulted the indices of many woodworking magazines but nowhere could I find a reference to different systems for measuring grit sizes.

—Art Anderson, Saratoga, Calif.

CONTRIBUTING EDITOR CHRIS MINICK REPLIES: Like it or not, woodworking is a small part of the global abrasive market. The metalworking industry is the largest single-segment consumer of abrasive products, and that industry prefers the European grading system.

European, or P-graded, abrasives are manufactured to tighter grit tolerances than CAMI graded abrasives, so they're less likely to cause unwanted stray scratches in the work. Grades P12 through P220 are roughly equal to the same grades in the CAMI system. Grades P280 to P600 are roughly two CAMI grades coarser than the numbers would suggest. For example, P400 is equivalent to 320 CAMI.

Grit numbers for grades P800 and higher must be halved to get the corresponding CAMI grade.

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

—Scott Gibson, editor

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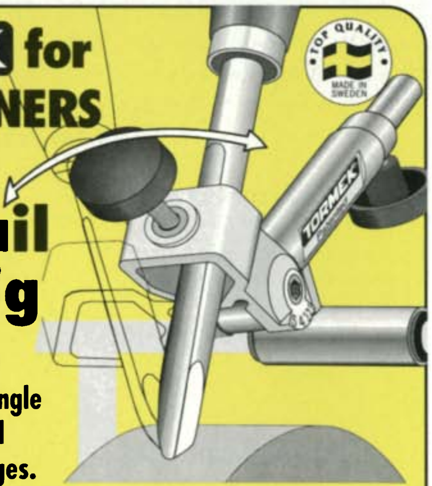

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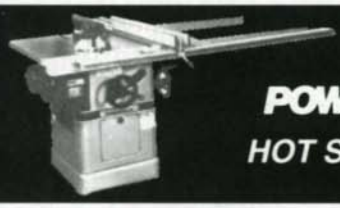

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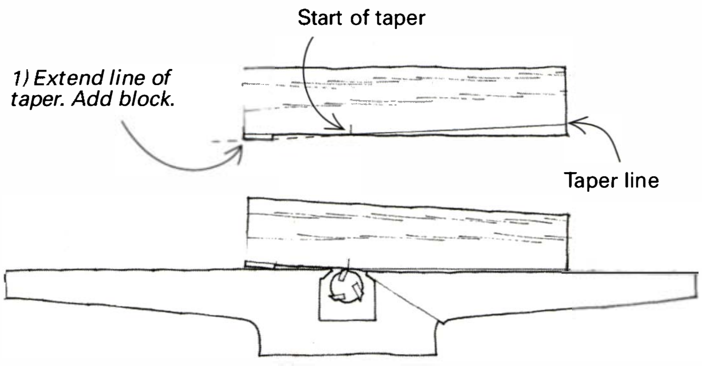
Another way to taper on the jointer

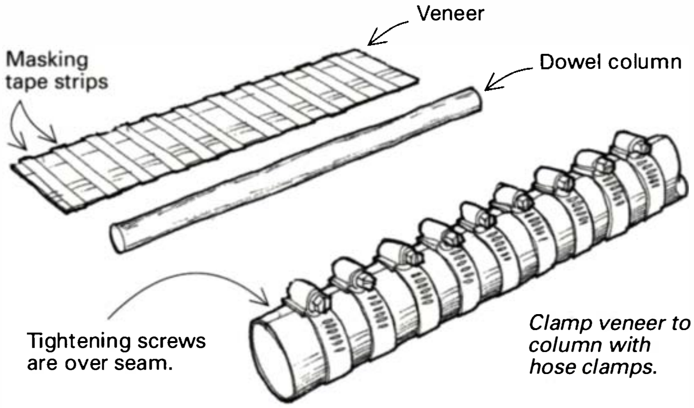


If you want to cut leg tapers on the jointer without fuss and adjustments, all you really need is a small block of ¼-in. or ½-in. plywood. Lay out the taper on the leg, and with a straightedge, extend a line beyond the start of the taper. The line will be off the stock. Position the block on the leg so that the corner of the block touches the extended taper line. You can tack the block in place with hot glue.

Before jointing, take a trial pass to make sure the block doesn't fall off the bed at the end of the cut. Now place the leg on the jointer with the block on the outfeed table (past the cutterhead) and the taper start line over the cutterhead. Push the leg through the cutter and repeat, taking light cuts until you reach your line.

—Dick Tuttle, Marietta, Ohio

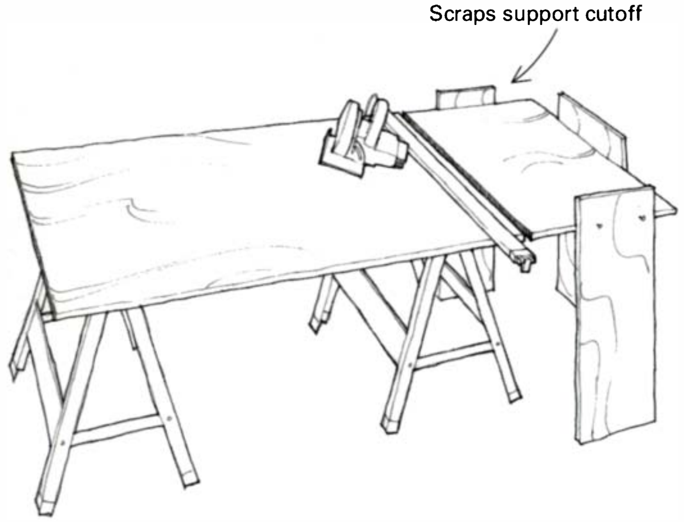
Veneering columns



I use columns veneered with crotch mahogany and other exotic woods on the grandfather clocks I build. The veneer is strengthened with strips of masking tape every 3 or 4 in. and then wrapped around a glue-coated dowel. I hold the veneer in place temporarily with masking tape or veneer tape. Radiator clamps slip in place with the tightening part of the clamp over the veneer seam. Normally, you can space the clamps about ½ in. apart, but some veneers may require closer clamp spacing. When the glue has set, I remove the clamps and the tape. Sometimes the masking tape will pull away small strips of veneer, so use caution. I've discovered that Anchor brand tape leaves less residue and is easier to remove than other brands of masking tape. To complete the veneered column, put it in the lathe for sanding and finishing.

—Vern Ziebart, Rapid City, S.D.

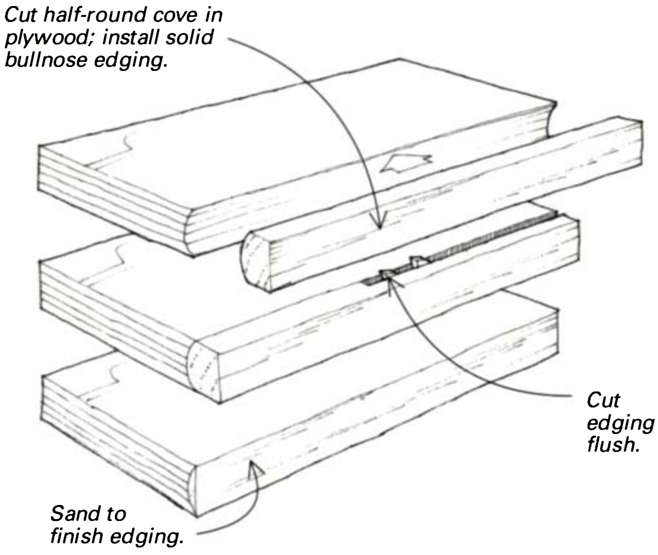
Plywood cutoff aid



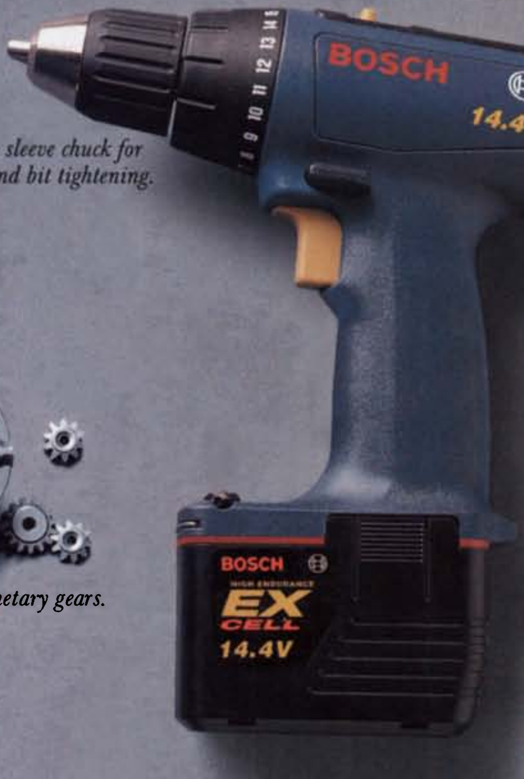
It is often easier to cut large sheets of plywood with an edge guide and a portable circular saw than to wrestle the sheet onto the tablesaw. To support the piece being cut off, tack two or three scraps to the edge of the piece, as shown, to serve as legs.

—Thomas Broderick, Tallmadge, Ohio

Edging plywood



Most of my cabinetry includes doors and drawer fronts made of plywood. I refuse to use veneer tape to cover raw edges, and solid edging, which I used for a while, is too conspicuous. So I came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up with edging that's strong, easy to set up and nearly invisible.

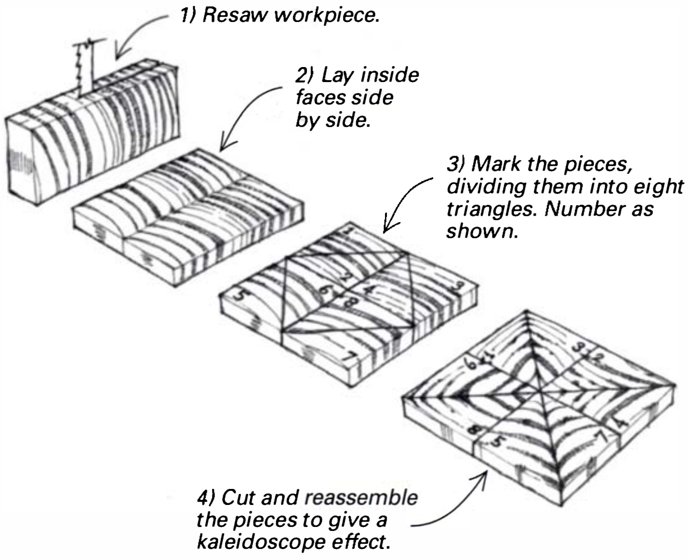
Start by installing a 1-in. half-round flute cutter in the shaper, centered precisely on the plywood stock. Adjust the depth of cut to produce almost, but not quite, a feather edge on the top and bottom edges of the plywood, as shown in the sketch on p. 12. There should be just enough flat left after the cut to support the edge against the outfeed fence. The fluted edges are not quite as delicate as they look, but they do require careful handling.

There is usually a plentiful supply of solid hardwood edging in the scrap bin. Install a 1-in. half-round bullnose cutter in the shaper. Center the cutter on the stock, and adjust the outfeed fence to the finished cut. If you prefer, bullnose both edges of the hardwood, so you can glue up two plywood blanks at once.

Glue and clamp the edging in the flute of the plywood panel. Or, if you bullnosed both sides of the edging, sandwich it in the flutes between two plywood blanks. After the glue sets, separate the plywood blanks by ripping the edge piece. Leave a little extra—this is not the final cut. Trim any tails, and dress the face to final thickness. With a sanding block, slightly round over the edges. The last step eliminates the slight groove between the plywood and the edge trim. *—Max Whitaker, Silverton, Ore.*

Quick tip: An extremely effective and durable bag for vacuum veneering can be improvised from a waterproof storage bag used for kayaking and white-water rafting. The bags are heavy-duty plastic and have excellent closure systems that are airtight. They can be modified for veneering by adapting the air tube (used for blowing up the bag) to fit the pump hose. *—Mark Moffatt, Denver, Colo.*

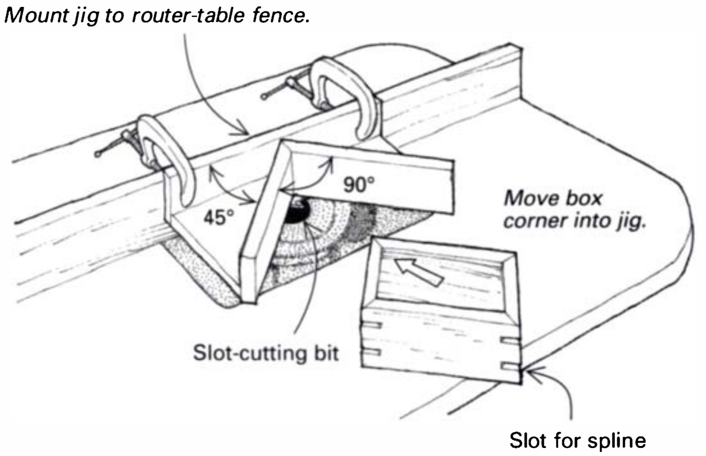
Kaleidoscope patterns in wood



I've been making book-matched boxes ever since reading about them back in 1982 (*FWW* #32, p. 14). I've wondered about other ways to create grain patterns. Recently, I tried a variation that produces interesting kaleidoscope-like designs.

First resaw your stock in half, and cut the pieces in two to form square quarters. Split each square along the diagonal, as shown. (A thin-kerf blade in a miter saw works well for this step.) Recombine the pieces using the numbering shown in the sketch. The more complicated the grain of the original pieces, the more interesting the result. No matter how wild the grain, a perfectly matched pattern will result. *—W. Esser, Los Angeles, Calif.*

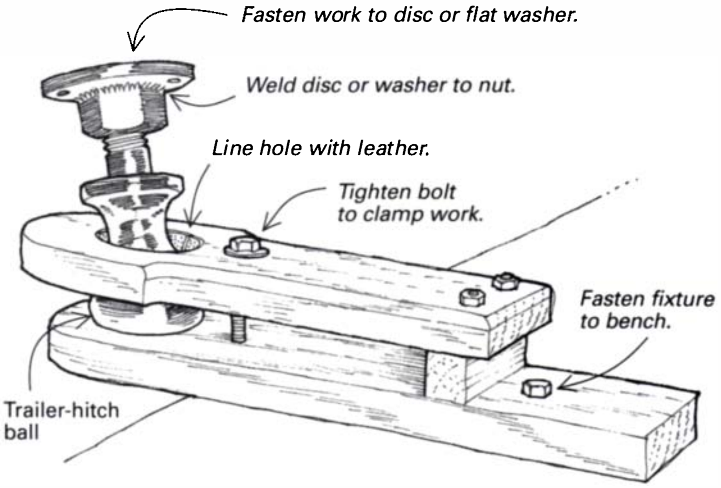
Jig cuts slots for corner splines



A commission for six identical boxes led me to develop this router-table jig for cutting spline mortises in outside corners. The jig is used with a slot-cutting bit. To make the jig, mount two 1x3s joined at a right angle to a backing board at a 45° angle. Clamp the backing board to the router-table fence so that the jig is directly above the bit. Adjust the fence in or out to get the right spline depth. To cut the slot, guide the box corner into the jig until it stops at the vertex. Using the jig, I cut 48 slots in less than 10 minutes.

—Mark Maiocco, Spotsylvania, Va.

A work holder that swivels



I recently needed a swivel-type work holder—the kind carvers use. Because the price for a commercial holder was about $125, I decided to make my own with a trailer-hitch ball and some shop

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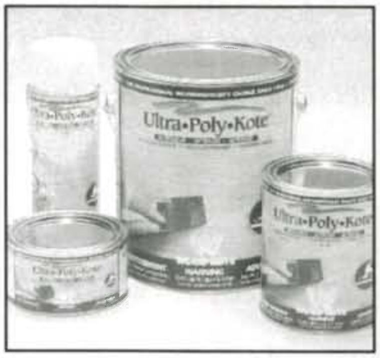
Gary Nokelby, Chapel Hill, NC.



A: Unfortunately, we are not aware of anything that you can simply apply to your cabinets to reverse the stickiness. No doubt, your kitchen cabinets are finished with lacquer which is the choice of many cabinet manufacturers because lacquer dries quickly and can easily be recoated to touch up scratches or blemishes. Lacquer, however, does not hold up well in a kitchen environment. Compounds contained in cooking vapors tend to collect on the cabinets and soften the lacquer creating a "sticky" surface that accumulates dirt. The problem is compounded when strong household spray cleaners are used as they will further soften the lacquer.

Regrettably, softened laquer must be removed from the cabinets using a scraper or chemical stripper. After the cabinet surfaces are stripped, sanded (and restained if necessary), we recommend applying three coats of a high grade polyurethane such as Wood•Kote **Ultra•Poly•Kote**™. Polyurethane takes longer to dry and is more difficult to touch up but it creates a durable finish that is resistant to harsh food substances and will hold up to repeated washing.

Hint: The lacquer finish on kitchen cabinets can be maintained for years if the surface is kept clean using mild soap or detergent.

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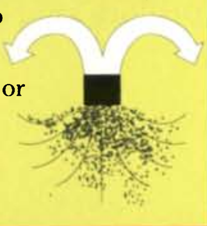

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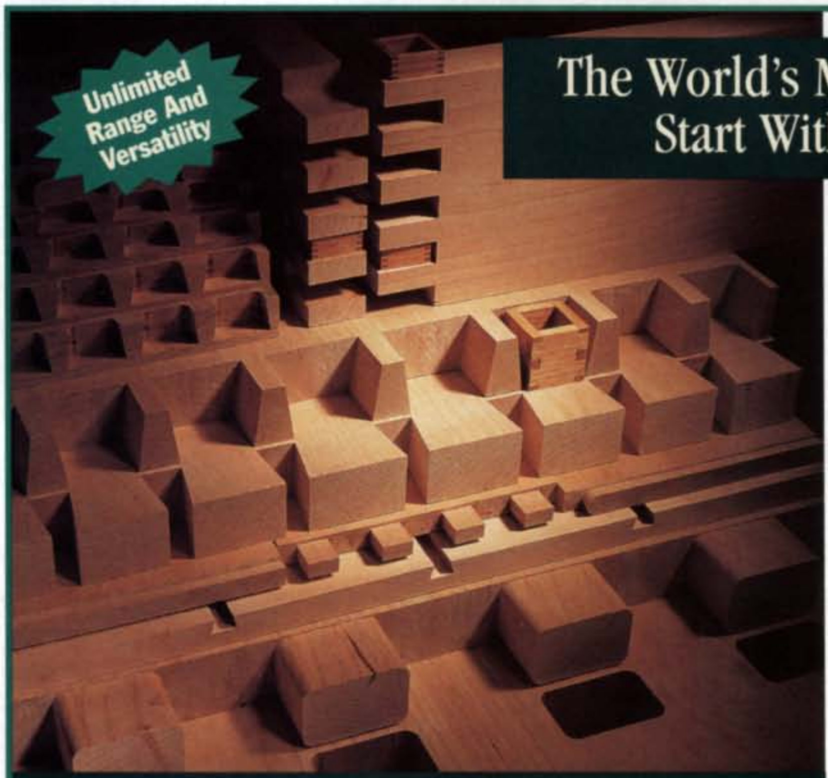

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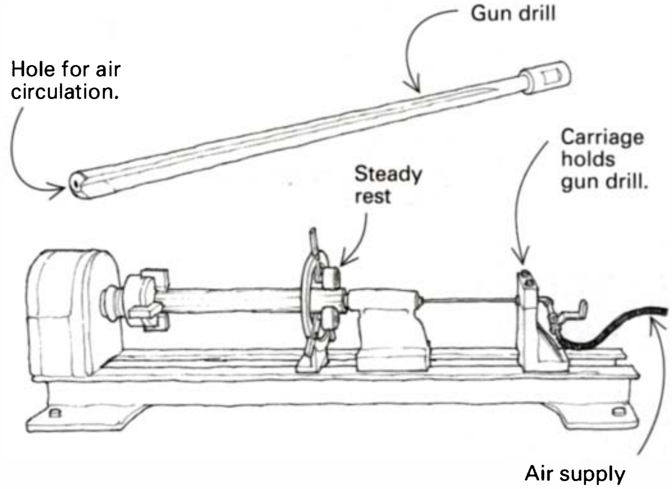
scraps, as shown on p. 14. The fixture is simply two pieces of hardwood that lock the hitch ball in place when a bolt is tightened. Line the hole in the top board with leather so it will grip better. For the workpiece plate, weld a large washer or disc to the nut, or attach it with screws tapped into holes in the nut.

—Harry J. Gurney, Taunton, Mass.

Quick tip: Shave buildup off the cutting edges of your router bits with a disposable razor, and then wipe the bits clean with turpentine. If you do this each time you use your router, you'll get cleaner cuts and prolong the life of your bits.

–Wells Mason, Austin, Texas

Drilling long holes with gun drills



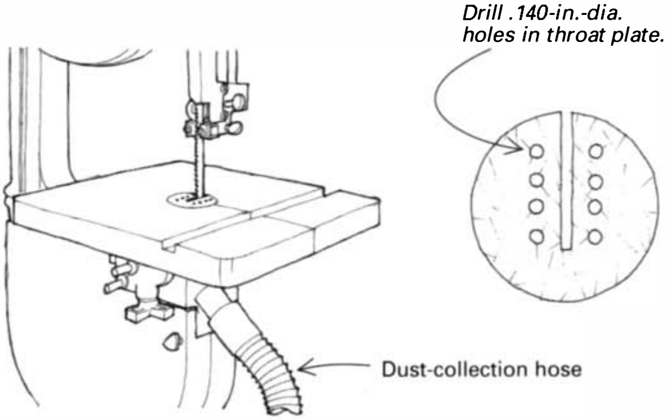
Chris Becksvoort's answer to the long-hole end-grain drilling question (*FWW* #116, p. 26) is right on target for woodworkers who do this occasionally. But if you are doing production drilling of long holes, a gun drill is the way to go. Gun drills are special bits made for drilling steel gun barrels. They are available in several lengths and diameters useful to woodworkers. One source is Danjon Manufacturing Corporation (1075 S. Main St., P.O. Box 212, Cheshire, CT 06410-0212; 203-272-7258).

The cutting edge of the gun drill uses a scraping action that will not wander in end grain. The most useful feature of the gun drill, however, is a hollow shank that permits the flow of pressurized air into the cutting area. The flow of air flushes out chips, allowing uninterrupted boring of smooth, precise holes.

I hold the drill shank in a carriage that slides on the lathe ways. The bit goes through a special hollow in the tailstock, dead center into the wood. I pump 100 psi pressure into the drill, and use a steady rest made by Andrew Shimanoff Tool Design (P.O. Box 1318, Ashland, OR 97520; 514-488-3059) to support the blank on the outboard end. With this setup, I can bore a 3⁄16-in.-dia., 15-in.-long hole in extremely hard wood, like African blackwood, in about 90 seconds. The bits are expensive, but drilling holes does not get any faster or more accurate than this. *—Michael A. Dow, York, Maine*

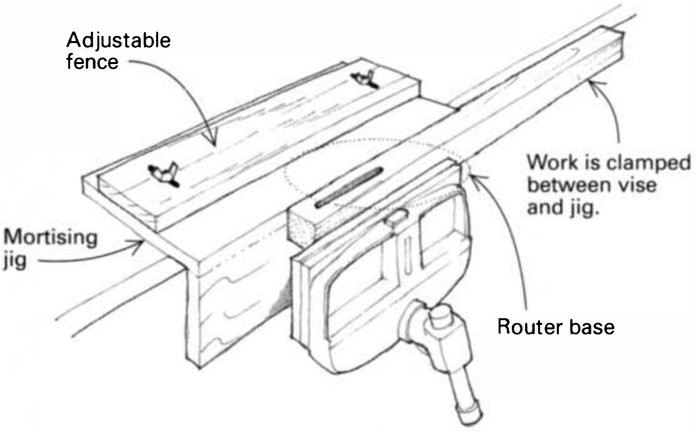
Quick tip: To clean up shavings after drilling, filing or machining steel, place a plastic bag, inside out, over a magnet. Attract the shavings with the magnet, and turn the bag right-side out. The shavings will be neatly contained in the bag. *—Alan L. Garst, Salem, Va.*

Collecting bandsaw-table dust



My bandsaw is equipped with a hose attachment to collect sawdust. But the space between the throat plate and the blade is so small that dust collection is not very efficient. I tried removing the aluminum throat plate. That helped, but offcuts would often fall into the gap and jam the blade. To overcome this, I drilled holes in the throat plate. Now the dust is collected efficiently, and the offcuts don't jam. *—Gil Warmbrodt, St. Louis, Mo.*

Router mortising jig



With this simple jig and a plunge router, you can rout mortises or panel grooves in any size leg or rail. The work is held between the jig and your bench vise, clamped flush with the surface of the jig. The jig provides a stable base for the router. Adjust the fence back or forth to orient the router cut to the workpiece. For longer pieces, make a longer jig, and clamp the workpiece at each end.

—Anthony Guidice, St. Louis, Mo.

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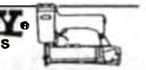

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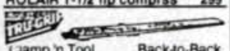

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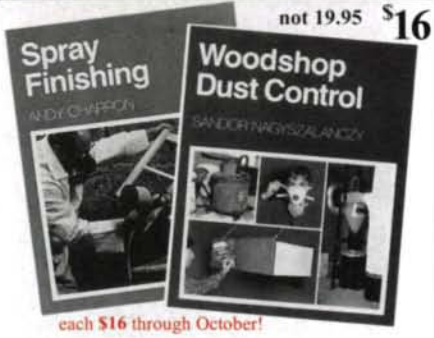

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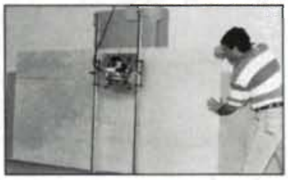

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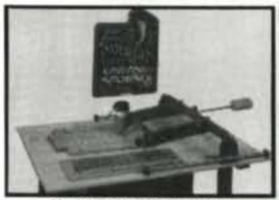

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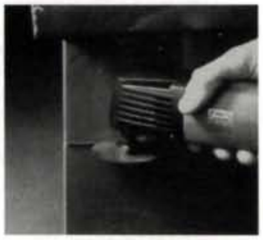

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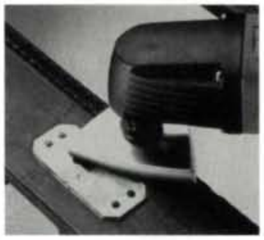

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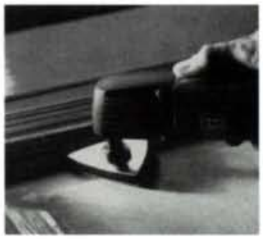

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Tooling is cause of sloppy hollow-chisel mortises

I enjoyed John West's article on hollow-chisel mortisers (FWW #116, pp. 70-74). I had wanted one for years, and about a month ago, I finally bought one. I found, however, that the holes it chopped had small indentations on two sides, as shown in the top drawing at right.

The mortises ended up looking something like the bottom drawing. The sketch is somewhat exaggerated but gives the general idea: The mortise was ragged and had to be cleaned up by hand with a chisel.

When I spoke to the technical advisor of the mail-order company where I bought the tool, he said that this is just the nature of hollow-chisel mortisers and that I would have to live with it. Because I had to finish the mortises by hand, I figured I might as well do the whole thing by hand. So I sent the machine back.

Is the ragged edge actually a fact of life with all mortisers, or do you think I would have had better success with a different brand?

—Phil DiLavore, Terre Haute, Ind.

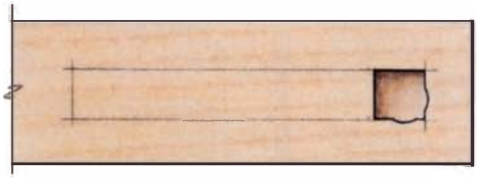
John West replies: It seems the problem has more to do with the tooling than the machine. A mortiser's operation is pretty simple—down and up.

It's not unusual for the sidewalls of a mortise made with a hollow-chisel mortiser to be slightly ragged. This is a function of how the tool works: It drills a round hole and simultaneously scrapes the corners clean. But there should be no large grooves down the sidewalls of the mortise, and the face of the wood where chisel and bit enter should be crisp and have square edges.

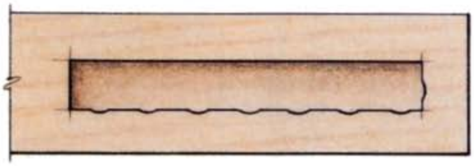
It sounds like the bit is oscillating wildly inside the chisel. This can occur when a bit is badly worn (not likely because yours was new) or poorly matched to the chisel. It also can happen when the bit diameter at the spur is larger than the width of the chisel. Generally speaking, these problems are restricted to cheaper bits and chisels.

The chisel width and spur diameter should be exactly the same. I have never measured much more than a 1/100-in. gap between the two on the tooling I use. But there's a cost for this tolerance. These chisel and bit combinations run $70 to $75 per set.

First plunge



Resulting mortise



An oscillating or oversized bit in a hollow-chisel mortiser can create divots in the side and entry walls of a mortise.

I'm sure you've noticed differences in cut quality with different grades of saw blades and router bits. Hollow-chisel bit sets are just the same. You generally get what you pay for.

[John West owns Cope and Mould Millwork Co. in Danbury, Conn.]

Why use Japanese chisels?

Though William Tandy Young's article on Japanese chisels (FWW #115, pp. 58-61) persuaded me that maintaining a Japanese chisel is not cumbersome, it failed to enlighten me about why I need them. Why does Mr. Young find both Western and Japanese chisels necessary in his workshop? What are the advantages and disadvantages of Western and Japanese chisels with respect to each other?

—J. Larsen, Cataumet, Mass.

William Tandy Young replies: If you're happy with the results you're getting with Western chisels, there's really no need for you to buy Japanese chisels.

What sold me on Japanese chisels was their length, heft, feel and cut. The chisels I use are much closer in size and shape to Western butt chisels. With shorter blades and friendlier handles, these chisels keep the hands, the tool and the work close together, fostering greater control.

But Japanese chisels aren't just for delicate paring operations. They're designed to take a pounding while cutting joints in large timbers. I can drive them hard with a steel hammer.

I also find that the high-quality steel in their laminated blades takes and holds an edge better than a typical Western chisel. It takes me a bit longer to sharpen my Japanese chisels, but I have to sharpen them far less frequently than I do my Western chisels.

[William Tandy Young is a furnituremaker and conservator in Stow, Mass.]

What is cast steel?

While perusing junk shops for usable tools, I picked up some old plane irons that are tapered in thickness along their length (not width). They're in quite good condition and are marked with the name "E. Preston" and the stamp "cast steel." What is cast steel? Would these irons be better or worse than new irons?

—N. Duxbury, Harrogate,
North Yorkshire, England

Horst Meister replies: Cast steel did not have the same meaning in the late 19th century as it has today. In the modern sense, cast steel is molten steel that's poured into a mold to form (usually) a finished structural shape, such as a part of a machine or a plane body. Cast steel is not at all suitable for making edge tools. It is coarse, grainy and rather brittle. It will not take or hold a sharp cutting edge.

The words "cast steel" stamped on 19th-century tools mean something else entirely. Back in the 1850s, Sir Henry Bessemer began producing steel by his patented Bessemer conversion process in the city of Sheffield, England. A Bessemer converter is a large crucible with provision for blowing air through a charge of molten pig iron. The air burns out impurities in the iron.

Because Bessemer steel was the best and purest steel available at that time, tool manufacturers stamped "cast steel" on their products to let prospective customers know that the tool was made using high-quality Bessemer steel. Naturally, the steel was subjected to further processing after the initial casting. Chisels and plane irons, for example, were forged from it.

As for plane irons produced today, most of them are stamped from flat stock using dies in a punch press. Most chisels and some plane irons are still forged. The

Drawing: Vince Babak

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READER SERVICE NO. 44

same basic high-carbon tool steel is still widely used, but modern alloy steels are metallurgically superior to the equivalent grade of 19th-century steel. Almost any plane iron made of a contemporary tool steel will very likely take at least as keen an edge, or better, as a turn-of-the-century iron and stay sharp as long or longer.

[Horst Meister is a professional toolmaker and model maker in Riverside, Calif. He is an amateur woodworker and makes many of his own woodworking tools.]

Removing old PVA glue

Can you tell me what the best solvent is for polyvinyl acetate (PVA) glue once the joint has dried? Does such a solvent exist? I am frequently asked to repair furniture that has been broken or damaged and has dried glue on the old joints. —*R.J. Farley, Strafford, Vt.*

Chris Minick replies: For all practical purposes, there is no solvent for dried PVA glue. A methylene chloride-based paint stripper will dissolve dried PVA glue. Unfortunately, in addition to the methylene chloride, these strippers also contain a wax that could cause problems or even prevent you from being able to reglue the joint. Lacquer thinner, acetone and methyl ethyl ketone (MEK) will all soften dried PVA glue, but none is a true solvent. You could use one of them, and then sand the pieces that make up the joint, but you'd compromise the fit of the joint.

I talked with a few friends in the furniture restoration business, but none had any magic tricks for removing dried PVA glue with ease. They all agreed it's a real headache. Nevertheless, they have to deal with it. Their consensus recommendation is as follows: Once the joint is disassembled, scrape as much dried glue from the wood surface as possible without destroying the wood. Then wrap the joint with a water-dampened rag for a few hours. The residual dried glue will absorb the moisture and turn white and spongy. Scrape off this whitened glue, and let the wood dry. After the wood has dried thoroughly, reassemble the joint using hot hide glue.

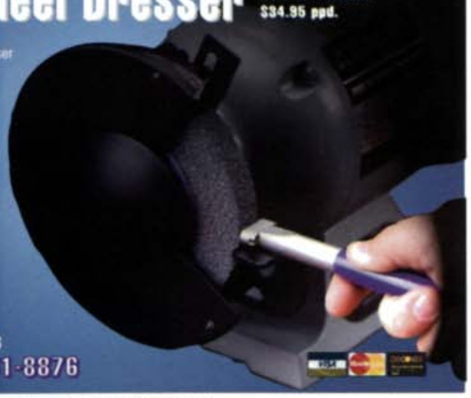
The time and effort required for this repair process is obviously justified if the piece is a valuable antique or a one-of-a-kind heirloom. However, I'm not sure it's worth the effort for all repair jobs.

I have had success in my shop regluing joints that were initially assembled with PVA glue by using quick-set epoxy. The procedure is simple. Scrape off the dry PVA glue, apply the epoxy and reassemble the piece. Keep in mind, though, that all glued joints will fail eventually. When this epoxy-repaired joint fails, subsequent repairs will be extremely difficult, if not impossible.

[Chris Minick is a finish chemist and woodworker in Stillwater, Minn., and a contributing editor to *Fine Woodworking*.]

Cleaning a rusted collet

The collets for my Bosch router have some fine surface rust, which makes bit removal difficult. How should I remove



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the rust without damaging the collet?
—Andrew Westerhaus, Burnsville, Minn.

Jeff Greef replies: If you remove too much metal when attempting to clean a rusty collet, the collet may not seat properly in the router. And a loose or poorly fitting collet can cause bits to spin off center or loosen during the cut. If you suspect that rust has compromised your collet, replace it. In industry, collets are replaced periodically as a matter of course—not a bad idea for frequent router users as well.

To clean a rusty collet that is otherwise in good shape, use a nylon abrasive pad (like Scotch-Brite) or steel wool. Don't use sandpaper or emery cloth; they will remove solid metal along with the rust.

Apply oil or grease to the collet (the type is not important), and then wipe it all off. What remains will fill the pores and help prevent new rust from forming. Don't try to prevent rust by coating the collet with lacquer or any other coating. The collet must seat snugly in the router, metal on metal, to be safe and effective.

Always remove the collet from the router spindle when changing bits, and clean out any chips, dirt or other debris before seating the next bit. This will ensure that the bit is as centered as the machining on the router and bit allows. [Jeff Greef is a woodworker and writer in Soquel, Calif.]

What keeps finish from drying on some tropical woods?

I recently made a small jewelry box out of padauk and maple. I put a lot of detail and handwork in it, and I was particularly proud of how well it turned out. When I finished it, however, I ran into some trouble that I hope you can help me with.

I used a polyurethane finish after wiping the box inside and out with acetone to remove any surface oils. Shop temperature was about 70°, and humidity was about 50%. After seven days, the polyurethane finish was still very tacky. I could easily scrape it with my fingernail. The finish on the maple portion of the box was as hard as a rock. What's wrong here, and what can I do about it?
—T.E. Harris III,
Birmingham, Ala.

I made a number of jewelry boxes last year, using both native and tropical woods. When it came time to finish them, I used a paste varnish, which I have used many times before with great success. Everything went fine, except on the one box made of bocote, which simply refused to dry. What can I do?
—Robert J. McMahon,
Pointe Claire, Que., Canada

Chris Minick replies: Many tropical hardwood trees produce natural chemical antioxidants, which are more or less evenly distributed throughout the living tree. But antioxidants tend to accumulate at the surface of the wood once the tree is milled. Surface antioxidants account for the oily feel of woods like rosewood, cocobolo, padauk, bocote and teak.

Surface antioxidants are responsible for several problems, including a lack of


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adhesion when gluing these woods. These antioxidants also can prevent varnishes (including polyurethane) from forming a dry film.

The obvious answer to this problem is to remove the offending chemical before finishing the wood. Unfortunately, the common practice of wiping the wood with a solvent may actually do more harm than good. More antioxidant chemicals can be pulled to the surface as the solvent evaporates from the wood than are removed by wiping.

The best way around this problem is to sand the wood surface lightly to remove the oils. Then apply a sealer coat of fresh, dewaxed shellac to prevent additional oils from bleeding to the surface. Shellac is unaffected by the sealed-in antioxidants, and it also makes a very good base for subsequent varnish coats.

An American tablesaw that will work in Europe

I am in the market for a tablesaw and am considering the Delta Unisaw, the Powermatic 66 and the General 350. All three are 10-in., enclosed-base saws made in the United States. I know all three will work perfectly in the States, but I will be returning to Germany eventually and would like to buy a saw with a motor that will work both here and at home in Germany. As far as I know, all three machines are equipped with a 230v, single-phase, 60-Hz motor. The electrical system in Germany supplies 50 Hz. What would you recommend?

—Werner Hinsken, Cary, N.C.

Ronald Rockovich replies: The bottom line is that you can run a 50-Hz motor on 60-Hz electricity, but you cannot do the reverse. Fortunately, all three of the machines you're looking at can be special-ordered with a 230v, 50-Hz motor at an additional cost of between $100 and $150 or so. While in the United States, the 50-Hz motor will run fine on 60-Hz electricity. When you return to Germany, just change the end of the power cord.

[Ron Rockovich services and rebuilds power tools and industrial machinery in Pittsburgh, Pa.]

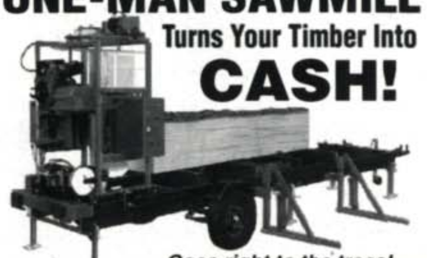
Looking for aromatic woods

I am working on a Judaic artwork project, one part of which is a ritual spice box. I need an extremely fragrant wood for this piece, preferably one that has a powerful, sweet smell. What would you suggest?

—Noah Greenberg, Safed, Israel

Vincent Laurence replies: There are undoubtedly dozens of woods worldwide that would meet your needs. But perhaps your best choice is a local one: Cedar of Lebanon, which grows throughout the Mideast. The wood is strongly scented and has a pleasant, golden color. Specialty lumber dealers sell the wood here in North America, so I'm sure you can get a hold of some in Israel.

Woodworkers facing the same problem in the United States have other choices. I know of three woods that are used specifically for their aromas. Aromatic

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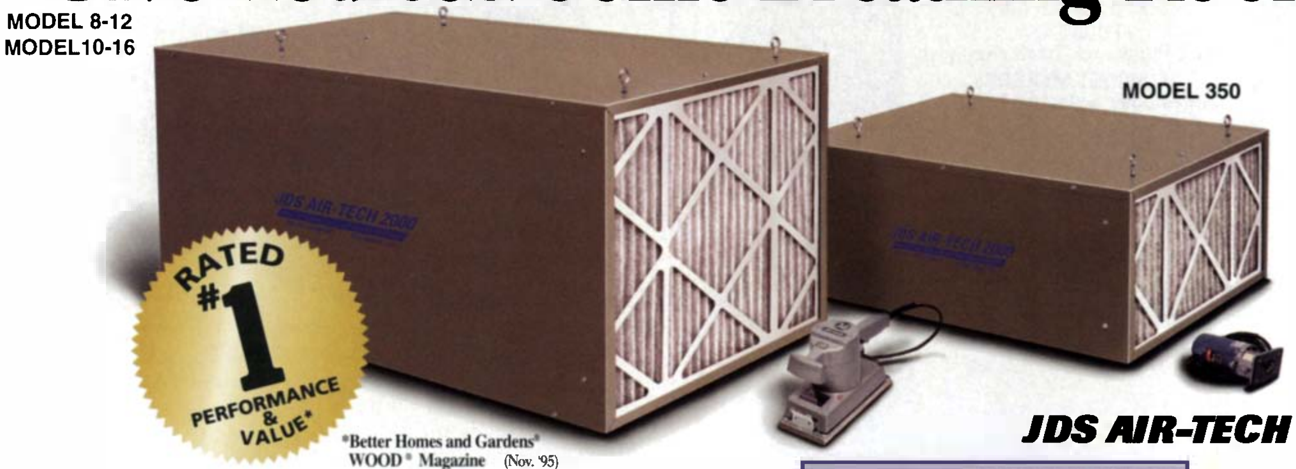
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cedar, sometimes called incense cedar or Eastern red cedar, is the most common of these woods and is often used as a liner in chests and closets. The scent of the wood, somewhere between sweet and pungent, is apparently offensive to moths and other fiber-eating insects. Aromatic cedar is a brick-red color with some variation. It is almost always knotty, and it's quite soft.

Port Orford cedar is less common than aromatic cedar, and it's native to just a small section of the Pacific coast in northern California and southern Oregon. Port Orford cedar is sometimes used in the same applications as aromatic cedar, though its scent, while also quite powerful, is more floral. It's an almost white wood and somewhat harder than aromatic cedar—about the same density as butternut.

Camphor wood is another aromatic wood, used most commonly for drawer sides or bottoms and in case interiors. It's a sandy brown wood, sometimes with pinkish highlights, and its scent is spicier than either of the cedars.

I have also heard of nutmeg being used as an aromatic wood, though I'm not personally familiar with it. Sandalwood is another aromatic wood, but it's quite rare these days.

Any of these woods probably would fulfill your requirements.

[Vincent Laurence is an associate editor of *Fine Woodworking*.]

What type of grease for a lathe headstock?

I own an old Sears wood lathe. The headstock rides in a sleeve that has no bearings. There are oil cups at each support. What type or viscosity of oil should I use?

—Kirby Slear, Hummelstown, Pa.

Robert Vaughan replies: It sounds like your machine is one of those made by Clausing for Sears Roebuck's mail-order customers during the 1950s. Assuming that your lathe is sound, I'd recommend using a few drops of 30-weight motor oil. The presence of any lubrication, though, is more important than the type.

I once paid a machinist to spend the better part of a day converting one of these stout little lathes to ball bearings. It was well worth the effort. And I would recommend it for your machine, too.

The problem with the lathe in its current condition is that the shaft just isn't held rigidly or accurately enough in the sleeve supports. And it's possible that the shaft has wallowed from wear. If this is the case, the shaft will need to be replaced. Any play at all can make woodturning all but impossible.

If you do convert the lathe to ball bearings, use wheel-bearing grease, but use it sparingly.

[Robert Vaughan tunes up, repairs and rebuilds woodworking machinery in Roanoke, Va. He is a contributing editor to *Fine Woodworking*.]

Do you have a question you'd like us to consider for the column? Send it to Questions & Answers, Fine Woodworking, *PO Box 5506, Newtown, CT 06470-5506.*


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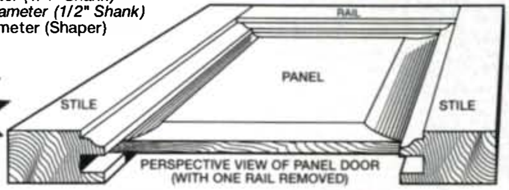
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Model	Description	List	Sale
9068	1/2" Impact Wrench with case	457	269
5455	7"/9" Polisher 1750 rpm	280	162
6078	7"/9" 13 amp grinder	295	159
0230-1	3/8" Drill 3.5 amp	231	128
5936	Belt Sander 4 x 24 w/bag 10 amp	495	275
6747-1	Drywall Gun 0-2500 rpm 5 amp	205	109
6016	1/4 sheet Palm Grip Sander	99	56
6017	6016 Sander with dust bag	101	58
6008	1/3 sheet 12,000 orb/min 5 amp	230	126
8975	Heat Gun 570° & 1000°	102	59
8980	8975 Heat Gun w/ case, & acc.	155	94
3102-1	Plumbers rt angle Drill Kit	401	229
5660	Router 1-1/2 HP 10 amp	357	198
6256	Variable speed Jig Saw 3.8 amp	278	149
6266-6	NEW Top Handle Jig Saw	315	165
6527	Super Sawzall with case	343	179
6528	above Sawzall with wired cord	339	185
6125	5" Random Orbit Sander	219	125
0406-1	9.6V Drill Kit with 2 batteries	315	159
0408-6	12V Drill w/keyless chuck & 2 batt	380	172
0231-1	3/8" Drill 0-1700 rpm	170	89
0224-1	3/8" Drill 4.5 amp magnum	236	132
0225-1	Same as 0224-1 w/kylss chuck	236	132
0234-1	1/2" Drill 5.4 amp mag 0-850 rpm	255	129
0236-1	0234-1 drill with steel case	288	149
0235-1	Same as 0234-1 w/kylss chuck	255	129
0244-1	1/2" Drill 5.4 amp mag 0-600 rpm	255	129
0222-1	3/8" Drill 3.5 amp 0-1000 rpm	213	119
0228-1	3/8" Drill 3.5 amp 0-1000 rpm	207	118
0375-1	3/8" close quarter Drill	255	148
0379-1	1/2" close quarter Drill	288	165
6539-1	cordless Screwdriver 190 rpm	139	78
6540-1	6539-1 with bits & case	175	95
6546-1	cdlss Screwdriver 200 & 400 rpm	150	86
6547-1	6546-1 w/bits 1/4" chuck, & case	185	105
5399	1/2" D-handle Hammer Drill Kit	356	194
1676-1	HD Hole Hawg with case	541	309
6507	Original SawZall with case	278	149
6508	Above Saw with wired cord	264	152
6517	6.5 amp Sawzall with case	296	159
6175	14" Chop Saw 15 amp	415	279
6010	Orbital Sander 1/2 sheet	235	129
8977	Variable temp. Heat Gun	137	82
5397-1	3.8" var. speed Hammer Drill Kit	275	145
5371-1	1/2" var. speed Hammer Drill Kit	360	194
5377-1	5371-1 with keyless chuck	360	194
3107-1	1/2" var. speed right angle Drill	411	234
3300-1	1/2" var. speed right angle Drill	378	199
5680	Router 2 HP -w/ 1/4" & 1/2" collets	367	165
6145	4-1/2" Grinder 10,000 rpm	179	94
6142	6145 with case & accessories	224	125
6749-1	Drywall Gun 0-2500 rpm 5.4 amp	235	135
6755-1	Drywall Gun 0-4000 rpm 5 amp	183	99
6767-1	Screw Shooter Kit	252	142
5367-1	Falcon 3/4" Rot Hammer w/cs	428	245
5353	Eagle 1-1/2" Rot. Hammer w/cs	1046	575
6365	7-1/4" Circular Saw 13 amp	229	125
6367	above Saw - double insulated	224	128
6366	6365 with fence & carbide blade.	237	129
6368	6365 w/fence, carbide blade, & cs	259	142
6377	7-1/4" Worm Drive Saw	345	194
6369	7-1/4" Circular Saw with brake	280	152
6490	10" Mitre Saw	496	265
6491	6490 w/ carbide blade & bag	594	329
6494	10" Compound Mitre Saw	585	315
0422-1	12V Hammer Drill w/ 2 batt	441	229
0431-1	12V Drill w/2 batteries	441	229
6496	NEW 10" Slide Compound Saw	1050	579

FREUD SAW BLADES

5/8" bore - Industrial Grade - Carbide Tipped

Model	Description	Teeth	List	Sale
LU72M010	General Purpose 10"	40	69	42
LU81M010	General Purpose 10"	40	78	44
LU82M010	Cut-off 10"	60	93	47
LU84M011	Combo 10"	50	78	42
LU85M010	Super Cut-off 10"	80	115	59
LM72M010	Ripping 10"	24	69	38
LU73M010	Cut off 10"	60	84	45
LU87M010	Thin Kerf 10"	24	72	44
LU88M010	Thin Kerf 10"	60	88	49
LU85M015	Mitre Saw blade 15"	108	175	99
LU91M010	Compound Mitre Blade	60	88	54
LU98M010	Ultimate 10"	80	128	68
LU89M010	Ferrous metal 10"	72	104	58
F410	Quiet Blade - 10"	40	95	49
F810	Quiet Blade - 10"	80	135	74
TK203	7-1/4" Framing - 24 tooth		31	18
TK303	7-1/4" Finishing - 40 tooth		38	25
TK306	10" Finishing - 40 tooth		47	29
TK903	7-1/4" Combo - 30 tooth		33	22
TK906	10" Combo - 50 tooth		53	32
SD306	6" Dado - Carbide		215	115
SD308	8" Dado - Carbide		230	119
SD506	6" Super Dado-carb. w/cs&shims.		292	145
SD508	8" Super Dado-carb. w/cs&shims.		344	168
F0	#0 - 1-3/4" x 5/8" Biscuit 1000 Qty		43	29
F10	#10 - 2-1/8" x 3/4" Bisuit 1000 Qty		43	29
F20	#20 - 2-3/8" x 1" Biscuit 1000 Qty		45	29
FA	Assorted Biscuits 1000 Qty		45	29
WC110	10 pc Chisel set w/cs 1/4"- 1-1/2"		143	92
FB107	7 piece Forstner bit set 1/4" - 1"		92	59
FB100	16 pc Forstner bit set with case		338	194
94-100	5 pc Router bit door system w/cs		320	169
BF3	NEW Router Table w/ fence & legs		495	289

FREUD POWER TOOLS

Model	Description	List	Sale
EB100	Edge Banding Machine	409	215
EDS132	13.2V cordless drill kit w/2 batt	415	209
JS102	Biscuit jointer w/adj. fence & cse	355	179
JS100	Biscuit jointer	334	168
FT2000E	3-1/4 HP Plunge Router v/spd	410	205

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MAKITA TOOLS

Cordless Specials

Model	Description	List	Sale
6172DWE	3/8" variable speed Drill Kit 7.2V with 2 batteries	222	109
5090DW	3-3/8" Saw Kit 9.6 volt	280	148
DA391D	3/8" angle Drill 9.6 volt	166	109
DA391DW	3/8" angle Drill Kit 9.6 volt	341	179
ML900	9.6 volt flashlight	Sale	14.95

Model	Description	List	Sale
6095DWE	9.6 volt Drill Kit w/2 batteries	Sale	125
6095DWLE2	6095DWE w/ flashlight	Sale	138
6095D	6095DW Drill only & case	Special	79
6011DWE	12 volt Drill Kit w/ 2 batteries	365	168
632007-4	9.6 volt Battery	47	30
632002-4	7.2 volt Battery	39	28

NEW CORDLESS DRILLS WITH HIGH CAPACITY BATTERIES

Model	Description	List	Sale
6201DWHE	9.6V 3/8" Drill Kit w/ 2 batt.	351	159
6211DWHE	12V 3/8" Drill Kit w/ 2 batt	368	169
6311DWHE	12V 1/2" Drill Kit w/ 2 batt	399	205

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6073DW 7.2V cdls Drill Kit. Variable speed & clutch. Complete w/ battery, charger, & case .... **Super Sale** 99

T220DW 9.6 volt Stapler Kit. Complete with battery, charger. & case .... **Super Sale** 99

Model	Description	List	Sale
9900B	3" x 21" Belt Sander with bag	347	179
9924DB	3" x 24" Belt Sander with bag	360	189
JR3000V	Var. speed Recip Saw w/case.	264	135
9820-2	Blade Sharpener	433	215
N1900B	3-1/4" Planer with case	263	129
1912B	4-3/8" Planer	352	189
BO4552	1/4 sheet Pad Sander w/bag	101	55
DA3000R	3/8" Angle Drill var. speed	355	175
2708W	8-1/4" Table Saw	637	309
2711	10" Table Saw with brake	1125	599
5005BA	5-1/2" Circular Saw	347	195
6405	3/8" Drill 0-2100 rpm 2 amp	115	65
6820V	0-4000 rpm Drywall Gun	185	99
6013BR	1/2" Drill Rev. 6 amp	270	145
5402A	16" Circular Saw 12 amp	1073	579
9401	4" x 24" Belt Sander with bag	458	219
LS1030	10" Mitre Saw	428	205
5007NBK	7-1/4" Circular Saw w/ case	250	125
LS1011	10" Slide Compound Saw	995	479
GV5000	5" Disc Sander	148	79
N9514B	4" Grinder 4.6 amp	118	65
N9501B	4" Grinder 4.0 amp with case	174	99
9217SPC	7" Sander/polisher var. speed	378	175
2414B	14" Cut-off Saw AC/DC	419	225
4320	V/spd Jig Saw 2.9 amp	182	98
6302	1/2" Drill 0-550 rpm 5.2 amp	250	115
BO5001	5" Random Orbit Sander	125	69
LS1211	12" Slide Compound Saw	1620	779
3901	Plate Joiner Kit	376	205
3612C	NEW 3 HP Plunge Router	492	259
9031	1-3/16" x 21" v/spd belt sander.	346	199

BOSTITCH AIR NAILERS

Model	Description	List	Sale
N80S-1	Stick Nailer	Super Sale	339
N80C-1	Coil Nailer	Sale	339
RN45	Coil Roof Nailer 3/4 - 1-3/4	845	369
N60FN-2	Finishing Nailer 1-1/4" - 2-1/2"	557	335
N60FN-2K	N60FN-2 w/ case. oil, & nails	618	345
T50S4-1	Decking Sheathing Stapler	618	355
MIIIFS	Flooring Stapler 15 gauge	902	529
S32SX-1	Finish Stapler - 1/2" - 1-3/8"	245	155
S32SX-1K	S32SX-2 with case & oil	269	165
BT35-2	Brad Tacker 5/8" - 1-3/8"	254	155
BT35-2K	BT35-2 with case, oil, & brads.	279	165
BT50-2	Brad Tacker 1-3/16" - 2"	297	189
BT50-2K	BT50-2 w/case, oil, and brads	335	209
PC5000-1	NEW Power Crown Stapler	242	159
CWC100	1 HP Pancake Compressor	440	289

PANASONIC CORDLESS

Model	Description	List	Sale
EY6181CRKW	9.6V Drill Kit with 2 batteries, 1 hour charger. & case	307	169
EY6181EQK	9.6 volt Drill with 15 minute charger, case, & Ironman battery	315	169
EY6100CRKW	12 volt Drill Kit with 2 batteries, 1 hour charger. & case	379	188
EY6100CQKW	Same as **EY6100CRKW** but has 15 minute charger	409	209
EY6100EQKW	12 volt Drill kit with 2 Ironman batteries, 15 min. charger & cs	379	199
EY6101SQK	12V 1/2" Drill with 15 minute charger, diagnostic battery, & case	438	249

PRAZI BEAM CUTTER

Model	Description	List	Sale
PR-7000	12" beam cutter for worm drive saws	149	124

ACCU-MITER

18-34	Professional Mitre Gauge	149	145

JDS AIRTECH AIR CLEANERS

Model	Description	Sale
350	12"x24"x28" 1/5 HP - 350 CFM	245
8-12	20"x24"x44" 1/3 HP - 800.1200 CFM	469
10-16	20"x24"x44" 1/3 HP - 1000,1600CFM	659

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00506	6" Quick Grip clamp	22.95	14.75	28.95
00512	12" Quick Grip clamp.	27.50	17.75	34.95
00518	18" Quick Grip clamp.	29.90	18.75	36.95
00524	24" Quick Grip clamp.	31.95	20.50	40.25
00536	36" Quick Grip clamp.	36.30	23.50	46.25
590L3	NEW 3/4" Quick Grip Pipe clamp - (does not require threaded pipe)	27.89	19.50	-------

PORTA NAILER

Model	Description	List	Sale
401	Porta Nailer complete	295	209
501	Face Nailer complete	295	209
1,000	Genuine Porta Nails - 1000 qty		16.50
5,000	Genuine Porta Nails - 5000 qty		74.95
10,000	Genuine Porta Nails - 10000 qty.		129.95

BIESEMEYER FENCES

Model	Description	List	Sale
B-50	50" Commer. Saw Fence	443	325
T-SQUARE 52	52" Homeshop Fence	360	269
T-SQUARE 40	40" Homeshop Fence	335	249
T SQUARE 28	28" Homeshop Fence	325	239

BOSCH

Model	Description	List	Sale
1587VS	Top Handle "CLIC" Jig Saw	292	139
1587DVS	above saw w/ dust collection	317	178
1584VS	"CLIC" Barrell Grip Jig Saw	288	139
1584DVS	above saw w/dust collection	306	178
	Bosch Metal Case for above Jig Saws	34	32
	Bosch 30 blade assortment for Jig Saws		28.99

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Model	Description	List	Sale
1942	Heat Gun 600°-900° temp	132	78
1289D	1/4 sheet Sander	113	68
1003VSR	3/8" Drill 0-1100 rpm	167	78
1194VSR	1/2" var. speed Hammer Drill	272	155
1194VSRK	above Hammer Drill w/case	303	169
1195VSR	3/8" var. speed Hammer Drill	247	139
1608LX	5.6 amp Laminate Trimmer w/ guide	189	110
1608T	5.6 amp tilt base Trimmer	189	115
1608U	Underscribe Laminate Trimmer	239	139
1609K	Laminate Installers Kit w/1609 Trimmer	355	199
1609KX	Deluxe Installers kit	425	234
1604A	1-3/4 HP 2 Handle Router	269	142
1604AK	Same as above w/case & acc.	337	185
1606A	1-3/4 HP D-handle Router	300	179
3270DVS	3"x21" v/spd Belt Sander w/bag	301	165
1613EVS	2 HP v/spd Plunge Router	369	199
1615EVS	3 HP v/spd Plunge Router	536	289
1614EVS	1-1/4 HP v/sp Plunge Router	295	169
3054VSRK	12 volt cordless drill kit	323	185
1370DEVS	6" Random Orbit Sander	446	248
B1650K	Biscuit joiner	Sale	169
B7000	Corner Detail Sander	126	68
B7001	Corner Detail Sander v/spd	Sale	89.95
B4050	In Line Jig Saw	206	119
3272K	3-1/4" Planer with case 4.2 amp	205	119
1347AK	4-1/2" Grinder w/ case & acc.	172	105
1348AE	5" Grinder 8.5 amp	237	135
11304	"The Brute" Breaker Hammer		1249
11305	Demolition Hammer 10 amp	1328	739
11314EVS	Demolition Hammer	921	539
11232EVS	1-1/2" Spline Hammer Drill	890	525
11224VSR	7/8" SDS Rotary Hammer Drill	404	229

NEW BOSCH TOOLS

Model	Description	List	Sale
1634VSK	NEW Recipro Saw 10.5 amp	335	189
1276D	NEW 4" x 24" Belt Sander	379	219
1275DVS	NEW 3" x 24" v/spd Belt Sander	379	219
1276DVS	NEW 4" x 24" v/spd Belt Sander	408	229
3300K	NEW 12V Drill Kit w/2 batteries	285	169
3310K	NEW 12V T-Handle Drill Kit with 2 batteries	345	178
3110K	NEW 9.6V T-Handle Drill Kit with 2 batteries	318	185
3610K	NEW 14.4 volt Drill Kit	354	195
3107DVS	NEW 5" Random Orbit Sander	165	98
3107DVSK	3107DVS with case	195	115
3725DVS	NEW 5" Random Orbit Sander	256	149
3727DVS	NEW 6" Random Orbit Sander	266	154
B3915	NEW 10" Slide Compnd Saw.	1050	619
11230EVS	NEW SDS-max 1-1/2" Rotary Hammer	910	519
11231EVS	NEW SDS-max 1-3/4" Rotary Hammer	1363	785
11223EVS	NEW SDS-max 2" Rotary Hmr	1595	915
11311EVS	NEW Demolition Hammer variable speed	1328	759

BUY 4 BOSCH SHAPER CUTTERS AND RECEIVE A FREE SKIL CORNER DETAIL SANDER

SKIL TOOLS

Model	Description	List	Sale
HD5825	6-1/2" Worm Drive Saw	313	172
HD2735-04	12 volt cordless Drill Kit	260	148
HD2736-04	2735-04 with keyless chuck	269	148
1605-02	Biscuit Joiner with case	234	135
5510	5-1/2" Circular Saw	196	119
5860	8-1/4" 60° Worm Saw	350	194
5660	8-1/4" 60° Circular Saw	292	164
5657	7-1/4" Circ Saw - pivot foot	220	125
5525	6-1/2" Circ Saw - big capacity	189	115
3400	10" Table Saw - Bench Top	360	189
77	Famous 7-1/4" Worm Drive Saw	Sale	144
77M	NEW 77 Mag Worm Saw - 2 lbs lighter than Model 77	Sale	165

RYOBI SPECIALS

Model	Description	List	Sale
JP-155	6-1/8" Jointer/Planer	700	325
RE600	3 HP Plunge Router var. speed	500	228
BE321	3" x 21" var. speed Belt Sander	310	148
BT3000	10" Table Saw with stand	1125	529
TR30U	3/4 HP Trimmer	174	88
AP12	12" Bench Planer	884	389
JS45	Top Hdle Jig Saw var. spd	98	54
BS900	9" Bench Band Saw	340	165
OSS450	Oscillating Spindle Sander	340	159
SC162VS	16" var. speed scroll saw	298	165
DS2000	Detail Sander - 2 speed	112	64
DC500	Detail Carver	120	64
ML618	Mini Lathe variable speed	418	219
WDS1600	NEW 16" x 32" Drum Sander.	980	579
HT20VSK	NEW Multi Tool	115	59
CD125K	12V Cordless Drill w/ 2 batteries	195	109
JM80K	Plate Jointer with case	218	109
R160K	1-1/2 HP Router with case	110	69
D18C	3/8" Drill	75	44

PORTER CABLE

Model	Description	List	Sale
690	1-1/2 HP Router 8 amp	278	142
9690	690 Router w/ steel case	325	159
691	1-1/2 HP Router D-handle	303	155
695	1-1/2 HP Router/Shaper	418	235
696	Heavy Duty Shaper Table	238	135
351	3" x 21" Belt Sander without bag	302	165
352	3" x 21" Belt Sander with bag	312	169
352VS	3 x 21 Belt Sander v/spd	321	174
360	3" x 24" Belt Sander with bag	397	214
361	3" x 24" Belt Sander without bag	377	204
362	4" x 24" Belt Sander with bag	412	224
363	4" x 24" Belt Sander without bag	392	214
314	4-1/2" Trim Saw	274	154
9314	4-1/2" Trim Saw 4.5 amp w/cs	299	169
97751	1/2" v/spd Hammer Drill w/cs	274	155
666	3/8" HD v/ spd Drill 0-1200 rpm	240	132
2620	3/8" HD v/spd Drill 0-1000 rpm	170	98
9118	Porta Plane Kit 7 amp	400	229
6645	0-2500 Drywall Gun 5.2 amp	170	95
96645	New Screwdriver Kit	240	134
505	1/2 sheet Pad Sander	249	134
6611	3/8" var. speed Drill 5.2 amp	190	109
6614	1/2" var. speed Drill 0-750 rpm	210	119
6615	6614 with keyless chuck	210	119
330	Speed Block Sander 1/4 sheet	120	65
556	Biscuit joiner with 5556 tilt fence	Sale	139
345	6" Saw Boss 9 amp	207	114
9345	345 comp. w/cs & carbide blade	237	138
332	Palmgrip Random Orb Sander	133	74
333	above Sander with dust bag	148	79
334	333 sander with PSA pad	148	79
1700	Heat gun 750 - 1000 degrees	135	82
550	Pocket cutter with case	352	195
552	Production Pocket Cutter	1000	575
7700	10" "Lazerloc" Miter saw	740	409
5116	16" Omni-Jig	484	269
7116	24" Omni-Jig	549	294
9647	TIGER CUB Recip. Saw	230	134
7519	3-1/4 HP Router 2 Handle	469	255
7518	3-1/4 HP 5 speed Router	534	279
7536	2-1/2 HP 2 Handle Router	389	215
7537	2-1/2 HP D-Handle Router	409	228
7538	3-1/4 HP Plunge Router	469	254
7539	3-1/4 HP var. spd Plunge Router	534	279
7310	5.6 amp Laminate Trimmer	176	98
7312	5.6 amp Offset Base Lam Trim	241	135
97310	Laminate Trimmer Kit comp	336	198
7335	5" v/spd Ran Orbit Sander	254	138
97355	7335 Sander w/cs & dust collect.	274	154
7336	6" v/spd Ran Orbit Sander	259	139
97366	7336 Sander w/cs & dust collect.	284	158
73333	Dust Collection system		24.50
693	1-1/2 HP Plunge Router	338	184
6931	Plunge Router Base	139	79
9853K	12V 3/8" Drill Kit w/ 2 batteries	Sale	158
9855	12V 1/2" Drill Kit	310	178
8500	12V battery for above drills	74	45
97549	Top Handle Jigsaw w/ case & blades	275	144
7649	Barrel-grip Jig Saw	254	149
7556	1/2" Right Angle Drill w/case	394	224
9444	Profile Sander Kit	220	115
7499	Ultimate Cut-out tool	119	69
97499	7499 w/ case & bits	150	89
340	1/4 Sheet Orbital Sander with dust collection	91	55
511	Cylindrical Lock installation kit	262	149
310	Production Laminate Trimmer	270	152
410	Underscribe Trimmer	280	154
347	7-1/4" "Framers" Circ Saw	230	129
347K	347 Saw w/ plastic case	250	134
743	347 Saw - left hand version	230	129
743K	743 Saw w/ plastic case	250	134
447	7-1/4" "Framers" Circular Saw with brake	259	139
843	447 Saw - left hand version	259	139
7800	Drywall Sander	589	335
7810	Wet/Dry Vac for above sander	452	259
9737	New Tiger Recipro Saw	307	165

NEW Porter Cable Pneumatic Nailers

Model	Description	List	Sale
BN125	Brad Nailer - 18 ga. 5/8" - 1-1/4"	144	95
BN200	Brad Nailer - 18 ga. 3/4" - 2"	238	145
FN200	Finish Nailer - 16 ga. 3/8" - 2"	270	165
FN250	Finish Nailer - 16 ga. 1" - 2-1/2"	362	225
DA250	Angle Nailer - 15 ga. 1-1/4" - 2-1/2"	412	249
NS100	Stapler - 1/4" crown 1/2" - 1"	154	99

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DELTA BENCH TOP TOOLS

Model	Description	List	Sale
23-700	Wet/Dry Grinder	206	159
23-680	6" Bench Grinder 1/4 HP	80	69
23-880	8" Bench Grinder 1/2 HP	134	115
11-950	8" Drill Press	176	128
28-160	10" Hobby Band Saw	210	145
31-050	1" Belt Sander 2.0 amp	95	78
31-460	4" Belt/6" Disc Sander	198	135
31-340	1" Belt/8" Disc Sander	270	209
31-080	1" Belt/5" Disc Sander	113	89
40-560	16" 2 speed Scroll Saw	230	165
11-990	12" Bench Drill Press	255	184
11-090	32" Radial Bench Drill Press	405	315
43-505	1/2" Bench Router/Shaper	398	299
22-540	12" Bench Top Planer with extra knives	557	369
36-220	10" Compound Mitre Saw	294	208
14-650	Hollow Chisel Mortiser	380	265
33-060	"Side kick" Miter saw	541	399
14-070	14" Floor Drill Press	405	359
28-190	12" Band Saw w/ stand	497	395
20-150	14" Cut-off Saw	299	229
36-090	10" Sidekick Miter Saw	310	219
37-070	6" var. speed Bench Jointer	351	255
36-275	8-1/4" Builders Saw	358	268
36-210	10" Compound Mitre Saw	344	249
36-040	8-1/4" Compound Mitre Saw	190	135
36-070	10" Mitre Saw	217	165
36-630	10" Contractors Saw II	721	579
34-182	Tenoning Jig	113	75
34-555	Sliding Table	487	325
36-230	12" Compound Mitre Saw	480	345

NEW TOOLS BY DELTA

31-780	NEW Oscillating Spindle Sander	253	188
23-710	NEW Sharpening Center	217	169
11-980	NEW 10" Bench Drill Press	195	154
28-185	NEW Bench Band Saw	213	175
37-190	NEW 6" Deluxe jointer	603	489
36-250	NEW 10" Slide Compound Saw	Sale	489
31-695	NEW 6" Belt/9" Disc Sander	441	349
40-650	NEW Q3 18" Scroll Saw	600	479

DELTA STATIONARY

17-900	16-1/2" Floor Drill Press	490	415
34-080	10" Mitre Box	Sale	218
33-990	10" Radial Arm Saw	981	779
37-280	6" Motorized Jointer	450	389
50-179	3/4 HP 2 stage Dust Collector	523	395
43-355	3/4" Shaper 1-1/2 HP	1025	849
46-700	12" Wood Lathe	575	479
33-055	8-1/4" Sawbuck comp with legs.	846	665
36-540	10" Table saw	229	169
34-670	10" Motorized Table Saw	492	395
32-100	Stationary Plate Jointer	351	269
36-905	30" Unifence	346	245
36-906	50" Delta Unifence	444	319
36-755	10" Tilt Arbor Saw	Sale	1129
33-890	12" Radial Arm Saw	Sale	1589
34-444	Table Saw with 1-1/2 HP motor & stand	Sale	659
34-445	34-444 Saw with 30" unifence	Sale	839
28-280V	14" Band Saw w/enc stand 1 HP	Sale	798
28-275	14" Band Saw with open stand 3/4 HP	Sale	649
22-675	NEW DC380 15" Planer	Sale	1175
37-154	DJ15 6" Jointer	Sale	1289

DEWALT TOOLS

DW364	7-1/4" Circ. Saw w/brake, 13 amp	294	158
DW306K	8.0 amp Recip Saw w/cs v/spd	291	164
DW610	1-1/2 HP 2 handle Router	266	152
DW411	1/4 sheet Palm Sander, 1.7 amp	88	58
DW705	12" Compound Mitre Saw	734	359
DW704	12" Mitre Saw	570	325
DW100	3/8" Drill, 4 amp, 0-2500 rpm,rev	118	68
DW250	4.5A Drywall Gun, 0-4000 rpm,rev	158	88
DW254	4.5A Drywall Gun, 0-2500 rpm,rev	162	88
DW280K	NEW Screwdriver kit complete.	222	124
DW673K	Laminate Trimmer kit	364	205
DW402	4-1/2" Grinder 6 amp	166	89
DW682K	Biscuit Joiner with case	448	219
DW625	3 HP Electronic Plge Router	520	275
DW675K	3-1/8" Planer with case	292	164
DW431	3 x 21 var. speed Belt Sander	338	184
DW420	Palmgrip Random Orb Sander	124	69
DW421	above Sander with dust collector	144	74
DW423	NEW Palm Random Orbit Sander variable speed	170	94
DW444	6" Random Orbit Sander	266	139
DW443	DW444 with hook & loop pad	266	139
DW935K	NEW 14.4V 5-3/8" Trim Saw kit.	444	237

DW935K Saw comes with 2 batteries!

DEWALT CORDLESS DRILLS

DW952K	3/8" v/spd w/ two 9.6V batteries	284	139
DW972K-2	3/8" v/spd w/ two 12V XR batt	362	189
DW904	12 volt flashlight		29.95

DW972K-2 drill & DW904 flashlight* Sale *205

DW991K-2	3/8" v/spd w/ two 14.4V XR batteries	415	225
DW994KQ	1/2" variable speed w/ one 14.4V XR battery	458	235
DW994KQ-2	DW994KQ drill kit w/ 2 batt.	Sale	259
DW996K	1/2" v/spd Hammer drill w/ one XR battery	396	245

Above drill kits come w/charger & steel case !

DW991KS-2	DW991K drill, DW935 saw, &cse		349

NEW DeWalt 18 volt Cordless Tools

DW995K	1/2" Drill Kit	428	229
DW997K	1/2" Drill / Hammer Drill Kit	454	249
DW936K	Saw Kit	458	249

WAPVACUUMS

Model	Description	List	Sale
766RDF	10 gallon turbo vacuum	845	465
766RDF-D	"Drywaller" 10 gal turbo vac	915	549
766RDF-DAS	Same as above w/auto start	950	589

CLAYTON OSCILLATING SPINDLE SANDERS

140	Portable sander w/ 4-1/2" spindle.	625	559
146	Portable sander w/ 9" spindle	685	609
100	Floor mount sander w/4-1/2" spnd.	785	709
106	Floor mount sander w/ 9" spindle	845	759

DREMEL TOOLS

3955	Moto Tool Kit with bits & case	134	75
3956	Super Moto Tool Kit w/ acc.	152	85
1672	16" Scroll Saw - 2 spd "Best buy"	302	174
1695	16" var. speed Scroll Saw	408	229
290	Electric Engraver with point	25	16
1731	5" Disc1" x 30" Belt Sander	189	114

JORGENSEN ADJUSTABLE HANDSCREWS

Item#	Jaw Length	Opening Capacity	List	Sale	Box of 6
#3/0	6"	3"	17.05	9.90	56.50
#2/0	7"	3-1/2"	18.30	10.70	60.95
#0	8"	4-1/2"	20.35	12.10	66.95
#1	10"	6"	23.30	12.90	71.95
#2	12"	8-1/2"	26.75	14.90	83.95
#3	14"	10"	33.85	18.55	105.75
#4	16"	12"	44.05	24.65	140.95

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

Item#	Jaw Length	List	Sale	Box of 6
3706	6"	10.85	6.20	33.50
3712	12"	12.05	6.80	37.25
3718	18"	13.25	7.60	41.05
3724	24"	14.55	8.15	43.95
3730	30"	16.20	9.05	48.85
3736	36"	17.70	10.20	54.95

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

Item	Jaw Length	List	Sale	Lots of 6
4512	12"	34.50	20.75	114.95
4518	18"	36.35	22.30	122.95
4524	24"	38.50	23.65	129.95

JORGENSEN STEEL "I" BAR CLAMPS

Model	Size	List	Sale	Lots of 6
7224	24"	35.75	20.30	112.95
7236	36"	38.35	22.35	124.75
7248	48"	42.15	24.45	134.95
7272	72"	48.50	29.60	168.75

PONY CLAMP FIXTURES

Model	Description	List	Sale	Lots of 12
50	3/4" Black Pipe Clamps	15.45	8.10	92.50
52	1/2" Black Pipe Clamps	12.65	6.95	74.95

MK TILE SAWS

Model	Description	List	Sale
MK770	1/2 HP - 7" blade	795	579
MK660	3/4 HP - 7" blade	795	589
MK880	1 HP - 8" blade	986	859

We stock all replacement blades for above saws.

Msxe6362	FEIN Triangle Sander v/spd	Sale	205
Msx625	FEIN NEW Air Triangle Sander	Sale	195
LPN672	PONY Air Palm Nailer w/ glove	Sale	94.99
RTM01	ROTOZIP Drywall cutout unit	Sale	68.95

BLACK & DECKER

1166	3/8" Drill 0-2500 rpm 4 amp	118	68
2600	3/8" Drill 0-1200 rpm 4.5 amp	173	98
79-034	Workmate 400	191	109
1350K	1/2" Timberwolf Drill 2 speed	573	325
1180	3/8" Drill rev. 0-1200 rpm 5 amp.	215	119
2037	Drywall Gun 0-4000 5.0 amp	178	95
2038	Drywall Gun 0-2500 rpm 5 amp	178	95
2054	Tek Gun 0-2500 5.0 amp	289	159
2750	4-1/2" Grinder 10,000 rpm 6 amp	159	89
2694	7-1/4" Super Sawcat Circ Saw w/cs	294	158
2695	8-1/4" Super Sawcat Circ Saw w/cs	328	179
3339	Elu 3 HP v/spd Plunge Router	520	269

Piranha Carbide Tooth Saw Blades by B & D

Model #	Diameter	# Teeth	List	Sale
73-715	5-1/2	16	14.39	8.30
73-716	6-1/2	18	14.39	8.30
73-717	7-1/4	18	14.60	7.99
73-737	7-1/4	24	18.06	9.50
73-757	7-1/4	40	32.87	17.49
73-718	8	22	20.95	11.25
73-759	8-1/4	40	46.88	26.95
73-719	8-1/4	22	20.63	12.45
73-740	10	32	34.63	18.85
73-770	10	60	70.37	36.95
73-711	10	50	68.33	36.95

DURA III- ADJUSTABLE STILTS

Model	Description	List	Sale
D1422	14"-22" extension	270	205
D1830	18"-30" extension	288	222
D2440	24"-40" extension	304	239

Above models include strap adapter kits

SIOUX TOOLS

8030	3/8" variable speed Drill	263	145
8000	3/8"variable speed close quarter Drill 0-1300rpm	211	125
8005	Same as 8000 but is 0-2500 rpm	221	139
690	5" Air Random Orbit Sander	228	132
658	5" Air Random Sander-dual action	269	155

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ALUMINUM LADDER JACKS

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

Model	Accepts Width	Stage Spans	Attaches to Rung	Sale
10-14-02	14"	2 rung	2 rungs	83.95
10-20-02	20"	3 rung	2 rungs	92.95
10-20-03	20"	3 rung	3 rungs	101.95

ALUMINUM ARTICULATED LADDERS TYPE IA -300 # RATING

Model	Length	Weight(lbs.)	Sale
M7-14	7'	43#	159.95
M8-16	8'	46#	189.95

FIBERGLASS STEP - TYPE 1- 250# RATING

6004	4'	13#	57.95
6005	5'	16#	68.95
6006	6'	18#	72.95

FIBERGLASS STEP - TYPE 1- 250# RATING

6004-S w/pail shelf	4'	15#	63.95
6005-S w/pail shelf	5'	18#	73.95
6006-S w/pail shelf	6'	20#	80.95

FIBERGLASS STEP - TYPE 1A- 300# RATING

6204	4'	14#	65.95
6205	5'	18#	76.95
6206	6'	20#	89.95

ALUMINUM FLAT STEP TYPE 11- 225# RATED EXTENSION

Model	Size	Working Length	Weight(lbs)	Sale
D1224-2	24'	21'	33#	179.95
D1228-2	28'	25'	42#	209.95
D1232-2	32'	29'	53#	239.95
D1236-2	36'	32'	62#	266.95

ALUMINUM FLAT STEP TYPE 1- 250# RATED EXTENSION

D1324-2	24'	21'	39#	195.95
D1328-2	28'	25'	50#	226.95
D1332-2	32'	29'	62#	257.95
D1336-2	36'	32'	77#	318.95
D1340-2	40'	35'	85#	359.95

ALUMINUM FLAT STEP TYPE 1A- 300# RATED EXTENSION

D1520-2	20'	17'	37#	189.95
D1524-2	24'	21'	45#	220.95
D1528-2	28'	25'	56#	246.95
D1532-2	32'	29'	66#	289.95
D1536-2	36'	32'(250# rating)	79#	339.95
D1540-2	40'	35'(250# rating)	89#	369.95

FIBERGLASS FLAT STEP TYPE 1A- 300# RATING EXTENSION

D6116-2	16'	13'	34#	199.95
D6120-2	20'	17'	40#	219.95
D6124-2	24'	21'	53#	254.95
D6128-2	28'	25'	60#	298.95
D6132-2	32'	29'	74#	379.95

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

D7116-2	16'	13'	37#	249.95
D7120-2	20'	17'	43#	269.95
D7124-2	24'	21'	58#	309.95
D7128-2	28'	25'	66#	344.95
D7132-2	32'	29'	79#	398.95

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

STABILA LEVELS

Model	Description	List	Sale
24640	24" Level w/ hand holes	62.20	43
24670	48" Level w/ hand holes	79.70	55
24680	72" Level w/ hand holes	145.45	99
27170	48" Level w/o hand holes	71	49
27000	78" Level w/o hand holes	146	102
80LMS	NEW Laser Level System	532	365

RECORD WOODWORKING VISES

Model	Jaw\Width	Opening	List	Sale
53E	10-1/2"\15"	Quick release	248	119
52D	7"\8"	Quick release w/dog	169	89
52-1/2D	9"\13"	Quick release w/dog	231	105

KRAUSE MULTIMATIC LADDERS

Model	Description	List	Sale
121482	12' Aluminum Multi Purpose	264	128
121499	16' Aluminum Multi Purpose	286	148

AEG POWERTOOLS

Model	Description	List	Sale
HBSE75S	3 x 21 v/ speed Belt Sander	329	184
FSPE100X	Barrel Grip v/spd Jig Saw	298	159
BSPE100X	Top Hdle v/sp Jig Saw w/cs	298	159
TXE150	6" var/spd Rand Orb Sander	253	139

HITACHI TOOLS

Model	Description	List	Sale
C8FB2	8-1/2" Slide Compound Saw	1169	489
998862	8-1/2" Carbide blade - 60 tooth	Sale	44.95
C10FS	10" Slide Compound Saw	1627	739
C7BD	7-1/4" Circular Saw with brake	281	139
M12V	3 HP variable speed Router	541	209
TR12	Plunge Router 3 HP	377	189
SB-75	3 x 21 Belt Sander w/bag 2 spd	315	158
DH24VBK	15/16" SDS Rotary Hammer	298	179
P12R	12-9/32" Planer	1688	795
P12RA	Planer/Joiner	2203	995
C10FC	10" Mitre Saw	533	209
C15FB	15" Mitre Saw	1346	675
DN10DYK	9.6V Right Angle Drill Kit	370	179
G12SA	4-1/2" Grinder 6.9 amp	177	95
DS10DVAK	12V Cordless Drill Kit w/ 2 batt	417	199
DV14V	3/8" Hammer Drill with case	230	115
NR83A	Framing Nailer 2 - 3-1/2 Full Head. ...		425
NR83AA	Framing Nailer 2- 3-1/2 Clip Head....		429
NT65A	16 ga. Brad Nailer 1 - 2-1/2	749	325
NV45AB	Coil Roofing Nailer 7/8 - 1-3/4	935	419
N5008AB	7/16" Stapler-16 ga. 1 - 2 lgth	679	325

WAGNER PAINT & SPRAYER PRODUCTS

959	Power Roller	140	109
255	Airless Kit	180	135
375E	Airless System	195	164
404	Airless Painter & Roller	320	265
505	High performance Airless Painter	440	369
HVLP	Fine coat finishing HVLP System	195	159
CS2000	Pro fine finish HVLP System	339	278

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Model	Description	List	Sale
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LP6-20XL	LP6-20 with 9056 tripod & 7620 rod	409	275
L6-20	Meridian Level - 20x	309	199
LT8-300	Level Transit - 26x	739	489
LT8-300P	above Level with optical plum	869	565
LT6-900	Level Transit - 20x	419	269
LTP6-900	Above Level with tripod & rod.	615	389
ALT6-900	Automatic Level - Transit - 18x.	666	429
ALTP6-900	above Level with tripod & rod	799	499
ALP6-18HD	Auto. Level-18x with tripod & rod	599	395
AL8-22	Automatic Level - 22x	583	339
AL8-26	Automatic Level - 26x	854	549
ALP8-26	above Level with 9075 tripod and 7620 rod	977	499
ML100I	Laser Level	1099	945
ML100	Laser Level w/detector	1249	1075
ML200	NEW Visible Beam Laser	979	799
LL100	NEW Finish Line Laser Level	199	135

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2201	Pump Jack Brace	30	20
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Model	Description	List	Sale
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SFN40	Finish Nailer w/case 1-1/4"-2-1/2"	569	399
SN325	Nailer 1-7/8" - 3-1/4"	665	419
SLP20	Pinner w/cse 5/8" - 1-5/8"	422	275
SKS	Stapler 5/8" - 1-1/2"	390	279
M2	Stapler 1-3/8" - 2" length	535	375
SN70	Framing - Clip Hd 2" - 3-1/2"	725	449
SN60	Framing - Full Hd 2" - 3-1/2"	708	469
SN65	15% more power than SN60	709	469

AIRY AIR NAILERS

Model	Description	List	Sale
0241SK	Brad Nailer 3/8" - 1-9/16" Same as Senco SLP-20	180	98
0250SK	Brad Nailer 3/4" - 2"	296	164
0626SK	1/4" Crown Stapler 3/8" - 1"	194	104
0645	1/4" Crown Stapler 3/4" - 1-9/16" Same as Senco SKS	310	175
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0565T	Angle Finish Nailer 1" - 2-1/2"	386	205
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RCN-60\225	Coil Roofing Nailer	710	425
CN-350	Framing Nailer - Full Head	702	399
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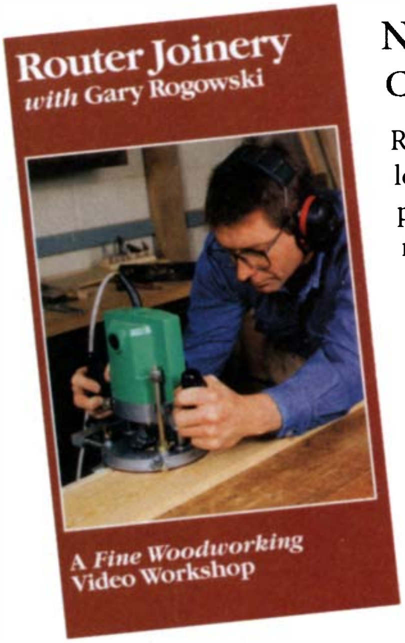

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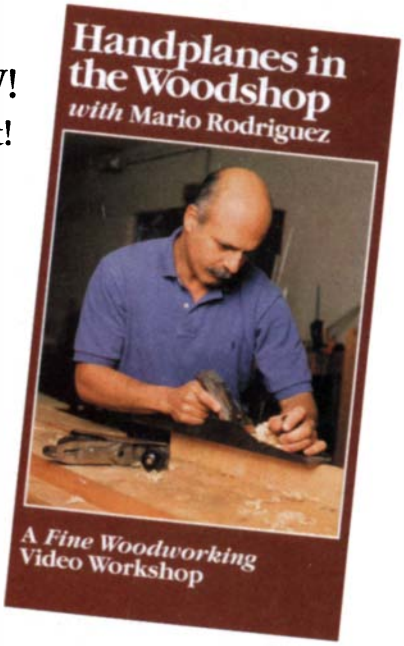

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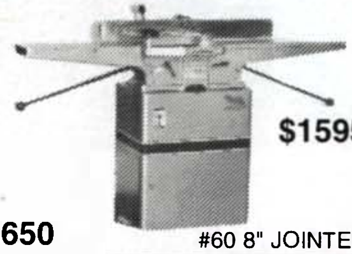
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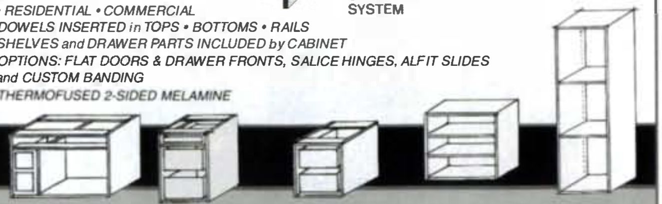

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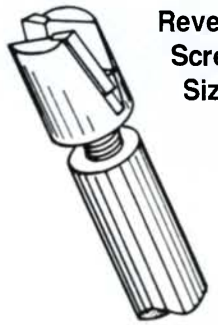

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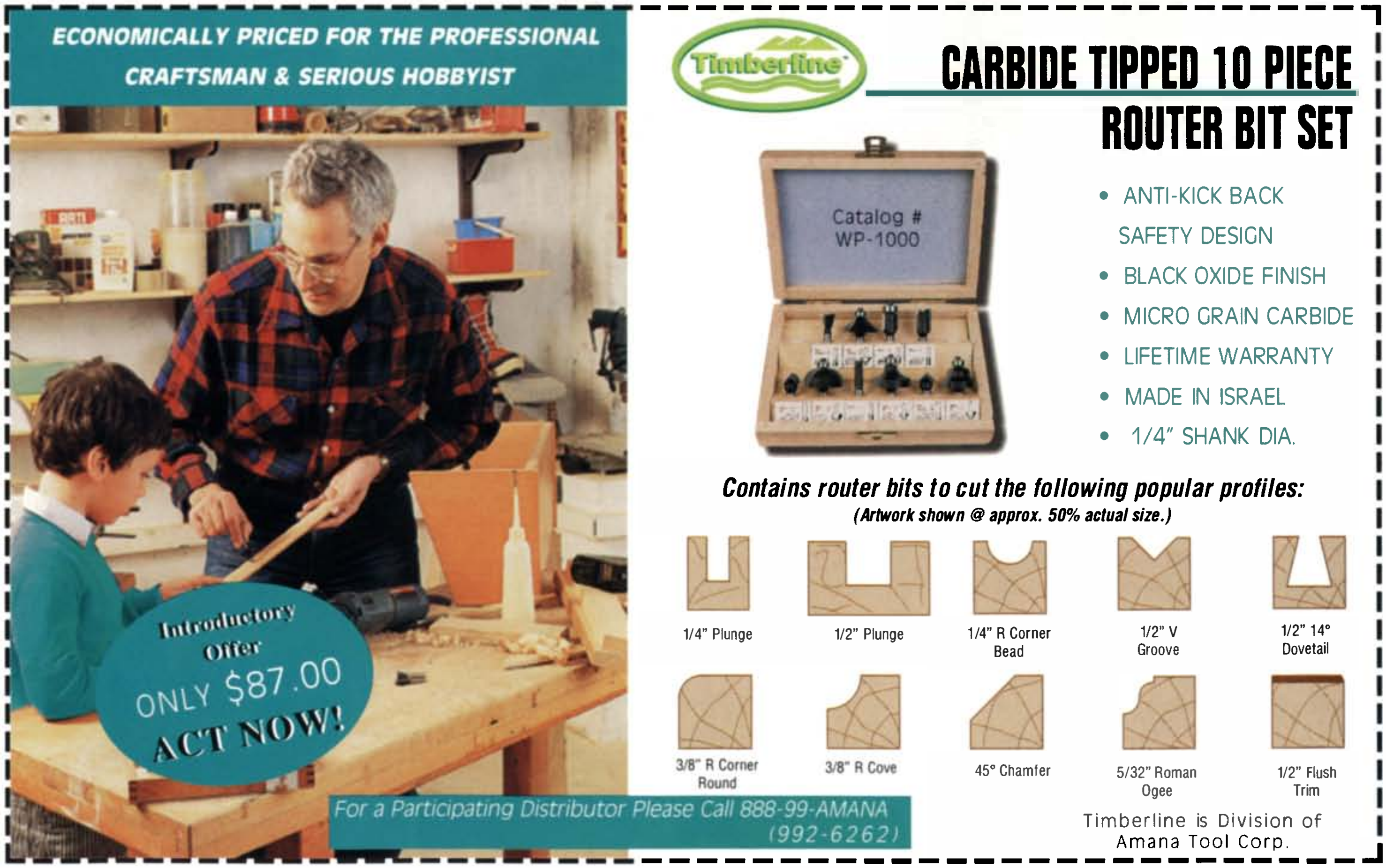


All-Purpose Sawblades

Designed to rip as well as crosscut, these blades handle a variety of materials

by Michael Standish

***Twenty-three all-purpose tablesaw blades** from 12 manufacturers were evaluated for both crosscuts and ripcuts. The performance difference among them was surprisingly small.*

For years, I have used one blade for ripping and another for crosscutting on the tablesaw. Somehow the idea that a single blade could both rip and crosscut seemed a product of aggressive advertising or a reflection of runaway consumer optimism (like the search for the 200-mpg carburetor).

After trying 23 of these industrial-grade, carbide-tipped blades (see the photo above right), I have come to an entirely different point of view. I now think that my best bet may indeed be an all-purpose blade with an identical backup blade to avoid sharpening downtime.

These blades will not rip as quickly as a blade made specifically for that purpose, and they may not produce the smoothest possible crosscut. But if you are making a lot of blade changes on the tablesaw as you switch from crosscutting to ripping operations, these blades are well worth looking at. And your checkbook will like it if you buy one blade that produces acceptable crosscuts and adequate ripcuts rather than two single-purpose blades.

The 10-in. blades I evaluated in the shop came from 12 manufacturers and range in price from $26 to $109. Depending on the manufacturer and the tooth pattern, you might see these blades called combination blades, all-purpose blades or general-purpose blades. But all of them are intended to

Photo at left: Dennis Preston; photos except where noted: Scott Phillips

rip and crosscut. For the sake of simplicity, though, I will refer to them generically as all-purpose sawblades.

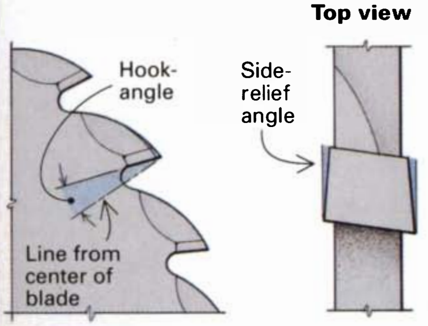
In appearance and in cost, there are obvious differences among these blades. But after cutting dozens of samples of wood, plywood and wood composites, I can tell you that any one of the blades will produce a good cut in a variety of materials (see the chart on pp. 42-43). Although I didn't use the blades long enough to find out which ones perform well over time, over the short run, they're remarkably similar.

Good blades start with a good plate

The plate is the foundation of the sawblade. It supports the cutting tips and clears chips from the cut. Plates are made from annealed (relatively soft) sheet steel, usually a nickel or chrome-vanadium alloy. They're rolled to a thickness of about

BLADE BASICS

Manufacturers adjust hook- and side-relief angles for the best compromise between ripping and crosscutting. Teeth on all-purpose blades may be ground to one of two patterns: alternate top bevel or alternate top bevel and raker.



Alternate top bevel

Points score the wood. *Alternate top bevel (ATB) teeth are ideal for severing wood fibers in crosscutting operations. Feed rates on ripcuts will be slower than with dedicated blades, which have fewer teeth.*

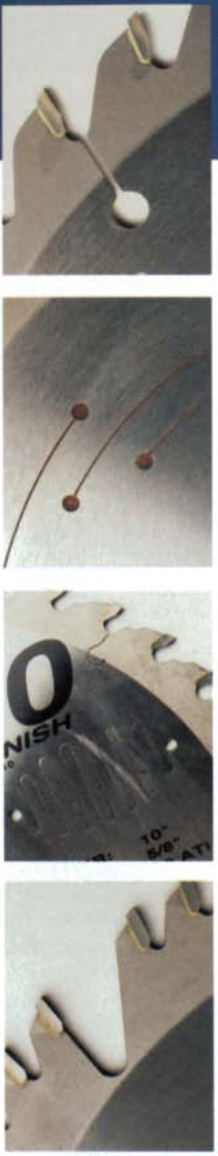
Alternate top bevel and raker

Raker teeth and deep gullets clear chips for faster ripping. *A group of four or 10 alternate top bevel teeth slice wood fibers, followed by a flat-topped raker.*

Drawing: Vince Babak

SLOTS KEEP BLADES FLAT, REDUCE NOISE

Expansion slots (top photo at left) allow the blade to increase in diameter as it heats up, helping the blade stay flat. Sound-suppression slots filled with a rubbery material (second photo) help deaden vibration and reduce noise. Other blades have both types of slots (third photo) or have deep gullets that serve as expansion slots (bottom photo).



.085 in. to .095 in. for regular kerf blades and .075 in. for thin-kerf blades.

Well-made plates, like the ones used in this evaluation, are either milled or laser cut. These techniques induce less stress than stamping, which is an inferior method. At this stage of manufacture, the plate is given the basic configuration: gullets and shoulder shape, tooth pockets, expansion slots, sound-suppression slots (if any) and arbor hole.

After being cut to shape and size, a plate is hardened and tempered. The relative hardness of steel is usually measured in terms of the Rockwell hardness scale (Rc). For normal woodworking applications, plates are hardened and tempered to between Rc38 and Rc44.

Not all plates, or blades, look alike (see the photos above). Some blades have expansion-control slots to minimize warping from heat buildup. Some blades also have sound-suppression slots, which dampen vibration and decrease blade noise. Gaps (gullets) in front of each tooth may vary. They provide a space where chips can accumulate before they are pushed out as the blade exits its cut. A larger gullet will get rid of waste more readily but will increase the noise and shock load on the tooth.

Tensioning helps a blade run true

Selectively applying force by hand or with a machine builds strain into a blade. This is called tensioning, and it counteracts warping caused by thermal expansion. With roll-tensioning, rollers under as much as four tons of force squeeze a small amount of the plate's steel in a concentric pattern. A ⅛-in. ring about 2 in. from the blade's circumference is evidence of this process. Hand-tensioning is accomplished by a saw smith using hammers, an anvil, a dial indicator and straightedges.

Tensioning becomes more critical as a blade's diameter or cutting speed increases and as plate thickness decreases. Because expansion slots or deep gullets will accommodate some deformation, a relatively small blade, carefully ground flat, may deliver adequate cutting results without benefit of tensioning. The need for tensioning plates as small as 10 in. or as thin as .095 in. may be debatable, but the best plates, like the ones in this evaluation, still receive this treatment.

Blades have two possible tooth patterns

Sawblades in this survey have one of two tooth arrangements. One type is the alternate top bevel (ATB). On this blade, the top of each tooth is ground at an angle to the left or right (see the top photo in the box on p. 39). The point of each tooth severs wood fibers at the edge of the kerf and then removes the waste with a slicing action. For crosscutting, this tooth style is ideal. ATB teeth also give a clean cut for ripping, but the feed rate is slower than it is with a dedicated rip blade.

All-purpose blades also may use a tooth arrangement called alternate top bevel and raker (ATB&R). These are often called combination blades. A series of alternately beveled teeth (usually four or 10 in a group) are followed by a rip-style tooth called a raker. The ATB teeth score the stock, and the raker tooth, with its extra-deep gullet, clears dust and chips (see the bottom photo in the box on p. 39). The raker tooth is ground about .01 in. lower than the ATB teeth.

Although they look alike, sound the same and have similar amounts of runout, these all-purpose blades are not quite identical.

Blades with an ATB&R pattern are capable of surprisingly crisp crosscuts and permit reasonable feed rates when ripping. As tooth count rises, crosscut quality improves but ripping becomes sluggish. Because the raker gullet takes a large bite of air, the resulting increase in turbulence can also make the blade noisier and may increase the chance of kickback. To lessen this risk, some blade manufacturers add a spur to the back of each shoulder to limit the bite of the following teeth.

Tooth geometry affects the cut

Hook- and side-relief angles are not very apparent to the eye, but they do play a crucial role in blade performance. Increasing the hook angle to 20° improves the feed rate but also increases tearout—the lower the hook angle, the cleaner a blade cuts. Blades in this survey have hook angles that range from 10° to 20°.

Although side-relief angles are hard to spot, they greatly affect cut quality. The more parallel to the plate, the more the tooth scrapes through the cut, resulting in higher operating temperatures. Hot-running blades cause resins in wood and adhesives in man-made materials to burn. The resins are then baked onto the blade, reducing cutting efficiency. A gummed-up blade will never perform as it should.

Thin-kerf blades use less power

Thin blades remove less waste, improve the feed rate and require less horsepower to drive the blade. This is most noticeable when ripping. Removing less waste can also mean better yield from a given amount of material. But except when resawing, the difference between a standard blade and a thin-kerf blade may not be meaningful.

Improved feed rate and yield come at the cost of an increased tendency of the blade to warp or flutter, which results in rougher cuts. The findings of the cut samples from this survey were mixed (see the chart on pp. 42-43). With a 3-hp tablesaw, there was virtually no difference in feed rate when ripping thick stock.

Brazing and carbide

All the blades evaluated in this survey have very hard tungsten-carbide teeth brazed or silver soldered to the plate. The scale used to describe the hardness of carbide includes about 20 classifications; however, only three or four of them are relevant to cutting wood.

Hardness ranges from C1 to C4; the larger number indicates a higher percentage of carbide granules and less binder. But this system is not very precise: one manufacturer produces almost a dozen grades that can be correctly called C2.

Generally speaking, though, as granule size and binder percentage increase, the resulting material is tougher (more shock resistant) but softer and more vulnerable to corrosion. This is important because heat and chemicals are even more destructive to carbide than abrasive materials. High heat can cause the cobalt binder to flow much like solder, which is greatly aggravated by chemical reactions with acids and other components, especially those in man-made materials like medium-density fiberboard (MDF).

Without a supporting binder, carbide granules will fall off like bricks without mortar. The loss of these particles at the cutting edges is the defining feature of a dull tooth.

I didn't cut enough stock to judge long-term durability of the carbide tips—with 23 blades, a huge quantity of material would have to be consumed before any degradation would be noticeable. The objective was to determine the quality of the cut.

Evaluating blades under real-shop conditions

Some materials are just plain difficult to cut cleanly, yet they are very common in the cabinet trade. I chose four of these materials for evaluating the blades: Baltic-birch plywood, melamine-faced particleboard, MDF and 2-in.-thick red oak.

I cut the birch plywood across the grain to maximize the chance of splintering. Melamine-faced particleboard is prone to chipping, especially on the back of the cut where the blade exits. Medium-density fiberboard readily shows sawmarks along the cut edge. And the oak was chosen to evaluate how well the blades ripped heavy stock. With each sawblade, I cut a dozen 24-in. lengths of each material on a General model 350 tablesaw.

***Measuring runout indicates flatness.** Blades in this evaluation had runout of between .003 in. and .005 in.*

***Blades all produced about the same noise levels,** around 93 decibels.*

Initially, I used a zero-clearance throat plate so that the blades would yield the best results. There was little difference in performance among the blades. I retrenched and used a well-worn throat plate so that the stock was free to splinter with the slightest cutting irregularity.

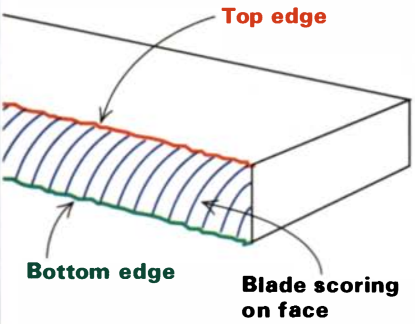
Checking for runout—Blade wobble, called runout, causes scoring on the edge of the cut and chipping on the back face of the stock. A good blade has only a little

Photos this page: Dennis Preston

Blade characteristics and performance

This chart summarizes blade characteristics and performance in solid wood and composites.

How to use this chart



Ratings:

E = Excellent G = Good
A = Acceptable

Top edge	Bottom edge	Blade scoring
E/G/A	E/G/A	S

Use both letters and colors. Letters refer to the quality of cut—the less chipping or splintering, the better the job. Colors show which edge is being graded (see the drawing above). For example, the Amana blade made an **E**xcellent, chip-free cut on the top edge of plywood and an **A**cceptable cut on the bottom edge. A blue "**S**" denotes scoring, or sawmarks.

Manufacturer	Model	Average retail cost	No. teeth	Tooth type
Amana	610504	$65	50	ATB+R
CMT	Maxi-Combination	$58	50	ATB+R
CMT	Maxi-Combo Light	$65	50	ATB+R
Delta	35-614	$55	48	ATB
Delta	35-613	$43	40	ATB
Delta	35-617	$45	50	ATB+R
DML	Planer 74020	$80	50	ATB+R
DeWalt	DW 3213	$53	40	ATB
Eagle America	610-5501	$80	55	ATB+R
Eagle America	610-5001	$60	50	ATB+R
Forrest	Woodworker II	$89	30	ATB
Forrest	Woodworker II	$107	40	ATB
Forrest	Woodworker II	$89	30	ATB
Forrest	Woodworker II	$107	40	ATB
Freud	F 40 Hyper Finish	$60	40	ATB
Freud	LU 72-M010	$45	40	ATB
Freud	LU 84-M011	$50	50	ATB+R
FS Tool	L 55250	$65	50	ATB+R
Oldham	Wizard Elite	$45	40	ATB
Oldham	Tracker	$26	40	ATB
Ridge Carbide	TS 2000	$109	40	ATB
SystiMatic	Budke Combination	$50	50	ATB+R
SystiMatic	Plymaster	$75	55	ATB+R

runout. Using a dial indicator, I measured runout with the probe 4 in. from the arbor center (see the top photo on p. 41), over two or three revolutions of each blade. The blade was then repositioned on the arbor and the reading taken again. I did this in four 90° increments to see whether the arbor flange and blade runout might negate each other. The runout measured between .003 in. and .005 in. for all the blades.

Although this method is not particularly sophisticated, it does represent real shop conditions. The numbers I recorded may not be too meaningful by themselves (it's certainly possible that a speck of sawdust was trapped between blade and arbor flange), but the relative numbers are useful for comparing the blades. My findings are tabulated in the chart above, which gives the average of several measurements on each blade.

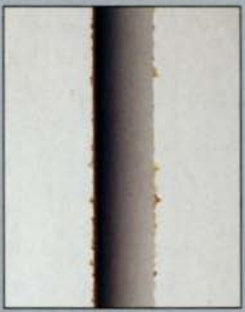
Measuring noise—I measured the noise the blades produced while cutting with a Radio Shack sound meter. It was clamped to a stand next to the saw at roughly ear height (see the bottom photo on p. 41).

Predictably enough, a 2-lb. blade with a rim speed of about 100 mph makes a lot of noise; it is pushing a lot of air. The intensity of the sound waves is measured in decibels (dB). This scale is non-linear, so an increase of 3 dB represents a doubling of the intensity.

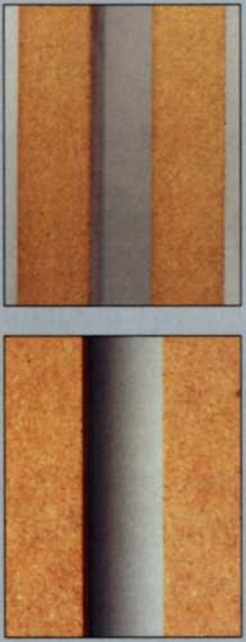
All the blades measured 93 dB, spiking 1 dB higher and lower when cutting the oak. I attribute the relative quiet and uniform readings of these blades to two main factors. First, the high-quality saw I used has lots of sound-dampening cast iron, and second, these blades all have been manufactured to extremely high standards.

Kerf	Runout	Plywood (crosscut)	Melamine	MDF	Oak (ripcut)
regular	.005	E A	E E	E E S	G
regular	.005	E G	E G	E G S	G
thin	.003	E G	E E	E E	G
regular	.005	G A	E G	E E S	G
regular	.005	E G	E G	E E	G
regular	.005	E A	E G	E E S	G
regular	.004	E E	E A	E G S	E
regular	.005	E E	E E	E E S	G
regular	.005	E E	E E	E E S	G
regular	.004	E E	E E	E E S	G
regular	.004	E E	E G	E E S	E
regular	.004	E G	E G	E E	E
thin	.004	E E	E E	E E	E
thin	.005	E G	E G	E E	E
thin	.005	E G	E E	E E S	G
regular	.005	E G	E G	E E S	G
regular	.005	E E	E G	E E S	A
regular	.005	E G	E G	E E S	G
regular	.004	E G	E G	E E	E
thin	.005	E G	E G	E E S	G
regular	.003	E G	E G	E E	E
regular	.004	E G	E E	E E S	G
regular	.004	E G	E E	E E S	G

The bottom edge of the plywood shows the difference. *The crosscut sample at left is representative of the best blade performance. The sample at right is an example of blades that made acceptable cuts.*



Chipping on the bottom edge of the melamine. *Excellent-cutting blades produced samples like the one at left. Acceptable cuts look like the one on the right.*



Medium-density fiberboard cuts smoothly. *Differences in blade performance were not significant when it came to scoring, or sawmarks, left behind by blades in the sawn face of MDF (photo at left). That is also the case in how blades performed on the bottom edges of MDF samples (bottom photo).*

Finish quality—All the blades displayed a high level of finish, reflected in crisp arbor holes, uniform brazing cleaned by sandblasting (except Forrest, which is cleaned by grinding), fine and concentric plate grinding, and nicely honed teeth with well-defined edges. And with the exception of Oldham's garish graphics, these blades present a handsome, well-made appearance.

Looking at the cut—Although they look alike, sound the same and have similar amounts of runout, these all-purpose blades are not quite identical.

All the blades produced a crisp cut at the top edge of plywood cut across the face grain. The most noticeable difference was on the bottom edge where tearout varied from hardly noticeable to splintering from ⅛ in. to ⅜ in. back from the edge (see the top photo above).

It is difficult to eliminate chipping in melamine. Each blade in the survey produced a crisp, chip-free cut on the top surface. There was little difference between the best and the worst on the bottom edge (see the second photo above).

There was a more noticeable difference between the best and worst cuts in MDF, but they didn't seem significant to me. The best cuts showed no scoring along the sawn face, and the worst showed only slight scoring (see the third photo above). There was hardly any difference on the bottom edges (see the bottom photo above).

All the blades easily handled deep cuts when ripping hardwood. The best left a crisp, smooth edge that didn't need further jointing; the poorest had slight scoring. ☐

Michael Standish is a trim carpenter and woodworker from Jamaica Plain, Mass.

Chisel Handles to Order

Handles you turn yourself make tools a pleasure to use

by Mario Rodriguez

Woodworkers who visit my shop always ask how I have managed to find such a large variety of chisels with matching handles. And they always want to know what kind of wood the handles are made of. The answer is I make my own handles, and I mainly use wood from cutoffs pulled out of my scrap bin. I've pulled some really spectacular pieces of wood from my firewood pile.

Making my own chisel handles lets me customize their size and shape. The result is a tool that looks and works better. Making my own handles also lets me have my pick of all those unhandled antique chisels and gouges that everyone else passes up at flea markets and yard sales (see the photos at right).

Rehandling a chisel is much less of a project than most woodworkers realize. It doesn't take a machinist's precision to make a handle that stays on. A few rough measurements, a good eye and a test-fit or two will get you there. And it only takes a half-hour or less to make, finish and attach a handle.

Chisels have sockets or tangs

Although there's a chisel for every imaginable woodworking task, all chisels have either a socket or a tang. You'll find more socket than tang chisels at flea markets and used-tool sales. Socket chisels used to be the standard, but they're not made much now.

A socket is simply a conical recess in the steel. One end of the handle is tapered to a cone that mates with the socket. A friction fit holds the chisel and handle together. Pounding on the back end of the chisel seats the handle more tightly, so socket chisels are well-suited for chopping as well as paring.

Most modern bench chisels and gouges are made with a tang. This is a tapered projection, usually about 1¼ in. long, that mates with a centered hole in the handle. These chisels are great for paring, but they should not be used for any heavy chopping because the tang can split the handle.

Making the handles

Initially, making a handle for both socket and tang chisels is the same. Determine a length and a diameter for the handle, and prepare a blank to those dimensions. Adding a few extra inches to the blank will make turning easier. If you're turning a handle for a socket chisel, don't forget to include the part that fits inside the socket.

Think about the size of the blade and how that will affect the balance of the chisel. Consider the chisel's intended use. I make a short, thin handle for a chisel that has a narrow blade because this chisel does more delicate work. On my firmer chisel, which I use for chopping, I made a long, beefy handle. It will stand up to more abuse and will help counterbalance the weight of the blade.

Start by marking the center of the blank at both ends; diagonals from corner to corner will cross at the center. Remove the drive center from the headstock of your lathe, center its point on the center of the blank. Tap the blank a few times with a hammer, just enough so the spurs bite well but not enough to split the blank. Now chuck the blank in your lathe, and position the tailstock.

Using a roughing gouge and then a shallower gouge will take the blank to the approximate shape you want (see photo 1 on p. 46).

Photos: Vincent Laurence

***You can't buy these handles.** Making your own chisel handles lets you customize their size and shape so they will fit your hand perfectly. Flea market chisels are inexpensive and can be handled in beautiful woods you'd never find on store shelves.*

Use a pencil line to mark all transitional locations, and come back with a parting tool. You'll want to mark the point where either the socket or ferrule starts, as well as the actual tail end of the chisel (see photo 2 on p. 46). On more complicated chisel patterns, mark the locations of beads, coves and other details.

Socket chisels—If you're rehandling a socket chisel, turn the cone to rough dimension now. I use a carpenter's rule held above the spinning blank to estimate diameter. You might prefer calipers. Keep the cone about 1/8 in. shorter than the socket depth, so it won't bottom out. Clear away some space on the waste side of the tail end of the chisel, and then round over the tail end with a small gouge (see photo 3 on p. 46).

Remove the chisel handle from the lathe, and check the fit of the cone in the socket (see photo 4). You're looking for a snug fit that takes a fair amount of effort to seat. You won't get this fit right away, but you'll know what to remove by looking for shiny or dirty spots on the cone when you remove the socket (see photo 5). When test-fitting the handle to the blade, look for about 3/16 in. to 1/4 in. between the socket and the shoulder of the handle (when the handle is finished and you've driven it home onto the blade, there should be a gap of about 1/8 in.). Re-chuck the blank, use a gouge or parting tool to remove a little material from the cone and test the fit again. Repeat until the fit is right.

Sand to 320-grit, and then burnish with some of the chips and shavings you've just removed. This will start to bring up a shine. For a finish, I use Qualasole, a padding lacquer made by Behlen (sold through Garrett Wade; 800-221-2942 and Woodworker's Supply; 800-645-9292). I just pour a little on a T-shirt scrap, apply it while the lathe is spinning and I'm done (see photo 6). The finish dries in a minute or two.

Remove the handle from the lathe, clamp the chisel blade firmly into a vise and hammer the handle home. A little duct tape around the blade will help prevent it from slipping or being damaged if

SOCKET HANDLE

1. Use a roughing gouge to turn the blank to approximate shape. *Then take a shallower gouge to smooth the blank. Position the tool rest as close to the blank as you can; move it in as you remove material.*

2. Mark transitions with a pencil and then a parting tool. *The pencil mark on the right is where the cone will start. The part on the left defines the tail end of the chisel.*

3. Round over the tail end of the chisel. *Clear some space on the waste side of the part first, though, so your gouge won't catch. Turn the cone to rough dimension.*

4. Test-fit cone to socket. *A snug fit with about 1/8-in. space between the shoulder and the end of the socket is what you're after. This one is still a little too tight.*

5. Dirt and burnished areas mark high spots. *Re-chuck the handle, remove more material and check the fit again. Repeat until the fit is right.*

6. Put on a coat of finish. *Padding lacquer, which is the author's choice, goes on quickly and dries almost immediately.*

7. A faceted end *can be a nice custom touch.*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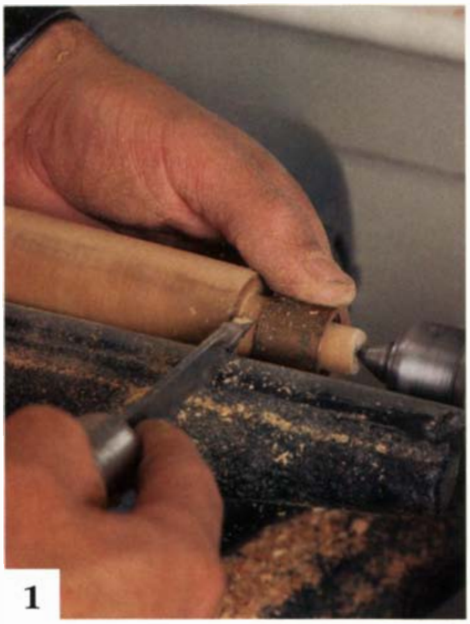


1

2

TANG HANDLE

1. Sneak up on a perfect fit. *Make the section for the ferrule twice as long as it needs to be, turn the end smaller than the inside diameter of the ferrule and keep parting away the section near the shoulder until the ferrule fits.*

2. Drill a hole for the tang. *Replace the center in your tailstock with a chuck. Use a brad-point bit about the size of the tang or a little smaller. Center the point of the bit, and advance the tailstock slowly as the lathe runs.*

3. Pare or file the hole in the end of the handle *until the tang fits. Or you can use a drill with a bit in it as a power rasp. Don't remove too much material, or the handle will split.*

you're clamping it in a metalworking vise. Saw off the excess blank, and pare, file or sand the end until you're happy with it. The end of the handle can be made perfectly smooth like the rest of the handle or faceted so there's some texture (see photo 7).

Tang chisels—The major difference between rehandling socket and tang chisels is that a tang chisel requires a ferrule. The ferrule, simply a metal ring around the handle where the tang enters it, helps prevent the chisel handle from splitting. I make ferrules from brass, or more commonly, copper plumbing pipe. Don't use a hacksaw to cut the pipe, or you'll distort the ferrule. Use a pipe cutter instead, and you'll have a ferrule that will go on easily.

I make the end of the chisel where the ferrule sits twice as long as it will be on the finished chisel. This extra length gives me a place to hold the ferrule as I turn the spot where the ferrule will sit to the proper diameter. This allows me to sneak up on a perfect fit (see photo 1 above).

After getting the ferrule snugly onto the end of the handle, finish turning the blank to shape, sand, burnish and finish it, just like the socket chisel. I file the end of the ferrule to remove any burrs and to give the end a nicely beveled appearance.

Remove the lathe's tail center, and replace it with a tailstock chuck and a bit that's about the same diameter as the tang. I use a brad-point bit because I can center the point on the depression left by the tail center. Advance the tailstock slowly into the end of the handle while supporting the handle with your other hand (see photo 2 above). If I can't advance the tailstock far enough, I'll cut off some of the excess where I held the ferrule. Then I'll repeat the drilling process after moving the tailstock closer.

After drilling the hole just a little deeper than the tang is long (so it doesn't bottom out and split the handle), remove the handle from the lathe, saw off the excess at the blade end, and square up and expand the hole until the tang fits snugly (see photo 3 at right). If the tang is too loose, use shims to tighten it. When you have the fit you want, clean up the end and you're done. □

Mario Rodriguez is a contributing editor to Fine Woodworking.

3

Making an End Table

The beauty of this Arts-and-Crafts design is in the details

by Stephen Lamont

***Beauty that's more than skin deep.** This end table is solidly constructed and meticulously detailed. It should last generations.*

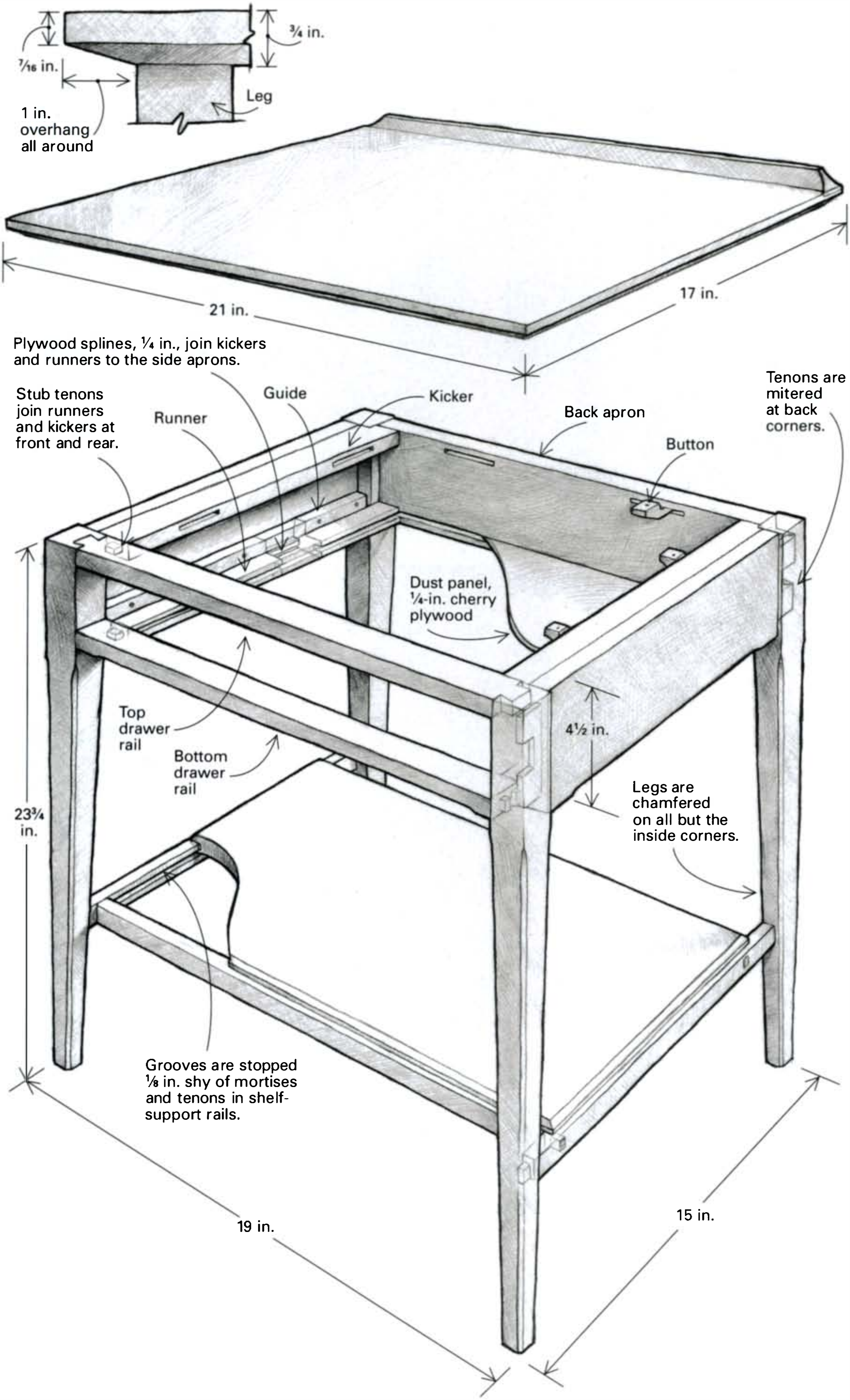
About 10 years ago, I began to tire of my job as a corporate pilot. The work was challenging and enjoyable, but the time away from home put a strain on my family. The job was becoming more technical, too. Temperamentally, I've always been more of a craftsman than a technician.

After considerable soul-searching, I decided to become a furnituremaker. I wanted a solid foundation of basic skills, so I went to England where I trained with Chris Faulkner. He emphasized developing hand-tool skills and building simple, comfortable furniture that asked to be used—a basic tenet of the British Arts-and-Crafts movement. My preferences to this day are for this kind of furniture and for the use of hand tools whenever their use will make a difference.

About two years ago, I designed and built the end table shown in the photo at left. Although it's an original design, many details come from other pieces of furniture in the British Arts-and-Crafts tradition. The joinery is mortise-and-tenon and dovetail throughout.

The construction of the table can be divided into five main steps: stock preparation and panel glue-up; making the front and rear leg assemblies; con-

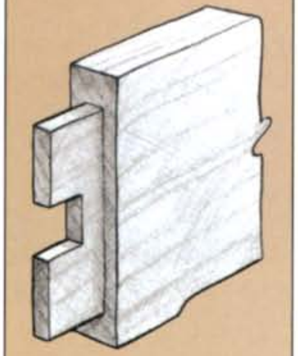
Photos: Vincent Laurence



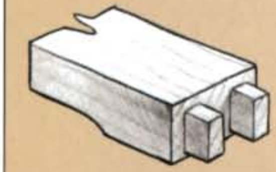
Drawings: Bob La Pointe

JOINERY DETAILS

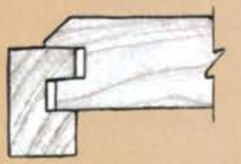
Careful joinery adds to the strength of this Arts-and Crafts table without compromising its delicate lines.



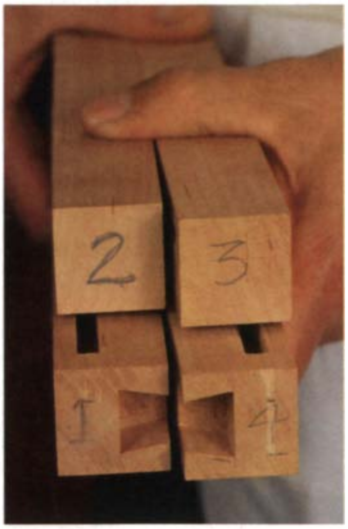
Apron to leg
Two small tenons connected by a stub tenon provide nearly the same glue-surface area and resistance to twisting as a full-width tenon, without weakening the leg as much.



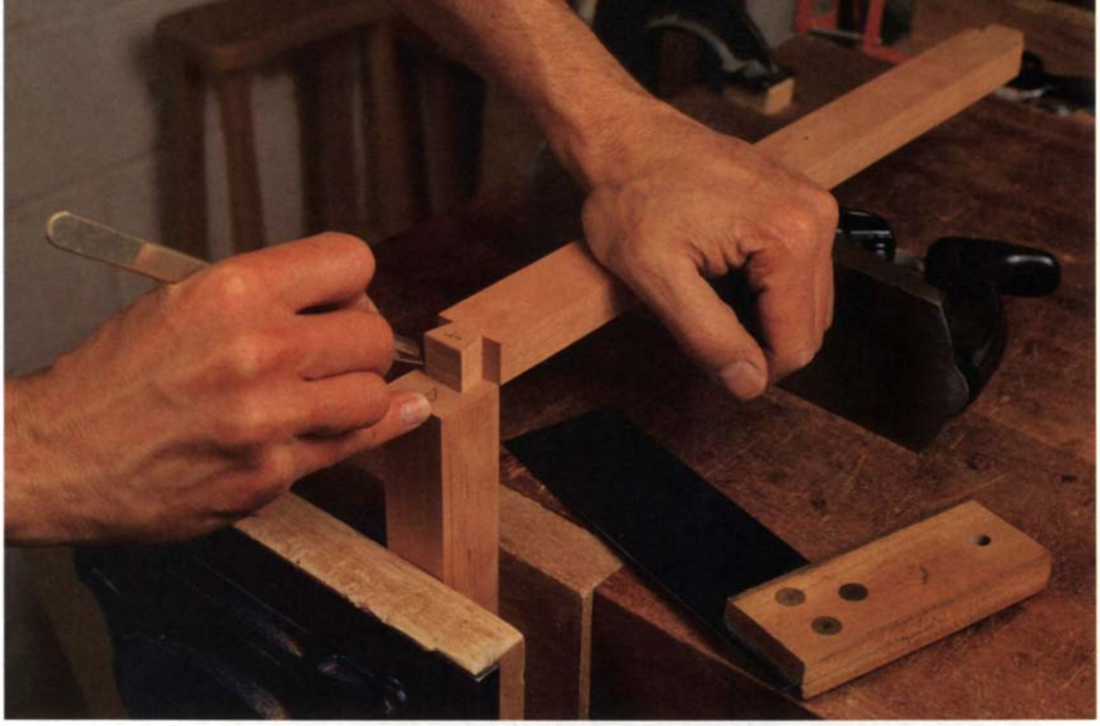
Lower drawer rail to leg
Two small, parallel tenons effectively double the glue-surface area that would be available on a single tenon on this delicate frame member.



Shelf-to-shelf support rail
The bottom tongue of the shelf's edge nests in the groove of the rail, providing a positive yet inconspicuous connection. The shelf can expand and contract freely with changes in humidity.



***Keeping track of the legs** is easier when they're numbered on top, clockwise from the front left. This system helps prevent layout errors.*



***Marking out the dovetail socket**—Scribing the socket from the bottom of the slightly tapered dovetail ensures a good fit in the leg.*

necting these two assemblies (including making the shelf and its frame); making and fitting the drawer; and making and attaching the top.

Stock selection and preparation

I milled all the stock for this table to within 1/16 in. of final thickness and width. I also glued up the tabletop, the shelf and the drawer bottom right away to give them time to move a bit before planing them to final thickness. This helps ensure they'll stay flat in the finished piece. With these three panels in clamps, I dimensioned the rest of the parts to a hair over final thickness. I finish-planed them by hand just before marking out any joinery.

Making the front and rear assemblies

Layout began with the legs. I numbered them clockwise around the perimeter, beginning with the left front as I faced the piece, writing the numbers on the tops of the legs (see the top left photo). This system tells me where each leg goes, which end of a leg is up and which face is which.

Dovetailing the top rail into the front legs—The dovetails that connect the top rail to the front legs taper slightly top to bottom. I used the narrower bottom of the dovetail to lay out the sockets in the legs. The slight taper ensures a snug fit (see the top right photo). Don't make the dovetails too large, or you'll weaken the legs.

After I marked, cut and chopped out the sockets, I tested the fit of these dovetails. By using clamping pads and hand screws across the joint, I eliminated the possibility of splitting the leg (see the photo at right). The dovetail should fit snugly but not tightly. Pare the socket, if necessary, until you have a good fit.

Tapering and mortising the legs—I tapered the two inside faces of each leg, beginning 4½ in. down from the top. I removed most of the waste on the jointer and finished the job with a handplane. The tapers must be flat. To avoid planing over a penciled reference line at the top of the taper, I drew hash marks across it. With each stroke of the plane, the lines got shorter. That let me know how close I was getting.

I cut the mortises for this table on a hollow-chisel mortiser. It's quick, and it keeps all the mortises consistent. I made sure all mortises that could be cut with one setting were done at the same time, even if I didn't need the components right away.

Tenoning the aprons and drawer rail—I tenoned the sides, back and lower drawer rail on the tablesaw, using a double-blade tenoning setup (for more on that subject, see *FWW* #95, pp. 72-75). It takes a

***Checking the fit of the top-rail dovetail**—A hand screw prevents a leg from splitting if the dovetail is too big. The fit should be snug but not tight.*

little time to get the cut right, but once a test piece fits, tenoning takes just a few minutes. After I cut the tenon cheeks on the tablesaw, I bandsawed just shy of the tenon shoulders and then pared to the line.

One wide apron tenon would have meant a very long mortise, weakening the leg. Instead, I divided the wide tenon into two small tenons separated by a stub tenon (see the drawing detail on p. 49). That left plenty of glue-surface area without a big hole in the leg.

Mortising for runners, kickers and buttons—The drawer rides on runners that are mortised into the lower front rail and the back apron. Similarly, the kickers at the tops of the side aprons, which prevent the drawer from drooping when open, are mortised into the top front rail and the back apron. I cut the ¼-in.-wide mortises for the runner and kicker tenons on the back edge of both drawer rails and on the back apron. There are eight mortises for the drawer runners and kickers. Another seven mortises of the same size are for the buttons that attach the top to the table's base—three on the back apron and two on each kicker.

I also cut grooves for the dust panel at this time. The ¼-in.-thick panel is set into the frame of the table just below the drawer. It's a nice touch, even if it's not needed structurally. I cut the grooves for the panel into the bottom of the back apron and into the back of the drawer rail. (I cut the dust-panel grooves in the drawer runners later.) Then I made a test-fit with a scrap of the same ¼-in. cherry plywood used for the panel.

Chamfering and gluing up—Stopped chamfers are routed on the legs and aprons of this table, each terminating in a carved lamb's tongue. I stopped routing just shy of the area to be carved and then carved the tongue and the little shoulder in three steps, as shown in the photos at right.

Gluing up the table base is a two-step process. First I connected the front legs with the top and bottom drawer rails and the back legs with the back apron. To prevent the legs from toeing in or out because of clamping pressure, I inserted spacers between the legs at their feet and clamped both the top and bottom. Then I check for square, measuring diagonally from corner to corner (see the photo at left on p. 52). It ensures that the assembly is square and that the legs are properly spaced.

Connecting the front and rear assemblies

To hold the legs in position while I measured for the drawer runners and kickers and, later, to get the spacing on shelf-support rails correct, I made a simple frame of hardboard and wooden corner blocks (see the photo at right on p. 52). The frame ensures the assembly is square and the legs are properly spaced. After I marked the shoulder-to-shoulder lengths for the runners and kickers, I cut and fit the stub tenons that join these pieces to the front and rear assemblies. The back ends of the runners and kickers must be notched to fit around the inside corners of the legs.

Runners, kickers and dust panel—I cut the ¼-in. grooves for the dust panel in the drawer runners next. I also cut grooves for the splines with which I connected the drawer runners and kickers to the sides of the table. There are 10 grooves in all—one each on the inside and outside edges of the drawer runners, one on the outside edge of each of the kickers and two in each side for the splines.

Then I dry-clamped the table and made sure the tops of the kickers were flush with the top edges of the sides, the tops of the runners flush with the top of the drawer rail and the bottoms of the runners flush with the bottom edges of the sides. Then I cut the dust panel to size, test-fit it and set it aside until glue-up.

Building the shelf frame and shelf—The shelf on this table is a floating panel captured by a frame made of four rails. The two rails that run front to back are tenoned into the legs; the other two are joined to the first pair with through-wedged tenons.

I put the dry-assembled table into the hardboard frame and clamped the legs to the blocks. Then I clamped the pair of rails that will be tenoned into the legs against the inside surfaces of the legs and marked the shoulder of each tenon (see the photo at right on p. 52). I also marked the rails for orientation so that the shoulders can be mated correctly with the legs.

Tenons were cut and fit next. With the rails dry-clamped into the legs, I measured for the two remaining rails to be joined to the first pair. I laid out and cut the through-mortises in the first set of rails, chopping halfway in from each side to prevent tearout. I cut the tenons on the second set of rails, assembled the frame and marked the through-tenons with a pencil line for wedge orientation. So they don't split the rails, the wedges must be perpendicular to the grain of the mortised rail.

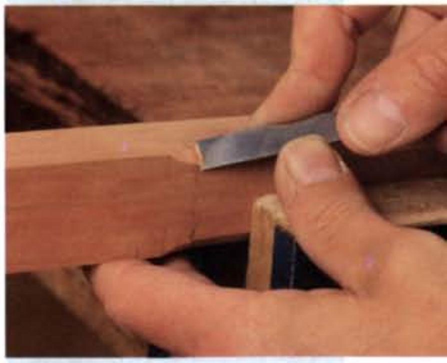
I flared the sides of the through-mortises (not the tops and bottoms) so the outside of the mortise is about $1/16$ in. wider than the inside. This taper, which goes about three-quarters of the way into the mortise, lets the wedges splay the tenon, locking the rail into the mortise like a dovetail.

Next I marked the location of the wedge kerfs in each tenon, scribing a line from both sides of the tenon with a marking gauge for uniformity. I cut the

CARVING A LAMB'S TONGUE

Step 1: Pare to marked baseline. *Strive for a fair, even curve, and cut down toward the chamfer.*

Step 2: Tap a stop for the shoulder at the baseline. *Avoid cutting too deeply; just a light tap is needed.*



Step 3: Pare into stop to create a shoulder. *You have to cut toward the shoulder, so take light cuts and watch which way the grain is running. If you must pare against the grain, make sure your chisel is freshly honed.*

Check diagonals to make sure assemblies are glued up square. *Clamps and a spacer at the bottom of the legs prevent the clamping pressure at the top from causing the legs to toe in or out.*

Simple frame keeps legs spaced accurately *and the base of the table square. A 1/4-in.-thick piece of hardboard and some scrap blocks make up this handy frame. With the legs properly spaced, the author can mark the shoulders of the shelf-frame rail against the tapered legs as well as take precise measurements for runner and kicker lengths.*

kerfs at a slight angle. Wedges must fill both the kerf and the gap in the widened mortise, so they need to be just over 1/16 in. thick at their widest.

An interlocking tongue and groove connects the shelf to the rails that support it (see the drawing detail on p. 49). Using a 1/4-in. slot cutter in my table-mounted router, I cut the groove in the rails, working out the fit on test pieces first. The slots are 1/4 in. deep. I stopped the grooves in the rails 1/8 in. or so short of the mortises on the side rails and short of the tenon shoulders on the front and back rails. I notched the shelf to fit at the corners (see the drawing).

I measured the space between the rails of the shelf frame and added 1/2 in. in each direction to get the shelf dimensions. I cut the tongue on all four edges on the router table.

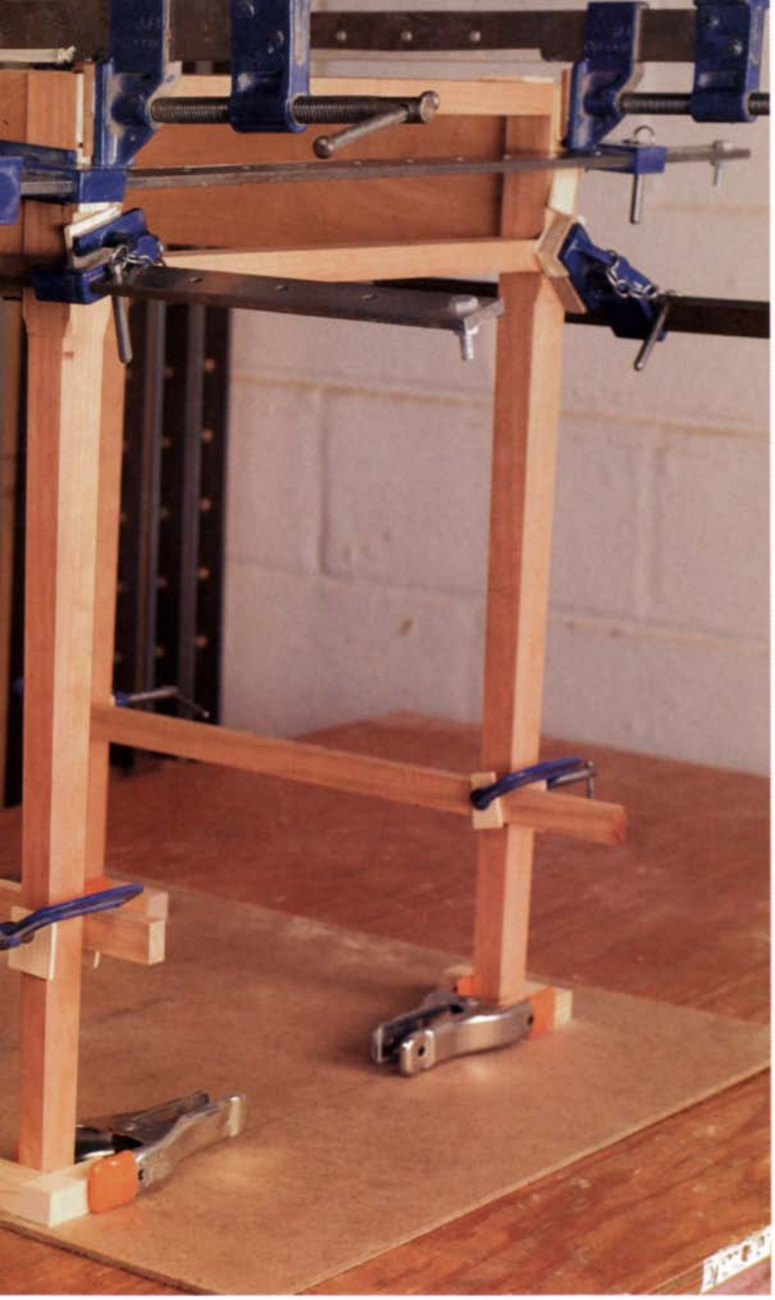
Gluing up the shelf-frame assembly—Before gluing up the shelf frame, I routed hollows in clamp pads to fit over the through-tenons on two of the shelf rails. Then I began gluing up the shelf assembly. I applied glue sparingly in the mortises and on the tenons so I wouldn't accidentally glue the shelf in place. I pulled the joints tight with clamps and then removed the clamps temporarily so I could insert the wedges.

After tapping the lightly glue-coated wedges into the kerfs in the tenons, I reclamped the frame. I checked diagonals and adjusted the clamps until the assembly was square. Once the glue was dry, I sawed off the protruding tenons and wedges and planed them flush.

Overall glue-up—With the shelf frame glued up, the entire table was ready to be assembled. I began the large front-to-back glue-up by dry-clamping the front and back leg assemblies, sides, runners, kickers (with splines), dust panel and shelf assembly. I made adjustments and then glued up.

I made and fit the drawer guides next (see the drawing for placement). I glued the guides to both the sides and the runners and screwed them to the sides with deeply countersunk brass screws.

I did a thorough cleanup of the table in preparation for drawer fitting. I removed remaining glue, ironed out dents



Rabbeted clamping block helps provide pressure in two planes. *The author clamps down the cove strip with six C-clamps and into the rabbet with six bar clamps. A spring clamp on each end closes any visible gaps at the ends.*

and sanded the entire piece with 120-grit sandpaper on a block. I gently pared sharp corners, taking care not to lose overall crispness.

The drawer

I particularly enjoy making and fitting drawers. A well-made drawer that whispers in and out gives me great satisfaction. I use the traditional British system of drawermaking, which produces what my teachers called a piston fit. The process is painstaking (see *FWW* #73, pp. 48-51 for a description of this method), but the results are well-worth the effort. That, however, is a story for another day.

Making and attaching the top

After I thicknessed and cut the top to size, I placed it face down on my bench. I set the glued-up base upside down on the top and oriented it so it would have a 1-in. overhang all around. I marked the positions of the outside corners and connected them with a pencil line around the perimeter. This line is one edge of the bevel on the underside of the top. Then I used a marking gauge to strike a line 7/16 in. from the top surface on all four edges. Connecting the two lines at the edges created the bevel angle (see the drawing on p. 49). I roughed out the bevel on the tablesaw and cleaned it up with a plane. The bevels should appear to grow out of the tops of the legs.

Making and attaching the coved lip—The cove at the back of the top is a strip set into a rabbet at the back. I cut the cove from the same board I used for the top so that grain and color would match closely. I ripped the cove strip on the tablesaw and handplaned it to fit the rabbet. I shaped the strip on the router table, leaving the point at which it intersects the top slightly proud. To provide even clamping pressure, I used a rabbeted caul, clamping both down and in (see the photo at right above).

When the glue was dry, I planed the back and the ends of the cove flush with the top. To form a smooth transition between top and cove in front, I used a curved scraper, followed by sandpaper on a block shaped to fit the cove. I frequently checked the transition with my hand and sanded a wider swath toward the end. It's easy to go too far and have a nasty dip in front of the cove.

I drew the ends of the cove with a French curve and then shaped the ends with a coping saw, chisel and sandpaper. The curve should blend into the tabletop seamlessly.

Finishing up with oil—After finish-sanding, I applied several coats of raw linseed oil diluted with mineral spirits in a 50/50 mix, a few more coats of straight linseed oil and, finally, two to three coats of tung oil to harden the surface. I let the oil dry thoroughly between coats. After the last coat of oil was dry, I rubbed the surface down with a Scotch-Brite pad and gave the table a few coats of paste wax. The drawer was the exception: Aside from the face of the drawer front, all other surfaces were finished with wax alone.

Attaching the top—I screwed the top to the top-drawer rail from beneath to fix its position at the front. That way, the mating of the bevel with the front rail will be correct and any seasonal movement of the top will be at the back. I attached the top to the base with buttons on the sides and in the rear. □

Stephen Lamont is a professional furnituremaker. He recently accepted a position as craftsman with the Edward Barnsley Educational Trust in Hampshire, England.

Machine Dovetails by Eye

Cut perfect pins on a simple tablesaw jig; finish up with a bandsaw

by Jeff Miller

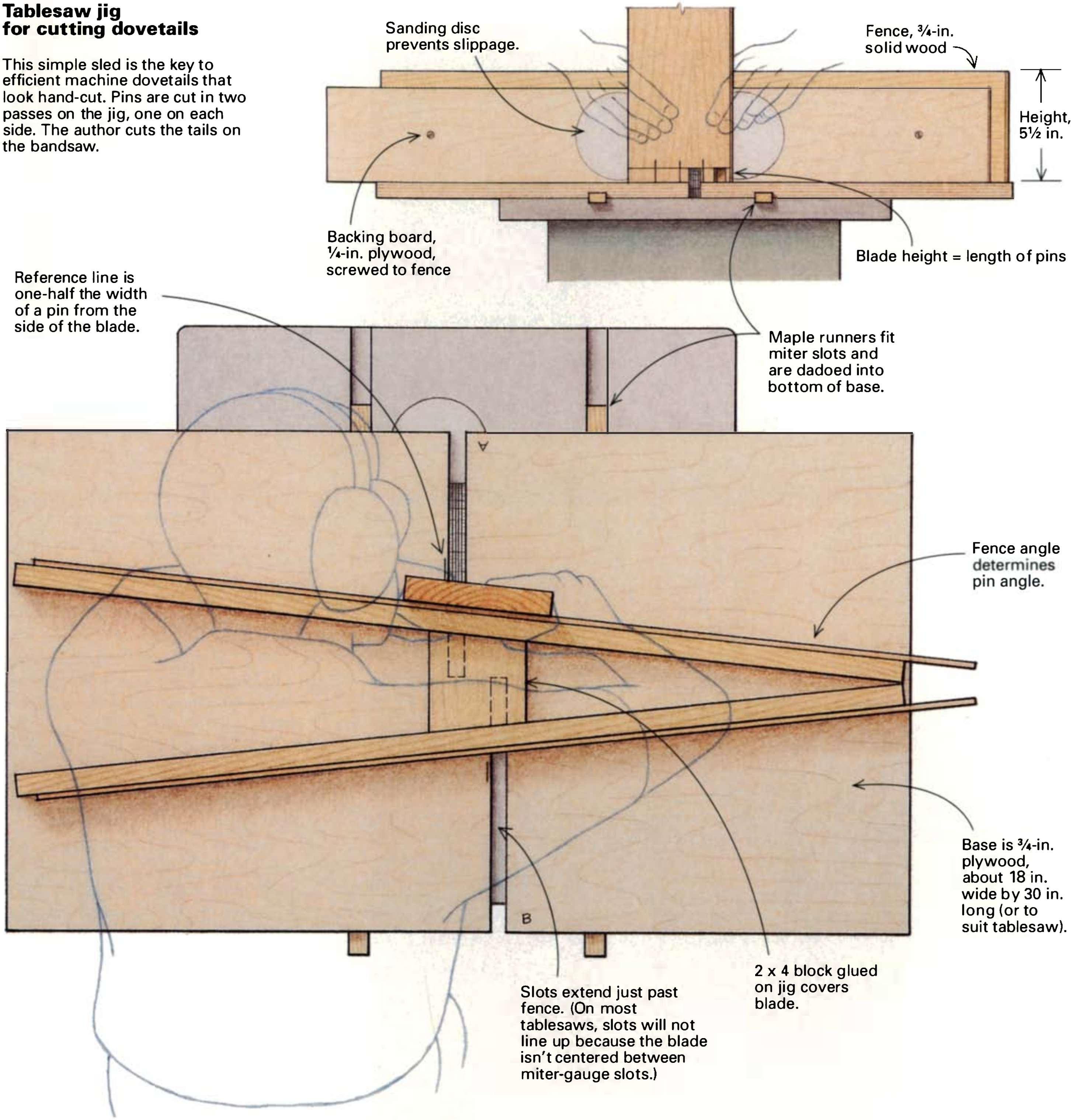
I like cutting dovetails by hand, but the nature of my business doesn't let me stay in practice. And I admit, I tend to lose a little accuracy when I'm out of shape. I've tried router jigs, but I've never found one I like. I find them fussy to set up, and to my eye, router-cut dovetails never look as good as those cut by hand.

Some years ago, a friend showed me a way to use my tablesaw and bandsaw to make dovetails that look hand-cut. The jig is surprisingly fast to set up, and it lets me cut dovetails of any size and spacing. It's not a production jig, but it's fast enough to use in a professional shop, and it works well in limited production situations. Disadvantages? The quality of the fit will depend on your ability to cut accurately to a line. But I like that; I find it far more satisfying than using a dovetail jig. In some ways,

Photos: Aimé Fraser

Tablesaw jig for cutting dovetails

This simple sled is the key to efficient machine dovetails that look hand-cut. Pins are cut in two passes on the jig, one on each side. The author cuts the tails on the bandsaw.



this is still a hand-cut procedure (I can hear the traditionalists howl). The finished joint certainly looks as if it's been hand-cut (see the bottom photo on the facing page).

A simple jig cuts the pins

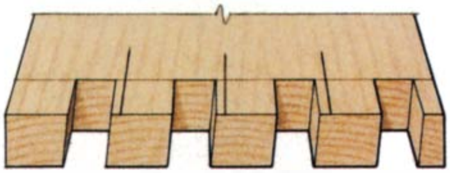
The key to this method is a tablesaw jig for cutting the pins. Two fences angled to a narrow V-shape are mounted on a sled that runs in the miter-gauge slots of my tablesaw. I make the pins in two passes over a ½-in. dado cutter (see the top photo on p. 56). With the first pass, I cut one side of each pin. Then I rotate the sled and cut the other side. I use the pins to mark the tails before cutting them on the bandsaw.

The base of the sled is made of ¾-in. plywood, 18 in. wide by 30 in. long (see the drawing). The runners for the miter slots are glued into shallow dadoes on the bottom of the sled. To ensure the dadoes are parallel to one another, I run the same edge against the fence while cutting each dado.

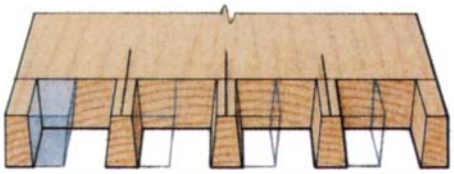
The fences are set at 6° off a line drawn perpendicular to the blade, which gives a pin angle of 6°. This is a 9:1 ratio. I picked that angle simply because I think it looks best. I recently discovered the jig I had been using for years had one fence set at 6°, the other at 8°. I never noticed until I

Drawings: Vince Babak

CUTTING PINS WITH THE JIG



Make the pins in two passes over a dado cutter. *The first pass cuts one side of each pin. The author aligns the centers of the pins with the pencil mark on one side of the sled.*



The second set of cuts finishes the pins. *After cutting one side of each pin, rotate the jig 180°, and cut the angle on the other side. Align the centers of the pins with the reference mark on the other side of the sled.*

measured it for drawings. The lesson: Don't worry too much about the angle.

The fences are made of ¾-in. solid wood, 5¾ in. high and fastened from below with screws. Because the blade cuts through the sled between the fences, I glued a block into the space as a guard. After cutting a few dadoes of different widths and heights, the fence was chewed up in the area of the blade. So I mounted ¼-in. plywood backing boards on the fences to prevent tearout. I move the backing boards each time I change the dovetail profile and replace them when necessary. Sanding discs glued to the backing boards keep the pin board from slipping. Just make sure that the discs are not in the path of the cut or sparks will fly.

Jig setup is based on pin width

Laying out the dovetails is simple. As I do with hand-cut dovetails, I use a marking knife to scribe a line on both faces of the board to locate the bottoms of the pins and to help prevent tearout on the waste portion. I set the dado cutter so the depth of cut just touches the scribed line. On the outside face of the board, I mark the centerlines of the pins. I space them evenly, but you can space them any way you like. The angle of the cut is set by the angle of the fences; the width of the pins is up to you.

I made a pencil line on each side of the jig (see the drawing on p. 55) to determine pin width. The distance from the pencil lines to the cutter is half the width of the pins. When cutting, I align each layout line on the pin board with the pencil line on the jig.

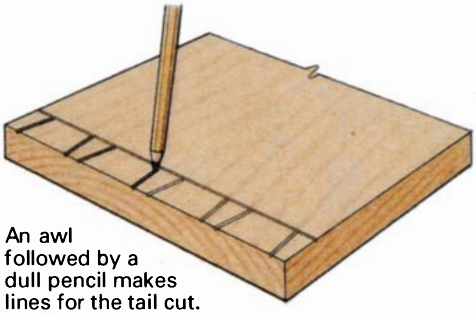
The first round of tablesaw cuts puts the angle on one side of the pins. I line up the reference marks, as shown in the top photo at left, run the sled through the blade and repeat at the next mark. I like the half-pins at each end to be close to full width, so I align the edge of the board with an imaginary line that's twice as far from the blade as the reference mark. When I've cut one side of all the pins, I turn off the saw and rotate the jig 180° to cut the other side of the pins at the opposing angle (see the photo at left). If there's any waste left between the two cuts, I scoot the board over and make another pass.

A bandsaw cuts the tails

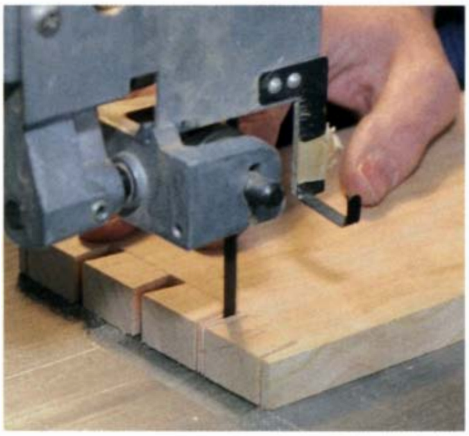
The first step in laying out the tails is to scribe a baseline across both sides of the end of the board with a marking knife.

TAILS ON THE BANDSAW

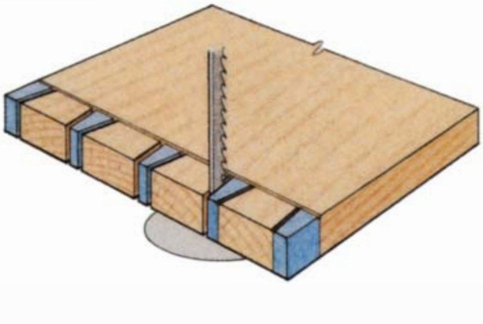
Use an awl to mark the tails from the pins. *The author supports the pieces on his jointer as he scribes the marks for the tail cuts.*



An awl followed by a dull pencil makes lines for the tail cut.



A bandsaw completes the job. *Cut to the lines on each side of the tails, and then nibble away the waste. Take care not to cut beyond the scribed baseline.*



The author gets an almost perfect mallet-tight fit right off the bandsaw. *With a little practice, anyone can have the same results.*

Then the tails are scribed with a sharp awl. I do the marking on my jointer because it has a handy right-angle surface (see the top left photo). The outside face of the tailboard goes down on the jointer table, and the pin board stands on it with the marked face (outside) against the fence. Before I go any further, I label all the mating pieces to avoid confusion.

Cutting the tails is nothing more than cutting to the line on the bandsaw. And this is the crucial task here. In the woodworking classes I teach, many beginners have trouble cutting to a line. There are three things that go into cutting to a line accurately: sharpening the perception of the line, sharpening the perception of the cut and practicing to get the two to meet.

Consider the line first. I like a scribed line because it makes a precise mark, as long as the scribe is made with consistent pressure. A scribed line is actually a little canyon cut into the wood. To make this clearer, I have students trace the scribed lines with a dull pencil (see the top drawing). The result is two pencil lines, one on either side of the impression left by the scribe. Cut away one of the pencil lines, and you've cut to the line.

I cut sides of the tails to the line and use the blade to nibble away the rest of the waste, being careful to stop at the scribed baseline (see the bottom left photo). I rotate the piece 90° and cut along the scribed line for the bottoms of the half-pins at the ends. Slightly ragged bottoms on the tail can be cleaned up with a chisel. After some practice, you can dispense with this step.

The moment of truth

The first few times I cut dovetails this way, the fit was a little tight, and I had to pare the high spots with a chisel. If one section is loose, a small wedge glued in place can make an almost invisible repair. Sanding dust mixed with finish can make a good joint look almost perfect. ☐

Jeff Miller's Chicago studio serves as shop, showroom and classroom for his woodworking courses. The Taunton Press will publish his book on chairmaking next year.


DEWALT

Making Full-Sized Doors

Combining machine and handwork makes a tightly coped joint where rail meets stile

by Joseph Beals

Making full-sized doors is a fine job for a small shop. The design for frame-and-panel doors offers an opportunity to draw from a broad spectrum of traditional styles. One of the most important design questions concerns something you can't even see when the door is finished—the joinery that holds it together. To hold up over time, the frame must be joined with full mortise-and-tenon joinery or with dowels. I've made more than two dozen doors for local contractors using dowels, and I have decided that it's a demanding, tedious and unforgiving method.

When I found time to build several doors for my own house, I devised a method that combines simple machine work and traditional mortise-and-tenon construction. The joints are strong, and they can be fitted and tuned before final assembly, a convenience that doweling does not offer. You can cut the joints in a number of ways that don't require expensive tools or machinery. I use a shaper to cut the pattern molding on the inside edges of the rails and stiles, but you could also cut it with a router, tablesaw molding head or even by hand with a molding plane.

***A passage door built to last**—The author always dry-fits a door before final assembly (facing page) and fine-tunes the joints as required. The finished door (above) is well-suited for the site, a 150-year-old house in New England.*

Lay out the joints with scraps

Rip and joint all the frame stock to the finished width. Leave all the pieces several inches long for the initial pattern shaping to allow for snipe and to dress off any bad ends. At the same time, mill several test pieces for laying out the molding, the panel groove and the joints. These test pieces can be the same width as the stiles, and the pieces should be at least a foot long for convenience and safety.

With the first test piece, set up the pattern molding and panel groove. Install a single standard pattern cutter on the shaper to make the molding. I use a single cutter as a simple profiling tool, so it's not restricted to a particular door thickness. And I mill the pattern molding on one edge of the test piece at a time, making a separate pass for each side. If the pattern looks good, I plow the panel groove with my shaper. You could also cut the groove with a dado blade on the tablesaw. The first pass removes the bulk of the waste; a second pass made with the stock turned over will ensure a perfectly centered groove.

The depth of the panel groove must match the depth of the pattern molding (see the top drawing on p. 60). The width of the panel groove will define the thickness of the tenons, about ⅝ in. for a 1¾-in.-thick exterior door and ⅜ in. for a 1⅜-in.-thick interior door. The exact width can be fine-tuned to work with the pattern molding and can be adjusted as needed.

Lay out the mortises with a pencil— Use the first test piece, with the pattern-and-groove cut, as a guide for marking the stiles. Clamp the two stiles together, face to face (see the bottom drawing on p. 60), and define the two up edges as the inside edges. Mark the top and bottom of the door, leaving an equal amount of excess length at each end. Mark where each of the three rails intersects the stiles.

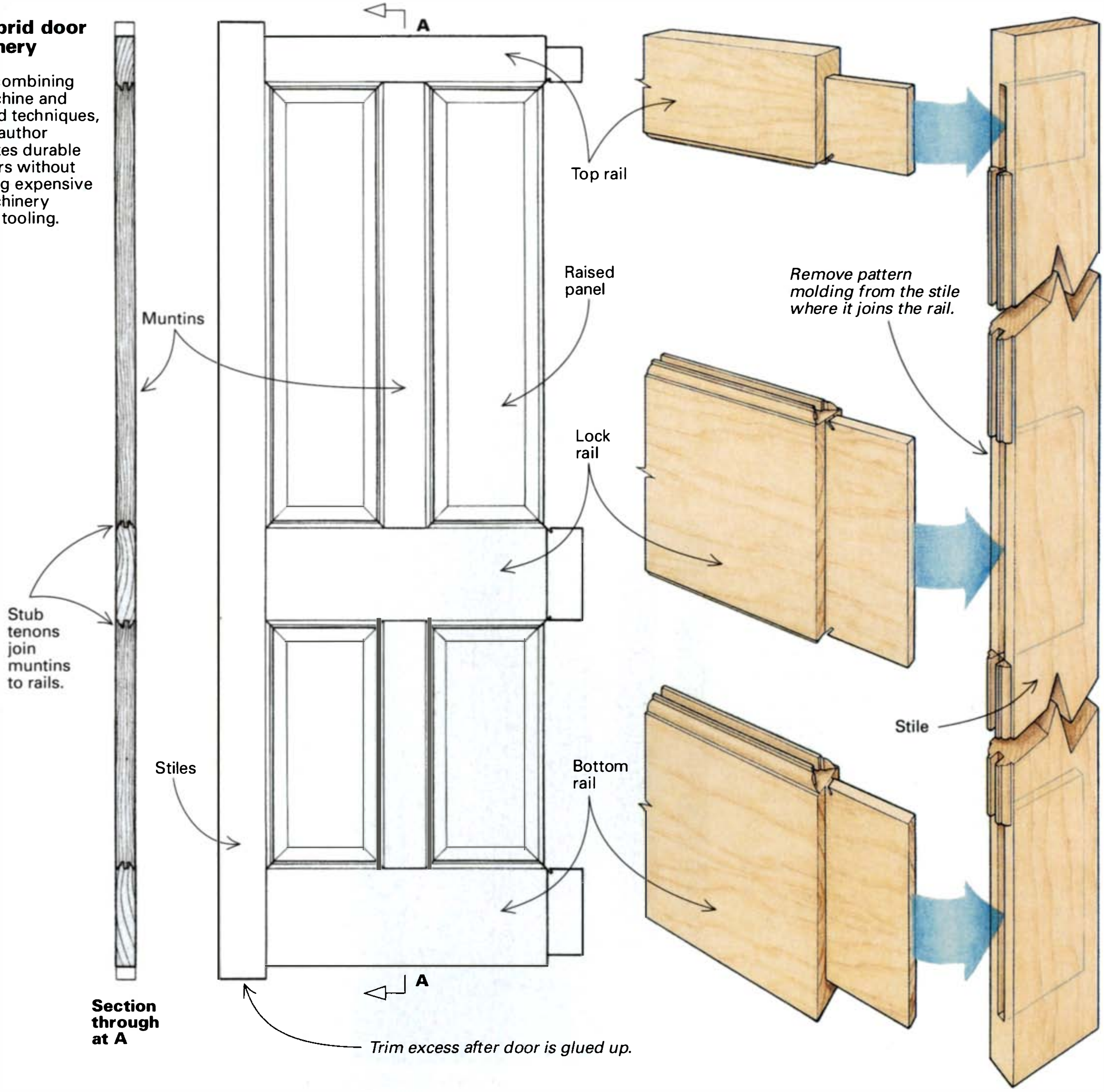
Within these three pairs of marks, lay out the bottom of the panel grooves, as measured off the test piece. That mark will show you where to cut the mortises. Finally, mark 1 in. inward from the top and bottom of the door to define where top and bottom rail mortises will end.

Cut the mortises before shaping the frame pieces— Cut all the mortises with a drill press and hand chisels before doing

Photos: William Duckworth

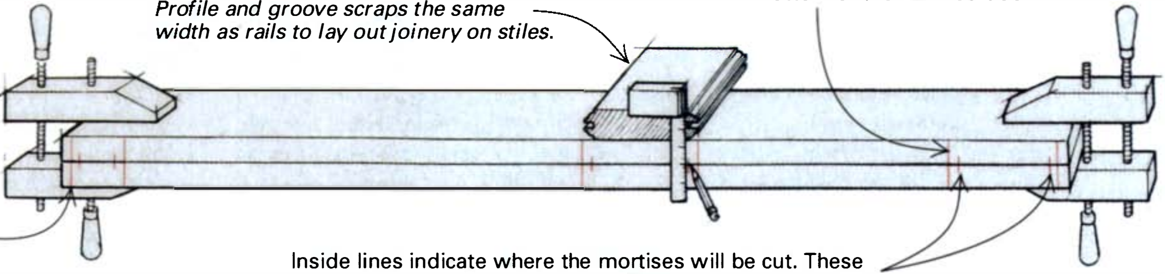
Hybrid door joinery

By combining machine and hand techniques, the author makes durable doors without using expensive machinery and tooling.



Marking the mortises

Stiles, ripped and jointed to width, are left long and trimmed after the door has been assembled. Pencil marks provide easy guidelines to follow in cutting the joinery.



Profile and groove scraps the same width as rails to lay out joinery on stiles.

Outside lines indicate the location of all three rails, and they define the top and bottom of the finished door.

An offset of 1 in. at the top and bottom of the door leaves enough stock for trimming later.

Inside lines indicate where the mortises will be cut. These marks also define where to cut back the pattern molding.

Drawings: Heather Lambert

any more work on the stiles. Using the test piece as a guide, set up the drill press by centering a regular twist bit in the panel groove. It's important to use a fence or a clamp, like the one shown in the photo at right, to register the stiles so that the bit cuts consistently at the center of the mortise. Set the depth ½ in. or so short of the outside edge of the stile to leave enough material to trim the door to width.

A twist bit equal in diameter to the width of the panel groove is ideal for drilling out the mortises. A smaller bit will serve the purpose, but you will have more handwork when cleaning out the mortises. Avoid using spade augers: They can wander and produce an oversized or eccentric hole. Drill all the holes for the mortises, but wait until after you have cut the panel grooves to clean them up with chisels.

Muntins can be fit to the frame one of two ways—Before machining the panel grooves and pattern molding, you'll need to choose the style of joint between the two muntins at the center of the door and the rails. I use my door-making cope-and-pattern cutter set. This joint is not structural, and the stub tenon that fits into the panel groove in the rails is quite adequate. If you don't have a cutter set or if you would prefer to make full mortise-and-tenon joints, you can cut mortises in the rails just as you did in the stiles. The mortises can be shallower—1 in. or so would be plenty deep.

If you machine-cope the muntins, determine their length by measuring from panel groove to panel groove between the rails. You can take their length right off the marked stiles. Set up the coping cutter by using the test piece as a reference, and cope one end of another test piece to check the fit. When all is well, cope the muntin ends. Some splintering is normal on the exit side of the cut, but it will disappear when you shape the pattern molding.

Clean out the mortises, and shape the moldings

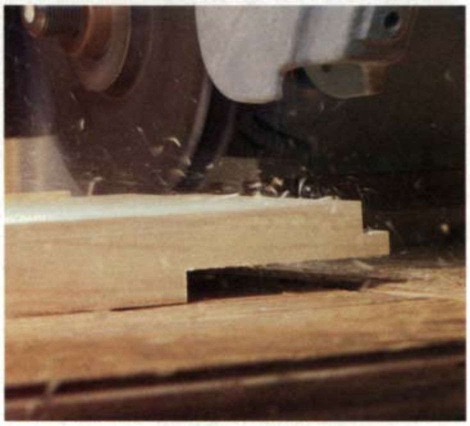
At this point, you can machine the pattern moldings and the panel grooves on the inside edges of the stiles, the top and bottom rails, both edges of the muntins and the lock rail. It makes no difference which shape you cut first, unless you are concerned about protecting the pattern molding when you clean out the mortises in the stiles. If so, cut the panel groove first, clean out the mortises as described below and machine the pattern molding afterward.

Mortising the stiles—The author uses his drill press with a twist bit to remove most of the stock. You could also use a router, a mortiser or chop out the waste by hand.

Sharp chisels make a difference—Lay the stiles on a flat surface, such as a good bench or a machine table, and clean the mortises with a wide chisel honed to a very keen edge. Pare the mortise sides dead flush with the sides of the panel groove (see the photo at right). I use a mortising chisel to clean out the bottom of the mortises and to square the ends. You could leave the ends round from the drill bit, and round over the tenons to fit.

Remove the pattern molding from the stile—The tenon shoulders of the rails seat on the common bottom of the pattern molding and panel groove on the stiles. To make the seat, you need to remove the pattern molding on the stiles between the ends of the mortises for all three rails. You can cut the pattern molding down with a back-

Cleaning out the mortise—After drilling mortises, the author cuts the panel grooves on his shaper. The grooves provide a good reference for paring the mortises with a chisel.



A dado blade on a radial-arm saw works well for cutting back the pattern molding on the stiles and for making the tenons on the ends of the rails. The author cuts to precisely marked lines and uses stop blocks for repetitive tasks.

saw and pare off the waste with a chisel, or you can use a dado blade on a tablesaw or radial-arm saw. I prefer the radial-arm saw for this task because it's quick and accurate, once you've spent the time setting up the cut with scraps.

Mark the rail tenons directly from the mortises

After all the stiles have been mortised and the pattern molding cut back to receive the rails, mark the rails for length, and cut the tenons. Lay the stiles on a table or a set of sawhorses, spaced apart the exact width of the finished door. Lay the rails across the stiles. If the rails have been mortised to receive hand-coped muntins, make sure these mortises are dead center between the stiles. Mark the location of all tenon shoulders directly off the joint seats, as described previously. At the same time, mark the ends of the rails for tenon length—¼ in. or so short of the bottom of the mortise. That clearance provides space for excess glue and debris and ensures that the joint will draw up tightly.

For uniform accuracy when cutting the tenons, I use the radial-arm saw with a stop block against the fence (see the bottom photo). Always check the setup with a test piece. The tenon, as it comes from the saw, should fit the mortise snugly. If it slides home easily, it's too loose.

Because the top and bottom rail mortises stop 1 in. from the actual top and bottom of the door, you must remove this excess from the tenons. Cut down the shoulder with a backsaw, and saw off the waste or split it off with a chisel. Dress the tenons with a rabbet plane, and chamfer the ends to ease the tenon's entry into the mortise.

Cope the pattern molding on the rails—This final step in making the joints—coping the rails—looks like a difficult, exacting job. But as the four photos on the facing page show, it's rather simple, and it gives a very satisfying result. Pattern moldings on both rail and stile could also be mitered, but that is not a good option. A mitered joint between the pieces of a door frame is difficult to fit precisely, and any movement of the rails will spoil it.

To cope the pattern molding, first cut a miter on the ends of the rails (and the muntins, if applicable) with a tablesaw. The end of the pattern molding is the exact end of the miter. I use a block against the tablesaw fence as a convenient stop. If the muntin ends are to be mitered for a hand-coped joint, you will have to reset the fence for the shorter tenons.

As the photos on the facing page show, start coping the joint by darkening the miter profile with a pencil to show the line clearly. A chisel and an in-cannel gouge complete the job (undercutting the cope slightly ensures a tight joint).

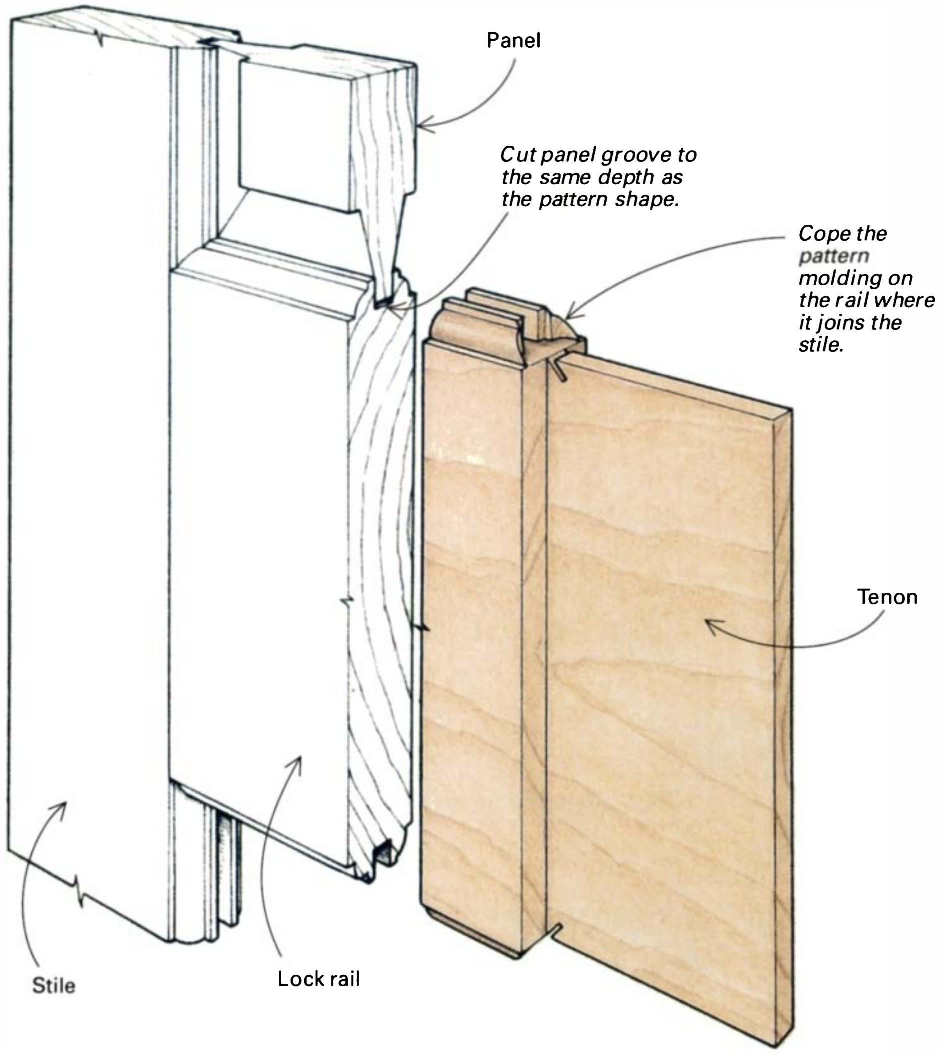
Dry-fit the door frame before assembly

With this type of construction, you can test the door frame before assembly. I fit all the joints individually, and mark all the pieces, shaving the tenons, mortises or both for a smooth fit with just a little resistance. Then I dry-assemble the frame.

Because the muntins are trapped between the rails, all three of which are fit into their own mortises in the stiles, any discrepancy in muntin length will be instantly apparent. Muntins that are too long will prevent the frame from coming together. The obvious cure is to shorten them as necessary. If muntins are too short, the problem can be corrected by shifting the top or bottom rail toward the lock rail. You can do this by removing stock from the tenons at the inside edge of the rails and trimming the pattern molding on the stile by the same amount. This will allow the rail to slide toward the lock rail, tightening the loose muntin. If shifting the top or bottom rail locations makes the door too small for the opening, you'll just have to bite the bullet and make new muntins.

Check that the frame is flat—When the frame is fully assembled and all the joints are tight, clamp lightly across the rails to simulate the pressure applied when the final assembly takes place. The large shoulders on the rails will square up the frame, but they are not proof against twisting. You can correct twist by shaving the tenons or paring the insides of mortises on diagonal-

Coping the pattern molding



ly opposite joints until the clamped frame lies dead flat. Such a small amount of stock is removed that fit isn't compromised.

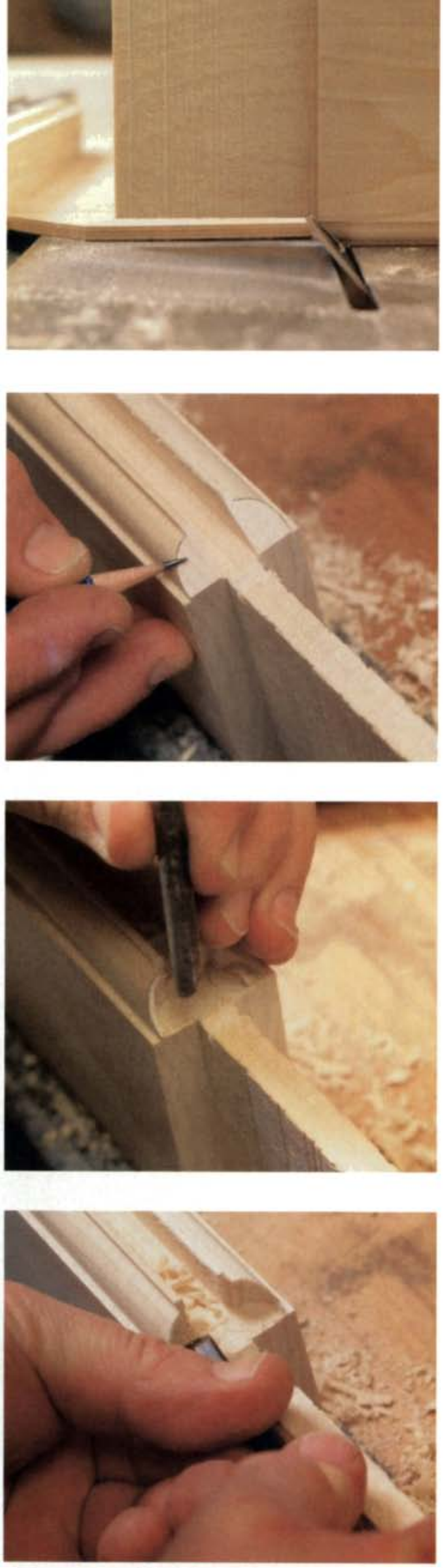
Take panel dimensions off the assembled door frame, with appropriate allowances for panel movement. There are several ways to make panels (*FWW* #94, p. 65). One design option I like is to make panels that are raised on both sides. They can be solid or made from a pair of panels placed back to back, which is especially useful for exterior doors. Panels can be machined to fit the groove snugly, inhibiting water entry, and the inside and outside surfaces can move independently.

Use epoxy for the final assembly

Mortise-and-tenon door joints are traditionally fastened by pins or wedges, but for exterior doors, epoxy is a superior alternative. I use West System epoxy together with a thickening additive (available from Gougeon Brothers, Inc., 706 Martin St., Bay City, MI 48706; 517-684-7286). Epoxy is strong, waterproof, gap-filling and creeps only slightly under load. West System epoxy has a very long shelf life and mixes easily using metered dispensing pumps. Unlike aliphatic resin glues, epoxy has no initial grab. In fact, its lubricity is a great convenience when drawing together the large multiple joints in a full-sized door. Since I started using epoxy, I dumped my plastic resin and resorcinol glues in the bin.

Assemble the door by making a tree of the rails and muntins, slip the panels in place, apply glue to the mortises and tenons, and draw both stiles home simultaneously. Clamp lightly, check for twist and make any corrections by fine-tuning opposing pressure on the clamps. Check the pattern molding at the coped joints, and remove glue squeeze-out. □

Joseph Beals is a custom woodworker in Marshfield, Mass.



***Coping the rails**—To define the shape of the cope, the author starts by mitering the rail of the pattern molding on the tablesaw. He uses a stop block off the fence as an index. The pencil mark along the edge helps to highlight where the cope will be cut. The curved part of the cope is cut with and in-cannel gouge. All flat surfaces are cut with a paring chisel.*

Creating an Antique Painted Finish

Two days and a dozen steps to a centuries-old look

by Kirt Kirkpatrick

No, it wasn't made by the conquistadors. *Though it looks like it's been in a Spanish Colonial mission for several hundred years, this hall table is really less than a year old.*

Photos: Vincent Laurence

I started experimenting with painted finishes that look old because I live in a very old region of the country. The Native American and Spanish Colonial cultures are still very much a part of the look here in New Mexico.

In collaboration with my friend Dwayne Stewart, who's a painter and professional finisher in Kansas City, Mo., I've developed a method that makes even new furniture look like it's been around for a long time.

Selecting and preparing the wood

I use old wood whenever I can, but new wood can be stained dark to make it look older.

Tool marks make a big difference, too. I eliminate machine marks with hand tools, and I gouge the wood intentionally. A 17th-century Spanish craftsman here in the desert Southwest might have had an adze, a drawknife, maybe a handplane (but likely not) and not much more. And he certainly didn't have any fancy sharpening stones. So the surfaces you see on most old furniture around here is kind of rough. I achieve a similar effect by planing against the grain in places (especially near knots), causing tearout, skewing the blade on my plane so it gouges the surface, keeping the blade intentionally dull and burnishing sharp edges. This may run counter to everything you've learned, but the results are convincing (see the photo at left).

Once I'm happy with the surface, finishing begins. Because I use latex paint and a quick-drying clear coat, I can complete the process in less than two days (see "An antique finish in 12 steps" for a thorough description of the process). Not bad for a finish that looks like it's seen some history. ☐

Kirt Kirkpatrick lives in Albuquerque, N.M. He carves and builds furniture and doors.

AN ANTIQUE FINISH IN 12 STEPS

1. ***Burnish the edges.*** *Furniture doesn't age, or wear, evenly. Sharp corners, edges and other crisp details soften first. The author uses the shank of a large nail to round over the sharp edges on a tabletop.*

2. ***For a light wood like pine, use a dark stain.*** *Because wood changes color as it ages, the author uses a pigmented oil stain (Minwax Early American) to darken this tabletop made of ponderosa pine. But any kind of stain will do. Then he lets the stain dry according to the manufacturer's instructions.*

3. ***Seal in the color with a clear coat.*** *The author brushes on two coats of lacquer, but other clear finishes will work as well. Just be sure to use something with a low sheen.*

4. ***Scuff-sand the clear coat.*** *A quick once-over with 220-grit dulls the sheen and gives the clear coat enough tooth to hold a coat of paint.*

5. Wax prevents paint from adhering, *which lets the stained wood show through. Rub a bar of paraffin lightly over the edge and a bit on the top. Let the bar skip along, so the pattern will be uneven. Wax the edge more heavily, but still intermittently.*

6. Apply a first coat of flat latex paint. *Coverage doesn't have to be perfectly even, and it's probably better that way. Choose a color that contrasts well with the topcoat. Give it an hour or two (or whatever it says on the can) to dry.*

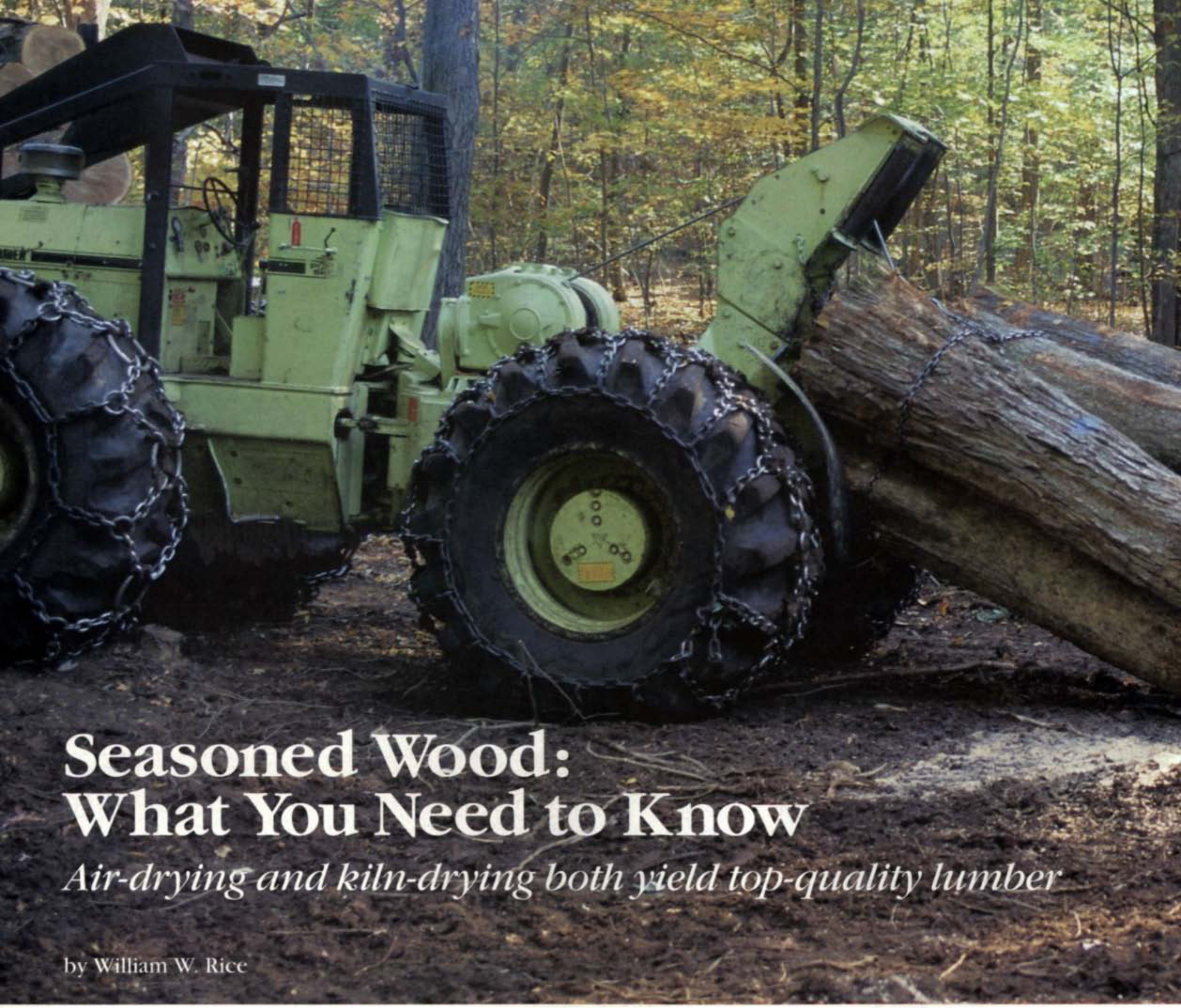
7. Brush on a coat of hide glue. *The author uses premixed liquid hide glue, but hot hide glue also works. If the premixed glue appears too thick to brush out, thin it slightly with some warm water. Mix well before applying it. A thicker coat will give you fewer, bigger cracks in the next layer of paint; a thinner coat will give you smaller cracks but more of them. Don't worry about laying down an even coat (variations in the size of the cracks look more realistic), but apply the glue in only one direction. If you're haphazard with your strokes, the crackle pattern won't look right. This is the only step you really have to be finicky about. Give the glue half an hour or so to dry.*

9. & 10. Scrape and then sand the top and edges. *When the second coat of paint is dry, use a paint scraper to remove paint sitting on top of the wax. The scraper also will dislodge loose chunks of paint to reveal the first layer below. Mist the surface with water, and then rub with your fingers to create an even more authentic look. Sand lightly to soften sharp edges.*

8. Apply a second coat of flat latex. *Make sure that the paint is flat; semigloss or gloss paint won't crackle. Keep a wet edge, move quickly and don't go over your previous strokes, or you'll fill in the cracks. This second coat starts to crackle almost immediately. Let it dry thoroughly, preferably overnight.*

11. Apply a coat of medium- or dark-tinted liquid wax. *The author uses Watco dark-satin finishing wax. This wax seeps into all the cracks and recesses and gives the whole piece a darker, almost dirty look—instant patina. Temperature affects drying time. The author usually waits about 10 to 15 minutes.*

12. Remove most of the tinted wax with a clean rag. *If the whole piece or just some areas are too dark, you can remove some of the color. Apply a clear coat of paste wax and rub vigorously. The solvent in the wax lifts the excess color from the surface. The paste wax protects the surface, too.*



Seasoned Wood: What You Need to Know

Air-drying and kiln-drying both yield top-quality lumber

by William W. Rice

As a consultant and wood technologist, I'm frequently asked whether air-dried or kiln-dried wood is best for making furniture. The answer is short and simple: It doesn't really make any difference, as long as the wood has been seasoned properly. Both methods produce good cabinet-grade material that is difficult, if not impossible, to tell apart. Properly dried wood is just that—properly dried wood.

Many furnituremakers have a preference regarding air-dried or kiln-dried lumber. Their opinions probably are a result of what kind of lumber is available to them and what they're used to working. And it's true there are some subtle differences between air-dried and kiln-dried lumber. But the way lumber is handled during the drying process and how it is stored before use have much more to do with its overall quality.

The basics of wood and moisture

Unless it's standing dead wood, lumber is water-laden when it's cut. Good drying, or seasoning, regulates the rate of moisture loss so that shrinkage is controlled. Checks, splits and twist occur when this process is rapid and uncontrolled.

To understand wood seasoning, you need to know a little about the terminology of drying. The amount of water in a piece of wood is expressed as a ratio of water to the weight of the wood when it's perfectly dry. This percentage is called the wood's moisture content (MC). A freshly cut log contains a lot of water. In some species, the MC exceeds 100%, meaning that the water trapped in a piece of wood weighs more than the wood itself.

Wood should have an MC of between 6% and 8% before it is used, unless you make green-wood furniture. Both air-drying and

Photo above: Dennis Preston

***These red oak logs,** being cut in Connecticut, will go to either a dry kiln or a drying shed. With care, beautiful lumber will result from either journey.*

***A moisture meter eliminates guesswork,** whether you dry your own wood or buy it at a lumberyard.*

kiln-drying accomplish that. Even after it has dried, wood responds to surrounding temperature and humidity. Wood gives up moisture when the air is dry and absorbs moisture when it's humid. Eventually, wood comes into balance with its environment when it is no longer absorbing or giving up any water. That's its equilibrium moisture content (EMC). Keep in mind that all wood, whether it has been air-dried or kiln-dried, responds in the same way to changes in humidity. An accurate way to check the MC, whether wood has reached equilibrium or not, is with a moisture meter (see the photo at right).

Kilns are faster than air-drying

Air-drying uses natural atmospheric conditions to evaporate the moisture from the wood. On average, wood left outside under cover will stabilize at 15% to 20% MC. Careful, uniform stickering and protecting the stack from rain and direct sunlight minimize checks, splits and warp (see the photo at right on p. 70). Circulating air through the stack and supporting it at least 15 in. off the ground will prevent stain and decay.

How long it takes to bring wood to 15% to 20% MC depends on the species, thickness and weather. For example, 1-in.-thick white pine stacked outside between April and September takes about four weeks to dry to 20% MC. Pine boards 2 in. thick will take six to eight months in reasonably good weather. Red oak boards, 1 in. thick, stacked in the summer will dry to 20% MC in about eight weeks, and 2-in. red oak may take 1½ to two years.

A kiln controls the temperature, humidity and air flow, bringing the lumber to a uniform MC (see the top left photo on p. 70). This

Photos except where noted: Boyd Hagen

Checks, splits and twist occur when the drying process is rapid and uncontrolled.

Kilns season wood quickly and uniformly. *Commercial kilns are capable of seasoning large quantities of wood.*

Careful stickering, stacking and storage *(right) yield high-quality lumber. Air-drying is well-suited for small shops with a ready supply of native trees.*

Properly stored wood *(below) achieves equilibrium with the shop environment.*

environment prevents checks, splits and discoloration. Kiln temperatures range from 110° to 200°F and relative humidity ranges from 25% to nearly 100%. Drying times are much shorter when using a kiln. For example, 1-in.-thick pine dries from 120% MC to about 8% in 11 days, 2-in.-thick pine takes four weeks, 1-in.-thick red oak dries to about 8% in about a month, and 2-in.-thick red oak takes about three months.

If possible, control temperature and humidity

Old-time cabinetmakers stored their air-dried lumber in the shop, often in an overhead loft. Today's woodworker also should store dry lumber indoors. Ideally, lumber that will be made into furniture and cabinets should be stored where the temperature is between 68° and 70° and the relative humidity about 42%. These conditions will allow kiln-dried material to maintain an MC of about 8%. Additionally, this temperature range and humidity level will allow stock that's been air-dried to 20% MC or less to come into equilibrium at about 8% MC in eight to 10 weeks.

Wood should be stacked on a level surface. Air-dried stock will

Top left photo: Scott Gibson; bottom left photo: Jonathan Binzen

equalize in MC faster when separated by uniformly placed stickers, which keep the stock flat as air gently circulates over the pieces. Do not store lumber on or close to a basement furnace or room heater because the humidity will be too low, causing excessive drying. The result will be shrinking and cracking.

Drying conditions affect wood's color

Air-dried lumber often has a grayish color from sunlight and oxidation. This easily can be surfaced off, leaving the wood bright. Kiln-dried green wood will maintain its bright color if the kiln temperature is kept below 160°.

When a species with natural sugars, such as maple or birch, must be kept as white as possible, kiln temperatures should not exceed 130° (except for a short period at 160° to relieve drying stress). When the sapwood in these woods looks dark, it is probably because kiln temperatures were above 170° for several days, which caramelized the sugars in the wood.

Both air- and kiln-drying can cause a chemical gray stain in hard maple. Brown stain in white pine often begins in the air-drying stage, though invisible at that point. The stain is exposed when kiln-dried at temperatures above 130°. If maintaining color is of prime importance, properly controlled kiln-drying is the best method.

Check moisture before bending or gluing

For steam-bending wood, the method of drying prior to steaming is unimportant. Steam the wood at about 25% MC to make the material easier to bend and less likely to crack or buckle.

Cold-bending wood (as practiced by green-wood chairmakers, for example) requires less force if the stock is green. But 25% MC stock is better because wood that dry can still be bent yet can be pulled from the bending form much sooner than green wood.

Stock that will be used for glue-laminating requires that the wood be dried to the MC recommended by the glue manufacturer, generally between 6% and 12%. Kiln-drying is more likely to produce both the low MC and uniformity of moisture distribution this technique requires.

When gluing up boards, either face to face in a flat lamination or as a wide panel, make sure all pieces have roughly the same MC. That will help the panel stay flat with its gluelines intact when put into service. At most, the difference in MC between individual pieces should be no more than two percentage points. It's also a good idea to make panels from lumber that is free of casehardening, a type of residual drying stress. Casehardening is not something that can be cured in your woodshop. But you can check for the problem (see the drawing at right).

Differences in finishing and workability

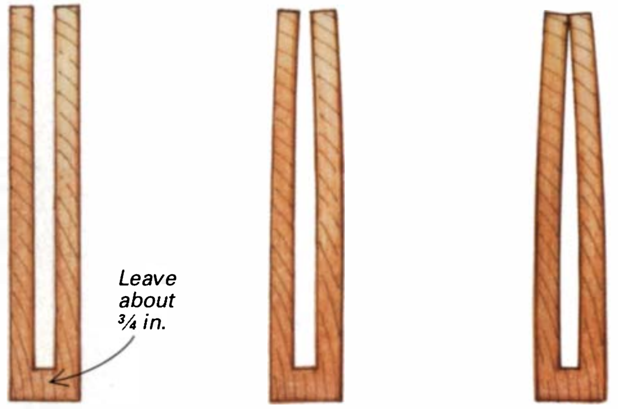
Some finishing materials, such as preservative stains and latex paints, are more tolerant of higher moisture, making them better suited to air-dried lumber. Lacquers and acrylics perform best if the wood has been dried to 6% to 8% MC. A special finishing problem occurs in species containing pitch (as in white pine and spruce). This natural material will bleed through most finishes if it's not set or crystallized. Setting pitch is done by subjecting the wood to a temperature of at least 165° for about 24 hours and should be done during the last stage of kiln-drying.

The drier the wood, the harder and stiffer it becomes, so air-dried stock can be worked somewhat more easily with hand tools than wood that has been kiln-dried to a lower MC. The ease of cutting air- or kiln-dried wood with power tools is, for practical purposes, the same. However, surface quality is dependent on MC. Wood machines best between 6% and 12% MC. Above 15% MC, wood fibers tend to spring back after the knife passes, leaving a fuzzy surface. Stock dried below 5% MC becomes brittle, and grain tearout may occur when planing the wood.

A shop test for casehardening

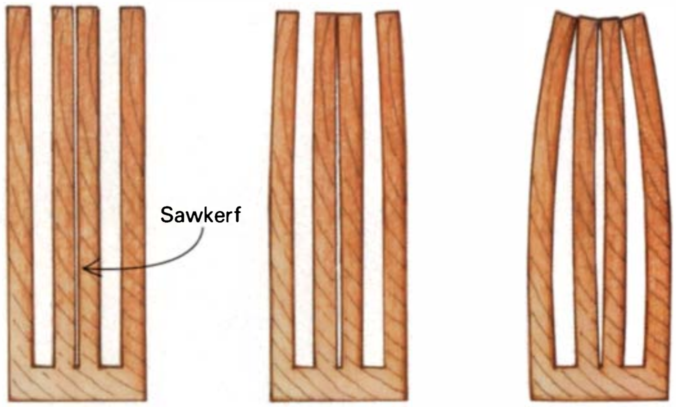
Casehardening, drying stress left in lumber after it has been kiln-dried, can affect the quality of glued-up panels. To check for the condition in stock up to 1½ in. thick, take a 1-in. sample off the end of a board, and cut out the center to create two prongs. For thicker material, create three prongs with a sawkerf at the middle of the sample. Prong movement, which occurs immediately, indicates casehardening.

For stock up to 1½ in. thick



Not casehardened — Slightly casehardened — Casehardened

For stock over 1½ in. thick



Not casehardened — Slightly casehardened — Casehardened

Relocating cabinetry and furniture

Moisture content should match the humidity of the place where the piece of furniture will be used. With the wood air-dried to 15% MC, a cabinet made in a shop located on the sea coast that is then shipped to Tucson, Ariz., is very likely to develop cracks and loose joints. Conversely, a cabinet made in Tucson with wood air-dried to 6% to 8% MC would behave fine in the heated coastal home in the winter, but drawers and doors would swell and stick in the humid summer atmosphere. ☐

Dr. William W. Rice is a drying consultant and retired professor of wood technology at the University of Massachusetts. He lives in Amherst, Mass.

Drawings: Chris Clapp

Turned Ornaments

Three-piece decorations shaped and polished on the lathe

by Michael Sage

***Elegant shapes on the lathe**—Ornaments turned in three parts save small pieces of figured wood from the scrap bin and help embellish a tree or a window.*

I turn wood for a living, and I sell just about everything I make. But there are a few things I like to turn just for family and friends. Wooden ornaments, turned from brightly colored or highly figured woods, are my favorites (see the photo at right). They're great for stocking stuffers or for dressing up a home during the holidays. These ornaments don't take long to make, and they're a great way to use up odd scraps of wood.

I make them in three parts: a bell, a stem and a finial (see the drawings on the facing page). Each part is turned separately. Glued together, the parts make a simple, bold form that really shows off a beautiful piece of wood. I have used clear, solid woods as well as spalted, segmented, inlaid, dyed and bleached woods. I have even used Colorwood, which is a dyed plywood made of 1⁄16-in. maple veneers (Craft Supplies USA, 1287 E. 1120 S., Provo, UT 84606; 800-551-8876).

Start by making the bell

The bell begins as a 2-in.-sq. blank of wood 3 in. to 4 in. long. It's chucked between centers on the lathe and turned to a cylinder with a 1-in.-dia. by ½-in.-long tenon on one end.

I remount this piece on the lathe for final turning with a glue chuck, which is nothing more than a scrap block, with a hole drilled in it, screwed to the faceplate (see "making the glue chuck" on the facing page). The tenon in the end of the bell piece is glued into the hole in the glue chuck. After the glue has dried, I snug up the tailstock and turn the outside of the blank to roughly the shape of the bell (see "turning the bell" on the facing page).

Hollowing out the bell of the ornament gives it a more delicate feel. To make an access hole for hollowing, I slide the tailstock out of the way and drill a ½-in.-dia. hole in the end of the bell about 2 in. deep.

I find that a hook tool is the best thing for hollowing. I made mine from a length of 3⁄16-in. drill rod. I bent the rod into a hook shape, sharpened it and added a wooden handle. When hollowing, I leave a ¼-in.

Photos: Alec Waters

shoulder so I can glue on the stem. After hollowing, I move the tailstock back in place, turn the bell shape the rest of the way and then sand it. I use a skew to part the bell from the lathe. The end has to be hand-sanded.

The stem adds form to the middle

For the stem, I start with a blank of wood 1 in. sq. by 3 in. long. I often use a wood that contrasts with the bell and the finial. I mount the blank between centers (a minidrive works well at the headstock) and turn the blank into a cylinder.

I turn a ½-in.-dia. by ¼-in.-long tenon on the tailstock end of the cylinder. Then I remove the tailstock and check the tenon's fit in the hole in the bell. If the fit is good, I replace the tailstock and turn the rest of the stem shape. I taper the headstock end down to 3/16 in. dia. (see "turning the stem"), but I leave a rim of waste so the spurs of the drive center stay secure. Then I sand the stem smooth.

The finial crowns the ornament

I use the same kind of wood for the finial as I did for the bell. I mount a 5/8-in.-sq. by 1-in.-long blank on the lathe using a friction-type drive. To make a drive, I take a 3/16-in.-dia. drill rod, grind the end to a chisel point and then snug it in a Jacob's chuck fitted to the headstock, as shown in "making the finial."

A friction-type drive, by the way, also can be used to hold the bell part of the ornament on the lathe. It's quicker than using a glue chuck. For the bell, though, I'd use a ½-in.-dia. drill rod.

The drill rod fits in a 3/16-in.-dia. by 3/8-in.-deep hole in the center end of the finial blank. I slip the blank on the drive, and with the tailstock providing extra support (see the drawing), I turn and sand the finial. I back off the tailstock and drill a 3/64-in.-dia. hole in the tip of the finial.

Polish the parts while they're on the lathe

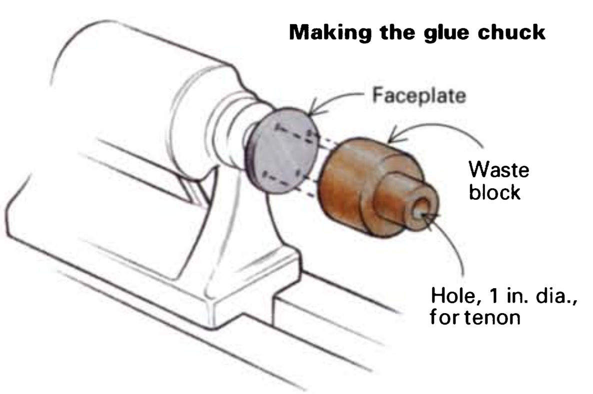
I finish the ornament parts while they're still on the lathe (see the photo at left on the facing page). Or I'll hold the parts against a buffing wheel. After I polish the pieces, I glue them together. I drill a tiny eyelet in the top of the finial for hanging the ornament. ☐

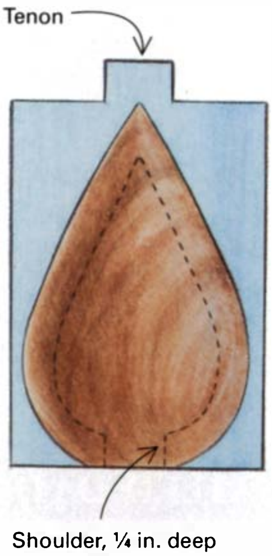
Michael Sage turns wooden artwork in Mountain View, Calif.

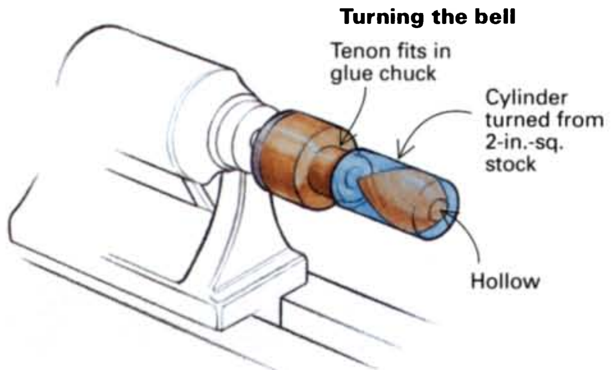
Drawings: Bob La Pointe

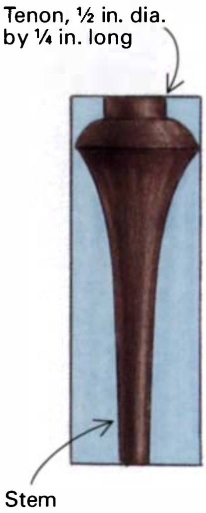
An ornament in three parts

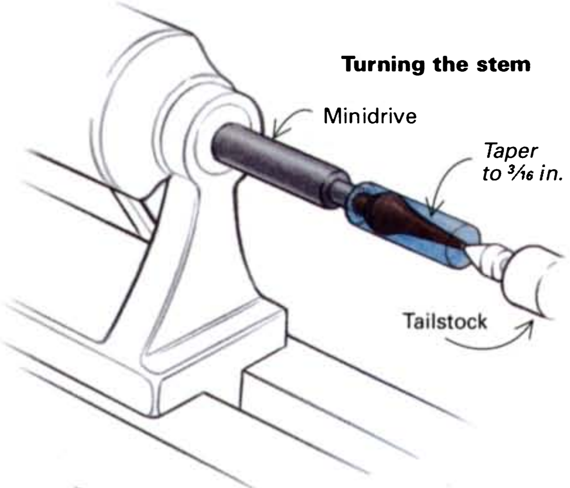
A tenon on one end of the stem is glued into the bell. The other end of the stem is glued into a hole in the finial.

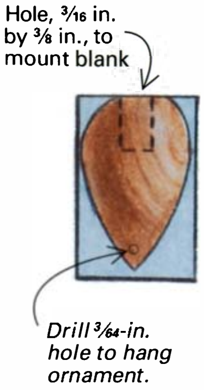

Making the glue chuck

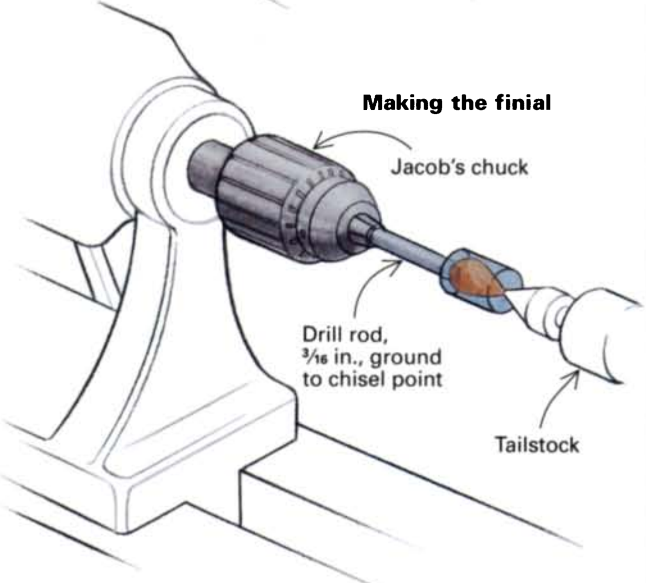



Turning the bell




Turning the stem




Making the finial

Supporting Shelves *Five methods for installing*

by Stephen Winchester

I earn my living by making cabinetry—not cookie-cutter kitchens, but one-of-a-kind pieces and custom built-ins. Every cabinet I build has at least one shelf. And some—hutches and book cabinets, for example—have many. As both designer and fabricator in most cases, I try to balance style, function and cost when figuring out how to support shelves in a cabinet.

Over the years, I have come to favor several techniques that achieve that happy balance between elegance and efficiency (the five methods I use most often are described below and on the following four pages). My methods aren't as crude as using stamped-steel brackets but neither are they as fussy as routing tapered sliding dovetails.

Fixed or adjustable shelving

Style of cabinetry is the most important factor in determining which of the methods of shelving support I use. The next most important factor is cost. For cabinets in kitchens, pantries and utility rooms, fixed shelves are generally fine (see the story below). But for most of my work, clients want adjustable shelves. Shelf standards,

BLIND-NAILED DADO

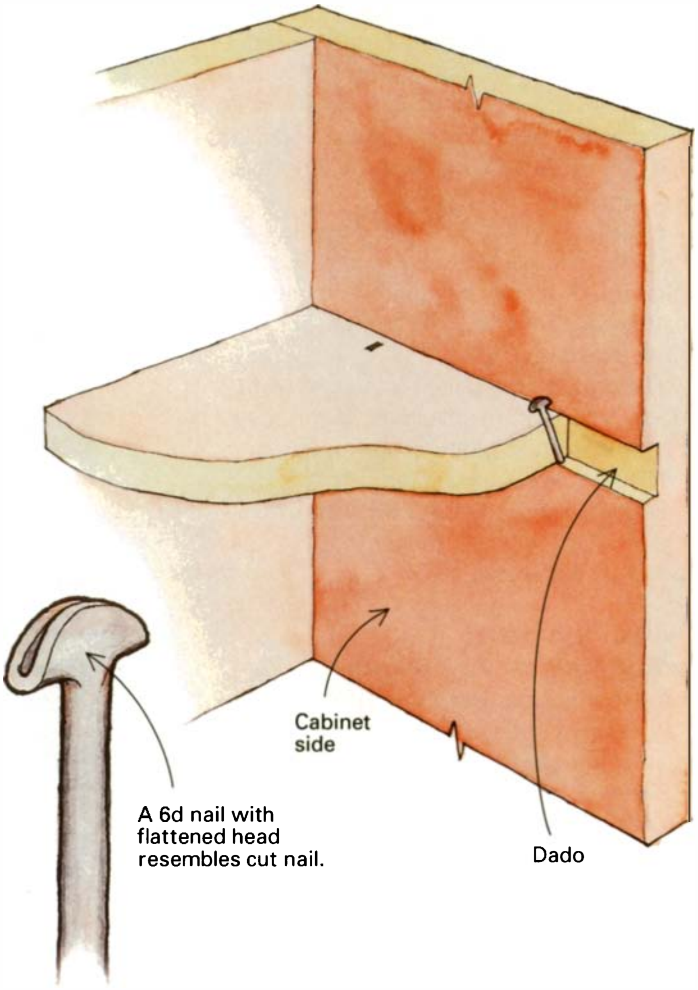
For fixed shelving, there's only one choice

Here in New Hampshire, painted pine cupboards are popular. They're a frequent choice for kitchen cabinets, where one or two shelves are all that's necessary. These shelves can be fixed at standard intervals to allow for stacks of plates and glasses. For these shelves, I use a blind-nailed dado (see the drawing at right). It's quick, and the shelves are strong and look neat.

Because my clients like the look of handplaned boards, I plane the sides, top, bottom and shelves of the cupboards after taking them to thickness with my planer. Then I cut the shelf stock ¾ in. longer than the inside measurement of the cabinet (this allows for a ⅜-in. dado in each upright) and mark the dadoes directly from the ends of the shelves, using a sharp knife. I also number everything so that if the shelves vary slightly in thickness, they will still fit their dadoes snugly.

I remove the waste with the radial-arm saw, using a dado set that's slightly smaller than the width of the finished slot. I take two passes and cut just to the scored line on each side. Shelves are installed as the case is assembled. Then I drill for the nails to avoid splitting the stock. I use 6d box or finish nails and take care not to drive one through the side of the cabinet. With the box nails, I hammer the heads flat on the sides, so they look more like a cut nail.

These cabinets are of a traditional style, so I usually attach a face frame to their front edges. If you want a frameless, more contemporary-looking cabinet, you could stop the dadoes shy of the front of the cabinet, square them up and have blind dadoes.



Drawings: Jim Richey

shelves that combine elegance and efficiency

long vertical tracks that go into a case's sides, are the most visible and utilitarian-looking, but they're also the quickest to install (see the story below). Drilling holes in the side of the case for shelf pins is the next quickest (see the story on p. 76). Another technique employs what I call invisible wires that slip into thin kerfs in the ends of the shelves (see the story on p. 77). And there are sawtooth supports, which are quite elegant, but relatively time-consuming (see the story on p. 78). The more complicated the method, the more I have to charge.

As far as function goes, any of these supports will hold a reasonable load: 3 ft. of books shouldn't be a problem. Even the thin, invisible wires have a tremendous amount of shear strength.

In the rare instances I've made shelves longer than 36 in., I've used a strongback, which is a wooden reinforcing bar either beneath or at the front of a shelf. Even with a strongback, though, I wouldn't plan to stack 4 ft. of encyclopedias on an otherwise unsupported shelf.

Stephen Winchester is a professional cabinetmaker and furnituremaker in Gilmanton, N.H.

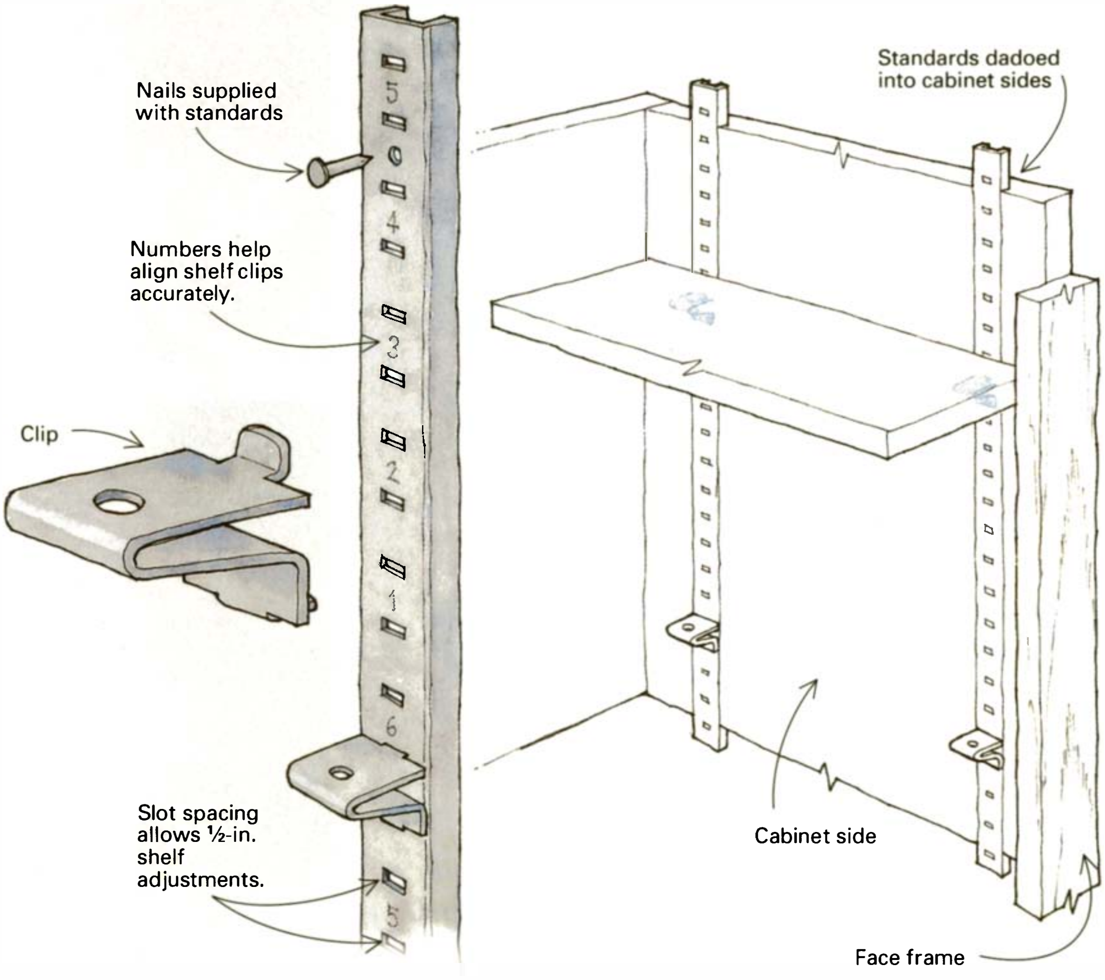
SHELF STANDARDS

Utility player: quick and simple

Shelf standards are the quickest, simplest way of installing adjustable shelving (see the drawing at right). They're not, however, the most attractive. Still, there are situations where they're the perfect solution, and they can be painted to match the cabinet. The spacing between holes for the clips is ½ in., so standards are the most adjustable of the methods I use.

To install the standards, I plow a dado ⅝ in. wide and ³⁄₁₆ in. deep all the way from the top to the bottom of the cabinet sides. Then I assemble the cabinet, finish it and nail the standards in, paying attention to which end of the standard is up.

I nail the standards to the cabinet sides with the special nails that come with the standards. If cabinets are going to be placed next to each other, make sure they don't share a side (each case needs to have its own wall), or the nails will hit each other.



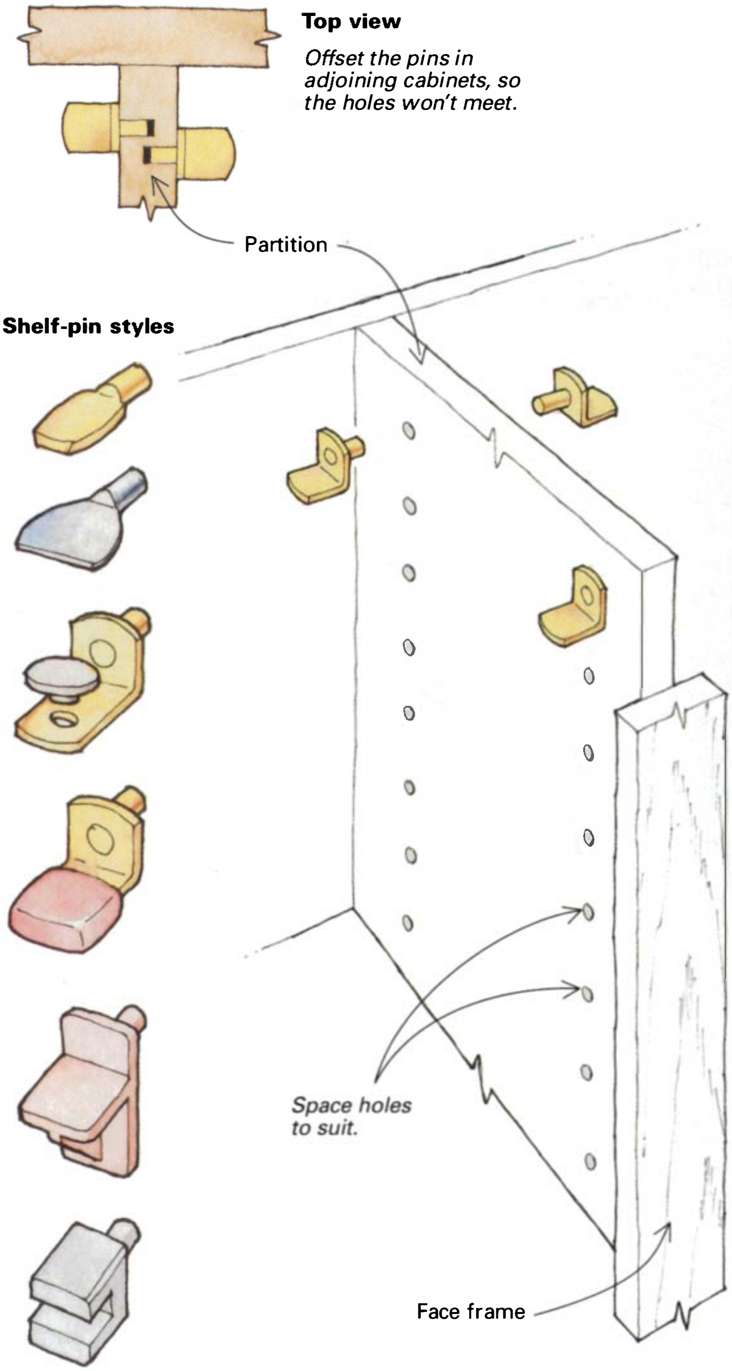
SHELF PINS

The old standby

I like shelf pins because they're quick and easy to install (see the photos below), very little hardware shows and, depending on how closely the holes are spaced, they're almost infinitely adjustable. Spacing the holes 1 in. on center works out about right. I also set the row of holes 1½ in. from the edges of the case sides. I drill the holes using a shopmade template before assembling the cabinet. I measure for the shelves after assembly.

Pins are available in a number of different shapes, sizes and materials, including plastic, plated steel and brass. You can even get pins with rubber cushions for use with glass shelving. The most common sizes are 5mm and ¼ in. And if you don't like the look of commercial pins, you can always whittle your own (see *FWW* #98, p. 65).

I don't need to drill holes all the way from the top to the bottom of the sides. I figure out the minimum and maximum spacing I'd like between shelves. Then I lay out lines on the case sides reflecting those parameters. For example, I never drill holes closer than 5 in. from the top or bottom of a case because a shelf that close generally wouldn't be useful.



***Drilling shelf-pin holes.** A template with an end-stop positions the template accurately top to bottom and eliminates the possibility of measuring errors (left). A gauge block ensures a consistent setback from the edge of the case. Different-width gauge blocks can be used for special applications, such as drilling offset pin holes from both sides of one upright (inset photo above and drawing at left). A wooden stop block sets the depth (left). It won't move either, like many metal collars. Blue masking tape indicates where the holes in the case sides should stop.*

Great for contemporary cabinets

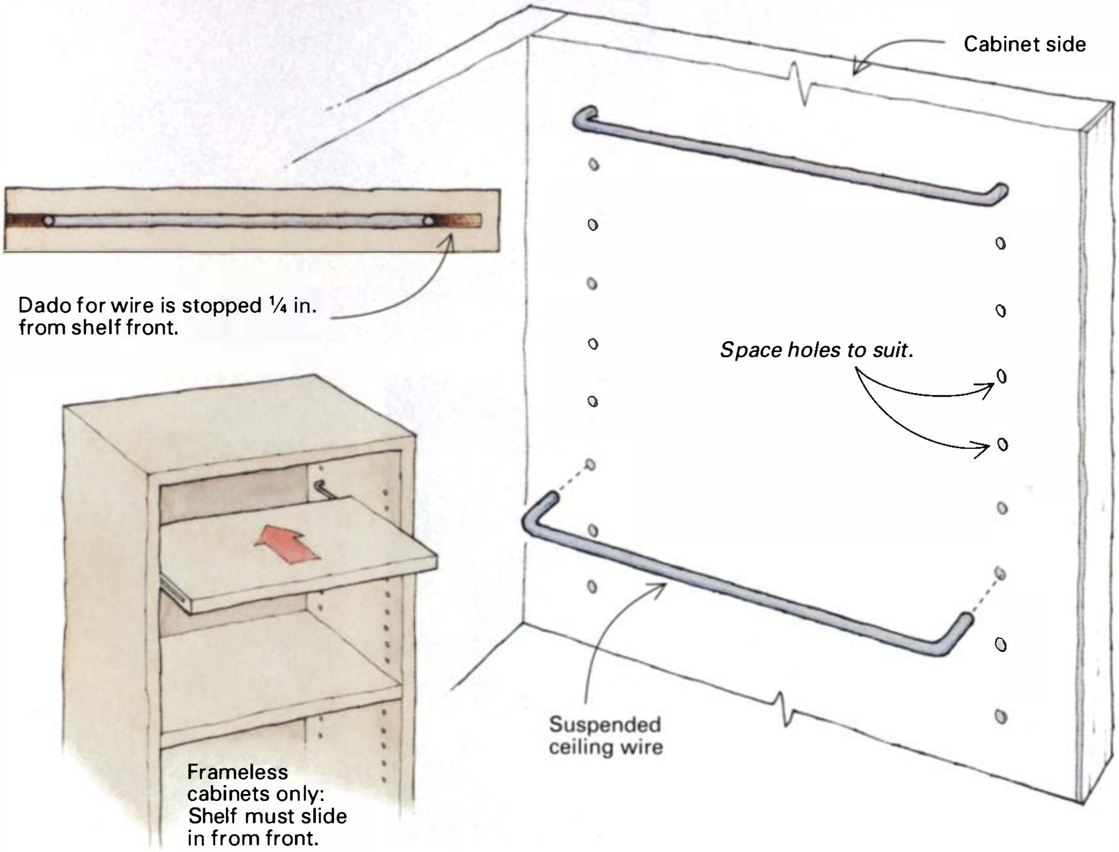
This method is pretty slick and looks great on more contemporary, frameless cabinetry. The only thing that will show on a cabinet with shelves supported by these "invisible" wires is a series of ⅛-in. holes. No hardware is visible at all. But because the shelves slide onto the wires, you can't use them on cabinets that have face frames (see the drawing below).

It's nearly as easy to cut, bend and install invisible wires as it is to install shelf pins. If I have a bunch of cabinets to do, I make a template, just as I do for shelf pins. If I only have a few to do, I use a marking gauge and a tape measure to lay out the hole centers.

I use suspended-ceiling wire (available from most home centers and large lumberyards) for the supports. It's about ⅛ in. dia., and a 10 ft. length costs less than $2. In a pinch, coat-hanger wire could be used. I measure the diameter of the wire with a caliper and then choose a bit to match. I also drill a test hole to make sure the wire fits snugly but not so tightly that it has to be pounded in.

I snip the wire to length with a pair of lineman's pliers and bend the wires in a vise. To get the wire to bend in the right place, I position it so the mark indicating the bend is just above the vise jaws. I bend it by hand first and then tap the corner flat with a hammer. Blind slots for the wires are cut in the ends of each shelf on the tablesaw but are stopped ¼ in. shy of the front edge of each shelf. I use a standard-kerf blade, but if you use a thin-kerf blade, just make two passes. The slots are centered on the ends of the shelves.

__Installing wire supports.__ Drill the holes about ⅝ in. deep (top left). Masking tape is an effective depth gauge. Cut the wire to length, and mark it for bending (top right). The wire should be as long as the distance between the holes plus 2½ in.—twice the depth of the holes and twice the amount of wire sticking out before it bends. To bend the wire, put it in the vise, push it over by hand and tap it flat with a hammer (bottom left). Check for consistency (bottom right). Wires should protrude about ⅝ in. from each hole. Trim if necessary.



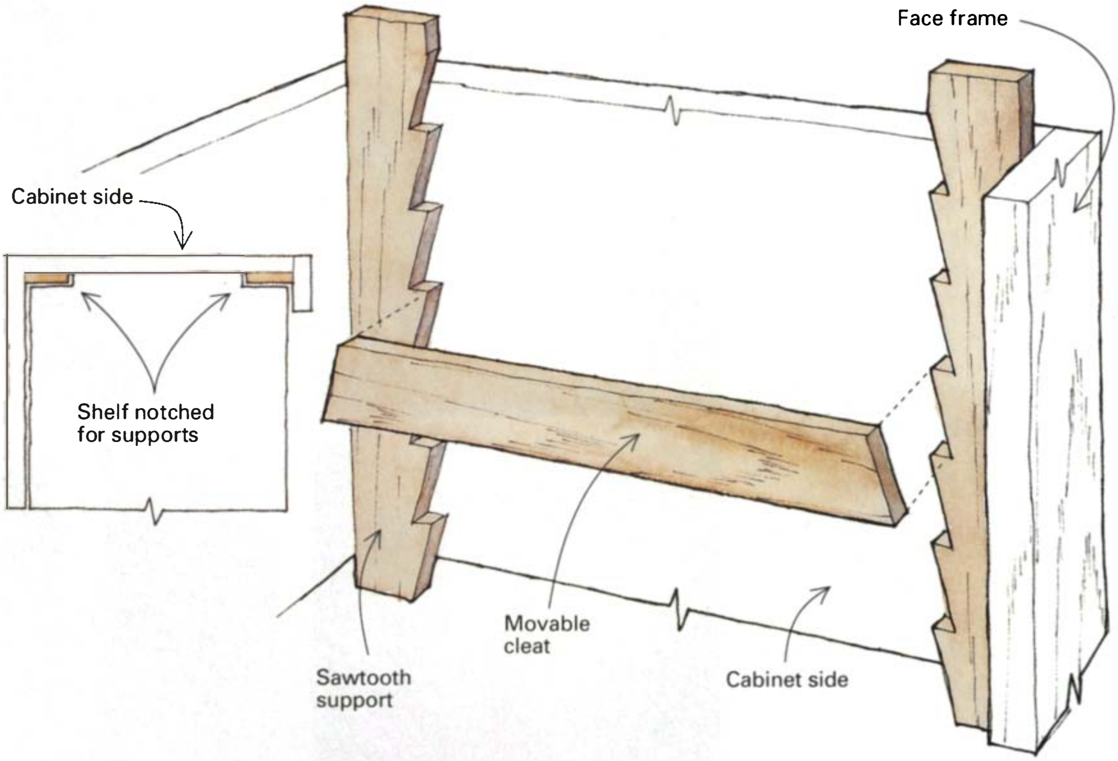
Photos: Vincent Laurence

The most elegant supports

I've saved the best-looking shelf supports for last. They're not difficult to make—just a little time-consuming (see the photos below).

After milling stock for the sawtooth supports and the cleats that go between them (both are the same dimensions, about ⅜ in. to ½ in. thick and 1¼ in. wide), I mark the four uprights from a sawtooth pattern. Then I saw them out together on the radial-arm saw and the bandsaw.

I clean up sawmarks with a chisel and glue and nail the sawtoothed strips to the carcase sides at the front and rear. Cleats span the distance between supports; the shelves are notched around them.



***Making sawtooth supports.** Mark out sawtooth patterns on the dimensioned stock (top left). A pattern made from ¼-in. hardboard speeds layout. Tape the four uprights together, and then tape the pattern to the stack to keep the pattern in place. Cut the straight part of the sawtooth on the radial-arm saw or tablesaw (top right). Bandsaw the angled part of the sawtooth (bottom left). Then pare the faces of the sawteeth smooth, and clean out the corners (bottom right).*

Threaded Inserts

A versatile fastener for making strong connections

by William Tandy Young

***Stronger than screws**—Boston furnituremaker Bill Howard uses threaded inserts to attach decorative end pieces to a credenza (above). A ¼-in. insert (right) has about 50% more surface area in the wood than a #14 screw.*

My friend Andy called one day to ask if I wanted to take part in a bulk order of threaded inserts. I'd seen threaded inserts in catalogs but had no experience with them. I asked Andy how he used them, and after a moment of stunned silence he replied, "Where do you want me to start?" He told me he used them on everything from tools and jigs to high-end furniture. Threaded inserts are so valuable around his shop that craftsmen working there guard their private stocks. Andy's never steered me wrong, so I joined the bulk order and got some of my own.

Once I started working with threaded inserts, I quickly saw how handy they are. They look like round nuts with machine-screw threads on the inside and wood-screw threads on the outside (see the inset photo at left). Threaded into a hole, inserts make it possible to use machine screws to fasten wooden parts. Inserts have a large outside diameter and coarse threads, and their surface area is more than 50% greater than comparable wood screws. The surrounding wood fails long before inserts pull out. Inserts hold so well they can be difficult to remove. Some designs are impossible to remove, short of splitting them out.

Since that first order, I've used threaded inserts to replace wood screws where strength was important and on knockdown furniture. I've fixed wobbly chairs by replacing stripped wood screws with threaded inserts, and I've made all

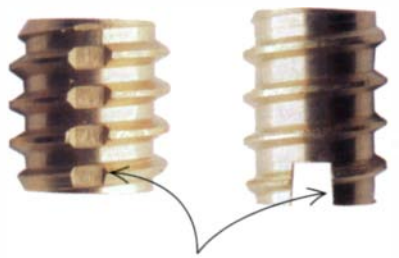
Top photo: Aimé Fraser

kinds of jigs and fixtures with inserts. I might toss the jig when the job is done, but not before I've salvaged the inserts.

Three types of inserts for woodworking

There are dozens of types of inserts made for use in almost every material. Only three are suitable for wood: inserts that cut threads in the wood, inserts that form threads and barbed inserts, which have no threads. Whatever type you choose, they're generally available in brass, zinc alloy and steel. Zinc-alloy inserts are the least expensive but also the softest. The internal threads will strip after repeated use. Brass is harder, and steel inserts are the toughest of all.

Thread-cutting inserts

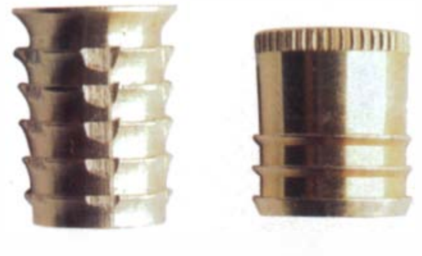


The external thread on a thread-cutting insert isn't continuous (see the photo above). The threads are broad and flat-topped with a notch, slot or groove that breaks the threads in one or more places. As the insert is driven, the sharp edges of the break cut threads into the wood. Thread-cutting inserts are easier to drive. I use them when I'm installing large inserts and when I'm working in hardwoods.

Thread-forming inserts

Thread-forming inserts have continuous thin, sharp threads (see the photo above). These inserts work like wood screws, displacing the wood around the threads rather than removing it. Thread-forming inserts install easily in everything but the hardest woods. I don't use them in thin stock or in the edges of boards because they can bulge the wood around the insert or cause a split.

Barbed inserts



Barbed inserts don't have threads; they have angled fins that let the insert go in but not come out (see the photo above). These inserts are installed with a hammer.

Though barbed inserts are sold for use in solid wood, they aren't as secure as externally threaded inserts. Barbed inserts are designed for engineered wood like medium-density fiberboard where threading an insert is likely to crumble the material.

Choosing the right driver

Driving inserts with a screwdriver is a torturous, experience. You're far better off using a driver made for the job. Stud-type drivers, which screw into an insert's internal threads, are one option. These devices range from the simple nut-and-bolt driver shown in the photo below to more elaborate production drivers, like the ones shown in the photos at right. Although these drivers are able to break a jam between driver and insert, they can't back an insert out of its pilot hole once it's been installed.

Specialty drivers engage inserts either with a hex-shaped stud or with a pair of tabs that fit into the top of the insert. These drivers also are capable of removing an insert.

Nut-and-bolt driver

This non-power driver is simple, but it's slow and fussy to use. You can make one from a nut and a bolt; you will need two wrenches to use it. Here's how it works: Thread the bolt into the insert with the nut between the insert and the bolt head. Tighten the nut to contact the insert, and with a wrench on the bolt head, drive the insert into the pilot hole. If the insert wants to back out while unthreading the bolt, just hold the nut against the insert with the other wrench and back out the bolt.

Production drivers

At the other extreme are expensive, hardened-steel industrial production drivers for use in a drill press, variable-speed drill or screw gun. There are two types, and they aren't cheap. But if you drive inserts into hardwoods all day long, they may be worth the investment.

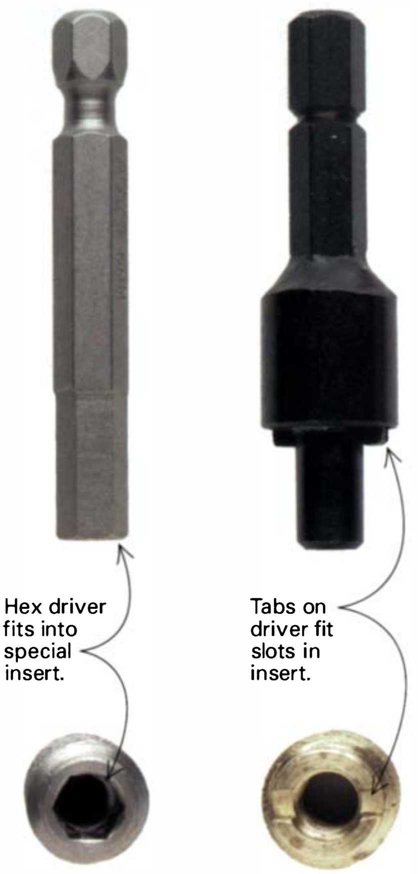
The less expensive version is basically a nut-and-bolt driver with a shank that chucks into a drill. A wrench is used to break a jam (see the photo at right above). Prices start around $50.

A more expensive version can break a

Photos except where noted: Scott Phillips

jam without a wrench (see photo on the facing page). These drivers look complicated, but they are nothing more than fancy nut-and-bolt drivers that produce an impact to break a jam. They cost upward of $150 each.

Specialty drivers



Hex driver fits into special insert.

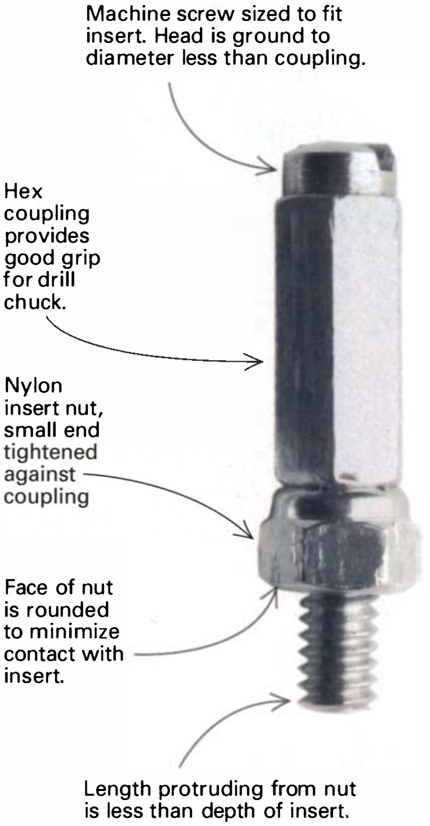
Tabs on driver fit slots in insert.

Internal-thread drivers can install any insert, but some inserts also can be installed with a specialty driver. Two kinds of specialty drivers are readily available at a cost of around $11 each. One has a smooth shaft to pilot the driver in the bore, with small tabs that engage a slot in the top of the insert, and the other uses a hex socket (see the drivers in the photos above).

Specialty drivers have two clear advantages over stud-type drivers. For one thing, jamming isn't an issue. Drive the insert, and then pull out the driver. More important, inserts made for specialty drivers can be removed. If you don't want the insert where you drove it, just reverse the drill and back it out. Inserts without a slot or socket have to be drilled or split out.

Shopmade power driver

Made from commonly available parts, this driver will install inserts efficiently.



Machine screw sized to fit insert. Head is ground to diameter less than coupling.

Hex coupling provides good grip for drill chuck.

Nylon insert nut, small end tightened against coupling

Face of nut is rounded to minimize contact with insert.

Length protruding from nut is less than depth of insert.

***Avoiding jams**—To reduce contact between driver and insert, the author rounds over the nut at the bottom of the driver. The nut has been threaded on a machine screw that is chucked in a drill to make grinding easier.*

For my work, a shopmade driver (see the top photo above) is just as effective as a top-of-the-line production driver. I can make a set to fit every size insert for lunch money or less. I make smaller-size drivers from a machine screw threaded through a hexagonal coupling. To make a good bearing surface against the insert, I snug a nylon-lined stop nut against the coupling. I put the small end of the nut facing the drill.

Before assembling a driver made with a coupling, I grind the head of the machine screw to make it slightly smaller than the diameter of the coupling. This helps the drill chuck grip the coupling, not the screw. Then I grind a radius on the large end of the stop nut, as shown in the bottom photo, so the nut touches the insert but not the surrounding wood.

This works well in the smaller machine screws, but the outside diameter of a 5⁄16-in. coupling won't fit in a 3⁄8-in. chuck. For larger inserts, I use a bolt that isn't threaded full length and cut the head off.

Drill the right size pilot hole

No matter what driver you use, the right size pilot hole is essential. I determine the right size the same way I do when driving wood screws. For hardwood, I make the pilot hole for an insert slightly larger than the root diameter of the insert. For softwood, I make the hole slightly smaller. I always run a test in a scrap piece of the same wood to make sure the insert drives easily.

Whenever I can, I drill the pilot holes in a drill press to ensure they're square to the surface. I drill the holes a little deeper than the insert by about one diameter, and I keep them one insert diameter from an edge. ☐

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

Sources of supply

The following are sources for threaded inserts and drivers:

Groov-Pin Corp. (201) 945-6780. Minimum order $200. For smaller orders, call for name of local distributor.

McFeely's (800) 443-7937

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Bottom photo: Aimé Fraser

Craftsmanship on Wheels

This specialized woodworking is best appreciated in the driver's seat

by Scott Gibson

Car with a frame of wood—Vince Wanklin assembles a frame for a Morgan sports car, the last production car in the world still built this way.

Cradled in a plump leather seat, behind a door that closes as solidly as a bank vault, I'm staring at a dash and console in perfectly matched walnut burl veneer. It is a Bentley Turbo R in midnight blue, just off the production line. I have seen plastic dashboards in every incarnation of cracked old age, and all this polished walnut is a lot to take in. The man from the factory seems to know this, as he must know it of every first-time traveler in a Bentley. He's smiling faintly as he roars down the narrow country road, veering around trucks and sailing through a trail of mud left by a farm tractor.

If I had been buying the car instead of just riding in it to lunch, I could have had trim in bird's-eye maple, wenge, quilted mahogany, burl elm or anything else. Whatever the wood, it will be protected behind six coats of hand-rubbed lacquer, a finish capable of withstanding a direct hit from a Cuban cigar. Owners of new Bentleys and Rolls-Royces—some 1,600 of them a year—want this level of finish (see the photo on p. 85). That's one of the reasons people pay $200,000 for a Rolls or Bentley when the same money would pay for a lifetime of Chevrolets.

Both owned by Vickers PLC, Bentleys and Rolls-Royces are built in Crewe, a railroad town between Manchester and Birmingham, England. Unlike London or Oxford, Crewe is not a town where tourists will spend much time, but Crewe is the place where buyers go to work out the design details for one of the most exclusive motorcars on the planet. And the woodworkers who turn out the meticulously veneered interior woodwork for these cars take pride in knowing that.

If driving the car is, in the company's words, a seat-of-the-pants experience, so is building one.

About 80 miles to the south, in Great Malvern, a much smaller work force builds Morgan sports cars. A Morgan is a good deal less expensive than either a Rolls or a Bentley, but you will have to wait a lot longer to get one—up to six years in the United Kingdom. One reason buyers will wait so long is that these cars are still coach-built. Unlike a Chevrolet, or even a Rolls-Royce, a Morgan is made by hand-fitting steel or aluminum body pieces to a separate frame made of ash. Morgans, the company says, are the only production cars that are still manufactured this way.

These two car builders are among the last in the world to give any serious consideration to wood or to woodworkers. A handful of other luxury car makers and custom shops aside, the rest of the world has turned to injection-molded plastic and robots: faster, cheaper, more uniform and less hassle.

At Rolls-Royce and Bentley, veneer is king

There really isn't much wood in a Rolls-Royce or a Bentley, if measured by weight or volume—something less than 30 sq. ft. of veneer in the rough, plus a little solid wood and plywood. In a standard Rolls-Royce Silver Spur, there are 18 veneered pieces: three in the dashboard (or fascia, as it's called), four trim pieces to cap the tops of the doors (waistrails), seven pieces to make up the center console, two rear mirror frames (called companions) and a few fold-down trays called picnic tables.

All the wood you can see is veneer, and it's the best stuff the company can track down. Buyers travel to towns large and small—Rome, London, Cincinnati, Pleasant Hill, Missouri—where they will buy about 12,000 sq. meters of veneer a year. The veneer is .6mm-thick (about 1/40 in.) rotary-cut material, much of it from burls, or burrs as the English call it. Car buyers have traditionally favored walnut burl, and most of the cars still get that.

All the veneer in a car is taken from consecutive sheets of the same log and then bookmatched. Thin panels, like the dashboard and console, are veneer over a plywood substrate. Thicker trim pieces, like the waistrails, are veneer laid up on solid walnut and tulip cores. Veneer is attached with a two-part urea-formaldehyde adhesive in one of two heavy presses. The presses use a combination of heat

Frames start as slabs of European ash. *A Morgan frame begins its journey on a bandsaw in a shop adjoining the frame-assembly area (above). After frames are complete, cars move along for additional work (left).*

What looks haphazard really isn't. *Veneered trim pieces for the interiors of new Rolls-Royce and Bentley automobiles are carefully tracked through the woodshop so that veneers throughout each car match perfectly. Below, a woodworker repairs a minor defect in veneer for a Rolls-Royce door.*

and vacuum to form a bond. In all, it will take the woodworkers approximately 55 hours over 23 working days to finish the veneered woodwork for a single car.

Lower demand for cars, but plenty of work

These are coveted jobs in Crewe, all the more since a recession in the early 1990s cut sales of these cars in half and forced some workers out the door. What the company wants, explains woodshop manager Ian Kerhsaw, are team players.

Adrian Minshull is part of that team. He joined the company when he was 16 years old and spent the next four years moving around the factory before going to the woodshop. He's been there for about nine years and is one of those who does the veneer scouting. He loves it.

Part of what saves Minshull and the others from the boredom of repetitive factory work is the sheer pleasure of working with some of the finest wood veneers available (see the photos above). And because the customers get exactly what they ask for, there's often something just a little bit unusual coming through the shop. Custom colors for veneer range from gun-metal gray to primrose yellow. Minshull remembers working with a purple bird's-eye maple veneer that was later teamed up with sky-blue leather in the rest of the car. And the workers are still shaking their heads over two marquetry buffalo heads set into facing door panels in the back of another car, a memorable special order.

At Morgan, the wood is in the frame

On the outside, the Morgan plant has the same feel as the Rolls factory: low, brick buildings clumped together just off the road and cars in various stages of undress rolling through the shops. But things are done a little differently in Great Malvern. The workers don't fool around with primrose veneer or buffalo heads, and they're not into polishing book-matched veneer to within an inch of its life. Morgan builds revered, if somewhat dated, sports cars the old-fashioned way: no unibody construction, no robotics, no long assembly lines. If driving the car is, in the company's words, a seat-of-the-pants experience, so is building one.

At Morgan, the dash is made somewhere else because, as co-managing director Charles Morgan puts it, making a dashboard isn't that difficult. Instead, woodworkers at Morgan build ash

Photos except where noted: author

Woodworking art on wheels—Meticulously fitted and finished, this dashboard and console in burl walnut veneer is a characteristic detail of the Rolls-Royce, this one in a busy Connecticut showroom.

> *Whatever the wood, it will be protected behind six coats of hand-rubbed lacquer, a finish capable of withstanding a direct hit from a Cuban cigar.*

frames, the foundation for hand-fitted body parts and part of the car's mystique (see the photo on p. 82). Morgan hasn't given up on the wooden frame for several reasons: It helps keep the car light (about 1,900 lbs.); it's strong and resilient, and metal body parts attach easily to it. A wooden frame also is traditional, and well, this is England.

Morgan builds about 500 cars a year (only 30 to 40 of them are sold in the United States); a dozen of its 135 employees are woodworkers. Charles Morgan, grandson of the founder, oversees this domain from an 8-ft. by 12-ft. cinder-block office, awash in papers, photographs, books and the occasional suspension part. The pale blue and white walls are illuminated by a single fluorescent tube in the ceiling. Outside the office, bins of car parts are in a storage room. His father, Peter, a co-managing director and the son of the company founder, is in the office next door with his dog, Jade, who sleeps on the carpet in front of the desk. The company is small, friendly and homey. It has little of the glitter that infuses every corner of the Rolls operation.

Ash frames in just over a day

Parts for a Morgan sports-car frame are cut and shaped from kiln-dried European ash treated with a preservative. In the assembly shop, the half-dozen or so woodworkers at benches around the perimeter of the shop get a rolling chassis, which has an engine and transmission but little else. The builders are expected to assemble and fit each chassis with a wooden frame, including a pair of doors, before sending the car off to the metal shop next door.

It takes a man (no women work in the woodshop) 10½ hours to make a frame. Although the roughly 100 pieces that go into one already have been cut to shape (see the photo at left on p. 83), there's still a good deal of trial-and-error fitting. Half-lap joinery for door frames, for instance, must be laid out and cut at the bench before pieces are glued and screwed together. The doors form a gentle compound curve, like a dome segment, as they sweep in from top to bottom and from front to back. There are half-lap, mortise-and-tenon, spline and butt joints, all held together with a combination of waterproof glue and wood screws. The only bent-laminated parts in the car are the wheel wells, made from three layers of marine-grade plywood.

Even though the frames are made of wood, the standards are exacting. Charles Morgan says the two diagonals of a frame, which are just about 13 ft., are within 2mm of each other (that's about 5/64 in.). Woodshop foreman Graham Hall says it's less.

This shop has a long memory

There are several models of Morgans, so some variety is built into these jobs. Beyond that, Morgan takes pride in being able to reproduce frames for older cars that have been damaged or are being rebuilt.

One day last winter, Hall was working with an apprentice on a frame for a 1961 two-seat Plus Four. The shop can handle that. In the back room are all the jigs they'd need to make parts for frames back to 1950. Hall, who has been working at Morgan for more than 40 years, can recite virtually any measurement from any model of car the company's made, and he's capable of identifying unmarked dashboards hanging on a wall from 50 ft. away. ☐

Scott Gibson is editor of Fine Woodworking.

Photo this page: Boyd Hagen

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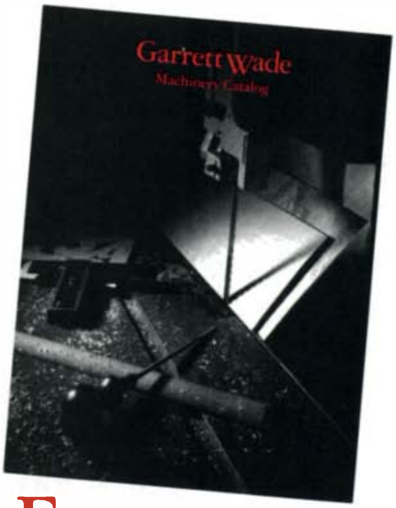

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Rick Price

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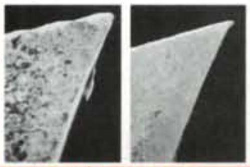

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Lie-Nielsen adds No. 4 bench plane to its line

Maine plane maker Lie-Nielsen Toolworks is now offering a No. 4 smoothing plane (see the photo at right). The new plane, with a 2-in.-wide blade and a 9½-in. sole, is patterned after the Bedrock No. 4 (long out of production). It's an ideal size for a range of woodworking tasks.

One reason Lie-Nielsen's version works so well is a precise fit between the frog and plane body. With a solid bed for the blade assembly, chatter across the work is just about eliminated.

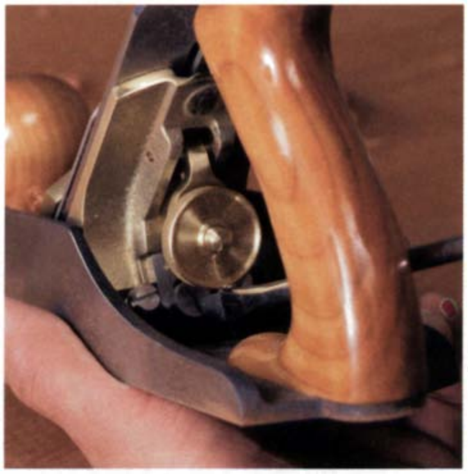
But the real secret to the plane's performance is an easily adjustable frog (see the bottom photo at right). Ideally, a woodworker should be able to set both the blade projection and the mouth opening for every planing operation, and the Lie-Nielsen No. 4, like the Bedrock before it, makes this a simple operation.

When planing clear pine or straight-grained oak, you can set a wider mouth opening for a heavier cut. A curly walnut plank with swirling grain might require a very fine mouth opening to avoid ugly tearout. On a standard plane, this adjustment requires removal of the lever cap and blade assembly to get to the screws holding the frog to the bed. That's usually followed by trial-and-error adjustments of the frog to get the mouth opening just right.

The Bedrock design allows the plane to remain intact while two locking screws are loosened and a center adjustment screw is turned to advance or retract the frog. The result is a mouth opening that can be set rapidly for the work at hand.


Photos: Vincent Laurence

New plane from Lie-Nielsen—The No. 4 smoothing plane, based on the Stanley Bedrock pattern, is available in either bronze or cast iron.



***Mouth opening is easy to adjust.** There's no need to remove the lever cap and blade assembly to adjust the frog on Lie-Nielsen's new No. 4 plane—a big advantage over standard designs.*

The new No. 4, like other Lie-Nielsen planes, is available either in manganese bronze or cast iron. A bronze plane weighs more than the cast-iron version, meaning less vibration and smoother planing.

But a cast-iron plane wears extremely well and stays flat. It can survive a head-on collision with a bench dog more easily than a bronze plane. Cast-iron planes have a no-nonsense look about them.

What does it all boil down to? Nothing more than personal preference.

The plane costs $225, and it can be ordered from Lie-Nielsen Toolworks Inc., P.O. Box 9, Route 1, Warren, Maine 04864-0009; (800) 327-2520. *—Mario Rodriguez*

***A sanding block that's a pleasure to use.** Oregon cabinetmaker Tony Allport designed this Douglas fir and Alaskan yellow cedar sanding block that holds a quarter-sheet of sandpaper.*

Wedge Wood sander

Tony Allport is a cabinetmaker and self-proclaimed tool snob who rooted around in his scrap bin for a sanding block once too often. "I wondered," Allport writes, "why I didn't have a really nice sanding block that I kept track of and enjoyed using along with some of the other tools that I am fortunate to own."

The result of Allport's ruminations and tinkering is the Wedge Wood sander, a sanding block (see the photo at left) that holds a quarter-sheet of sandpaper. Two wooden wedges connected by surgical tubing hold the paper in the body of the block. The bottom of the block is cushioned with cork.

Allport charges $30 for a finished block, $17.50 for a kit. Until I used it, that seemed like a lot of money for something I had been getting free, just like Allport, from the scrap box in the corner. After using Allport's modest invention for several weeks, I've changed my mind. The price seems just fine. The block is beautifully designed:

Bottom photo: Scott Gibson

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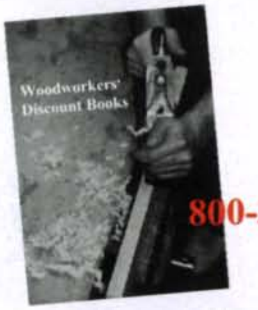

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It fits my hand nicely, holds sandpaper securely and is a pleasure to look at. My only complaint is that the cork bottom is susceptible to damage when sanding corners or sharp edges.

No one's shop will come to a standstill without the Wedge Wood sander—there's always the scrap box. But this is a tool most woodworkers would truly enjoy using. Tony Allport Cabinetmaker is at 2402 N.E. 14th, Portland, OR 97212; (503) 284-2900.

—Scott Gibson

First aid for sticky drawers

Heat and humidity can soon render a beautifully made piece of furniture into a frustrating assembly of jammed drawers and stuck doors. Although I wax moving parts, more wax usually has to be reapplied some months later. Slipit looks to be a cure for that problem.

A lubricating compound, available without silicone, Slipit can be applied to any wood or metal surface. When used on metal parts, Slipit prevents rust and oxidation. When brushed on wood surfaces, it seals the wood, preventing moisture absorption and, therefore, sticking.

Slipit has been on the market since 1939. It's nice to see a product that has been around for so long find a new niche. After using this product in numerous applications, I would not hesitate to recommend it to anyone. Slipit comes in several sizes; a pint is $7 when ordered directly from Slipit Industries (Route 299, Highland, NY 12528; 914-691-8400). *—Karen Robertson*

A cure for sticky drawers*—Slipit applied to moving wooden parts prevents moisture absorption and sticking.*

Porter-Cable detail sander for molding profiles

A detail sander for curved profiles*—The linear motion of Porter-Cable's Model 444 detail sander, coupled with contoured pads, allows it to sand molding profiles easily.*

Most detail sanders just aren't designed for molding and other contoured shapes. The semicircular motion of the pad grinds down higher ridges without smoothing deeper valleys. Porter-Cable's answer to this problem is the Model 444 detail sander (see the photo above). It produces a front-to-back linear motion and comes with a variety of blocks that snap into the bottom of the tool.

Porter-Cable sells rolls of adhesive-backed sandpaper ranging from 80- to 220-grit. The paper matches the various shapes and styles of pads.

By purchasing the complete sanding kit, you get a dust-collection system, which helps the machine sand cleaner and faster. If a vacuum hose held by duct tape isn't classy enough for you, Porter-Cable makes a hose and an adapter that will connect this and other tools to your vacuum.

The 2-in.-dia. barrel-style grip fits comfortably in medium-sized hands. The relatively small and quiet motor had plenty of power for its short stroke (⅛ in.). I won't pitch my old detail sander, but from now on, I'll be sanding all my molding, start to finish, with the Porter-Cable 444. The in-line sanding compares well to careful hand-sanding. You can buy the detail-sander kit for about $120 from a number of retail outlets and mail-order houses.

—Sven Hanson

Mario Rodriguez is a woodworker, teacher and contributing editor to Fine Woodworking. *Scott Gibson is editor of* Fine Woodworking. *Karen Robertson is a furnituremaker living in Victoria, B.C., Canada. Sven Hanson is a woodworker and writer in Albuquerque, N.M.*

Top photo: Sven Hanson; bottom photo: Aimé Fraser

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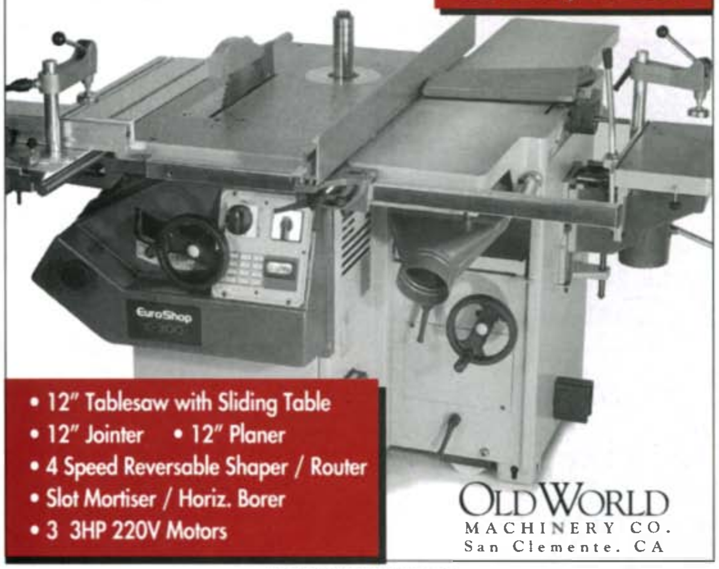

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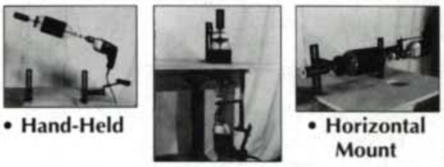

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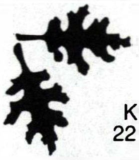

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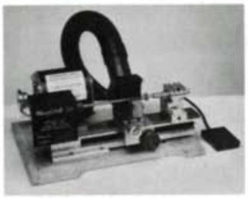

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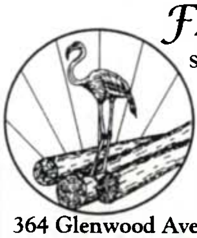

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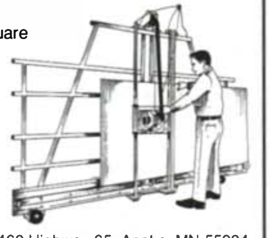

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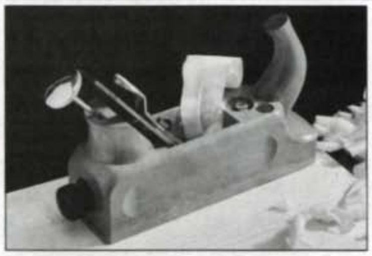

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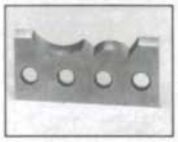

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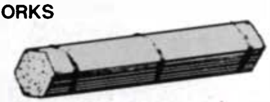

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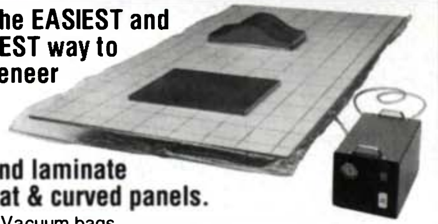

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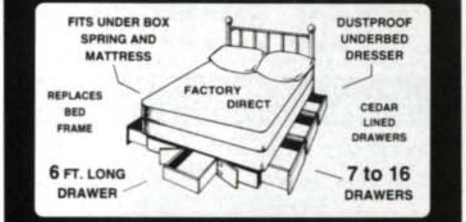

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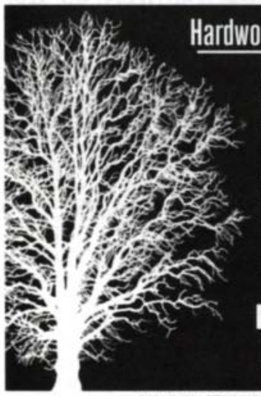

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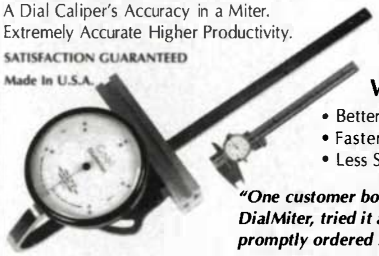

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$159

2695	8-1/4" super sawcat w/br.	189
79-034	#400 workmate	109

Emglo

AM78-HC4V
1-1/2 HP Vertical
Twin Tank
$309

AM79-HC4V	**New** 1-1/2hp vert	329
AMDOL78-HC4V	1-1/2hp oilss	279
AM99-HC4V	2 hp ver twin tnk	399
AM39-HC4V	3/4hp v twin tank	299
K15A8P	1.5 hp wheelbarrow	619
K2A8P	2 hp wheelbarrow	689
K5HGA-8P	5hp Honda whlbrw	769
045	3/8" x 50' Goodyear hose	20

POWERMATIC

1660760
66 Saw 3 HP
w/50" Biesemeyer
$1999

Acc'y Pkg.

1120001	belsaw 12" plnr/mldr	1499
1270100	#27 shaper 3 hp 1 ph	2099
1000099	#100 planer/12"/2hp	2799
1800205	5hp18" pl w/knife gr	5799
1500040	6" jointer 3/4hp 1 ph	1399
1610050	8" jointer 1.5hp 1 ph	1699
1310001	6x48 belt/12"disc sdr	1399
1410040	14" bndsw 3/4hp1ph	1499

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64 Artisan Saw
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1791209	**New** 15" planer	1329
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3.25 HP
VS Router
$209

Includes Edge Guide

JS102	joining sys cs & adfnc	179
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94-100	5 pc router cabinet set	159
91-100	13pc 1/2" router bit set	189
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Package
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10" Sliding Table
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Includes Router Jig Kit

DS2000	**New** 2 spd detail sander	64
DC500	**New** detail wood carver	64
RE-600	3 hp vs plunge router	229
JP-155	6-1/8" jointer/planer	329
TSS200	8-1/2"slide cmpnd saw	399

AP12
12" Portable
Planer
$409

Includes Extra Knives

OSS450	osc. spindle sander	169
TR30U	laminate trimmer	89
BE321	3x21 vs belt sander	149
WDS1600	16-32"w drm sndr	589
WDP1850	18-1/2"wood drl prs	439

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10" Jet Saw
3 HP w/50"
Xacta Fence
Motor Cover
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JWCS-10JF	2 hp sw w/Jet fnc	999
JPM-13	13" planer/moulder	799
JWP-12	12" portable planer	379
JWS-18HO	1hp wood shaper	499

JWTS-10JF
10" Saw
w/Jet Fence
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JWBS-14CS	14"1 hp wd bdaw	599
JWBS-14OS	14"3/4hp w bdsw	499
JDP-17MF	17"fl 16 sp dr pr	429

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6" Long
Bed Jointer
$499

JJ-8CS	8" long bed jointer	1149
JWL-1236	12" vs wood lathe	569
JWP-15HO	15"3hp w planer	1249
JWP-208-1	20",3hp w planer	1999

DC-650
1 HP, 650 CFM
Dust Collector
$229

DC-1200	2hp1200cfm collectr	449
DC-1900	3hp1900 cfm collectr	619
JSG-6	6" belt/12" disc sander	599

JDPN-607.2
18 ga 3/8"-1-1/4"
Nailer w/Case
$109

JDPN-671.4	16ga stplr w/cs	219
JDPN-6013.2A	18ga stplr w/cs	109
DHC15T4	1-1/2hp pncake cmp	299

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Wap

766RDF Turbo Vacuum
$479

776RDF-D	turbo drywaller vac	579
SQ14AS	Turbo Vac, auto start	599

BOSCH

B7000 NEW! Center Detail Sander
$69

B7001	vs corner detail sander	94
1370DEVS	6"hd randm sandr	229
1609KX	laminate trimmer kit	229
11222EVS	1-1/8"sds rotry hmr	399

1613EVS 2 HP, VS, Microfine Plunge Router
Includes Deluxe Edge Guide
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1655	**New** 7-1/4" circle saw	129
1289D	**New** 1/4 sheet palm sndr	69
B4050	**New** in-line jigsaw	129
3296K	**New** 3-1/4" planer kit	169

David White

LP6-20 20X Sight Level Package
$219

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ML200	**New** visible beam laser	899
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ALTP6-900	18auto lvl trnst pkg	509
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ALP6-18HD	18x auto package	399

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SFN-1 Plus	1"-2" finish nailer	349
SN60	full hd stick nailer	449
SLP-20	5/8"-1-5/8" brad nail kit	279
SLS20	finish stapler w/cs	279
SKS	1/4" crown finish stapler	279

makita

6095DWE 9.6 V 3/8" VRS Keyless Drill w/2 Batteries
$129

6095DWLE	9.6v w/2 bat & lite	139
5007NBK	7-1/4" saw w/case	129
2708W	8-1/4" tbl saw w/blade	319
2012	12" portable planer	489
3612C	**New** 3hp plunge router	269

LS1011 10" Compound Mitre Saw
Includes Carbide Blade
$429

LS1211	12" cmpnd miter saw	789
6201DWHE	9.6v hi cap kyls2 bt	179
6211DWHE	12v h icap kt .2 bt	169
9820-2	blade sharpener	214
JR3000V	vs recip. saw kit	139
N1900B	3-1/4" planer w/case	134
3901	**New** plate joiner	199

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1587VSK Top Handle Jig Saw w/Case
NEW!
$164

1584VSK	barrel jigsaw w/case	164
1587VS	**New** top handle jigsaw	139
1584VS	barrel grip Clic j;igsaw	139
1587DVS	top hdl dstlss jigsaw	179
1584DVS	barrel dustless jigsaw	179
1632VSK	vs recip saw kit	159

3107DVS Dustless Random Orbital Sander
$99

3107DVSK	5" rndm sander kit	119
1348AE	5" elec. mini grinder	139
1608	laminate trimmer	104
1609	offset base laminate trmr	149
1942	heavy duty heat gun	79

3310K New 12 Volt T-Handle w/2 Batteries
$179

3610K	14.4 v drill with 2 bat	199
1276DVS	4x24 vs belt sander	224
1275DVS	3x24 vs belt sander	209
3270DVS	3x21 vs sndr w/bag	164

1615EVS 3-1/4 HP, VS Plunge Router
$289

1604	1-3/4 hp router	144
1606	1.75 D-handle router	189
1003VSR	3/8" keylss 0-1100 drl	94
1404VSR	0-4000 drywall driver	94

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DW930K	12 volt cdls saw kit	199
DW930	12 volt cdls saw only	129

DW621 NEW! 2 HP VS Plunge Router
$219

DW625	3 hp vs plunge router	79
DW670	laminate trimmer	99
DW673K	laminate trimmer kit	199
DW615	1-1/4hp vs plng router	164
DW610	1-1/2 hp, 1/2" router	154
DW306K	8 amp, vs, recip saw	164

DW321K NEW! VS Jigsaw With Case
$164

DW705K	12" compnd miter sw	369
DW364	7-1/4"saw w/brake	159
DW361	7-1/4" saw & case	149
DW675K	3-1/8" planer w/case	169
DW402	4-1/2" angle grinder	89

DW682K Plate Jointer Kit
$199

DW106	3/8" 4 amp keyless dr	74
DW250	0-4000 drywall driver	89
DW254	0-2500 deck driver	89
DW280K	all purp scrwdrvr kit	119

DW421 5" Hook & Loop Dustless Random Sander
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DW423	5" vs random sander	94
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DW411	1/4 sheet sander w/bag	59
DW431	3"x21" vs belt sander	184

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DW972K-2	12v 3/8"dr kit/2b	189
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27000	78" level wo/hand holes	115
27010	96" level wo/hand holes	125

VEGA

U26 Utility 26" Fence
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U50	utility 50" fence	209
PRO40	professional 40" fence	259
PRO50	professional 50" fence	269
DU-36	utility 36" duplicator	399
D-36	prof. 36" duplicator	569

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EB3500XK1A	3500 watt gen	1499
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EB6500SXA	6500 watt gen	2479
EW171AB8	4000 w gen/weld	2059

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$659

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EM3500SXK1A	3500 elec strt	1629
EM5000SXK1A	5000 elec strt	1999
ES6500K1A	6500 electric strt	2679

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2201	top brace	20
2203	guard rail holder	21
2204	work bench	38
2601	**New** wall jack	109

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L360	**New** rotary laser	599
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2 Lbs. Lighter!
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AEG

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HBSE-75S	3x21 vs belt sander	189
FSPE-100X	brl grip jigsw w/cs	164
BSPE-100X	top hndl jigsw w/cs	164

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44045	bench top Const. Master	79

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$279

2721	1.5 hp fixed base router	149
3379K	plate joiner w/case	239
3375	3-1/8" universal planer	169

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8-12	air filtration system	489
10-16	air filtration system	689
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24-46	accu miter gauge w/bar	164

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$349

N80S-1	16d stick nailer	349
N80C-1	**New** coil nailer	349
BT50-2	1-3/16"-2" brad nlr kit	219
BT35-2	5/8" to 1-3/8"brd tackr	179
RN45B-1	**New** roofing nailer	399
MIIIFS	floor stapler	539

Porta-Nailer

401P Hardwood Floor Nailer
$214

501	floor face nailer	214
120	universal router table	339

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MSXE-636-2 VS Triangular Oscillating Sander w/Case & Paper
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MOX-621	pneumatic trian sndr	199

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310	Laminate Trimmer	143
312	Offset Trim Router	157
332	RO Sander	65
345	6" Saw Boss	103
361	3X24 Belt Sander	188
363	4X24 Belt Sander	198
410	Betterly™ Underscribe	147
411	Betterly™ MiterFold	164
447	7-1/4" Framer Saw	133
5008	12" Dovetail Jig	76
511	Door Lock Kit	138
5116	16" Dovetail Jig	256
556	Biscuit Joiner	132
693	1.5hp Plunge Router	168
6931	Plunge Base	72
695	Router Table w/motor	221
696	Router Table only	127
7116	24" Doevtail jig	292
7499	Drywall Cutout	62
7518	Vari Sp 3 hp Router	266
7519	3 hp Router	237
7536	2 hp Router	203
7537	2 hp D-Handle R'ter	212
7538	3 hp Plunge Router	241
7539	VS Plunge Router	264
7549	Jig Saw	127
7800	Drywall sander	326
7810	Vacuum	239
9118	3 1/4" Planer Kit	213
9314	Trim Saw Kit	156
96645	Screwgun w/ case	128
97310	Type 2 Trimmer Kit	184
97335	5" RO Sander	117
9743	7-1/4" Saw Kit	139

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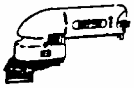

9444	NEW 25 pc Profile Sander Kit	112
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347K	7" Circular Saw RH with case	127
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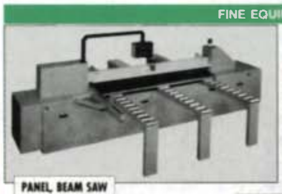

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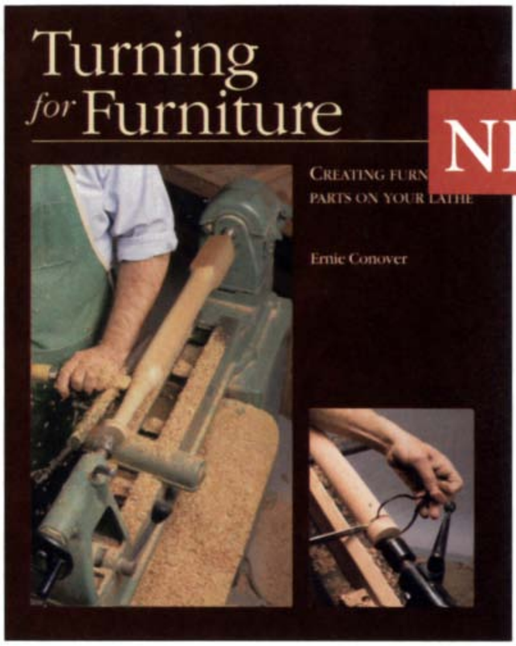
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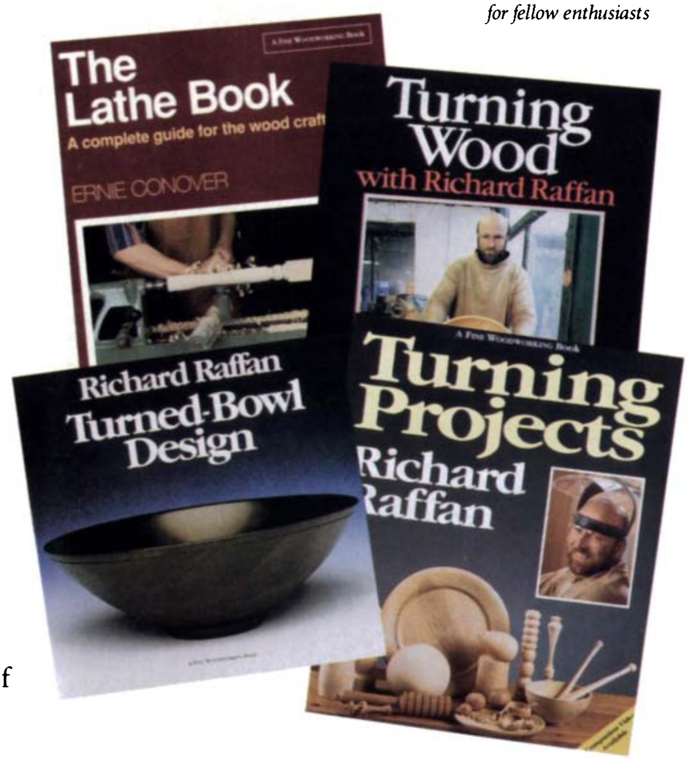
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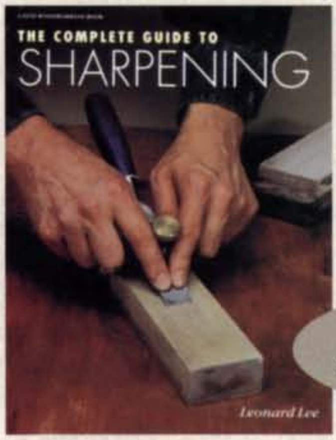

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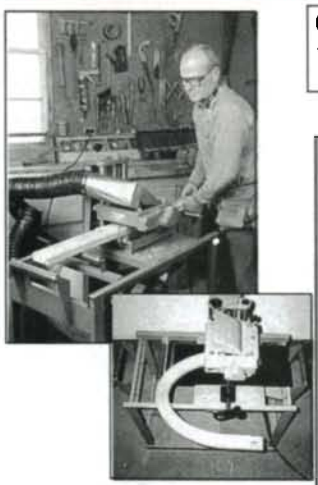

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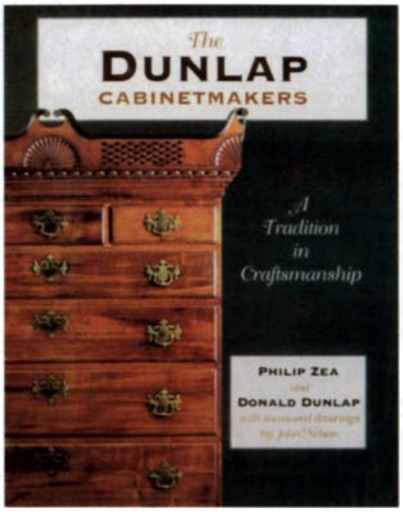
The Dunlap Cabinetmakers: A Tradition in Craftsmanship by Philip Zea and Donald Dunlap. *Stackpole Books, 5067 Ritter Road, Mechanicsburg, PA 17055 (800-732-3669); 1994. $49.95, hardback; 218 pp.*



Donald Dunlap is no ordinary cabinetmaker. The furniture he designs and makes in his Antrim, N.H., shop springs from a 200-year-old family tradition. The first Dunlap cabinetmakers, Captain John Dunlap and his brothers, practiced nearby in the late 18th century. In this book, Donald Dunlap and Philip Zea, curator of an historic district in Massachusetts, bring together the work of the many Dunlap cabinetmakers, showing the origins and development of the family's style.

The book begins with an in-depth study of the migration of the Scots-Irish and the Dunlaps to New Hampshire in the 18th century. What follows is a collector's history and analysis of the distinctive and curious Dunlap style, perhaps best illustrated by the high chests of drawers they made. The chests featured large, galleried pediments, pierced fretwork, "flowered ogees," deep lower cases and slender cabriole legs.

The largest part of the book, the catalog section, provides beautiful color photos of the furniture Donald Dunlap has recently built. Alongside, we can see the earlier Dunlap pieces on which Donald based his designs. John Nelson's accompanying construction drawings and details are nicely done and extremely precise. He presents each piece in a number of different views, some with parts removed so that you can see the insides. The curved parts are drawn on a grid so they can be enlarged.

This book is a great work in the study of the regional characteristics of the Dunlap school of furniture. It will be helpful to historians, collectors and cabinetmakers interested in that study. *—Philip C. Lowe*

Designs in Wood Project Manager (Version 1.0a). *Animated Data Systems, 760 Chaucer Lane, Tipp City, OH 45371 (513-339-5132); 1995. $49.95*

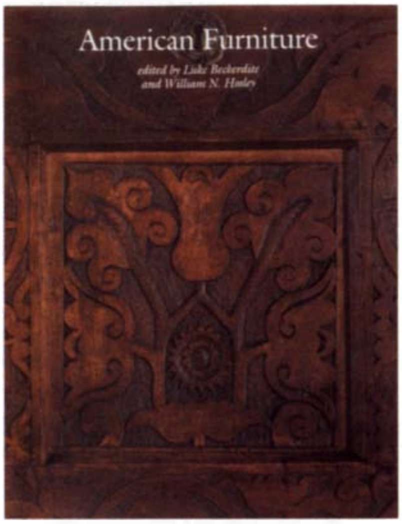
I have long been looking for a computer program to help me organize the maze of details it takes to run my one-man shop. I have never been able to keep track of things like hardware—where I got it, how much I paid for it or how long it took to install. Programs I've tried previously were oriented toward large production shops and had little bearing on what I did. They were just too sophisticated and narrow in their focus.

Designs in Wood Project Manager (Version 1.0a) from Animated Data Systems shows someone is at least thinking in the right direction. This program is designed specifically to help the small or one-person shop. It will help you track materials, labor and overhead for each project. It will generate several kinds of reports, including a cut list, a labor sheet, a time log, a bill of materials, a cost analysis, a quotation and an estimate. If you have never had access to your own computerized mailing list, this alone might be worth the price.

Even so, the program still suffers from some of the same problems I've encountered in other programs. It asks you to input such items as the five minutes it took to set up a bandsaw, or 10 minutes for sorting lumber. I don't know about you, but if I were to break my jobs down into increments such as this, I would never get anything done.

Because it is relatively simple, inexpensive and useful, this is a program I might actually use. It will run on any IBM compatible computer running Windows 3.1 or greater, including Windows 95. Installation and setup are very easy. *—Niall Barrett*

American Furniture: 1995 edited by Luke Beckerdite and William Hosley. *University Press of New England, 23 S. Main St., Hanover, NH 03755 (800-421-1561); 1995. $49.95, paperback; 298 pp.*



With more than 200 exquisite photos of 18th-century New England furniture—many of which show the backs and undersides of their subjects—the third annual volume of *American Furniture* is a treasure trove of visual information. The dense and scholarly essays examine furniture design from several Northeastern regions from social and economic perspectives.

It fascinates me to see how tradesmen from different crafts borrowed elements from each other. The similarities of design and ornamentation on the furniture pediments, doorways and gravestones of one region, for example, are striking. On the whole, this volume gives a good feel for what life was like for the craftsmen and the people who bought their work.

Even if the historical and social contexts are not of interest, I can still recommend the book for its value as a visual reference. It will prove helpful for both reproduction work and as a source of ideas for new designs.

—David Mukamal Camp

Philip C. Lowe designs and builds period furniture in Beverly, Mass. Niall Barrett is a furnituremaker in Narrowsburg, N.Y. David Mukamal Camp is a custom furnituremaker in La Cienega, N.M.

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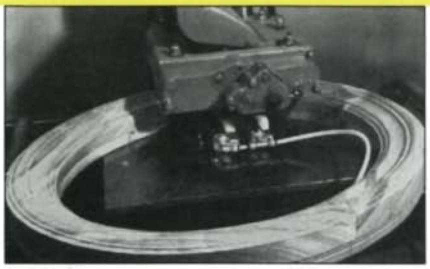

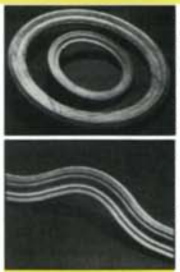

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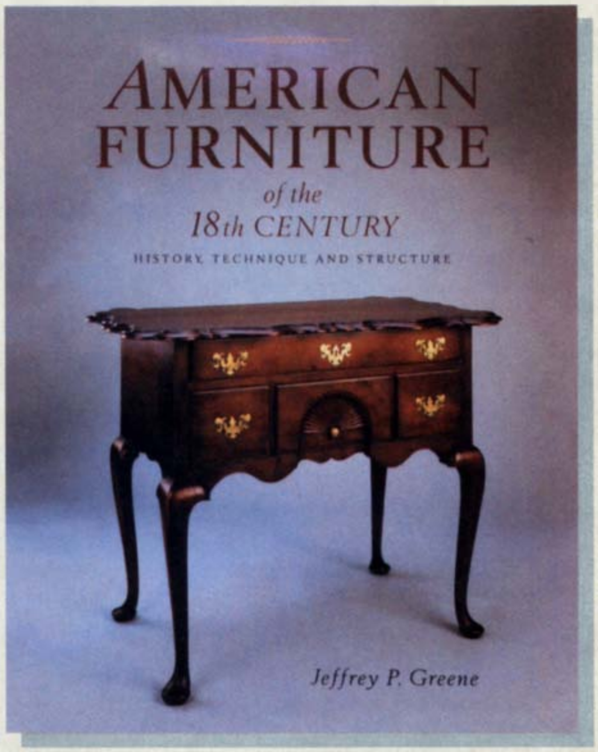

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Listings of gallery shows, major woodworking fairs, lectures, workshops and exhibitions are free but are restricted to happenings of direct interest to woodworkers. Only workshops sponsored by not-for-profit groups are listed. We list events (including entry deadlines for future juried shows) that are current with the time period indicated on the cover of the magazine, with overlap when space permits. We go to press three months before the issue date of the magazine and must be notified well in advance. For example, the deadline for events to be held in March or April is January 1; for July and August, it's May 1, and so on.

ALASKA: **Meetings**-Alaska Creative Woodworkers Association meets at 7:00 p.m. on the fourth Monday of each month at the Anchorage Museum. (907) 345-3077.

ARIZONA: **Show**-Turned Wood Sculpture by Dennis Elliot, October. Select Art Gallery, 3150 W. Highway 89A, Sedona. (800) 585-3199.

ARKANSAS: **Meetings**-Woodworker's Association of Arkansas meets the first Monday of each month at 7:00 p.m.; Central Arkansas Woodcarvers meets the second Tuesday at 7:00 p.m. and the fourth Tuesday at 6:30 p.m. J.T. Shannon Lumber Co., Woodworkers Center, 6200 Sears Drive, Little Rock, 72209.
Meetings-Ozark Woodturners meets the third Saturday of each month in Mountain Home. For more information, call Michael Kornblum at (501) 424-5893.

CALIFORNIA: **Show**-California Carvers Guild's (Central Coast Chapter) 20th annual wood carving show, Sept. 14-15. Coast High School, Cambria. For info, call (805) 528-8107.

COLORADO: **Juried exhibition**-12th annual Woodworkers Guild of Colorado Springs exhibition, Oct. 19 thru Nov. 30. Colorado Springs Pioneers Museum. For more information, call (719) 633-5015.

FLORIDA: **Meetings**-South Florida Woodworking Guild meets every second Monday at 7 p.m. Constantine, 1040 East Oakland Park Blvd., Ft. Lauderdale. For further information, contact Woody McLane at (305) 565-2729.
Meetings-Central Florida Woodworkers Guild meets the second Thursday of each month. Woodcraft Supply, 246 E. Semoran Blvd., Casselberry. For more info, contact Bob Elliott (407) 695-8960.
Meetings-Tallahassee Woodcrafters Society meets the second Tuesday of each month. Contact Walt Behrle at (904) 668-6653 or Austin Tatum at (904) 386-6876.
Meetings-St. Petersburg Woodcrafters Guild meets the fourth Thursday of every month at 7 p.m. Montgomery Electric and A/C, 1200 19th St. N., St. Petersburg, 33713. Contact Don Montgomery at (813) 898-0569.
Call for entries-12th annual Fine Furniture show, sponsored by Woodcrafters Club of Tampa. Feb. 6-17. Florida Expo Park, Tampa. Deadline: mid-January (Florida residents only). For info, call Lois Dinsmore at (813) 962-8333.

GEORGIA: **Meetings**-Woodworkers Guild of Georgia meets the second Monday of every month. Southern College of Technology, 1100 S. Marietta Parkway, Marietta. For more information, call (404) 299-3972.

HAWAII: **Exhibition**-Woods of Hawaii '96, Sept. 7-15. Aloha Tower Marketplace, Pier 10, Honolulu. For more information, call Linda Butts at (808) 239-5563.

ILLINOIS: **Classes**-Ongoing woodworking classes, all levels. Elston Woodworking School, 2228 N. Elston Ave., Chicago, 60614. (312)342-9811.

KENTUCKY: **Meetings**-Kyana Woodcrafters meets the first Thursday of each month. Bethel United Church of Christ, 4004 Shelbyville Road, Louisville, 40207. (502) 426-2991.

MAINE: **Meetings**-Guild of Maine Woodworkers meets the first Wednesday of every month. Call (800) 805-5100.

MARYLAND: **Classes**-Woodworking classes, May thru December. Glen Echo National Park, 7300 MacArthur Blvd., Glen Echo, 20812. (301) 492-6266.

MASSACHUSETTS: **Classes**-Woodworking classes, most of the year. Contact Boston Center for Adult Education, 5 Commonwealth Ave., Boston, 02116. (617) 267-4430.
Workshops-Joinery, cabinetmaking, more. Hancock Shaker Village, Box 927, Route 20, Pittsfield, 01202. (413) 447-9357.
Classes-Year-round intensives in woodworking and wood carving. Horizons New England Craft Program, 108 N. Main St., Sunderland, 01375. (413) 665-0300.
Juried exhibition-Woodworking, furniture, more. Sponsored by the Society of the Preservation of New England Antiquities, Sept. 18. Codman House, Lincoln. For more information, call Janet at (617) 259-8843.

MICHIGAN: **Meetings**-Metro Carvers of Michigan meets second Tuesday of each month (except July and August) at 7:30 p.m. Helen Keller High School, 1505 N. Campbell Road, Royal Oak. (810) 771-1040.
Demonstrations-Sixth annual Wood Expo, Sept. 6-7. Carving, lathe turning, more. Johnson's Workbench, 563 N. Cochran Ave., Charlotte, 48813. (517) 543-1660.

MINNESOTA: **Meetings**-Minnesota Woodworkers Guild meets the third Tuesday of each month at 7:15 p.m. Demonstrations presented each month. Contact Richard Gotz at (612) 544-7278.
Call for entries-The Minnesota Woodworkers Guild's Northern Woods Exhibition, Oct. 17-20. Southdale Center, Edina. Deadline: Sept. 16. For application, write Northern Woods Exhibition, c/o 4th Street Guild, 2625 4th St. S.E., Minneapolis, 55414. (612) 378-2605.
Show-Twin Cities Woodworking Show, Oct. 4-6. Minnesota State Fairgrounds, Education Building, Snelling & Commonwealth Avenues, St. Paul, 55108. (310) 477-8521.
Class-Kiln drying, Sept. 16-19. University of Minnesota, St. Paul. For more information, call Harlan Petersen, Department of Forest Products, at (612) 624-3407.
Show-Seven Corners Hardware woodworking show, Sept. 25-28. 216 West 7th St., St. Paul. (800) 328-0457.

MISSOURI: **Class**-Fundamentals of woodworking with Ron Diefenbacher, Sept. 10, for 15 weeks. Washington University Fine Arts Institute, St. Louis. (314) 935-4643.
Symposium-Joy of Turning, Sept. 14-15. St. Louis. Contact Ken Schaefer, Woodturners of St. Louis, at (314) 966-2268.

NEBRASKA: **Meetings**-Omaha Woodworkers Guild meets at 7 p.m. the third Tuesday of every month. Westside Community Center, Omaha. For more info, contact John Cahill at (402) 334-5550.

NEW HAMPSHIRE: **Classes**-Various woodworking classes. The Hand & I, P.O. Box 264, Route 25, Moultonboro, 03254. (603) 476-5121.
Auctions-Antique and craftsman's tool auctions, year-round. Contact Richard A. Crane, Your Country Auctioneer, 63 Poor Farm Road, Hillsboro, 03244. (603) 478-5723.
Show-New England Woodworking Show, Sept. 13-15. National Guard Armory, 771 Canal St., Manchester, 03101. For more information, call (310)477-8521.
Classes-Guild of New Hampshire Woodworkers, meeting and demonstrations on finishes, Sept. 21. Keene State College Woodworking Shop, Butterfield Hall, Main St., Keene, 03431. Contact Steve Bussell (508) 392-5405.

NEW YORK: **Meetings and classes**-New York Woodturners Association meets bi-monthly. YWCA, 610 Lexington Ave. (53rd St.), New York City. Contact Howard Alalouf (914) 337-0226.
Classes-Traditional and contemporary woodworking with Maurice Fraser, Bill Gundling, Jack Van Deckter and Susan Perry. The Craft Students League at the YWCA, 610 Lexington Ave., New York City. (212) 735-9731.
Meetings-Long Island Woodworker's Club meets the first Wednesday of every month, September thru June. Brush Barn, 211 Jericho Turnpike, Smithtown. (516) 360-1216.
Show-Second Handmade home show, Nov. 15-19. Lexington Avenue Armory at 26th St. For more information, contact Richard Rothbard at (800) 834-9437.
Show-Metro-New York woodworking show, Sept. 20-22. Westchester County Center, Main Hall, Bronx River Parkway & Central Avenue, White Plains, 10606. (310) 477-8521.

NORTH CAROLINA: **Meetings**-North Carolina Woodturners meets the second Saturday of each month. For more information, contact the North Carolina Woodturners, P.O. Box 1833, Hickory, 28603. (704) 324-5960.
Classes-Carving, whittling, bent willow furniture, thru December. Southern Highland Craft Guild's Folk Art Center, Milepost 382 of the Blue Ridge Parkway, East Asheville, 28815. (704) 298-7928.
Classes-Carving plane making, lapstrake boatbuilding and more, thru December. North Carolina Maritime Museum, 315 Front St., Beaufort, 98516. (919) 728-7317.
Call for entries: Gallery Americas Southern Furniture exhibition. Deadline: Jan 1. Open to artists from southern states. Send an SASE to George Melone, Gallery Americas, Historic Carr Mill, Carrboro, 27510. (919) 929-1002.

OHIO: **Meetings**-Cincinnati Woodworking Club meets from 9:00 to noon on the second Saturday of January, March, May, September and November. Reading High School, 801 E. Columbia Ave., Reading. Contact Cincinnati Woodworking Club, 5974 Gaines Road, Cincinnati, 45247.
Meetings-Woodworkers of Central Ohio meets on the second Saturday of November, February, April and June. For more information, call Chuck at (614) 457-3704.
Show-Greater Cleveland woodworking show, Sept. 27-29. Cuyahoga County Fairgrounds, Building 23, 164 Eastland Road, Berea, 44017. For more info, call (310) 477-8521.
Workshop-Bowling Green State University's spray finishing technology workshop, Oct. 23-25. ITW De Vilbiss Training Center in Maumee (Toledo). For more info, contact Dr. Richard A. Druppa at (419) 372-7560.

OREGON: **Meetings**-Cascade Woodturner's Association meets every third Thursday. For more information, contact Cascade Woodturners, 11575 S.W. Pacific Highway, #104, Tigard, 97223. (360) 887-3903.

PENNSYLVANIA: **Workshops**-Woodcarving instruction, thru October. Contact Sawmill Center for the Arts, P.O. Box 180, Cooksburg, 16217. (814) 677-3707.
Call for entries: Best essay on how to build an Albany Sleigh, cash prize of $400. Deadline: Nov. 1. For more information, contact Carriage Museum of America, P.O. Box 417, Bird-In-Hand, 17505. (717) 656-7019.

RHODE ISLAND: **Exhibition**-Contemporary studio furniture by Rhode Island School of Design graduates and instructors, thru Nov. 10. 175 Newbury St. (between Dartmouth & Exeter), Boston, 02116. (617) 266-1810.

TENNESSEE: **Workshops**-Turning, carving and more, year-round. For more information, contact Arrowmont School of Arts and Crafts, P.O. Box 567, 556 Parkway, Gatlinburg, 37738-0567. (615) 436-4101.
Classes-Lumber selection and more. For more information, contact Tennessee Valley Authority, 17 Ridgeway Road, Box 920, Norris 37828-0920. (615) 632-1656.

TEXAS: **Meetings**-Woodturners of North Texas meets the last Thursday of every month, 7:30-10:00 p.m. Paxton Beautiful Woods Store, 1601 W. Berry St., Fort Worth, 76110. (817) 927-0611.
Meetings-North Texas Woodworker's Association meets the third Tuesday of each month. For info. contact Bruce May, P.O. Box 831567, Richardson, 75083. (214) 271-0125.
Show-Texas Mesquite Association annual meeting and woodworking show, Oct. 11-13. Market Square, Fredericksburg. For more information, call (210) 997-8515.
Show-Rio Grande Valley woodcarvers show, Jan. 17-18. McAllen Civic Center, McAllen. For more information, contact Dorothy Chapapas, Rural Route 2, Box 150, McAllen, 78504. (210) 581-2448.

VERMONT: **Exhibition**-In The Tradition: contemporary Vermont furniture inspired by history, thru Oct. 31. Bennington Museum, Bennington.

WASHINGTON: **Juried show**-The Kitsap County Woodcarvers 11th annual show and sale, March 15-16. Westside Improvement Club, Bremerton. For more information, call (360) 373-6173.

WISCONSIN: **Show**-Green Bay Woodworking Expo, Sept. 13-14. Brown County Expo Centre, 1901 S. Oneida St., Green Bay. Contact Tom Sargeant (309) 693-9667.

CANADA: **Association**-Canadian Woodturners Association, Markham, Ont. For more information and to receive newsletter, call (905) 479-0755.
Meetings-West Island Woodturners Club (Montreal) meets every Tuesday, thru May. For more information, contact Dennis Brown, 8817 Cure Legault, Lasalle, Que., H8R 2V9. (514) 366-6071.
Association-Superior Woodworking Association meets 7:00 p.m. the last Monday of each month. Confederation College, Ont. Contact Vic Germaniuk at (807) 767-5964.
Show-British Columbia Woodworking show and sale, Oct. 25-27. Cloverdale Fairgrounds, 176 St. and 62 Ave., Surrey. For more information, call (519) 351-8344.

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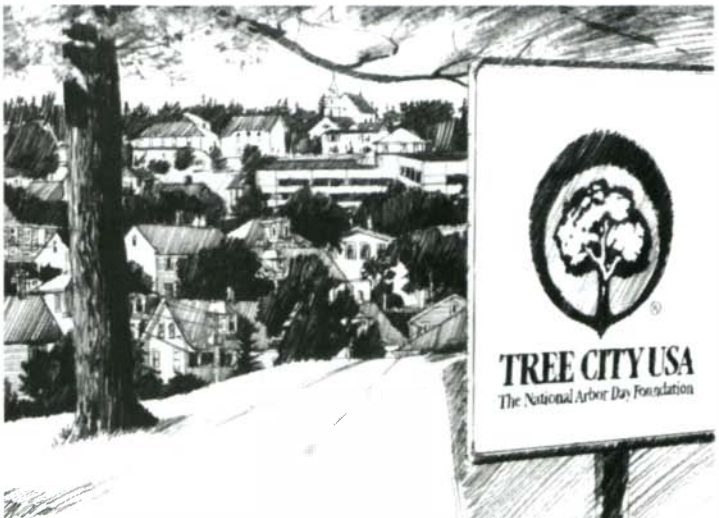

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READER SERVICE NO. 162

Mathematical puzzles

I had my tonsils out the week my ninth-grade math class graphed algebraic equations, and ever since, I've been behind in math. But if I had been able to get my hands on some of Wayne Daniel's puzzles, I might have grown up to build satellites rather than cabinets.

Daniel builds wooden puzzles that are three-dimensional representations of mathematical equations (see the photos at right and below). He began building the puzzles full-time 10 years ago when he retired from his job as a research physicist. Each puzzle is made of dozens of pieces pinned together with dowels.

To make his design work easier, Daniel wrote a computer program. He gives the computer an equation and the number of pieces he wants the puzzle to have, and it prints out almost everything he needs to build a complex three-dimensional puzzle. The printout includes a cut list.

The computer randomly locates dowel pins of various diameters, so each piece will be unique. It also gives a drill list and offsets for the location and diameter of every hole. After the holes are drilled in each piece, Daniel assembles the puzzle and shapes the curves with a bandsaw and a battery of sanders.

Daniel has made dozens of formulae into puzzles. If you know what the formula is supposed to look like, the puzzles go together fairly quickly. It takes non-mathematicians like me about three hours.

—Aimé Fraser, assistant editor

Photos: Wayne Daniel

The jig used to build this cocobolo Möbius puzzle *is as complicated as the mathematics that define its shape. Each piece of the puzzle has a different compound angle.*

Damped sine. *This ash and cherry puzzle by Wayne Daniel graphs the equation* $z = [a-b(x+y)]\sin[4\pi(x+y)] - b(x+y) + c$.

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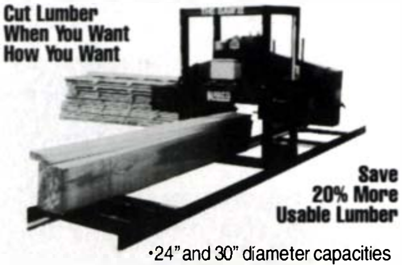

Spiraling ribbons

Twenty inches high, this spiral is so delicate it weighs only 4.1 oz. John McAbery carves the ribbons from solid blocks of mountain laurel without using electricity. He uses a driftwood stump for a vise bench and keyhole saws, carving knives, rasps, sandpaper and beach stones to shape and smooth his sculptures.

John McAbery lives and works in a precisely hand-crafted driftwood cabin on a northern California beach. His shop is a small front porch, and his bench is a driftwood stump with a vise attached (see the photo at right). In this remote and rustic setting, he carves solid blocks of mountain laurel into spiraling ribbons.

His carvings often start as doodles on paper. McAbery may play with an idea for days, using ribbon as a visual aid, to arrive at a three-dimensional form. Then the design is transferred to a solid block of California mountain laurel.

Initially, McAbery roughs out a ribbon with keyhole saws to about $1\frac{1}{4}$ in. by $1\frac{1}{4}$ in. Then he defines the twists and curves, thinning the ribbon down to about $\frac{5}{16}$ in. by $1\frac{1}{8}$ in. He continues removing material and smoothing the curves with a carving knife, rasps and sandpaper. The final dimensions of the ribbon are about $\frac{1}{8}$ in. by 1 in.

His partner, Gretchen Bunker, sands the pieces to 600-grit. After that, she burnishes them with a polished beach stone and gives each a light coat of bay oil. Typically, a ribbon takes about 150 hours to complete.

—Craig Carter, Petrolia, Calif.

Musical chair

After years of working as a musician, I found the lure of building furniture so strong I sold my musical equipment to buy woodworking machinery. But I couldn't part with the last symbol of my first love, a wooden bass guitar. It languished in a closet for a few years until I brought it into my present life by making it into a chair.

My chair (see the photo above) was featured last year in "Sound Furniture" at The Gallery of Functional Art in Los Angeles. The exhibit opened with a concert of original music performed with this chair and other playable furniture.

—Gregory J. Beeckman, Los Angeles, Calif.

Notes and Comment

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

Photos at left: Gretchen M. Bunker; photo at right: Peter Saxby

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Rare Renaissance Intarsia

This intarsia-paneled room was created between 1478 and 1483 for the Gubbio, Italy, palace of Duke Federico da Montefeltro. After an eight-year restoration, the room was opened in May as a permanent display at the Metropolitan Museum of Art in New York City. The Gubbio Room is one of only two such “intarsia studiolos” to exist and the only one of its kind in the United States. Amazing illusions of depth and space were created by artists who carved out the background wood and glued in inlay pieces of more than a dozen species of wood, including walnut, oak, beech and rosewood. Antoinie Wilmering (left), the museum’s chief conservator, led a talented team of specialists in the restoration.

Photos: courtesy of Metropolitan Museum of Art