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June 2000 #115

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Popular Woodworking®

June 2000, Vol. 20, No. 3

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Out on a Limb

R. J. DeCristoforo

Taught millions of woodworkers through books, magazines.

It is with deep regret that I report to you the passing of one of woodworking's titans and one of our most highly regarded contributing editors, R. J. DeCristoforo.

R.J. DeCristoforo: 1926-2000

What you may not realize about Cris is that he was your champion. His writings spanned the entire second half of the last century and earned him the well-deserved title, "Dean of Home Workshop Writers." Above all else Cris wrote for the hobbyist, the "Joe woodworker" who puzzles out a project in his garage or basement.

His place in the pantheon of woodworking greats was earned by his genius for explaining complex processes in clear and simple prose. As such, he was arguably woodworking's greatest educator. And educate he did, publishing thousands of magazine articles and more than 40 books.

His magazine career began as a contributor to *Popular Science* in the post-World War II years. In 1951 he moved from New York to California to prepare a book for Magna Engineering, the parent company of the venerable Shopsmith multi-purpose woodworking machine. That book, "Power Tool Woodworking for Everyone," was the "how to" bible for the Shopsmith machine. The book continues today as the holy grail for Shopsmith owners. This work laid the foundation for what became his tour de force, "DeCristoforo's Complete Book of Power Tools, Both Stationary and Portable." It is encyclopedic in its presentation of power tool use.

For example, his discussion of the radial arm saw spans an amazing 99 pages and shows more than 60 different operations, ranging from simple cross cutting to "carving" bowls, "turning" tapered legs, cutting perfect circles, even edge boring. It was not uncommon for manufacturers to comment that Cris found new ways of using their machines that dazzled even them.

DeCristoforo's first column appeared in *Popular Woodworking* late in his career (1994) under the title "Cris Cuts." He also wrote columns for us on tools and jigs under the heading, "Tool Talk." That first column shared his "system" for approaching any project. "One," he stated, "don't accept the dimensions on the materials list or a drawing, yours or another's, as bible. Two, most projects have a main component that should . . . be the basis for accurately determining, or checking, the sizes of other parts before sawing. Three, design always follows function."

That's the sort of practical advice you'd get from Cris. The quality, quantity and genius of his work earned his installation in *Wood* magazine's Woodworking Hall of Fame, one of only 16 to thus far be named. Some of the company he keeps in the "Hall" is impressive: Sam Maloof, Norm Abram, Gustav Stickley, Wharton Esherick and George Nakashima, to name a few. But keeping company with luminaries was not DeCristoforo's style. He much preferred the solitude of his home, the company of his loving wife, Mary, his three sons and his workshop, where he continued to produce books and articles for *Popular Woodworking* until his death. His final column appeared in our last issue. Fittingly, it had Cris reflecting on the tools that had changed woodworking over the course of his incredible career.

His wisdom and his friendship are sorely missed. **PW**

Steve Shanesy

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Safety Note

Safety is your responsibility.
Manufacturers place safety devices on their equipment for a reason. In many photos you see in *Popular Woodworking*, these have been removed to provide clarity. In some cases we'll use an awkward body position so you can better see what's being demonstrated. Don't copy us. Think about each procedure you're going to perform beforehand. **Safety First!**

LETTERS

Yet one more solution to rusty cast iron tools

Remove Your Rust With a Quick Trip to a Sporting Goods Store

In the February 2000 issue (#113) there were several letters about how to remove rust from cast iron table saws, jointers etc.

I have dealt with this problem before, and came up with what I think is the ultimate solution: gun blue!

What I have done in the past is first sand the surface with very fine sandpaper (220 to 300 grit) until the surface is shiny and free of rust. Then I use any brand of gun blue paste or liquid on the surface of the jointer. Use a synthetic Scotch-Brite pad between coats and apply two or three coats of gun blue until you have a deep blue or black color. Then wipe the entire surface with a damp cloth until it does not pick up any of the blue.

Lubricate the surface with a light coat of WD-40 or some other light machine oil. My tops stay slick and smooth and rust free. My jointer has been in an unheated garage now for 10 years since my last application, and the last time I inspected the surface it was still rust free. All I do now is from time to time hit it with WD-40 and wipe it with a dry cotton cloth.

I have treated my jointer twice in the 20 odd years that I have owned it.

David M. Pflumm
Burlington, North Carolina

Reader Has Two Good Sources for Parts for Hand Planes

In regards to the letter from Paul V. Mayer concerning his search for replacement parts for his hand planes (February 2000 #113), parts are available from two sources: William Alden Co. (800-249-8665) and Evans Precision, which reconditions hand planes, 2859 Central Ave., Evanston, IL, 60201, 847-864-6634.

I too am the proud owner of my great-grandad's Bedrock 608 24" jointer plane, which is dated April 2, 1895, and my grandad's 14" No. 5 corrugated base jack plane, which is dated April 19, 1910.

Robert Reemsnyder
Fayetteville, Tennessee

Where Can I Find Catalogs of Limbert Arts & Crafts Furniture?

We have enjoyed your magazine and loved the wastebasket you highlighted from the Charles P. Limbert catalog Booklet #112 item #255. Is there a way we can get these old booklets? We would love to look through them for ideas.

Sharon Fikes
Weatherford, Texas

I built that project after seeing it in an excellent reprint of the book "Limbert's Arts and Crafts Furniture," which is published by Turn of the Century Editions. You can order it directly from the publisher for $20 plus $3 shipping. For information, go to the company's website at http://www.taconic.net/totc/ or contact the company at Turn of the Century Editions, P.O.Box 908, Philmont, N.Y.,12565, phone/fax 518-672-4639.

— Christopher Schwarz, senior editor

Bag Filters Seem Hard to Find for the Shop-Built Air Cleaner

After reading the February 2000 article about the "Shop-Built Air Cleaner," within a week I had a squirrel cage fan for free. The HVAC guy even wired it up before I got there, and he ran it for a couple hours

Continued on page 10

WE WANT TO HEAR FROM YOU

***Popular Woodworking* welcomes letters from readers with questions or comments about the magazine or woodworking in general. We try to respond to all correspondence. Published letters may be edited for length or style. All letters become the property of *Popular Woodworking*.**

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Continued from page 8

to make sure it was OK. So now I figured I had the hard part done and was off to start building the housing.

First I needed to get the filters so I would know how big to make the case. The only bag filter I found was a replacement for Home Depot's Ridgid air cleaner, and it was a non-standard size. So I searched the Internet and didn't have a whole lot of luck there. So I was wondering where the author, Michel Theriault, found the bag filter he used in his?

Bob Bibbings
Kingston, Georgia

The best source for bag filters is a commercial HVAC contractor. I got mine through a Honeywell service provider (and they simply purchased it through a wholesaler). Penn State Industries also sells 12" x 24" bag filters. 800-377-7297.

— Michel Theriault

Couldn't You Use Antifreeze to Slow Water-Based Stains?

A comment about "Why Water-Based Finishes Aren't Catching On" in the January 2000 issue (#112). Bob Flexner discusses adding a manufacturer's solvent, "propylene glycol," to water-based stain to keep it from drying too fast.

I was wondering why you couldn't use antifreeze? It's mainly "propylene glycol."

Austin Graton
Plymouth, New Hampshire

You could probably use antifreeze. But it is usually ethylene glycol, which is much more toxic, and it has a dye in it that will affect the color of the stain. I think manufacturers should supply us with the solutions to the problems we have using their products. They should supply us with propylene glycol that works with their stain. But try a little antifreeze with your stain and see if it helps.

— Bob Flexner, contributing editor

Error in the Air Cleaner Article

Your article "Shop-Built Air Cleaner" came just in time for my needs. It helps, not only in showing "how to," but distinguishes differences between a dust collector and an air cleaner. Many with dust collectors wonder why their system still leaves the shop filthy with dust, without realizing the dif-

ferent micron sizes involved. Sawdust looks bad in a shop, but fine airborne dust is more dangerous to the lungs.

One point, if I may: the section on fan speed is erroneous on two counts. You state, "Static pressure varies as a square of the fan speed. If the speed is halved, static pressure capability is reduced by ¼."

I think you meant *to* ¼. If the fan speed were 4 rpm, the square would be 16. If the speed is halved it would be 2 rpm and the square is 4. If we follow your logic, reducing the static pressure "by" ¼, you would have: 16 minus [¼ x 16]=12. This is incorrect. It should be 16 x ¼=4.

You make the same error in the next paragraph, discussing power required varying as the cube of the fan speed, using the word "by" when it should be "to."

Gil Weiss
Stamford, Connecticut

Don't Throw Away Those Tennis Shoes, Mount Them to the Wall

I was just reading my latest issue of *Popular Woodworking* and I saw a really neat recycling idea that perhaps your readers had not noticed.

On page 63 of the February 2000 issue you can see in the bottom right corner how an old running shoe is being used as a holster for a drill. This should be placed in your "Tricks of the Trade" column. This trick could reduce the number of shoes we woodworkers throw out by half. (OK, maybe not, but every bit helps.)

Kevin Stroet
Smithers, British Columbia

We published that trick in 1995 and in a collection of the best of the Tricks of the Trade in our 100th issue in 1998. People laugh when they see the shoes on the wall in our shop, but after the hysterics are over they realize it is a great idea. **PW**

Corrections and Clarifications

In the September 1999 issue (#110) there is one line that's off in "The Little Shop Mark II" article. On page 48 under "Drawers and Doors," the third sentence should read: "Use a ¼" x ½" rabbet cut on the drawer sides...."

Very Scary Sharp

A sheet of sandpaper, a slab of marble, a simple jig and wow!

Some years ago, Steve Lamantia of Seattle, Wash., posted a long, rambling letter to the Internet news group rec.woodworking (better known as "Wreck Wood") entitled "The D&S Scary Sharp™ System." Once you waded through Steve's superlatives, exclamations and his stream of consciousness, his message boiled down to just this: You can put a very fine cutting edge on hand tools with sandpaper. That's right — sandpaper. (To read Steve's original message, check out www.shavings.net/scary.htm#)

Other travelers through Wreck Wood spotted Steve's post, tried his methods and posted their own raves. The news spread, sandpaper stock soared, and the term "scary sharp" became part of the popular woodworking lexicon. All of which amused those who remember woodworking before there was so much virtual sawdust flying about.

About 40 years ago, I participated in a rite of manhood known as the Boy Scouts of America. There, in the old "Handbook for Boys," wedged between square knots and Morse code, is this advice: Sharpen your pocket knife with sandpaper.

Well, it was good advice then and better advice now. Continuing developments in abrasives make sandpaper an excellent sharpening material. In many ways, it's easier to use, less expensive to get started with and more versatile than traditional sharpening stones.

Sandpaper — It's Not Just for Sanding Anymore.

The most common abrasives in sandpaper are aluminum oxide and silicon carbide, both of which were originally intended to abrade steel. Their application to woodworking was an afterthought. Point of fact — these are the very same abrasives in India stones, grinding wheels, ceramic stones, even Japanese waterstones. Sandpaper is just another form of the abrasive you may already use for sharpening.

The difference is that sandpaper comes in a much wider range of grits than stones and grinding wheels. Grits between 50# and 2,000# are readily available, and if you look around you can find sandpaper as coarse as 36# and as fine as 12,000#. It's this range that gives sandpaper the edge (pun intended) over other sharpening materials. Traditional stones start between 100# and 200#. The finest Arkansas stone is roughly equivalent to 900#, the finest ceramic and diamond stones are about 1,200#, and the finest waterstone, 8,000# in the Japanese grit system, is close to 2,000# in our American system.

Why is range important? Because proper sharpening technique requires that you hone with progressively finer grits, much like sanding a wooden surface. You can't put a super-keen, scary sharp edge on a tool with just one stone. Start with coarse abrasives to quickly condition the edge and repair any nicks. This leaves deep scratches in the steel and makes the edge jagged. The chisel is sharper than it was, but not sharp enough. You must continue sharpening with progressively finer abrasives. As you work your way up through the grits, the scratches grow smaller and the edge becomes keener.

Sandpaper not only extends the range from coarse to fine, it gives you more steps in between. If you've ever tried to jump from 80# sandpaper to 150# when sanding wood, you know how long it can take to work out the scratches left by the coarser grit. It takes less time and you get better results if you work your way up in increments. So it is with sharpening.

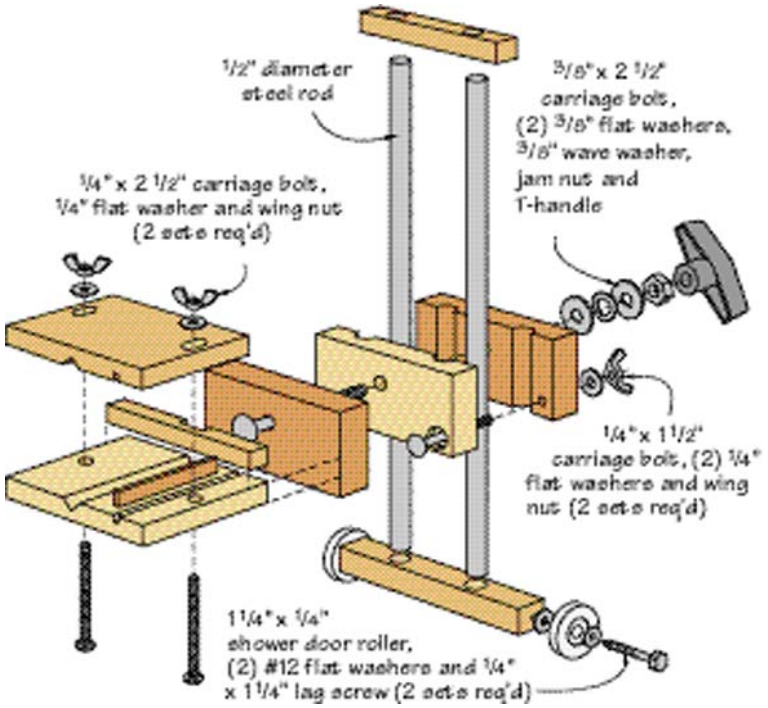
The Secret Formula

Stones have it all over sandpaper in one respect — they are rigid. To use sandpaper for sharpening, you must mount it to a flat, rigid surface. Steve and those who came after him recommended ¼"-thick plate glass, but this isn't rigid enough. It will flex slightly if your workbench isn't dead flat or there is a bit of sawdust under one corner.

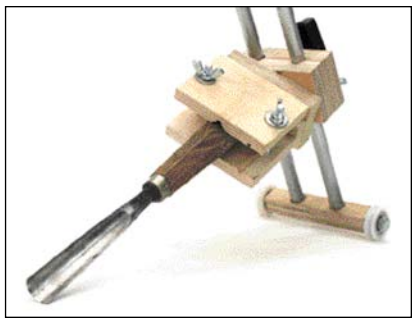
Instead, I use a marble slab to back up the sandpaper. (Talk about rigid!) You can purchase a precision-milled granite block known as a reference plate from a machinist's supplier, or you can take your straightedge to a cooking supply store and find a reasonably flat marble pastry stone (for rolling out pie dough) for a quarter of the cost. I have a 20"-square pastry stone that mounts eight different sandpaper grits — four on each side.

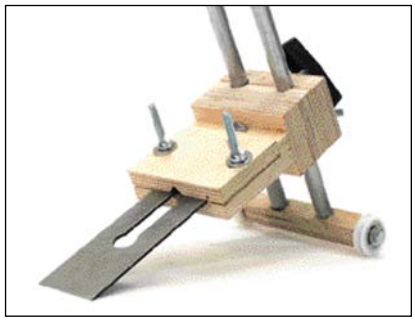
You can use ordinary sandpaper and stick it to the marble with a spray adhesive — this yields good results. However, I prefer self-adhesive 8"-diameter sanding discs. Because these are made for machine

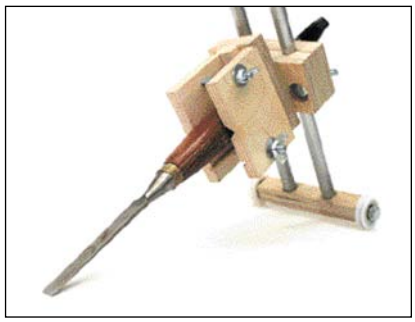
Nick Engler is the author of over 50 books on woodworking and normally prefers Flintstone bandages. As soon as his cuts heal, he'll be back at work building airplanes — very old airplanes. He has just finished a 1902 Wright glider and has begun a replica of the 1905 Wright Flyer 3. You can see his handiwork on the web at www.first-to-fly.com.

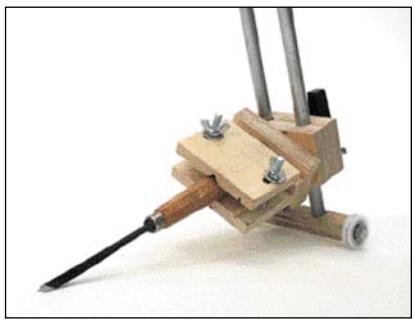


Illustrations by Mary Jane Favorite









In addition to chisels, the guide will accommodate gouges, plane irons, skews and parting tools.

sanding, they have an "open coat" — 40 percent less abrasive on the surface. They cut a little slower, but they last much longer. The open coat prevents the metal filings (the swarf) from becoming impacted between the grits and "loading" the paper. I also look for stearate-impregnated paper; this too reduces loading.

For most sharpening tasks, I work my way through four grits — 120#, 300#, 600# and 1,500#. I keep these all on one side of the pastry stone. On the other side, I have #50, 100#, 220# and 2,400#. The two coarse grits are to recondition badly damaged edges. The 220# provides an intermediate step between 120# and 300# when I'm flattening the backs of large chisels and plane irons. And the super-fine 2,400# is the last step when I'm flattening something.

As you sharpen, brush away the swarf frequently. I use the stiff bristles on the back of a file card. This keeps the abrasive clean and helps prevent loading.

The last step in my sharpening process is stropping. This is the secret ingredient in every successful sharpening formula, no matter what abrasive material you use. Stropping removes tiny burrs and refines the cutting edge, making it as keen as it can possibly get.

For this step, I've mounted a piece of leather to a hard maple board and "charged" it with chromium oxide, a polishing compound. (You might also use jeweler's rouge or tripoli.) Why not mount the leather to the pastry stone? Leather is considerably thicker than the sandpaper. Because of the type of honing guide I use to maintain the sharpening angle, it's important that the stropping surface be at the same level as the other abrasives. I've planed the wood to adjust for the thickness of the leather.

The Secret Weapon — The Very Scary Honing Guide

Yes, I use a honing guide. I know that some experienced sharpeners look down on these jigs as "training wheels," but I don't. If the first secret to successful sharpening is to hone with progressively finer grits, the second secret is to maintain a precise cutting angle as you do so. And you can be much more precise with a guide. After all, if our hands were all that good at maintaining an angle, we wouldn't need planes to hold plane irons.

One of the reasons some folks don't like honing guides is that the current commercial crop is difficult to adjust and not especially versatile. The homemade jig that I've developed holds a chisel by its handle rather than the blade. Because the jig makes a large triangle with the abrasive surface and the tool, it's easier to adjust and maintain the sharpening angle.

The tool holder conforms to every chisel handle that I've been able to find, and it's wide enough to accommodate an iron from a jointer plane. Additionally, the holder pivots, and it can be locked in place or adjusted to roll around an axis. This makes it possible to sharpen not only chis-

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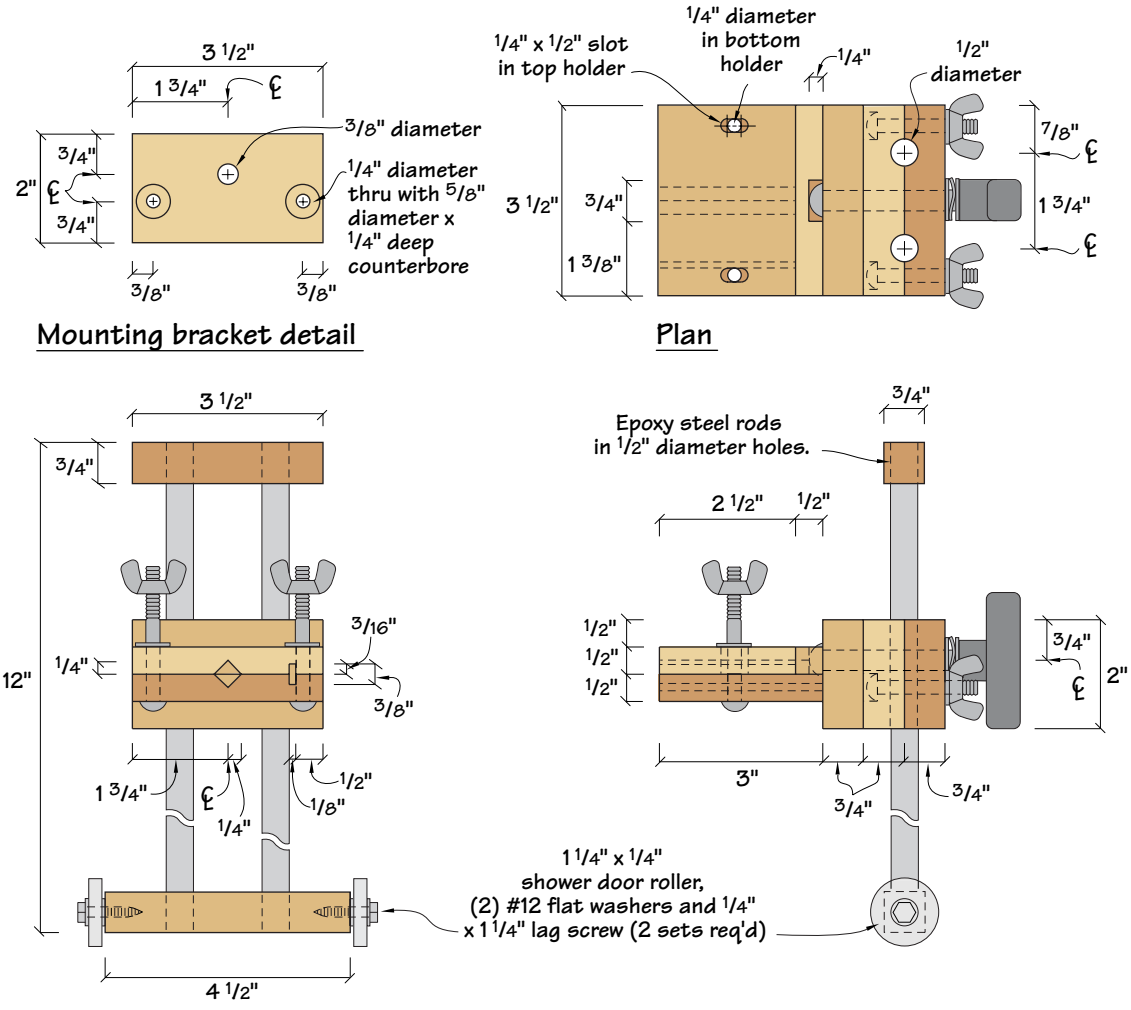
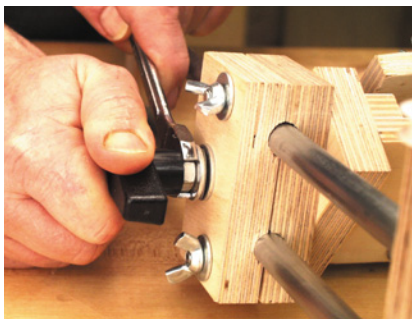


The basic Scary Sharp™ system consists of a selection of sandpapers and a rigid backing plate. I add a stiff brush and a honing guide.

After honing, strop your tools on a piece of leather charged with a super-fine abrasive polishing compound. If leather is hard to come by, a couple of pieces of typewriter paper adhered to a rigid surface work just as well.



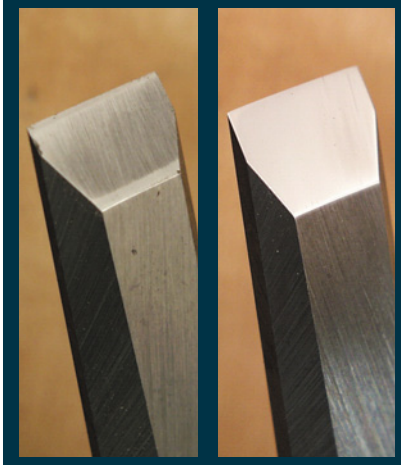
To adjust the holder to rotate, snug the jam nut against the washers, but don't collapse the wave washer. Hold the jam nut from turning with an open-end wrench and tighten the T-handle against it.

els and plane irons, but also gouges, skews and parting tools.

The tool holder mounts to two grooved brackets that slide along steel rods. To adjust the angle at which the guide holds the tool, slide the brackets up or down on the rods and tighten the wing nuts that lock them in place. To secure the holder, rotate it to the desired angle and tighten the T-handle. To adjust the holder so it will roll as you sharpen a gouge, insert a jam nut between the T-handle and the washers. Tighten the jam nut until it just begins to compress the wave washer. Hold the jam nut from turning and tighten the T-handle against it.

As shown, this honing guide will accommodate hand tools up to 18" long. For longer tools, extend the steel rods. **PW**

A Very Scary Shoot Out



On the right is the chisel I sharpened with sandpaper. Left, the one that Jim honed on his Arkansas set. Both cut the same, but I score points because mine's shiner, don't you think?

One of the most frequently asked questions about sandpaper sharpening is how it compares with traditional methods. To find out, *Pop Wood*'s Jim Stuard and I held a little contest. Jim's a whiz with Arkansas stones, and we pitted his method against mine

We each sharpened a ½" medium-quality chisel straight out of the box, then passed them around the shop for Steve, Chris and David to try. The winner? It was a dead heat. Both seemed to be equally sharp.

This was no surprise to Jim or me — we both finished up by stropping our chisels with a polishing compound. Presuming that our sharpening skills are relatively equal, the sharpness of each chisel is determined by the grit of the last abrasive used. We used different polishing compounds perhaps, but they were close enough in grit that the end results were indistinguishable. Had Jim stopped at black Arkansas (about 900#) and I at 1,500# sandpaper, my chisel should have been a little sharper.

The conclusion? Strop your cutting tools. No matter what sharpening material you use, stropping gives you the best possible edge.

Supplies

Adhesive-backed sandpaper
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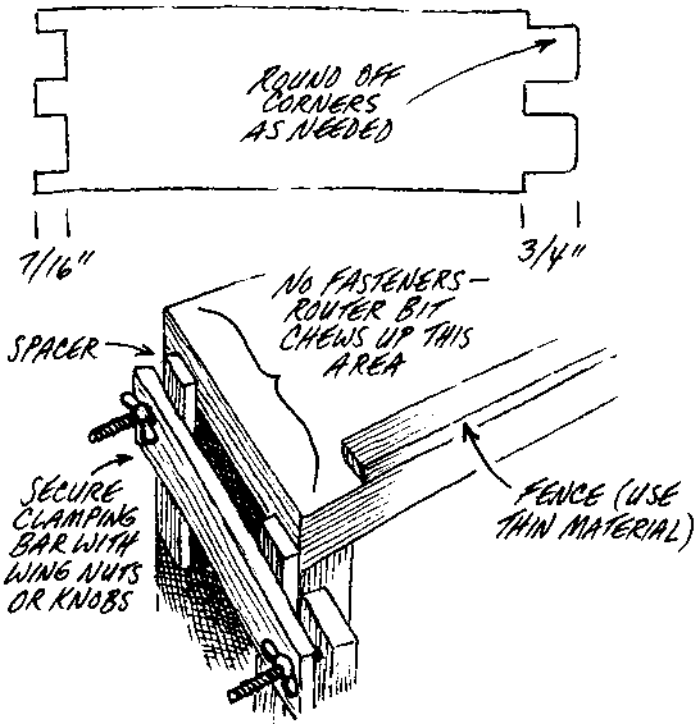
1217 W. Third St., Wilton, IA 52778
800-225-3006
www.micro-surface.com

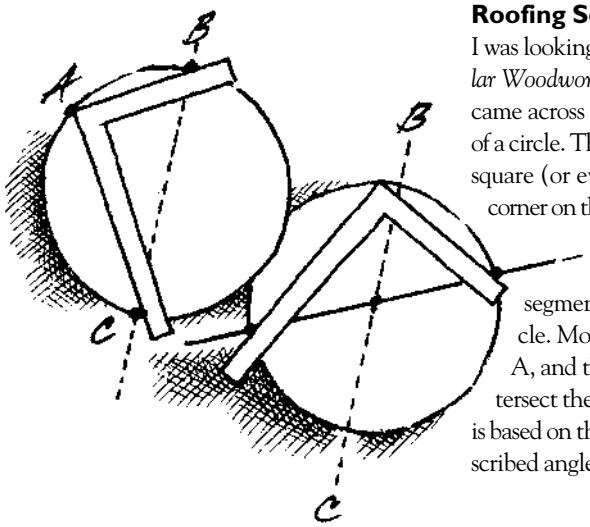
WINNER!

A Jig Worthy of Tails

Troy Sexton's $19.95 Dovetail Jig (September 1999) is a great idea, but I carried it a bit further. Rather than using a band saw to cut the tails, I made another router template on the other end of the template used for routing the pins. I used the pin template's teeth to lay out the tail notches a tiny bit wider than the teeth, then set up my saw to make the notches. The ends need to be rounded off, with the amount of radius determined by how far the router bit extends below the template. Cutting the tails requires a fixture to hold the drawer sides (inside face out) in a vertical position while you rout them. A fence made of material no thicker than the template makes it easy to align both the template (lying on top of the fixture) and the drawer side. It's easy to adjust the fit. First make a trial cut, then if they are too tight take a very light cut to widen the notches in the tail end of the template. If the drawer sides aren't flush with the ends, you can measure to see how far to move the template in or out to cut them so they will come out flush.

Gene Rhodes
Springfield, Illinois





Roofing Square Finds Your Center

I was looking through a friend's copy of *Popular Woodworking* from November 1998 and came across the article on finding the center of a circle. This way is simpler: Using a roofing square (or even a piece of paper), place the corner on the circle at any point, (call it point A). From this position, determine points B and C. The line segment BC is the diameter of the circle. Move the square and relocate point A, and the new line segment BC will intersect the old BC at the center point. This is based on the geometric principle that an inscribed angle equals one-half its arc.

John Dupasquier
West Linn, Oregon

'New' Math Slashes Fractions

I read "Splitting Odd Fractions" in the September 1999 edition, and I have a much simpler system to cut any fraction in half in your head. This revolutionary system eliminates fractions and has been used for a long time. It's called the "metric system." Everything is in decimals and can be added or subtracted in your head. To convert from millimeters (mm) to centimeters (cm), just move the decimal point one place. I've found the metric system superior to our English system, and I don't know why it is not accepted. All scientific and technical businesses use it, why do woodworkers hate the system?

H.R. Wheeler
Fallon, Nevada

Continued on page 21

BE AN INNOVATIVE THINKER AND WIN!

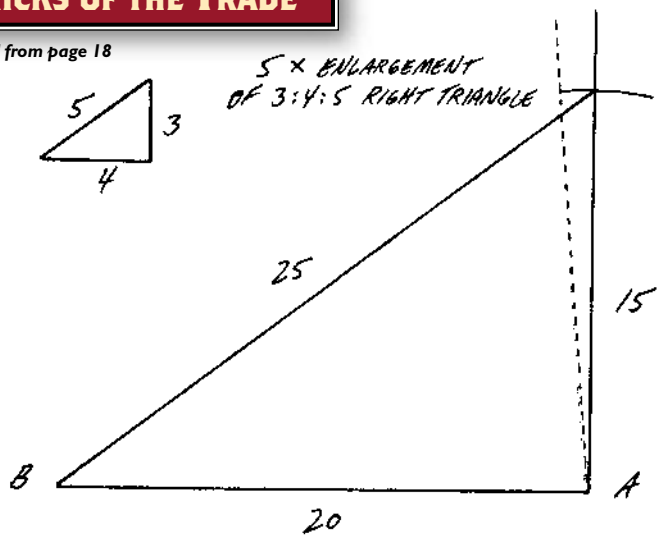
Turn your woodworking knowledge into a truly tricked-out tool from the Simpson Machine Tool Co. (www.smtco.com). Your best trick or shop tip can earn you a reproduction of the 19th Century Stanley Odd Job #1 — the original multi-tool — and a check for $50. The Odd Job is an inside miter and try square, mortise scribe, layout tool, depth gauge, beam compass and bubble level, with a 6" and 12" brass-lined maple rule. This re-creation of a classic tool is cast from solid manganese bronze and is machined to within .0015 tolerance. One winner will be chosen each issue; published runners-up receive $25.

To make things easier, you can e-mail your trick and daytime phone number to us at DavidT@FWPubs.com or mail it to: Tricks of the Trade • *Popular Woodworking* • 1507 Dana Ave. • Cincinnati, OH 45207. All entries become the property of *Popular Woodworking*.

Sponsored by SIMPSON MACHINE TOOL CO.

Illustrations: John McCormick

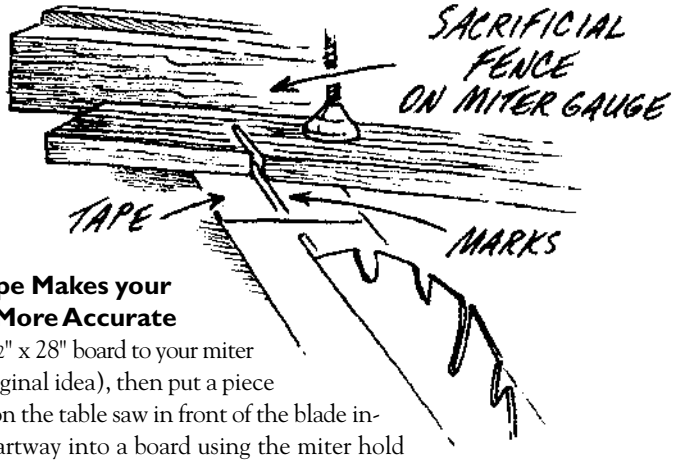
Continued from page 18



Choosing the 'Right' Triangle For the Job

For benchwork, we can mark things at 90 degrees with various squares, but if we get outdoors to lay out the foundations of a workshop, the base for a playhouse, or just a plot of land, squareness becomes a different problem. The corner of a 4 x 8 sheet of plywood is usually square and used to mark anything within its range, but many outdoor projects are bigger than that, and the best method to use to get a large square corner is the 3:4:5 technique. In a triangle with the sides in the proportion 3:4:5, the angle between the two short sides is 90 degrees. So, 1) Choose units in which one short side, usually the "3," is longer than the finished length you want. As an example, choose five feet. Stretch a baseline string 20 feet (four "units") between pegs or nails. 2) From the corner point of the triangle, stretch your tape measure 15 feet (three units). 3) From the other point measure 25 feet (five units) with another tape measure. 4) If you don't have two tape measures handy, a five unit (25') and a three unit (15') string starting from the A and B corners will meet on a direct line to the A corner point, which will be square to the baseline. You can then measure other positions from these square lines.

Percy W. Blandford
Stratford-on-Avon, England



A Piece of Tape Makes your Miter Gauge More Accurate

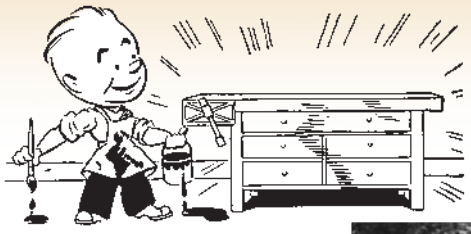
Attach a ¾" x 2½" x 28" board to your miter gauge (not an original idea), then put a piece of masking tape on the table saw in front of the blade insert. Then cut partway into a board using the miter hold down. Shut the saw off and slowly pull the board back until the board is half covering the tape. Mark a thin line on the tape to indicate both sides of the kerf. Now when you want to make an accurate cut, line up the mark on the workpiece with the mark on the tape. Change the tape when you change blades. **PW**

Bernard H. Derbyshire
Newtown, Connecticut

The Deltagram

A nostalgic look back at plans published by Delta Machinery shortly after World War II.

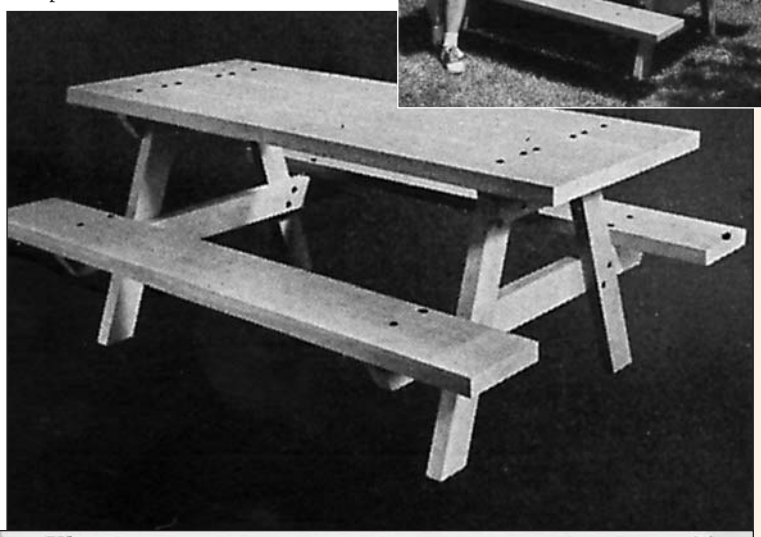
From Volume 16, Issue No. 6, 1946-47



Outdoor Picnic Bench

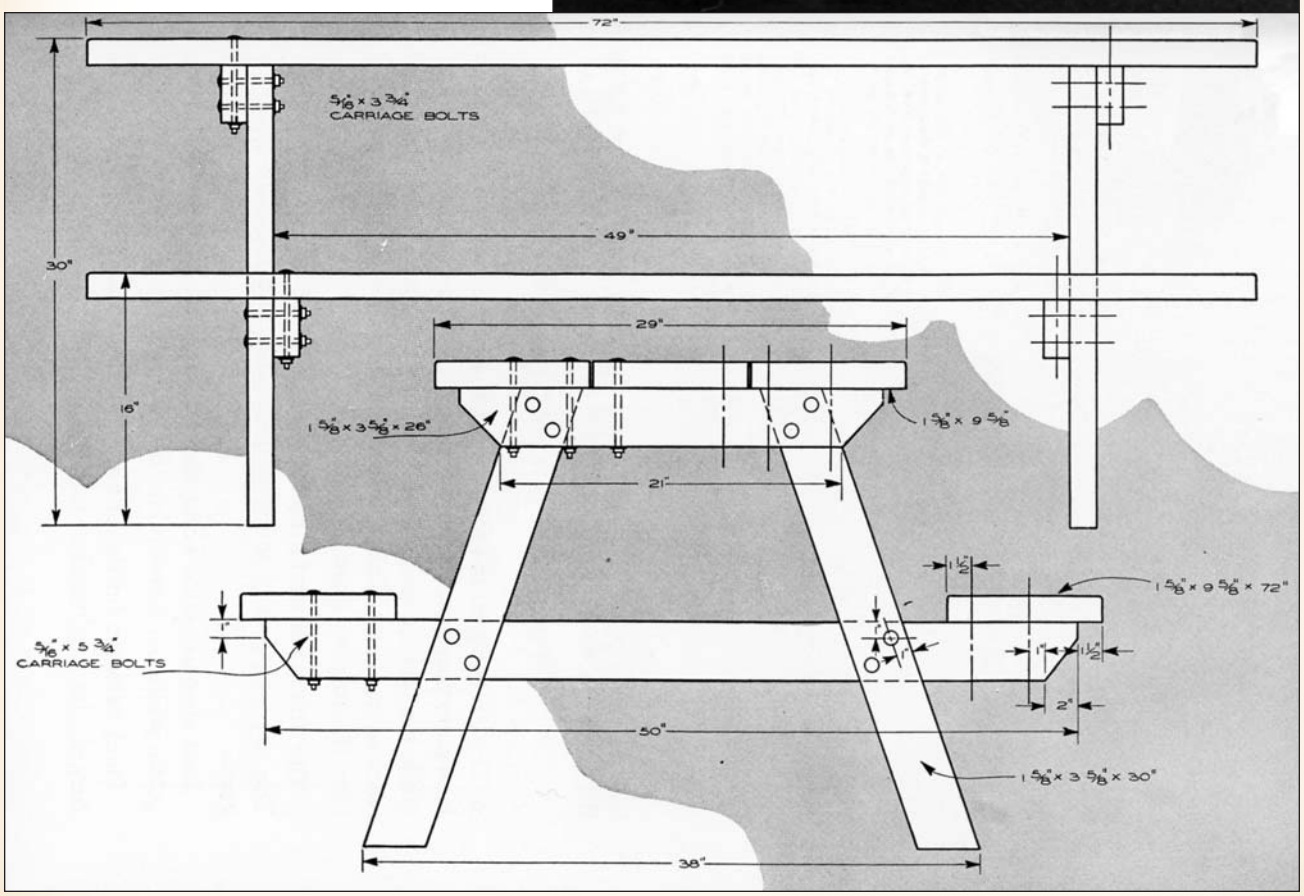
Always a useful project, this picnic bench has the added advantage of being built so you can take it apart for winter storage in the basement or garage. The circular saw or table saw with your miter gauge is the basic tool required. The jointer will come in handy for dressing the edges of the stock, and either a drill press or drill for the bolt holes.

Cut and fit together the cross members or horses first. Lay out the finished pieces and mark the holes for drilling. Assemble with carriage bolts as shown in the drawing. Place a flat washer under the nut on each bolt so that it does not cut into the wood.



Cut boards for the top and mark them for drilling. Cut the seat boards, mark and drill bolt holes. Assemble with carriage bolts, nuts and washers. Break all the sharp corners of the bench with a plane.

Benches of this type are usually left natural. Since this is an outside piece of furniture it should be preserved with several coats of boiled oil, brushed well into the wood. Allow 24 to 48 hours between coats. The bench may then be varnished, using a flat varnish if you desire. **PW**



Almost
every woodworker
has the skills to build the
most comfortable chair
in the house.

Morris CHAIR

I don't care what they say about dogs, Morris chairs are a man's best friend. The reclining back, wide arms and expansive seat create the perfect place to watch TV, read the Sunday paper or simply contemplate the finer qualities of a well-crafted beer.

For the last 10 years, I've spent every weekend planted in the original version of this chair, which was built by the Shop of the Crafters in Cincinnati, Ohio, during the heyday of the Arts & Crafts movement. The Shop of the Crafters was founded by German-American businessman Oscar Onken (1858-1948), who ran a successful framing company until he entered the furniture business in 1902, according to Kenneth R. Trapp's history of the company.

Unlike many furniture-makers of the day, Onken didn't want to merely copy the Stickleys of the world. Onken produced an unusual line of Arts & Crafts furniture that was influenced more by German and Hungarian designs than the straight-lined Stickley pieces of the day. In all honesty, a few of Onken's pieces were kind of ugly. Most, however, had a refinement and lightness that rivaled some of the best work of the day.

This Morris chair is an almost exact replica of the one produced by

by Christopher Schwarz

Photo by Al Parrish

Climb-Cutting Tenons

I own a commercial tenoning jig for my table saw, but I rarely use it. I get better and faster results by cutting tenons using a dado stack and a trick that Contributing Editor Troy Sexton showed me. To avoid tearout on my tenons' shoulders, I "climb cut" the last 1/8" or so of the tenon shoulder. You've probably heard of people climb cutting when using a router. Essentially, it's moving the router in the opposite way you normally would to avoid tearout in tricky grain.

That's exactly what you do on your table saw. The final cut on your shoulders is made by pulling the work toward you over the blade and only taking a small cut of material. It sounds awkward, but after a few tenons you get used to it. The risk of kickback is minimal because there's no wood trapped between the blade and the fence. To do this safely, hold your work steady and don't get into a hurry.

Here's how you do it: First install a dado stack into your table saw and set the fence for the finished length of your tenon (almost all of the tenons in this project are 3/4" long). Set the height of your dado stack to the amount you want to thin one side of your tenon (for most of the tenons in this project, that would be 3/16"). Then, using your miter gauge, push the work through the dado stack to cut the majority of your tenon.

When this cut is done, slide the work against the fence and pull the miter gauge back toward you to shave the shoulder of the tenon. Flip the work over and do the other side. Then do the edges.

Set your fence so the dado stack will make a 3/4" cut (the length of your tenon). Hold the piece about 1/8" from the fence. Push your work through the blade using your miter gauge.

After you finish that first pass, slide the work against the fence and pull it back toward you over the blade to shave the last little bit of the shoulder.

Repeat the same procedure for the edges of the tenon. (If you like a little more shoulder on your edges, increase the height of the blade.) First push the work forward.

Then slide it against the fence and pull it back toward you to make the final shoulder cut.

Make the mortises in the legs before you shape the curve near the bottom or make cutouts on the top.

Onken and his company. It differs in only two ways. One, the original chair was constructed using dowels at the major joints. After almost 100 years of use, the front and back rail came loose. This chair is built using pegged mortise-and-tenon joints. Second, I made one change to the chair frame so that furniture historians of the future will know instantly that this not an original piece. I did this to prevent people from passing off these reproductions as originals.

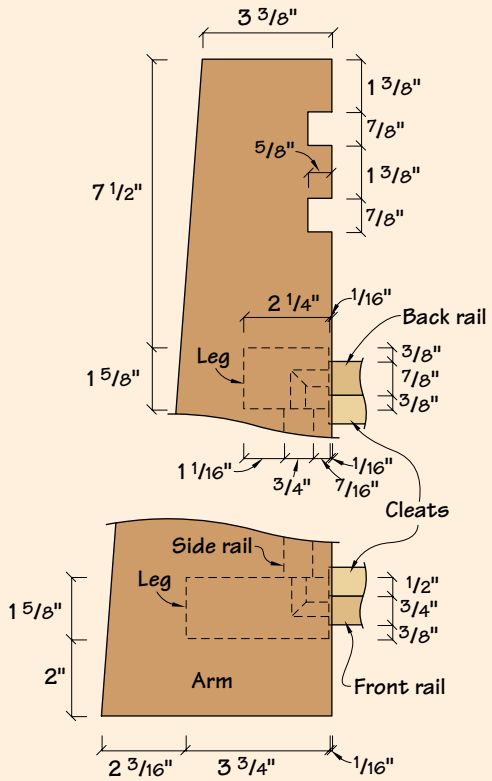
Though this project might look daunting to you, it can be completed by beginners who have just a few projects under their belt. There are only a few principles to learn here: mortising, tenoning and routing with a plywood template. Plus, I'll share with you exactly how I achieved this finish, which has been something we've been working at for several years.

How to Save Money on Lumber

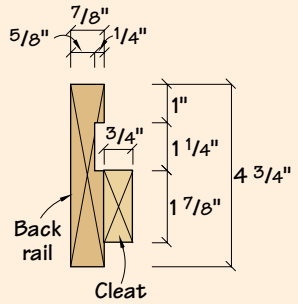
Begin by choosing the right quartersawn white oak for this project. It requires about 10 board feet of 8/4 and 30 board feet of 4/4 lumber. Quartered white oak can be expensive, from $6 to $12 a board foot. If you live in the Midwest, or will pass near east-central Indiana on your vacation, I recommend you check out Frank Miller Lumber Co. in Union City, Ind. (765-964-7705). The company is a huge supplier of quartersawn oak. As a result, prices are reasonable, about $4 to $6 a board foot. Once you buy your lumber, save the pieces with the most ray flake for the arms, legs, front and sides. To save money, use flat-sawn oak for the seat and the adjustable back.

Mortises: Machine or No Machine?

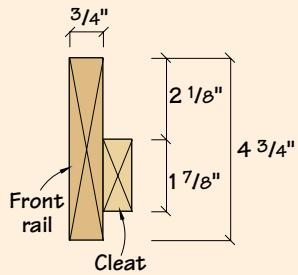
First cut all your pieces to size according to the Schedule of Materials and begin lay-



Rail Locations



Cleat Location, Back Rail



Cleat Location, Front Rail

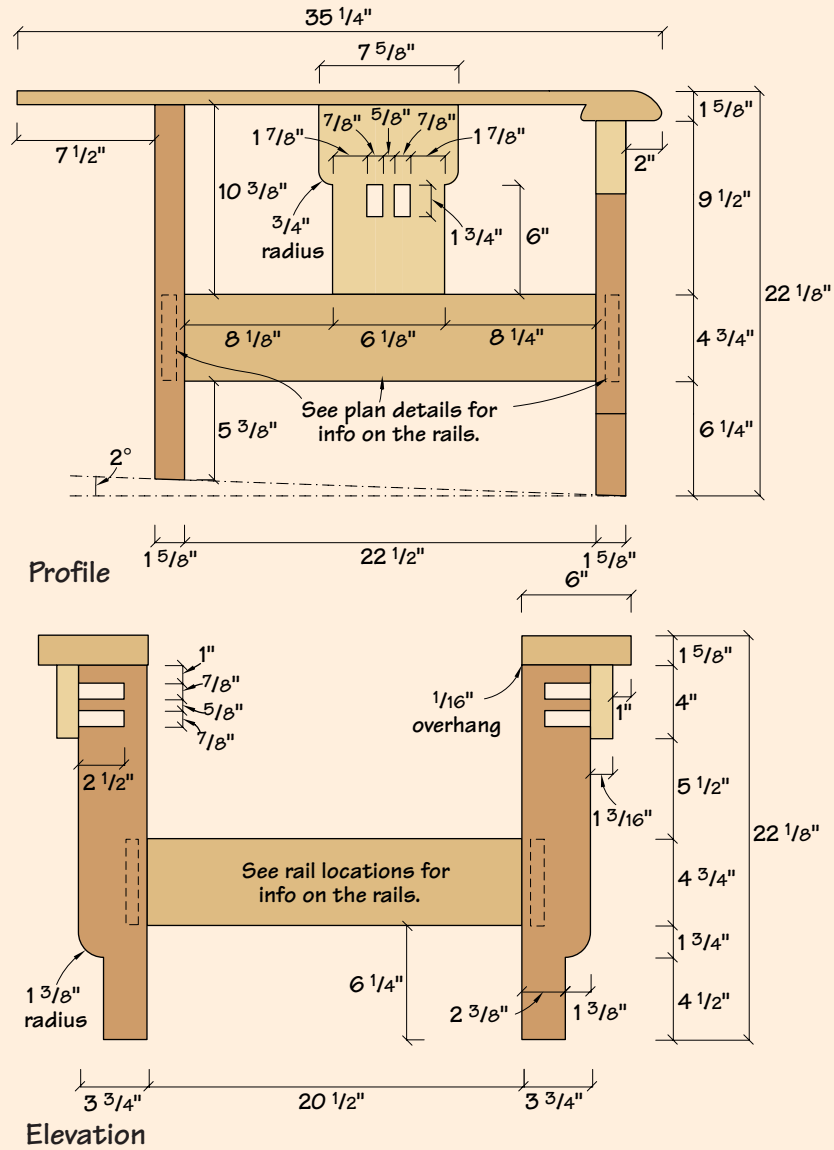
The "X" on the rails and cleats denotes a cross section rather than an end view.

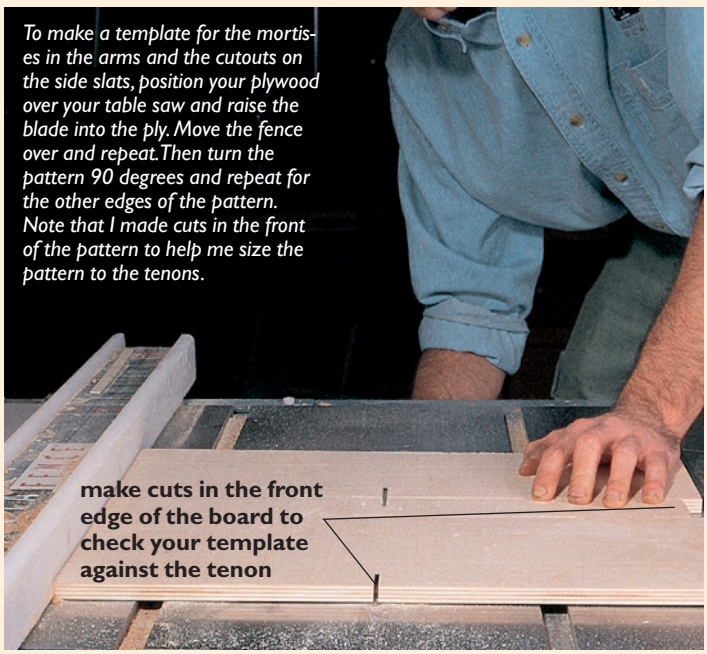
When pattern-routing the curve on the legs, make sure you have the work firmly clamped in place. I have the pattern and leg wedged between two pieces of oak (the pattern is on the underside of the leg). Then the leg itself is clamped to the table. You also could perform this operation on a router table with a starting pin for pattern-routing.

ing out the locations of your mortises. The rule of thumb is that your mortises should be one half the thickness of your tenon's stock. When your stock is ¾" thick, your mortises and tenons should be ⅜" thick. That means the tenons for the beefy back rail should be thicker (7/16") and those for the side slats should be thinner (¼").

Also remember that except for the tenons on the legs and slats, all the tenons are ¾" long. To ensure your tenons don't bottom out in your mortises, it's always a good idea to make your mortises about 1/16" deeper than your tenons are long.

After you mark the locations of all the mortises, it's time cut them. There are 38 mortises in this project. You'd be nuts to do these all by hand. Use this project as an ex-





To make a template for the mortises in the arms and the cutouts on the side slats, position your plywood over your table saw and raise the blade into the ply. Move the fence over and repeat. Then turn the pattern 90 degrees and repeat for the other edges of the pattern. Note that I made cuts in the front of the pattern to help me size the pattern to the tenons.

make cuts in the front edge of the board to check your template against the tenon

Schedule of Materials: Morris Chair

Chair frame

No.	Item	Dimensions T W L	Comments
2	Front legs	1 5/8" x 3 3/4" x 21"	1/2" TOE
2	Back legs	1 5/8" x 2 1/4" x 21"	1/2" TOE
2	Applied sides	1 5/8" x 1 3/16" x 4"	
1	Front rail	3/4" x 4 3/4" x 22"	3/4" TBE
2	Side rails	3/4" x 4 3/4" x 24"	3/4" TBE
1	Back rail	7/8" x 4 3/4" x 22"	3/4" TBE
2	Side slats	1/2" x 7 5/8" x 11 3/8"	1/2" TBE
2	Arm bldgs	7/8" x 6" x 4 1/2"	
2	Arms	3/4" x 6" x 35 1/4"	
2	Cleats	3/4" x 1 7/8" x 20 1/2"	
1	Back rod	3/4" x 2" x 23 5/16"	

Drop-in seat

No.	Item	Dimensions T W L	Comments
2	Seat stiles	3/4" x 2 1/2" x 23 1/2"	
5	Seat rails	3/4" x 2 1/2" x 17"	3/4" TBE

Adjustable back

No.	Item	Dimensions T W L	Comments
2	Back stiles	3/4" x 1 7/8" x 28 1/4"	
5	Back rails	3/4" x 1 7/8" x 17 1/2"	3/4" TBE
1	Bot rail	3/4" x 3 1/4" x 17 1/2"	3/4" TBE

TOE = tenon on one end • TBE = tenon on both ends

cuse to purchase a hollow chisel mortising machine (about $250) or a mortising attachment for your drill press (about $70). If you can't swing the cash, I'd make plywood templates and cut the mortises with a router and a pattern bit. Making plywood templates is something covered later in the story.

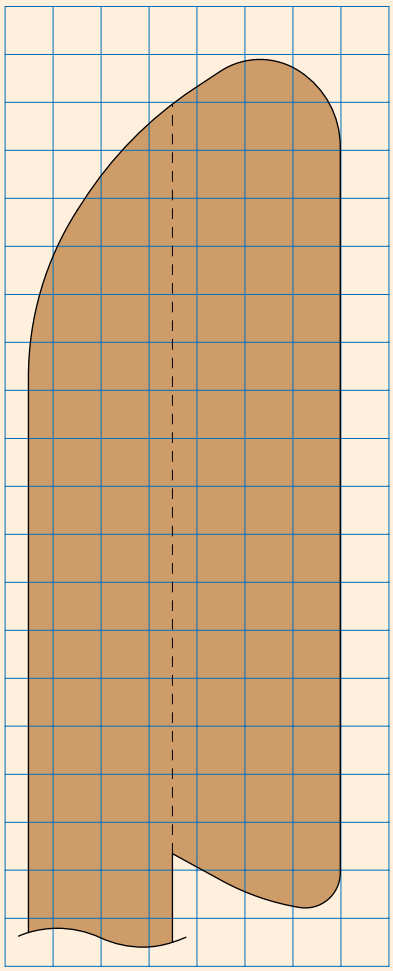
One more thing: don't cut the mortises in the arms or the arm buildups until the chair frame is assembled. You'll cut these with a router and a pattern bit after the chair frame is assembled.

Tenons With a Dado Stack

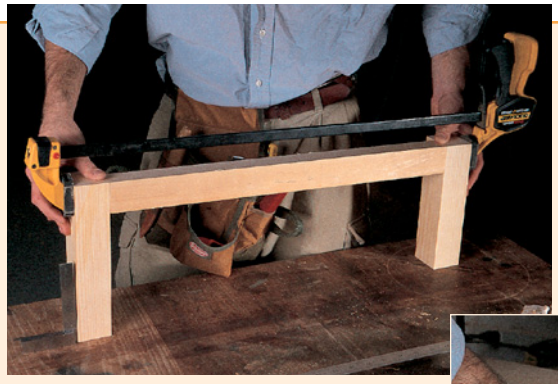
Once you get your mortises cut, make tenons that fit snugly into the mortises. You can use a tenoning jig or the fence on your table saw, or you can use a router. I prefer to use a dado stack and my miter gauge. See the story on the previous page for details on how to do this.

While your dado stack is in your saw, cut the groove in the back piece that holds the seat frame. See the drawing for the location of this groove.

Once you cut your tenons, prepare to assemble the drop-in seat and the adjustable back. To save yourself some grief, sand the edges of the rails that you won't be able to get to after the frames are assembled. Now put glue in all the mortises and clamp up the frames. Set them aside to dry.



Full-size Diagram of Arm



*Be sure to make a full-size mock-up of the legs and sides **(left)** to determine the angle you need to cut on the bottom of the legs. When you determine that angle, use a grease pencil or magic marker to paint the bottom of the legs. I cut the back and front legs simultaneously. Slowly inch your legs in after each cut until the color is all gone **(below).***

Curves and Cutouts

What makes this Morris chair stand out are the curves and cutouts on the legs, arms and slats. Each curve and cutout needs a slightly different strategy.

The large curves on the legs and the small curves on the side slats were cut using a plywood template and a pattern-cutting bit in a router. I made the patterns from ½"-thick Baltic birch plywood. Use the drawings to make your own plywood template using a scroll saw, band saw or coping saw. Smooth all your cuts with sandpaper, then try shaping a couple scraps with your template to make sure your pattern produces the right shape. When satisfied, cut the curves to rough shape on your band saw (about 1/16" shy of your finished line) and clean up the cut with a router and pattern bit. Finish shaping the legs with a chisel.

To produce the large cutouts on the front legs, do what Oscar Onken did: cheat a bit. Make the "cutouts" using a dado stack on your table saw, with the legs on edge. Then glue the applied sides to the legs to cover the open end of the cuts. Instant cutout. While you're at it, cut out the notches on the arm pieces for the rod that adjusts the back.

To complete the legs, you need to cut the bottom of all four legs at a 2-degree angle so the chair sits flat on the floor. I recommend you make a full-sized mock up (see the photo above) so you can get the angle exactly right. Cut the angle on a chop saw.

Assembly

Now you're almost ready to assemble the chair frame. You'll need to first miter the tenons slightly where they meet to fit in the mortises using your table saw. Now finish sand everything. I went to 150 grit using my random-orbit sander and hand sanded the whole piece with 180 grit. Yes, it makes a noticeable difference.

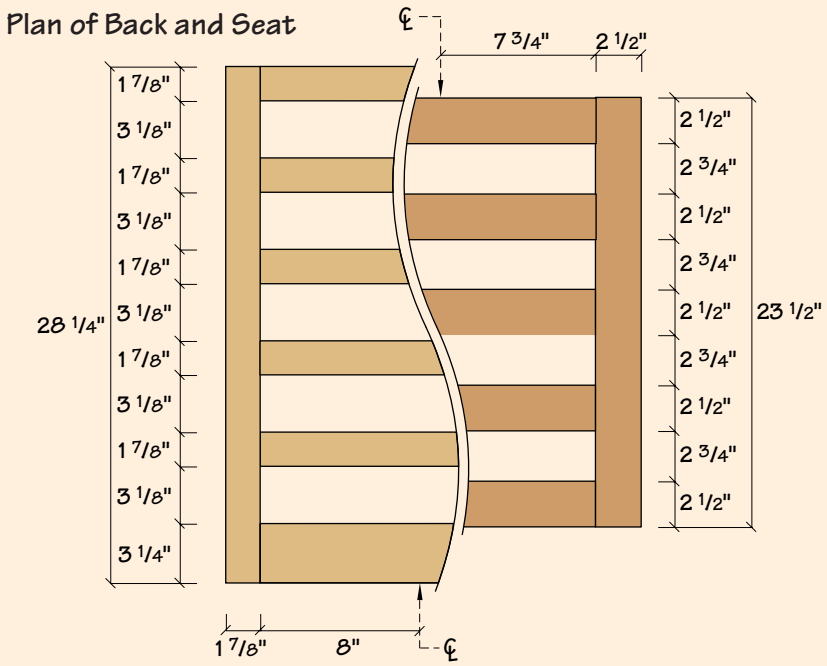
Now glue the front rail between the front legs and the back rail between the back legs. Clamp and allow your glue to dry. Use ¼" dowels to pin the tenons from the inside of the chair. This strengthens the weakest point of this chair. It's at this joint where the original chair came loose.

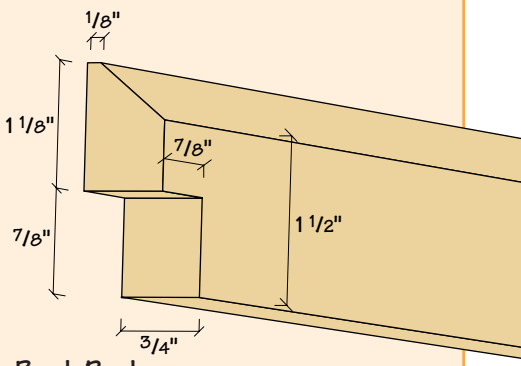
Glue the side rails between the front and back legs and you can see your chair take shape.

Learn to Make Square Templates

Now you need to work on the arms. First glue the arm buildup pieces to the front of the arms. Then get ready to cut the mortises on the arms that will hold the tenons on the legs and side slats. A word of advice here. Mock up an arm out of scrap wood and practice on it first.

To make plywood templates for the mortises, you need to make a square hole in the middle of a piece of ply. The best way to do this is by making plunge cuts into your ply-





Back Rod

Peg the tenons that join the front rail to the front legs and the back rail to the back legs. If you've ever pegged tenons before, you know that dowels can be wildly different sizes than they're supposed to be. Here's a trick. If your dowel is a bit undersized, glue it in place and cut it nearly flush to the surface. Then put several drops of thinned glue on the end grain of the dowel. It wicks in the glue, expands and glues up tight. When the glue is dry, cut the dowel flush.

wood on your table saw. Refer to the photo earlier in the story to see how to do this.

Now cut your mortises. I used a template bit with cutters on the bottom and a guide bearing on top. If you don't have a bit with cutters on the bottom, you can still plunge with a straight bit. Just plunge slowly and wiggle the router a bit as you go. Cut the mortises in two passes.

After you're sure the arms fit on the legs, cut the curve on the front of the arm. Attach the full-size pattern to your arm and cut the shape on a band saw. Clean up the cuts with a stationary belt sander. Now taper the arms with your band saw and clean up the cut with your jointer. Glue the arms and slats in place.

Now shape the back rod that adjusts the seat back angle. Bevel one edge of the rod on your jointer and cut notches on the ends so the rod fits between the arms. Attach the back to the seat frame with a piano hinge. Screw the cleats to the front and back of the frame in the locations shown in the diagram; slip the seat in place.

Be sure to make a test arm before you go mortising the real thing. You'll be glad you did.

Finishing

This takes some effort, but it is well worth it. The first step is to dye the chair with an alcohol-based aniline dye that's reddish. See the supplies list for ordering information. Then apply one coat of boiled linseed oil to the chair. You can get this at any home center store. Wipe off the excess and let it dry overnight. The linseed oil helps seal the wood before your final coloring step and helps bring out the ray flake.

Now wipe on a thin coat of Lilly's warm brown glaze. We live and die by this stuff when finishing Arts & Crafts furniture. We're not aware of a catalog that sells it, but you can visit Lilly's website (at the address in the supplies box) to find a paint store that carries this glaze. Wipe the glaze until you achieve an even tone. Allow it to dry overnight. Finally, apply three coats of a clear finish — whatever you're comfortable with. **PW**

SUPPLIES

Slotted Piano Hinge
Rockler Woodworking and Hardware: 800-279-4441 or www.rockler.com
Item # 19241 • $6.99

Moser's Aniline Dye
Woodworker's Supply: 800-645-9292
Medium red mahogany, alcohol soluble • item# A16701 • $8.80

Warm Brown Glaze
Made by Lilly Industries (formerly Guardsman). For a list of distributors of Lilly wood products, visit the company's website at: http://www.lillyindustries.com/en/sbu/wood/wooddist.htm

Editor's note: Plans for the Stickley side table shown in the opening photo can be found on the following page. Also, did you ever wonder what happens to projects built by the *Popular Woodworking* staff? Recently we've begun selling some completed projects on ebay.com, an internet auction site. The Morris Chair featured on the cover and the Stickley Table will go up for sale on May 1, 2000. Check out the auction at www.ebay.com

Stickley
SIDE TABLE

Not ready to build the Morris chair?

Try your hand at this side table to hone your skills.

by David Thiel

Patterned after the model #562 taboret shown in the L.&J.G. Stickley catalog of 1914, the original of this table now sells for $1,600 at auction.

As with all white oak Arts & Crafts pieces, wood figure is important to make a simple design stand out. Choose the best figure for the top and the panel pieces. If the stretchers and legs are also well-figured, so much the better.

After cutting the legs to size, mark the best faces for showing off the grain. Then cut ⅜" x 2⅝" x 1"-deep mortises in the legs for the stretchers, and ⅜" x 1⅛" x 1"-deep mortises for the aprons. These mortises are centered on the width of the legs and located as shown in the diagram. I used a benchtop mortiser for this step, but you could also use a plunge router with an up-spiral bit to cut them.

Now change the bit (either mortiser or router bit) to a ¼" bit and mark and cut the ¼" x 5⅜" x ½"-deep mortises for the panels in the aprons and stretchers.

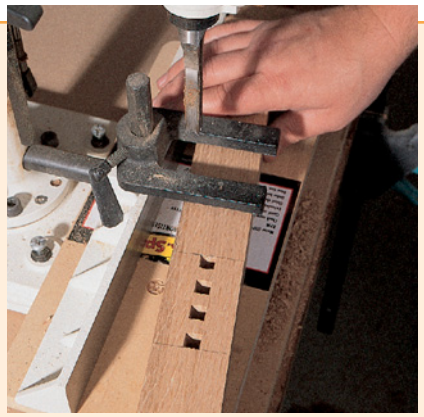
With the mortises complete, head for the table saw and get ready to cut tenons. I use a rip blade to form my tenons. I cut the cheeks first, then define the shoulders, so there isn't a chance of the shoulders being accidentally notched by the saw blade during the cheek cut. By cutting the shoulder last, any "notching" will happen against the tenon cheek.

When making the shoulder cut on the table saw, it's easiest to use the rip fence to define the 1"-tenon length. If you use the fence to the right of the blade, and the miter gauge to the left of the blade you will trap the fall-off piece between the blade and fence, causing it to shoot back from the blade. Instead, set the fence for 13" to the right of the blade and use the miter gauge to the right of the blade as well. This way you can cut both tenoned ends with a single setup, and the waste will fall harmlessly to the left of the blade.

If you're paying careful attention, you will realize 1" tenons are going to bump into one another in the mortises. After cutting the tenon shoulders, reset the fence and the blade angle to cut 45-degree miters on the ends of the tenons.

Don't leave the saw yet. You still need to form the ¼" x 5¼" x ½" tenons on both ends of the panels. You might have noticed that the tenons are ⅛" less wide than the mortise dimensions. This is no mistake. When the side panels are positioned between the stretchers and aprons, the shoulders of the panel tenons will fit snug against the stretchers and rails. If the mortises in the legs were the exact width of the tenons, and off by even a little bit, they would force a gap between the panels and the two rails. The ⅛" extra space on the panel tenons is to allow for wood movement.

Next, mark the 1" curve on the bot-



The best method for mortising is to first bore the areas at either end of the mortise, then space the next few mortises the width of the mortising chisel. In this case, the spacing works almost perfectly. The goal is to allow the chisel bit to have enough wood to drill straight without wandering from side-to-side. On some mortises the spacing between the first holes will be less than the width of the chisel ***(far left).***

Complete the mortise by drilling away the waste between the first mortises. This allows the mortise chisel to cut most efficiently without pulling to the left or right and bending the chisel ***(left).***

tom edge of each stretcher and cut the shape on the band saw. The easiest way to mark this curve is with a flexible 1/8" wood strip bent to the 1" mark and then traced with a pencil.

One last step before assembly. The top is held in place by table top fasteners. These are screwed into the underside of the top, and fit into 1/8"-wide grooves in the aprons. These fasteners allow the top to adjust to wood movement without affecting the base. Run these grooves on all four aprons on the table saw. This will let you decide which way the top will fit later.

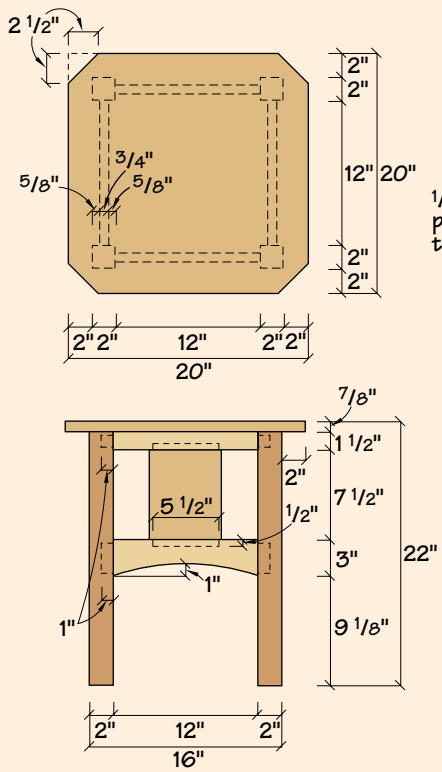
You're ready to sand, then glue up the base. A dry fit is definitely a good idea to make sure everything fits and to make sure you know how to hold everything in place once the glue goes on.

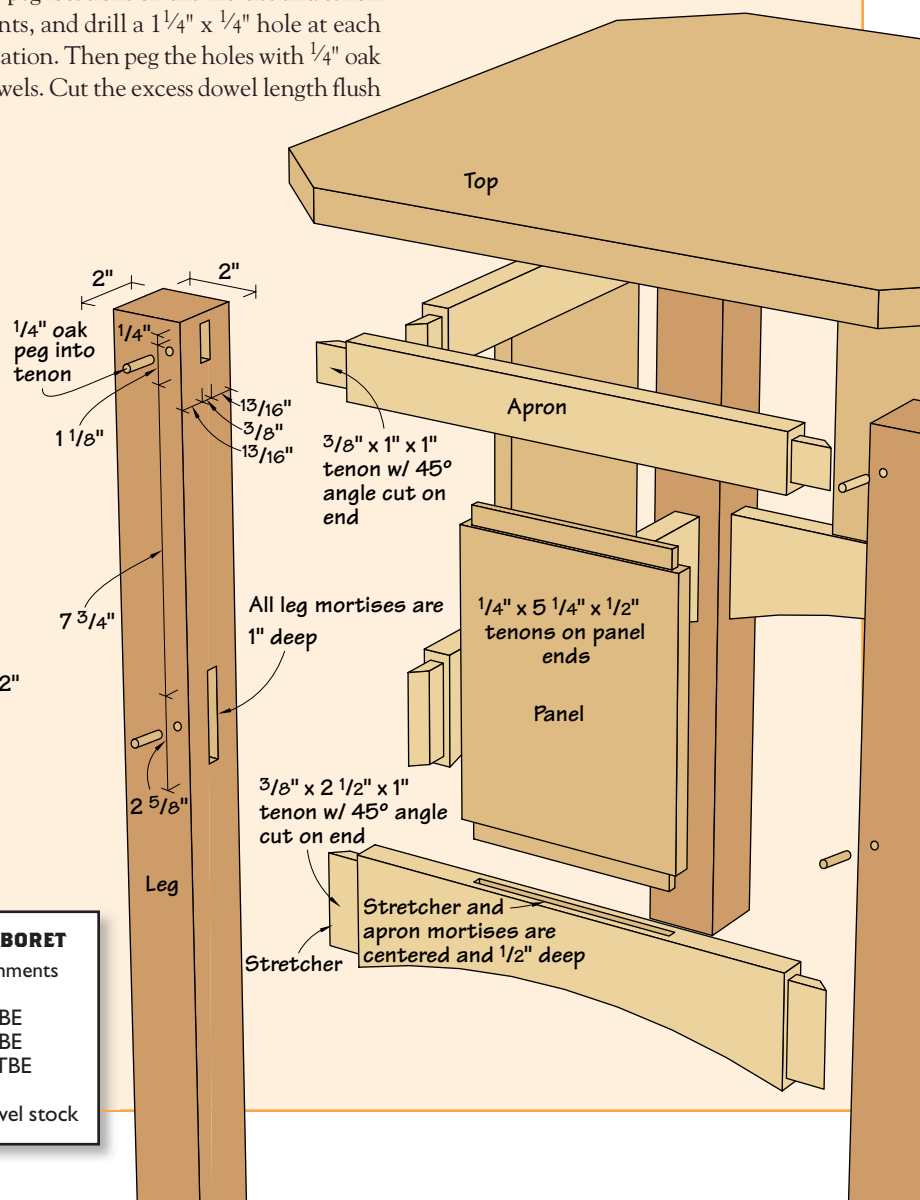
With the base glued and clamped, cut the pieces for the top, and glue them together. To reduce the amount of sanding necessary, a few biscuits added to the joint will help align the pieces and keep them from slipping during glue-up.

When the base is ready, mark each of the peg locations on the mortise and tenon joints, and drill a 1 1/4" x 1/4" hole at each location. Then peg the holes with 1/4" oak dowels. Cut the excess dowel length flush to the table leg and finish sand.

Unclamp the top and sand it flat. Then mark 2 1/2" in from each corner and run a line at a 45-degree angle to clip the corners of the top on the band saw to an octagon shape. Then finish sand the top.

I used the same finish on the table that was used on the chair. If you've built the chair as well, put a nice lamp on the table, get a good book, and sit down to some early 20th century comfort. **PW**





SCHEDULE OF MATERIALS: ARTS & CRAFTS TABORET

No.	Item	Dimensions T W L	Material	Comments
4	Legs	2" x 2" x 21 7/8"	WO	
4	Stretchers	7/8" x 3" x 14"	WO	1" TBE
4	Aprons	7/8" x 1 1/2" x 14"	WO	1" TBE
4	Panels	1/2" x 6" x 8 1/2"	WO	1/2" TBE
1	Top	7/8" x 20" x 20"	WO	
16	Pegs	1/4" x 1 1/2"	Oak	Dowel stock

DRY SINK TABLE

An indoor/outdoor plant stand that lets you water without worrying about spills on the furniture or floor below.

This table made a humble first appearance in *Popular Woodworking* as a prop in a photo of a featured project, the Blacker House's Greene and Greene Bench. Well, not only was the bench a hit with readers, but we had lots of calls about the table as well.

As a table/plant stand/dry sink, the project is a real hybrid. And like many projects produced in home workshops, this one was an answer to a particular problem. You see, my wife presented me with the bonsai tree shown in the photo. All of the sudden I was responsible for an 18-year-old miniature "tree."

Bonsai require frequent watering. Their sandy soils need a thorough drenching every day. The inevitable run-off begged for a solution easier than a daily trip to the kitchen sink. So I devised a plan for a table with a dry-sink top lined with a copper pan to catch the water.

It works well and looks good. The Japanese design influence provides just the right setting for a Japanese bonsai tree.

Construction follows the same principles and techniques as are typical for small tables: an arrangement of aprons at the top and stretchers set about mid-leg. In lieu of a top, the copper pan slips in from below and is supported by a plywood bottom that is held in place with cleats screwed to the aprons. The principal materials are redwood (although red cedar would be a less expensive alternative) and outdoor-grade plywood. The copper pan is sheet metal and is simple to fabricate.

Cut out the legs, aprons and stretchers following the Schedule of Materials. You can cut the stretchers about $\frac{1}{8}$" wider than given so there's a little left to trim when routing them with a template to finished shape. The legs are cut from redwood 2 x material and the rest is $\frac{3}{4}$" stock.

Now use Baltic birch, medium density fiberboard (MDF) or some other material without voids to make templates for routing the patterns on the aprons and stretchers. It's best if the template thickness is at least $\frac{1}{4}$" and not more than $\frac{1}{2}$". Make the templates to the shapes indicated by the diagrams. Be sure the edges are smooth after cutting them.

When the templates are done, position the one for the side stretchers or aprons. Make it easy to find the right position by penciling a center line across the width of the template and the width of the parts. Then it's just a simple matter of matching up the center lines and leaving a fraction of overhang along the width. Now trace the template shape on the parts and cut out the shape, leaving $\frac{1}{8}$" or less waste to be trimmed with the router.

When done, position the template on the part again and tack it in place with

by Steve Shanesy

Photo by Al Parrish

Make a Watertight Pan

Cutting, bending and soldering the copper for the pan is nothing to be intimidated by. You can cut the copper sheet metal on your table saw using a carbide crosscut blade, trim the corners with an ordinary pair of snips, bend the stock with a simple plywood jig and solder it to make it waterproof just as you would when joining copper plumbing.

I picked up the copper from a roofing company that uses this material for flashings. I paid a few bucks for the piece I needed. To fabricate the pan, just follow these simple steps.

1 **Carefully measure the inside dimension of the table from the inside corners of the legs, not the inside of the aprons.**

2 **Cut your copper to this size on the table saw (make sure you are wearing safety glasses and that the thin metal stock cannot slip under the fence).**

3 **If it matters on the copper you are using, turn the piece so that the good side is face down on your bench. Then measure from each edge and mark the height of the pan side, 1 ½". Score the material to make a crisp, square edge when bent. Score all four edges similarly.**

4 **Use your combination square and mark a 45-degree angle from each corner to the intersection of the score lines at each corner. Now cut away one of the triangles made in each corner.**

5 **Cut a piece of ¾" plywood that's at least as long as the longest side of the copper so that you end up with two pieces with a 45-degree angle on a long edge. Make one piece the height of the pan side and the other at least 6" wide. Cut one more piece with square edges only that is as wide as the pan side.**

6 **With the scored side down, place one edge of the copper so that the score line and the edge of the bench are the same. Clamp the wider plywood piece over the copper so that the point of the plywood angle is also at the edge of the bench. With the overhanging copper, make a sandwich of the copper, the square-edged plywood below and angle-edged plywood above. Be sure the points of the plywood angles touch and securely clamp the sandwich together.**

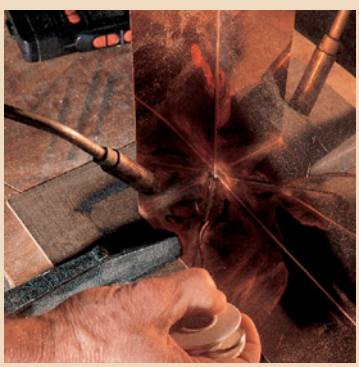
7 **Bend the edge of the copper up until the plywood angles close. Repeat the process until all four edges are bent. If the sides are not quite square, tap them with a hammer along the length of the bend.**

8 **Solder the corners together. First coat the surfaces with flux. Position the corner so it's square and lightly clamp with a steel clamp. Thoroughly heat the parts, especially close to the corner until the solder flows and is drawn in between the surfaces. Allow to cool and repeat for the other corners. When done, add water to the pan and check for leaks. Clean any flux residue with soap and water.**

After drawing a line from a corner to the intersection of two score lines, cut out one of the triangular shapes from each corner using snips.

A simple method for bending using plywood cut with a 45-degree angle and clamps. This ensures a bend in a straight line and a point to bend to. Clamp the metal to a table with the area to be bent overhanging the edge of the bench.

After clamping the overhanging piece, bend upward until the mitered edges close. Then remove the clamps and repeat for each side



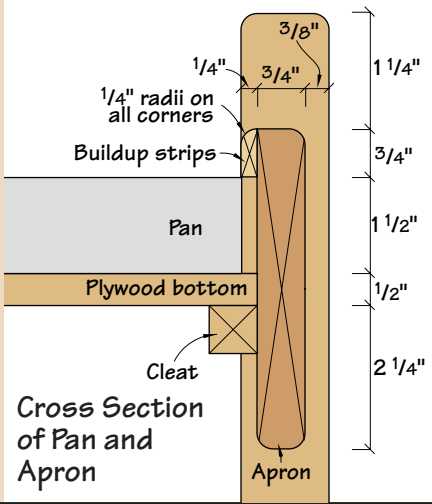
Heat the copper at the point where you want the solder to flow.

The finished shape of the stretchers and aprons is made using a template that guides the bearing on top of the router bit.

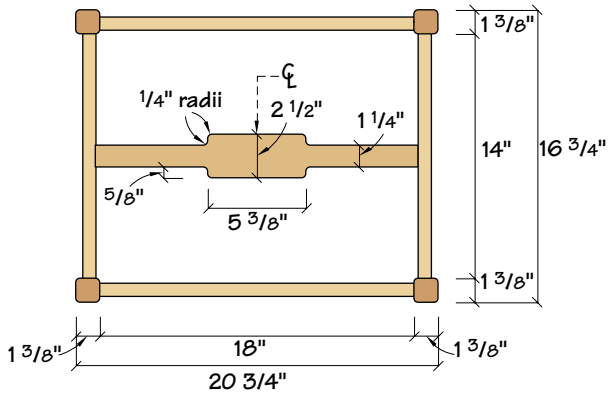
wire brads. Two should be sufficient. Now use a "pattern" router bit (a straight bit with a bearing of equal size as the diameter of the bit) in a router and secure the router in a router table. Elevate the bit to a height where the bearing rides against the template and the cutting edge of the bit will trim the overhanging waste from the part. Use this procedure for all the parts that are shaped from the two templates.

Now position the parts in their correct locations relative to the legs. Follow the diagram for these locations. Mark the aprons and legs for two #10 biscuits each and the stretchers for a ⅜" dowel. The biscuit slots will overlap, so cut one end off one of the biscuits about ½" back. Cut the slots and drill the holes. Dry assemble the parts.

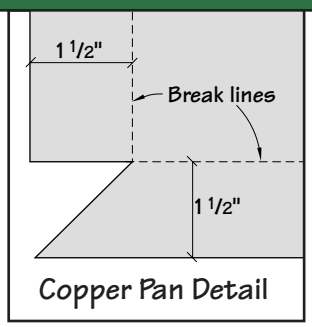
After taking the table apart, change the router to a ¼" radius bit with a bearing. Run all the edges of all the parts with the following exceptions: Leave the ends of the aprons and stretchers square and the inside top edge of the aprons; the bottom end of the legs remain square and the inside corner of the legs where the aprons start and stop are also square.



Cross Section of Pan and Apron



Plan

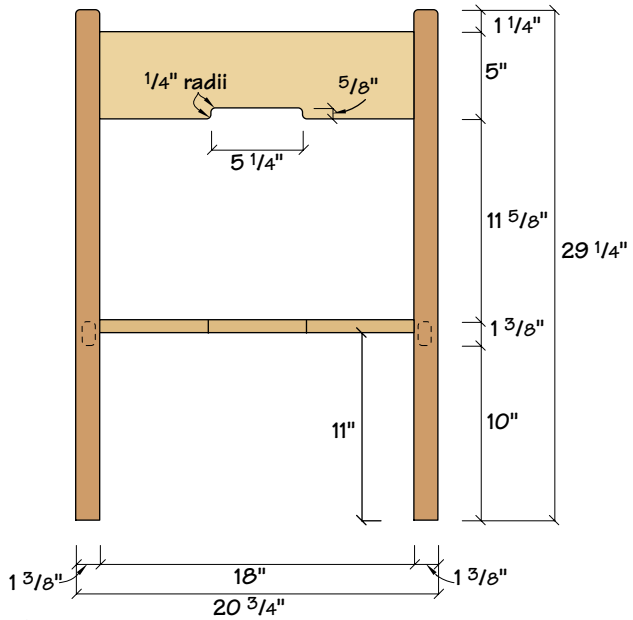


Copper Pan Detail

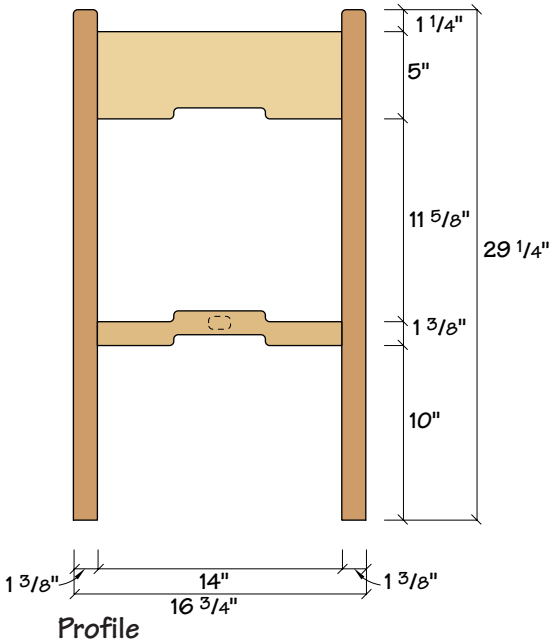
SCHEDULE OF MATERIALS: DRY SINK TABLE

No.	Item	Dimensions T W L
4	Legs	1 3/8" x 1 3/8" x 29 1/4"
2	Aprons	3/4" x 5" x 18"
2	Aprons	3/4" x 5" x 14"
2	Stretchers	3/4" x 2" x 14"
1	Stretcher	3/4" x 2 1/2" x 18 1/2"
2	Bld-up strips	1/4" x 3/4" x 18"
2	Bld-up strips	1/4" x 3/4" x 14"
1	Bottom	1/2" x 14 3/8" x 18 3/8"
2	Cleats	3/4" x 3/4" x 8"

One piece copper sheet metal 17" x 21"



Elevation

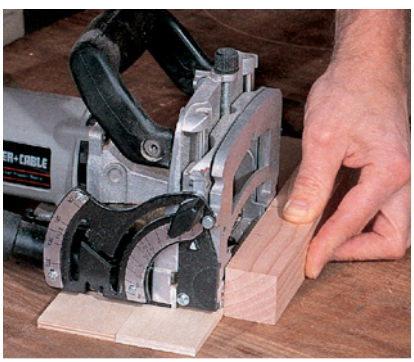


Profile

Now, before assembling with glue, presand the parts where it's easier now than later. When done, glue the two ends with stretchers first and let them dry, then glue up the long sides and center stretcher to complete the assembly.

Finish the woodworking portion of the project by cutting the plywood bottom and the redwood strips that will be tacked to the inside top of the aprons. With the bottom, notch the corners so it can slip in place without interfering with the legs. For the redwood strips, rout the 1/4" radius detail on one edge of a 3/4"-thick piece, then rip the piece off to 1/4" thickness, and repeat until you have the four pieces required. You can glue and clamp these in place or simply glue and nail them.

These strips provide a lip for the copper pan to seat to when installed from the bottom and give a clean, finished look to the "dry sink" top.



After the parts are shaped, cut slots for biscuits into the legs for joining the aprons. Center the slots in the apron ends, then elevate the biscuit joiner with a 1/4" piece of plywood to provide the correct offset for the inside of the apron when cutting the leg slots.

When the pan is complete, set the table upside down, position the pan, set the plywood bottom on top of it then screw cleats to the apron sides to hold the pan and bottom snugly in place.

Before assembly, rout a 1/4" radius detail on the stretchers, legs and aprons.

Because of the anticipated water abuse — including an occasional rain soaking while outdoors during the summer months — I left the table unfinished and will let time provide a very pleasing patina. Best of all, and assuming I can provide the proper care for the bonsai tree for the next 18 years, the table will still be just the right size. **PW**


Rift-sawn boards move more than quartersawn boards but less than flat-sawn boards. Lumber is rift sawn when all the growth rings meet the face of the board at angles between 30 degrees and 60 degrees.
Flat-sawn boards are most susceptible to movement. Lumber is flat sawn when the growth rings meet the face of the board at angles less than 45 degrees.
Quartersawn boards move the least during the seasons, but there is more effort and waste in cutting them. Lumber is quartersawn when all the growth rings meet the face of the board at angles more than 45 degrees.

The Way Wood Works

Everything you wanted to know about wood but didn't know what to ask.

Wood is a cantankerous substance; there's no two ways about it. Its virtues, of course, are legendary. It's attractive, abundant and easy to work. Pound for pound, it's stronger than steel. If properly finished and cared for it will last indefinitely. But none of that makes up for the fact that it's a complex and often perplexing building material.

Unlike metals and plastics, whose properties are fairly consistent, wood is wholly inconsistent. It expands and contracts in all directions, but not at the same rate. It's stronger in one direction than it is in another. Its appearance changes not only from species to species, but from log to log — sometimes board to board.

That being so, how can you possibly use this stuff to make a fine piece of furniture? Or a fine birdhouse, for that matter? To work wood — and have it work for you — you must understand three of its unique properties:

- Wood has grain.
- Wood moves more across the grain than along it .
- Wood has more strength along the grain than across it.

Sounds trite, I know. These are "everyone-knows-that" garden-variety facts. But there is more grist here for your woodworking mill than might first appear.

Wood Has Grain

As a tree grows, most of the wood cells align themselves with the axis of the trunk, limb or root. These cells are composed of long thin bundles of fibers, about 100 times longer than they are wide. This is what gives wood its grain direction. Additionally, a tree grows in concentric layers, producing annual rings. You must pay close attention to these two characteristics — grain direction and annual rings — the way a sailor watches the wind. Ignore them, and they'll bite you big time.

Sawyers commonly use two methods to cut trees into boards, each revealing a different type of grain.

by Nick Engler

Nick Engler has been writing about woodworking for a quarter of a century, and is the author of more than 50 books on the subject. His workbench, which is made from hard rock maple and white oak, is rated to withstand a five-alarm tantrum.

Astound Your Friends

Want to predict exactly how much a given board will move in a year's time? Look up the specific movement rate for the wood species in the Wood Handbook. Then call the National Oceanic and Atmospheric Administration to find how much the relative humidity changes from summer to winter. Multiply the change in humidity (as a decimal) times the movement rate (another decimal) times the width of the board. Of course, this level of precision is completely unnecessary, but the chicks dig it.

• Plain-sawn boards are cut tangent to the annual rings. The sawyer "cuts around" the log, turning it for each series of cuts so the faces of the boards will show mostly flat grain (also called tangential or plain grain).

• Quartersawn boards are cut through the radius of the growth rings. The sawyer cuts the logs into quarters or bolts, and then saws each bolt so the boards show quarter grain (or radial grain) on their faces.

Lumber doesn't always show a single type of grain on its face. Plain-sawn boards in particular may show mixed grain — flat grain in one area and quarter grain in another. The grain between the two, where the surface is cut at a 30- to 60-degree angle to the annual rings, displays rift grain.

Each type of grain has a distinct pattern, depending on the wood species. You can use these grain patterns to enhance the design of your furniture or your birdhouses. More importantly, if you know how to "read" the patterns, you can predict which way the wood will move and how much.

Wood Moves Across the Grain

Because of its unique structure, wood is constantly expanding and contracting. And you must cope with this movement in everything you build.

Wood moves as its moisture content changes. After the tree is felled and the sap has evaporated, the wood fibers continue to absorb and release water like a blotter. How much water they hold depends on the relative humidity of the surrounding environment. The more humid it is, the more moisture the fibers soak up. This moisture content is the ratio of water to wood. In extremely humid conditions, as much as 28 percent of the total weight of a board may be water — 28 parts water, 72 parts wood. The rule of thumb is that the moisture content of wood changes 1 percent for every 4 to 5 percent change in the relative humidity.

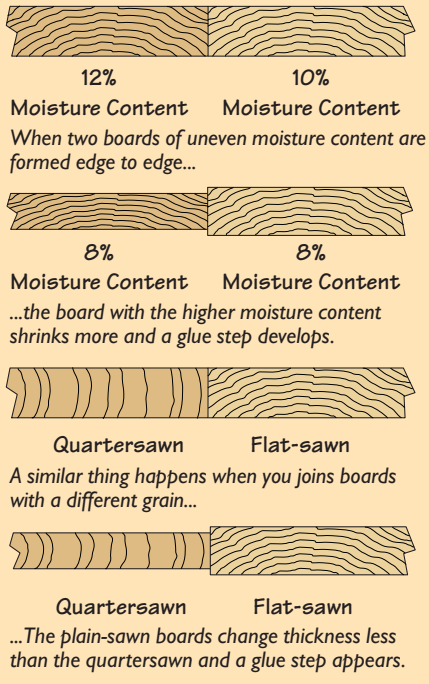
The more moisture a board absorbs or releases, the more it swells or shrinks. However the surface of a board moves differently depending on the grain direction and type of grain. Wood movement along the grain is almost negligible. From 0 to28 percent moisture content, a typical board will move only 0.01 percent of its length. However it will move about 8 percent across flat grain and 4 percent across quarter grain. This is why woodworkers consider quartersawn lumber more stable. It's also why boards with mixed grain (and mixed expansion rates) tend to cup.

So how do you predict how much a board will move and in what direction?

Glue Steps: At Last, a Practical Solution to an Age-Old Dilemma!

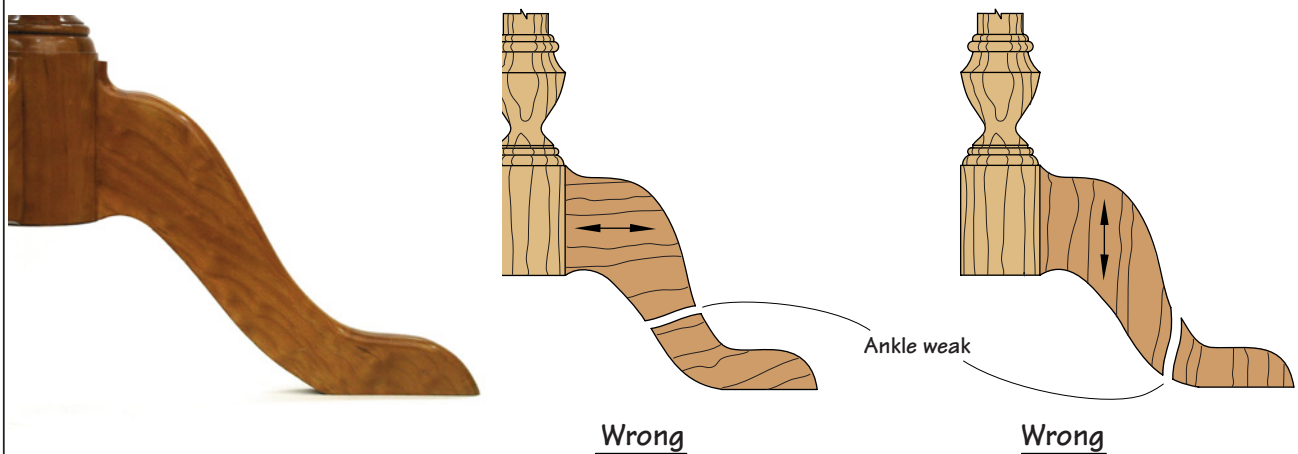
Want to see a practical application of this information? With what you now know about wood grain and movement you can solve a persistent problem that has dogged too many woodworkers for too long: glue steps. These are tiny changes in the surface level from one board to another at glue joints. They are especially unattractive in table tops where boards are joined edge to edge.

The common misconception is that these are caused by improper gluing technique. A talented and experienced craftsman once spent hours trying to convince me that glue steps are caused by the adhesive outgassing. (In my shops the adhesives are better behaved.) Despite his ardor, the glue steps are the result of uneven wood movement.



Sometimes a woodworker fails to shop-dry his lumber — let it rest in the shop long enough for all the boards to reach the same moisture content. When parts with dissimilar moisture contents are joined, the moister part moves more than the drier one. Or a craftsman glues flat grain to quarter grain, joining two surfaces that move at different rates, even when they have the same moisture content. In both cases a step results.

To avoid glue steps, shop-dry your lumber for a week or more before using it so the moisture content of the wood has a chance to reach an equilibrium with the relative humidity in your shop. When gluing boards edge to edge, always glue flat grain to flat grain and quarter grain to quarter grain.



The wood grain in the legs of this pedestal table runs parallel to the longest dimension, making the legs as strong as possible. Were the grain to run parallel or perpendicular to the pedestal, the legs would be weakest at their narrowest point, the ankles.

Wood Properties

This chart shows some important properties for 18 common species of wood. Specific gravity is the ratio of the mass or weight of the wood to that of an equal amount of water. Tangential and radial movement are given as a percentage (%) of a board's measurement across the grain as it dries. To find compressive strength, engineers load a block parallel to the grain until it breaks. They find bending strength by loading a block perpendicular to the grain. Both are measures in pounds per square inch (psi). Stiffness is determined by applying a load perpendicular to a beam until it deflects a certain distance. This is measured millions of pounds per square inch (Mpsi). For hardness, a metal ball is driven halfway into a wood surface. The force required to do this is recorded in pounds (lbs).

Wood Species	Specific Gravity	Tangential Movement (%)	Radial Movement (%)	Compressive Strength (psi)	Bending Strength (psi)	Stiffness (Mpsi)	Hardness (lbs)
Alder, Red	0.41	7.3	4.4	5,820	9,800	1.38	590
Ash	0.60	7.8	4.9	7,410	15,000	1.74	1,320
Basswood	0.37	9.3	6.7	4,730	8,700	1.46	410
Birch, Yellow	0.62	8.1	3.6	8,170	16,600	2.01	1,260
Cedar, Red	0.32	5.0	2.4	4,560	7,500	1.11	350
Cherry	0.50	7.1	3.7	7,110	12,300	1.49	950
Fir, Douglas	0.49	7.3	4.5	7,230	12,400	1.95	710
Mahog, Honduras	0.45	4.1	3.0	6,780	11,500	1.50	800
Maple, Hard	0.63	9.9	4.8	7,830	15,800	1.83	1,450
Oak, Red	0.63	8.9	4.2	6,760	14,300	1.82	1,290
Oak, White	0.68	10.5	5.6	7,440	15,200	1.78	1,360
Pine, White	0.35	7.4	4.1	4,800	8,600	1.24	380
Pine, Yellow	0.59	6.1	2.1	8,470	14,500	1.98	870
Poplar	0.42	8.2	4.6	5,540	10,100	1.58	540
Redwood	0.35	4.9	2.2	5,220	7,900	1.10	420
Spruce, Sitka	0.40	7.5	4.3	5,610	10,200	1.57	510
Teak	0.55	5.8	2.5	8,410	14,600	1.55	1,000
Walnut	0.55	7.8	5.5	7,580	14,600	1.68	1,010

That depends on the grain direction, type of grain and time of year. In most areas, the relative humidity climbs as the weather turns warmer. This causes the wood to expand. The rule is to allow for ¼" of movement across 12" of plain grain and ⅛" across the same amount of quarter grain. If you're working in the summer, the wood shrinks as winter approaches. When building in the winter, count on the wood expanding when summer comes. (Thus the old saw, "Work tight in summer, loose in winter.")

Wood is Strong Along the Grain

The wood cells are made from long, tough cellouse fibers, bound together by a glue-like substance, lignin. The cellulose is a lot tougher than the lignin. Consequently, it's much easier to split a board along the grain (separating the lignin) than it is to break it across the grain (snapping the cellulose).

This botanical trivia plays an enormous role in woodworking design. Can you imagine what might happen if you cut mortise-and-tenon joints in which the grain ran across the tenons? They'd snap if you just looked at them sideways. Yet tenons cut parallel to the grain will far outlast the woodworkers who cut them.

But wait there's more — when strength is paramount, grain direction may not be your only consideration. Some species of woods are naturally stronger than others. Windsor chairmakers, for example, typically use hard maple, birch and hickory for legs, rungs and spindles. Because these parts are fairly slender, weaker woods won't do.

A good indicator of a wood's strength is its density — the weight of a given volume of substance. Wood density is measured by calculating its specific gravity — the weight of a volume of wood compared to the same volume of water. Generally, the higher the ratio, the denser — and stronger — the wood.

Specific gravity, unfortunately, doesn't predict when a wooden board will break, sag or dent. For this, there are measurements of strength.

- Compressive strength tells you how much load a wood species will support parallel to the grain. If a corpulent relative sits in the chair, will the legs buckle?
- Bending strength shows the load wood can withstand perpendicular to the grain. How many kids can stand on that chair rung before it's firewood?
- The stiffness indicates how much the wood will deflect when loaded perpendicular to the grain. How far will those shelves sag when you display your collection of cannonballs?
- The hardness reveals how resistant the surface is to abuse. How hard can you pound when taking your frustrations out on the workbench?

Gotta Have It

All this information is in the Wood Handbook: Wood As An Engineering Material. This woodworking classic was written by the Forest Products Laboratory, an arm of the U.S. Department of Agriculture. Much of it reads like an income tax form, but you won't find a more complete reference. Write the Government Printing Office, Superintendent of Documents, Washington, DC 20402-9325.

A Parting Thought

Too often we approach our craft as if it were a collection of recipes. Take two boards, chop them up on a table saw, add a dash of glue and — presto! — a birdhouse. Or a Chippendale highboy, depending on how many boards and how finely you chop. But woodworking is more than knowing how to use a tool or follow a plan. It's the accumulated insights and inspirations of 5,000 years of craftsmanship. And at the heart of this craft is a surprising material that has yet to reveal all of its mysteries. **PW**

Photo by Al Parrish

The Secret to

Hand Scrapers

With a little magic, some patience and a burnisher you can turn a simple piece of steel into a fine woodworking tool.

The first time I saw a hand scraper in use I was sure some form of magic was involved. How else could such delicate, wispy shavings be produced from a rectangular piece of steel? Excited, I bought one, rushed home and immediately discovered that it did in fact require magic to work – or so it seemed. Years later, I learned that the magic behind a scraper is an invisible burr – a tiny hook – that you form on its edges. It's this burr that makes it possible to tackle jobs that will make a hand plane tremble in fear – squirrely grain like bird's eye or burls where the grain constantly shifts and changes direction. A hand scraper can smooth surfaces like these without worry of tearing out fibers.

But the No. 1 reason I reach for scraper is to quickly level high spots on a glued-up panel or tabletop. Sure, you could pull out a power sander, but why bother when a few quick passes with a hand scraper will do the job (and do it a lot quieter – and without the dust). Once you slip one of these into your shop apron, you'll find yourself reaching for it constantly. It's like having a pocket-sized cordless sander that doesn't require sandpaper and a hand plane that can be sharpened in seconds all rolled into one. If this sounds too good to be true, it isn't. All it takes is a quality scraper and a simple procedure to create the burr.

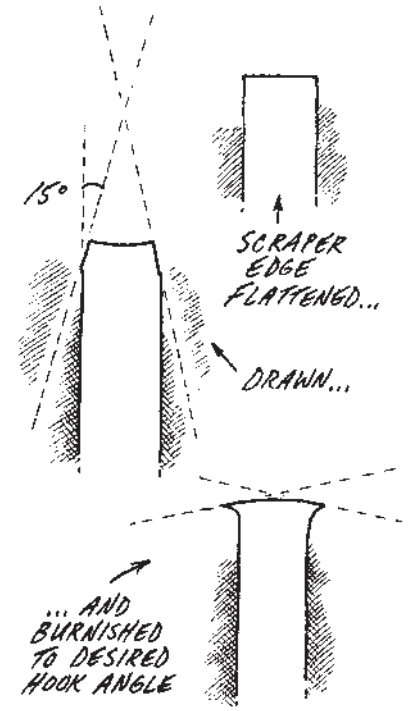
There are several tools called "scrapers." There is the rectangular piece of metal, the rectangular piece of metal in an oversized spokeshave body (called a cabinet scraper) and a rectangular piece of metal in a plane body (called a scraping plane). Each has its uses. Cabinet scrapers and scraper planes attempt to make the work less tiring. There's also myriad ways to sharpen and tune them. In this article, I'll focus solely on the hand scraper. Get the hang of this tool, and then move on to its bigger brothers.

Scrapers 101

Before delving into how to form a burr on a scraper, let's look at what makes a good scraper. The best indication of overall quality is its metal and hardness. Inexpensive

by Rick Peters

Rick Peters is a woodworker and publishing professional and resides in Emmaus, Pennsylvania.



Illustrations by John McCormick

hand scrapers are often sheared from spring steel with a Rockwell hardness of anywhere from C-30 to C-40. This makes them easy to sharpen, but the burr won't last long. A high-quality scraper is made from tool steel with a Rockwell hardness closer to C-50. These take a bit more effort to sharpen, but the burr lasts considerably longer.

Scrapers come in a variety of shapes and sizes. Rectangular scrapers are either 3" x 5" or 2½" x 6" and come in a variety of thickness, usually .020" and .030". Generally, the thicker the scraper, the more heavy-duty work it can handle – jobs like scraping off dried glue or paint. Thinner scrapers allow you to flex them more to prevent the corners from digging in.

Which scraper is best for you? If you'll be doing mostly rough work, a thicker scraper will hold up better. For finer work, use a thin scraper that's easy to flex. As to the size, it depends on whether you push or pull a scraper. I prefer to push a scraper, so I like the longer, narrower variety. Friends who pull a scraper like the 3" x 5" size.

Rectangular scrapers make quick work of smoothing flat or gently curved surfaces. For those jobs where you need to smooth or remove burn marks from a tight curve (such as a moulding), nothing beats a gooseneck scraper.

Burnishers are available in three basic flavors: round, oval or triangular (the one on the right is actually a combination of the three available from Lee Valley Tools). I prefer the oval variety because it can be buffed smooth easily and the slightly flattened profile affords a good grip.

Where to Get a Good Scraper

Finding a good scraper in the past was simple, you bought a Sandvik – the tool's well-deserved reputation for holding a keen edge made it the scraper of choice. The Garrett Wade catalog recently mentioned that Sandvik's scraper has been discontinued. We checked into it, and officials at Sandvik say that's not the case. Call Lee Valley Tools 800-871-8158 to buy a Sandvik for $4.95, item # 97K50.02.

However, choosing a scraper is now more difficult because Lie-Nielsen has come out with a scraper that I'm sure will compete with the Sandvik. The Lie-Nielsen scraper is the same size as the Sandvik and in my opinion sharpens as easily, yet still holds a solid burr. A set of two scrapers (.020" and .032" thick) are available from Lie-Nielsen ($15) at 888-751-2106 or at www.lie-nielsen.com.

Sharpening Supplies

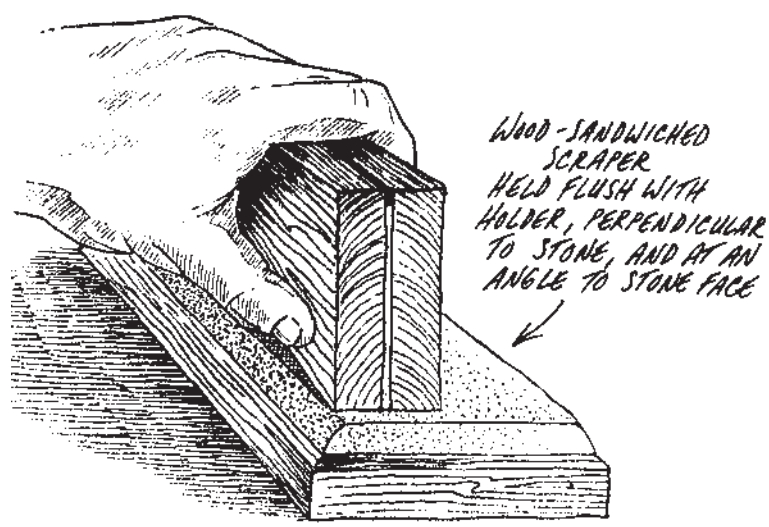
A scraper right from a store has no burr. It is in fact just a piece of metal. It becomes a fine tool once you create the burr. The burr is formed in three steps: filing the edge (to flatten it), honing the edge (to draw the steel up) and rolling the burr with a special tool called a burnisher. A burnisher is nothing more than a piece of tool steel – either round, oval or triangular – fitted with a handle. In order to do its job, it has to be harder than the scraper you're going to burnish and it must be absolutely smooth. I like to polish a new burnisher to a high gloss with a buffing wheel loaded with jeweler's rouge on the grinder .

Sharpening a Scraper

To create a uniform burr, it's essential that the edge of a scraper be flat. The easiest way to flatten it is to use a fine mill file held in a simple jig (see photo 1). A half-dozen strokes of the file will get the job done. Next hone the edges perfectly flat. Start by placing the scraper flat on a sharpening stone (along with the proper lubricant) and rub it in a circular motion to remove any burrs created during filing. To hone the thin edge of the scraper, I first sandwich it between two scraps of wood to make sure the scraper is held perfectly perpendicular to the stone. Then holding the sandwiched scraper at an angle on the stone, I rub it back and forth. (Note: If you don't hold it at an angle, the scraper will cut a groove in your stone.)

Burnishing

Burnishing a scraper is really a two-step process: drawing the edge and rolling the burr. Drawing the edge may seem myste-



A SIMPLE FILING JIG

One of the most critical steps to successfully sharpening a scraper is to first establish an absolutely flat, square edge. For years, I've used a simple shop-made file holder for this. The holder is just a short length of stock with a groove cut in it to accept a mill file. To use the holder, slip a file in the groove (if necessary, insert a paper shim to grip the file and keep it from shifting in the groove). Then with the scraper clamped in a vise, place the face of the wood against the face of the scraper and file in one direction only, lifting the file at the end of the pass. File until you can see a uniformly fresh edge on the scraper.

The first step to sharpening is to file a flat, square edge. Clamp the scraper in a vise and use a shop-made holder to ensure a square cut.

Remove any burrs you created when filing the scraper by placing the tool face down on a sharpening stone and rubbing in a circular motion.

To create a strong burr, first "draw" the burr to consolidate the metal on the edge. Lay the scraper flat and run the burnisher along the edge while held at a 15-degree angle. Go back and forth several times.

With the scraper clamped in a vise and holding the burnisher at a 15-degree angle, press firmly down and run it along the edge. Depending on pressure and the hardness of the metal, two to four passes will usually get the job done.

rious at first, but all you're doing is making it easier to roll a burr. At the same time, you're hardening the steel so the burr will last longer. To draw the edge, lay the scraper flat on the edge of your bench and draw the burnisher (held at about a 15-degree angle) along its edge. A drop of oil, firm pressure and a handful of strokes will do the job. Repeat this on all four edges.

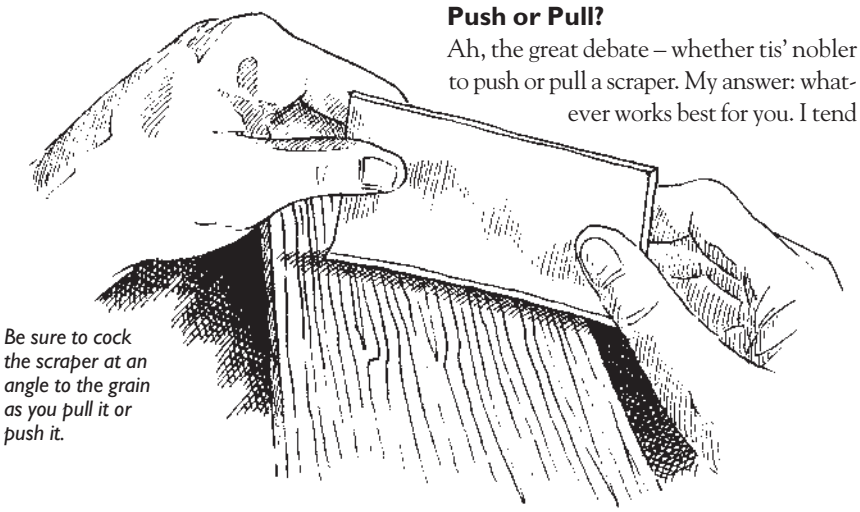
Next, to roll the burr on each edge, start by clamping the scraper in a vise. Now hold the burnisher at about a 15-degree angle and run it along the edge of the scraper. Firm, steady pressure works best – don't go overboard here. If you want a fine burr, stop after two or three strokes. Keep going for a heavier burr. Stop often and check the burr by sliding your thumb gently up the face of the scraper and over the edge. With experience, you'll soon be able to "gauge" the size of the burr.

Using a Scraper

I've often seen someone pick up a freshly sharpened scraper and not be able to get a decent shaving. Why? Rolling a burr isn't an exact science – every time you burnish it the angle changes. This means you have to "find" the best angle to hold the scraper. Quite often, all they have to do to get great shavings is to tilt the scraper one way or the other. It really is trial and error.

Push or Pull?

Ah, the great debate – whether tis' nobler to push or pull a scraper. My answer: whatever works best for you. I tend to push a scraper because it allows me to get more muscle behind it. For delicate work, I often switch to pulling as I feel it gives me finer control and allows better "feedback" from the wood.



Be sure to cock the scraper at an angle to the grain as you pull it or push it.

Regardless of whether you decide to push or pull, you'll have better luck if you flex the scraper. This does a couple things: it keeps the corners from digging into the surface, and it concentrates the scraping action on a smaller section of work. Another trick I often use is to skew the scraper slightly. This prevents it from following uneven surfaces (like planer marks) and quickly levels high points.

Scraping can be hard work, and if you need to remove a lot of material, you'll find the scraper may get too hot to handle – the friction and heat it creates will quickly spread to your fingers. Although I've seen lots of tips on preventing scorched fingers – everything from finger protectors to refrigerator magnets – I offer an alternative. If you have to remove a lot of material, a scraper isn't the best tool for the job. Set it aside and pull out a hand plane. Once the bulk of the material is removed, generate some of those wispy shavings with your new favorite tool. **PW**

VALET

For men, a jewelry box is unthinkable. Yet we still need a place to stow our stuff. This small-scale dresser-top box does the trick.

By Jim Stuard

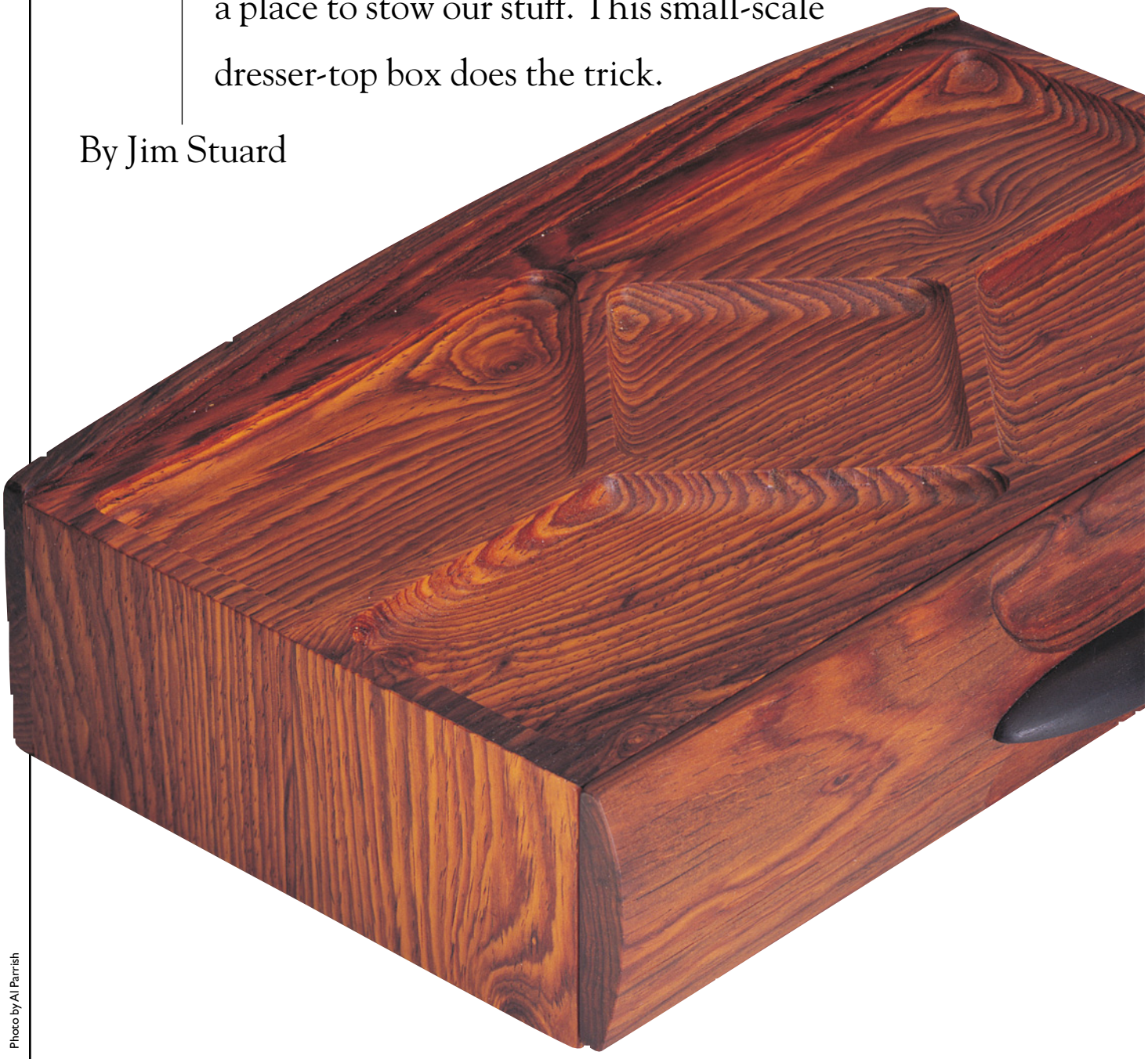


Photo by Al Parrish

SCHEDULE OF MATERIALS: VALET

No.	Ltr.	Item	Dimensions T W L	Material
1	A	Top	½" x 6¼" x 12"	P
2	B	Sides	½" x 6¼" x 2½"	P
1	C	Bottom	¼" x 5⅝" x 11½"	S
1	D	Bottom edge	¼" x ¾" x 11½"	P
1	E	Back	¼" x 3" x 12"	P
1	F	Drw. front	½" x 2½" x 12"	P
2	G	Drw. sides	¼" x 1¾" x 6⅜"	S
1	H	Drw. back	¼" x 1¾" x 10⅝"	S
1	I	Drw. bottom	¼" x 6¼" x 10⅝"	Plywood
1	J	Pull	½" x ⅝" x 3"	Ebony
1	K	Divider	⅛" x 1" x 10⅜"	S
2	L	Divider	⅛" x ¾" x 3⅜"	S
1	M	Dividers	⅛" x ⅝" x 10⅜"	S

P=primary wood • S=secondary wood, such as poplar.

It doesn't matter if I've been in the shop or at a swanky soiree. At the end of the day I empty the exact same contents of my pockets onto my dresser: wallet, knife, keys, change and watch.

Instead of keeping my manly necessities in one of my baseball caps, this valet seemed the perfect solution.

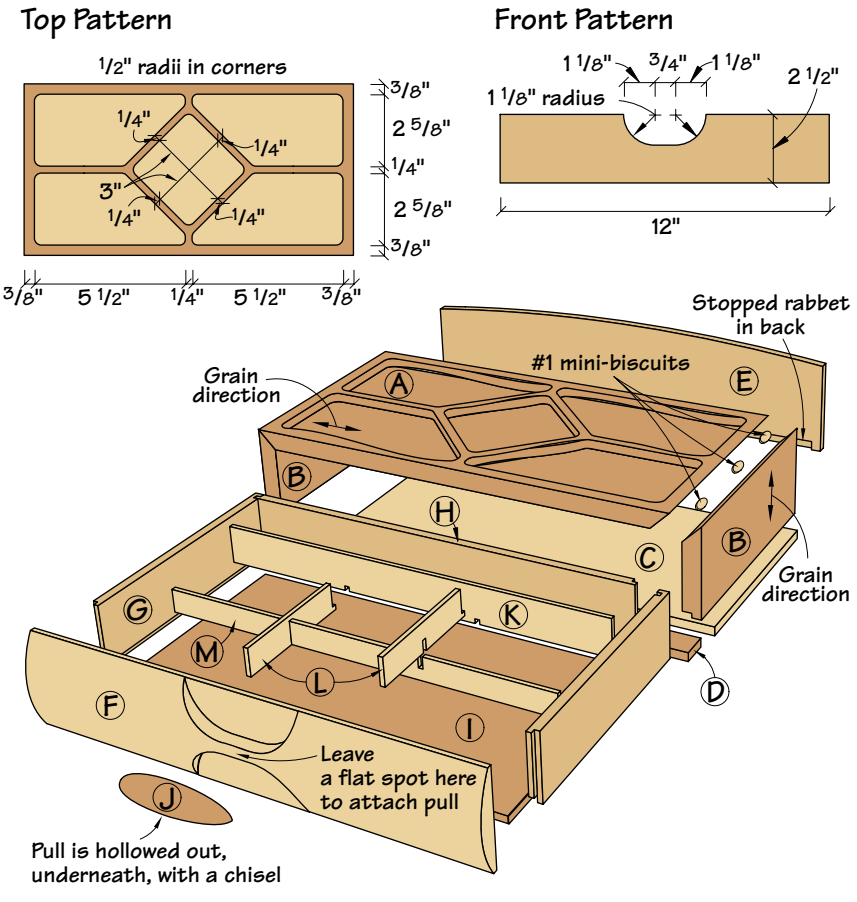
The wood in this project (cocobolo) priced out at $28 per board foot, so I had to be frugal with it. My first step was to make sure I had enough thickness to resaw two ½"-thick pieces from a board. Otherwise I would have to buy ½" stock. It's just too expensive to go shooting chips up a dust collector. Cocobolo is pretty stable, so there shouldn't be much movement after resawing.

Dish Out the Dividers

The next step is to make a template to rout the top. Lay out a full-size pattern from the diagram. Use ½" radii on the corners. The template for the top should be ½" Baltic birch. Make a copy of the pattern so you don't cut up the original. Paste the pattern down using spray mount or some other light adhesive. Don't worry about making sure the pattern is square to the board. You'll fix this after cutting out the holes. Rough cut the openings between the dividers. This is best done with a scroll saw. When you've finished, nail down guide strips, the exact same width as the dividers, right over the dividers in the pattern, and flush rout right up to the guides (see photo next page). After this is done, nail and glue guide strips to the back edge and one end of the pattern. When you place the top in the template, it will be square to the cut-out holes. Always do a test piece on scrap plywood. With a core box bit in your router, set the depth of cut to ¼" beneath the template. A core box bit with a bearing on top will give nice-looking results on the edges. However, because the tip of the bit only touches the bottom of its cut, the bottom will look a little rough from moving the router back and forth. Try to remove as much material as possible with the router; then, after assembly, scrape the bottoms out with the homemade scraper described on the next page.

Make the Case

Once the other box parts are cut out, form a ¼" x ¼" rabbet on the bottom edges of the sides to capture the bottom. Mill a ¼-thick bottom and glue a cocobolo front edge to it. The edge of the poplar bottom requires



The template is made by rough cutting the holes and nailing guides to the lines over the dividers. Clean up the openings with a flush-cut router bit. When done, simply pry the guides off and you're in business.

no prep before gluing, but the cocobolo does. One of the things you need to know about cocobolo is that it's an oily wood. Its oil content will actually weaken a standard wood glue joint, if not make it fail, over time. With the advent of polyurethane adhesives, this problem is basically eliminated. Simply wipe the cocobolo edges being glued with an oil-cutting solvent such as lacquer thinner. Apply poly glue to one edge and moisten the other edge with water, to accelerate curing. The same advice goes for the miters on the box. When the bottom is dry, rip it to finished size, which includes a stub that fits into a rabbet in the back.

Now cut the 45-degree miters on the box top and sides. Lay out and cut mini-biscuit slots in both joints. The only biscuit joiner that will do this is Ryobi's mini-biscuit joiner. The other option is to use a spline in the miter. Just be careful not to cut into where the routed depressions will be on the top. After preparing your joinery, including cutting the bottom to length, glue the box together with poly glue. Make sure the bottom is flush to the front. Because the open time on poly glue is pretty long (15 minutes or more), it's easy to get everything square. When cured, clean out the glue foam that squeezes out. At this time rout the top depressions with your template and clean up the depressions with a small scraper. On the back, cut a stopped rabbet, $\frac{1}{4}$" x $\frac{1}{8}$" by the length of the bottom, and fit it to the bottom sticking out of the box. Cut a 48$\frac{1}{4}$" radius on the back. A simple way to do this is to bend a metal rule, touching both ends and the middle of the back's top edge. Draw a pencil line and saw off the waste. Clean up with a plane. Glue the back in place.

Scraper from the Joint

Taking a cue from some of the tricks used by prison inmates, I used utility knife blades with a ground edge on both bevels to make a serviceable, miniature scraper for the depressions on the drawer front and box top. Simply dull the cutting edge of the blade and grind the bevels square to the sides. Grind a roundover on the sharp corner to get into the $\frac{1}{4}$" radius of the depressions. Wrap the middle with tape to keep a secure grip.

Build the Drawer

I found the best way to get a great fit on the drawer is to cut the front oversize and basically mount the drawer parts to it. Make sure to joint a straight, square bottom edge on the front. Start from the middle and lay out the $\frac{1}{4}$"-deep mortises for the drawer sides and the groove for the bottom. Use a shop-built square to guide a small router with a $\frac{1}{8}$" bit to cut the bottom groove first ($\frac{1}{4}$" up from the bottom edge). The $\frac{1}{4}$" thickness is nominal for birch plywood, so the groove will be closer to $\frac{3}{16}$". Make two passes. Then cut the mortises for the sides. Cut a tongue-and-dado joint as shown in the diagram to hold the back between the sides. Then cut a $\frac{1}{8}$" x $\frac{1}{8}$" rabbet on the inside, bottom edge of the drawer sides and back to match up with the groove in the bottom. This rabbet holds the drawer bottom. When you're happy with the fit of all the drawer parts, glue them together and check your drawer for square.

After the drawer is dry, clean it up and cut the ends flush to the case. Plane the top flush if necessary. Now prepare to rout the two relief cuts on the top and bottom of the front. First cut a template to size according to the diagram. You need to cut the rounded shape on only one side of the template. You can flip the template over to rout the other side of the drawer front. Nail stops to the edge opposite the cutout and the ends to index the template for routing. Rout the relief cuts.

Now form the curve on the drawer front. Make angled relief cuts to remove material on the top and bottom edges of the drawer front. Clamp the drawer in a vise and plane the radius on the front. Leave a small flat spot in the middle of the front for attaching the pull. Cut the pull from a single piece of Gaboon ebony as shown. Whittle and sand it to size and slightly undercut its bottom side. Attach it to the front with poly glue.

Make the drawer dividers from $\frac{1}{8}$"-thick maple and notch them together like an egg crate. When everything has been fit and sanded, apply three coats of clear Watco Danish Oil. After you apply the oil finish, mask off the internal drawer sides from the bottom, and use flocking to line the drawer bottom.

When done, place the dividers in the drawer and you're done. **PW**

Supplies

Woodcraft • 800-225-1153

Black flocking, 16W43 ($8.50).
Black adhesive, 17H31 ($8.50).
Mini flocking gun, 127115 ($4.99).

Dress up your dining room with this Southern delicacy that was used to serve drinks after a hunt. Breeches and jodhpurs are optional.

Classic Six-Legged Huntboard

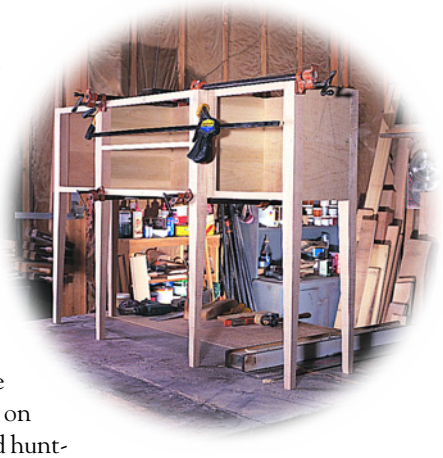


Photo by Al Parrish

My dad has been making this six-legged huntboard for a number of years now, and it's always sold well at the furniture shows we attend. One year he built one for a woman who requested glass knobs on the piece. As most business people know, the customer is always right. Though we weren't sure the glass knobs were right for this piece, we took that huntboard with us to a show to solicit sales anyway. Our first sale that day was for the huntboard. But there was one request: "Could you put some different handles on it?" I'm happy to present here a classic six-legged huntboard with the handles we usually put on the piece.

Quick Tapers for the Legs

The joinery on the huntboard is predominantly mortise and tenon, with all the rails and panels attached to the legs with tenons. The inner partitions are dadoed into the solid back and tenoned into the center legs. Start construction by cutting the legs to size according to the Schedule of Materials.

Each leg is tapered to 1" at the floor, starting 16" down from the top of the leg. The four corner legs are tapered on the two inside edges, but just to make it so you can't use one tapering jig setup (and because it's historically correct) the two middle legs are tapered on the back and both sides. I use a simple tapering jig on my table saw for the four corner legs. Rather

by Glen Huey

Glen Huey builds custom furniture in his shop in Middletown, Ohio, for Malcolm L. Huey & Sons and is a contributing editor for Popular Woodworking. *See his work at www.hueyfurniture.com*

Haunched Tenon Doors

The joinery used in the doors is a little complicated when you look at it, but makes so much sense that once you've done a set, you'll use this method without question.

1 With the rails cut to size, the first step is to define the shoulders of the tenon. With your rip fence set to cut 1 1/4" (don't forget the blade's thickness), cut 1/4" deep on the two wide faces for the rails, and on one edge of the rail. On the final edge, reset the fence to cut 1" and make the cut. This is the haunched part of the joint and will be the outside edge of the door.

2 The next step is to use a tenoning jig (you can see mine has seen a little bit of use) to cut the cheeks of the tenons.

3 The third step is to reset the fence to define the width of the tenon. First cut the full-depth side of the tenon, then reset the blade height and cut the haunched side of the tenon (shown).

4 The last step is to run the groove for the door panel. This same groove process works for the panels in the door section bottoms. When running a centered groove like this, I first make a cut approximately in the center of the piece. Then I adjust the fence and, with a scrap piece, test my cut. By running first one face against the fence, then flipping it and running the other, I am guaranteed the 1/4" x 1/4 groove is centered on the door piece.

When the stiles and rails are assembled, the haunch left on the tenon hides the groove on the stiles, making it unnecessary to make stopped grooves.

My tapering jig is simply a couple of pieces of 3/4" pine screwed to a 1/2" piece of Baltic birch. It is built to cut one particular taper, in this case the taper for a huntboard leg, and is inexpensive enough to be one of many tapering jigs I use. Unlike some tapering jigs, the leg is carried on the 1/2" piece, supporting the leg from bottom and side.

than make a new jig for the middle legs, I mark their tapers, cut them 1/16" proud on the band saw, then run them over the jointer to clean up the cut.

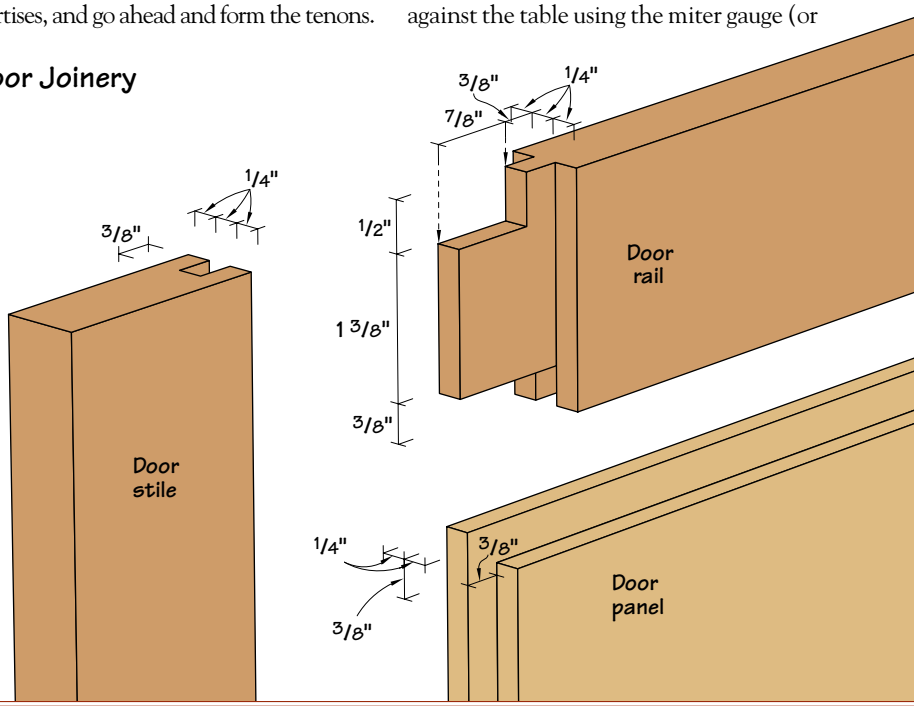
Many Many Mortises

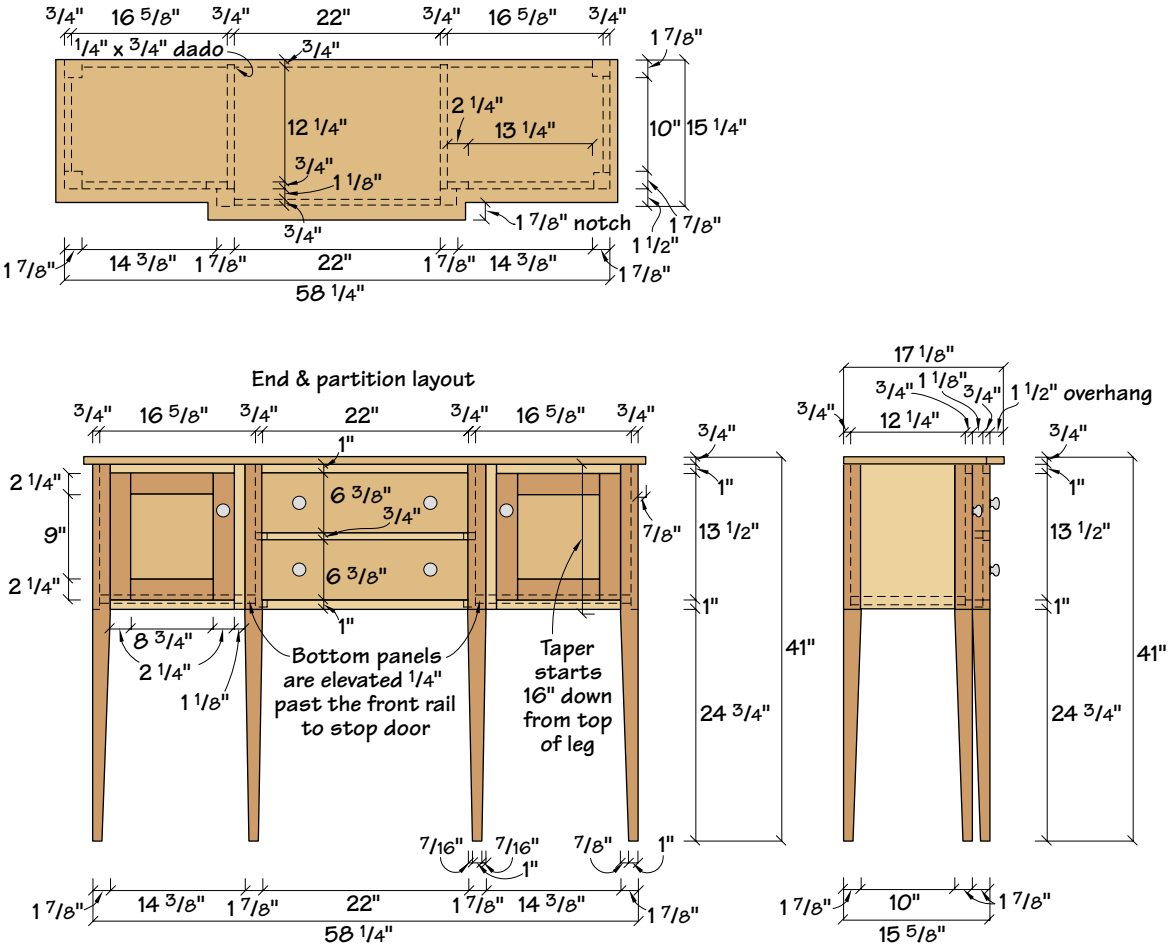
With the legs tapered, take a couple of minutes to glue up panels for the back, ends and partitions. Set them aside to dry. Next, mark each leg for mortises. Where the panels meet the legs there are three 1/4" x 3" x 1 1/4"-long mortises, evenly spaced along the top 15 1/2" of the leg and set so the ends will be flush to the outside face of the outer legs and the partitions flush to the inside edge of the two interior legs. Where the dividers and rails meet the legs, use 1/4" x 1/2" x 1"-long mortises, again orienting the mortises to keep the rails and legs flush to the outside.

With all the mortises cut, unclamp your panels and trim them to final size. Then mark the tenon locations to match your mortises, and go ahead and form the tenons.

If you use your table saw for this step, you'll notice that the back is a little difficult to mount in your tenoning jig without taking out a section of your ceiling. I'd recommend setting your rip fence for the 1 1/4" length of the tenon (don't forget to include the thickness of your blade), set the blade height to 1/4" and run the back flat against the table using the miter gauge (or

Door Joinery





a sled) to support the panel's back edge. Nibble away the rest of the tenon length with repeated saw passes. The rest can be cut with a hand saw.

If you haven't noticed, I'm a fan of solid wood — even on my backs, partitions and bottoms. Along with that appreciation of solid wood comes an appreciation of what solid wood can do when it moves with the seasons. Because of this, trim the width of your tenons on the panels as much as 1/8" per tenon. This should allow room for wood movement. In addition, when you get to the assembly stage, it's prudent to glue primarily the center of the panel, which will allow the ends to expand.

While you're milling the back, set your saw to cut two 1/4" x 3/4"-wide dadoes in the back to accept the ends of the partitions. Other necessary pre-assembly joinery includes mortises in the back of the drawer dividers for the drawer runners. Mark and cut the two 1/4" x 1" x 3/8"-deep mortises in each drawer divider.

There's plenty of work for a mortiser in my shop. To avoid taxing (or damaging) the mortising chisel, make your first two cuts one at either end of the mortise. Then skip a chisel-width space moving toward the center of the mortise, and come back to clear the space you skipped. This keeps the chisel from being bent.

When the door section bottoms are installed they must be notched to fit around the legs. They're attached using ¾" x ¾" cleats attached to the partition and end. Position the cleats so the bottom panel is proud of the door area rail. This allows it to act as a door stop. Screw the cleats in place. Then peg the bottom in place through the ends and partition.

How Many Clamps Do You Have?

You're now ready to assemble the case. You're going to need at least four clamps; more if you want a quick assembly. Start by attaching the three drawer dividers between the two center legs. Next attach the partitions between the drawer face assembly and the back piece. Clamp this up and set it aside to dry. If you own enough clamps to continue, glue up the two end panels between the front and rear corner legs. The final step is to glue the end assemblies to the back piece, and to attach the door area rails to the mortises in the legs, and the door area stiles. Screw the stiles in place to the back of the middle legs. Pre-drill a clearance hole and pilot drill the leg to avoid splitting.

Doors and Drawers

With the case assembled, turn to making up some frame-and-panel pieces — the doors and the bottoms of the door sections. I used a half-lapped frame and panel assembly for the bottoms in the door sections. The panel is rabbeted and rests in a ⅜" x ⅜" groove in the rails and stiles. By using a frame-and-panel bottom, I again help alleviate any problems caused by wood movement, while still using solid wood throughout the piece.

The doors are frame-and-panel as well, but are assembled with haunched mortise-and-tenon joinery, again with a rabbeted panel, with the recessed face showing to the outside of the cabinet. For both the bottoms and the doors, glue only the rail and stile joints, allowing the panels to float in the grooves.

While the doors and bottom panels dry, move back to the case and remove the clamps. To add strength and to enhance the appearance of the piece, I peg each of the mortise-and-tenon joints with squared oak pegs. Sharpening one end of the peg in a pencil sharpener allows me to start

The most complicated joinery location on the piece. Shown here is the intersection of the left, middle leg, with the partition, top drawer divider, and left door section stile and top rail. Once you get a good look, you can see it's simple.

SCHEDULE OF MATERIALS: CLASSIC SIX-LEGGED HUNTBOARD

Case

No.	Ltr.	Item	Dimensions T W L	Material	Comments
1	A	Top	¾" x 17⅛" x 60"	P	
6	B	Legs	1⅞" x 1⅞" x 40¼"	P	
2	C	Ends	¾" x 15½" x 12½"	P	1¼" TBE
2	D	Partitions	¾" x 15½" x 14½"	S	1¼" TOE
1	E	Back	¾" x 15½" x 57"	P	1¼" TBE
2	F	Drw. dividers	¾" x 1" x 24"	P	1" TBE
1	G	Center divider	¾" x ¾" x 24"	P	1" TBE
4	H	Drwr runners	¾" x 1¼" x 14⅜"	S	⅜" TOE
2	I	Door area stiles	¾" x 2¼" x 15½"	P	1⅛" Exposed
4	J	Door area rails	¾" x 1" x 15¼"	P	1" TBE

Door and Drawer Parts

No.	Ltr.	Item	Dimensions T W L	Material	Comments
4	K	Door stiles	¾" x 2¼" x 13½"	P	
4	L	Door rails	¾" x 2¼" x 11¼"	P	1¼" TBE
2	M	Door panels	½" x 9⅜" x 9⅝"	P	⅜" TAS
4	N	Drw. sides	½" x 6⅛" x 13½"	S	
2	O	Drw. backs	½" x 5⅜" x 22"	S	
2	P	Drw. fronts	⅞" x 6⅜" x 22"	P	
2	Q	Drw. bottoms	⅝" x 13¾" x 21½"	S	

Door Section Bottoms

No.	Ltr.	Item	Dimensions T W L	Material	Comments
4	R	Stiles	⅞" x 3" x 16⅝"	S	½ lap BE
4	S	Rails	⅞" x 3" x 12¼"	S	½ lap BE
2	T	Panels	⅞" x 6⅞" x 11⅜"	S	⅜" TAS
4	U	Cleats	¾" x ¾" x 12"	S	

TOE= tenons one end, TBE= tenons both ends, TAS = tenons all sides • P = maple, S= poplar

the peg in a round hole and end up with a visible square peg. After the joints are pegged, cut them flush and give the entire case exterior a thorough sanding.

When the doors are dry, use the same pegging technique, then sand the doors and bottom panels.

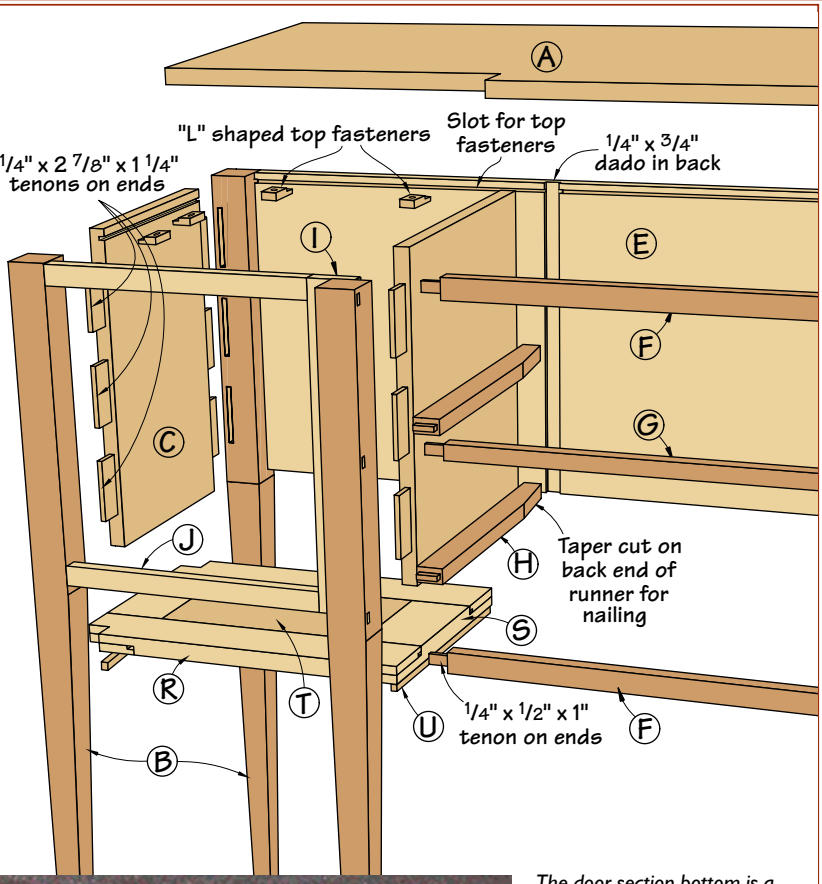
Next make the two drawers. They are constructed using half-blind dovetails on the front and through-dovetails at the back. The bottoms are solid panels raised on the table saw to fit into ¼"-wide x ¼"-deep grooves in the drawer sides, fronts and backs. The groove is cut ½" up from the bottom of each piece. If you do this on your table saw, make sure the groove is aligned properly with the dovetails to hide the groove at the joints.

The drawers ride on runners attached to the inside surface of the center partitions. Each runner has a tenon on one end that fits into the mortises cut earlier in the back of the middle and lower drawer divider. I taper the back end of each runner to make it easier to nail the back end in place to the partition, once the proper alignment is achieved.

Across the Finish Line

The last piece is the top itself. Glue up the pieces necessary, leaving them slightly oversized until dry, then cut the top to finished size. To attach the top to the case, I use "L"-shaped fasteners that I make myself. One end of the fastener is screwed to the underside of the top, and the other fits into slots cut on the inner surface of the case with a router and spline cutter. Don't push the tongue of the fastener all the way into the groove to allow for wood movement in the top from front to back. The front edge of the top is attached by screws run up through the top rails in the door and drawer sections.

Before finishing, attach the hardware for the doors, mortising the doors to accommodate the hinges. Test the doors and trim to fit if necessary.

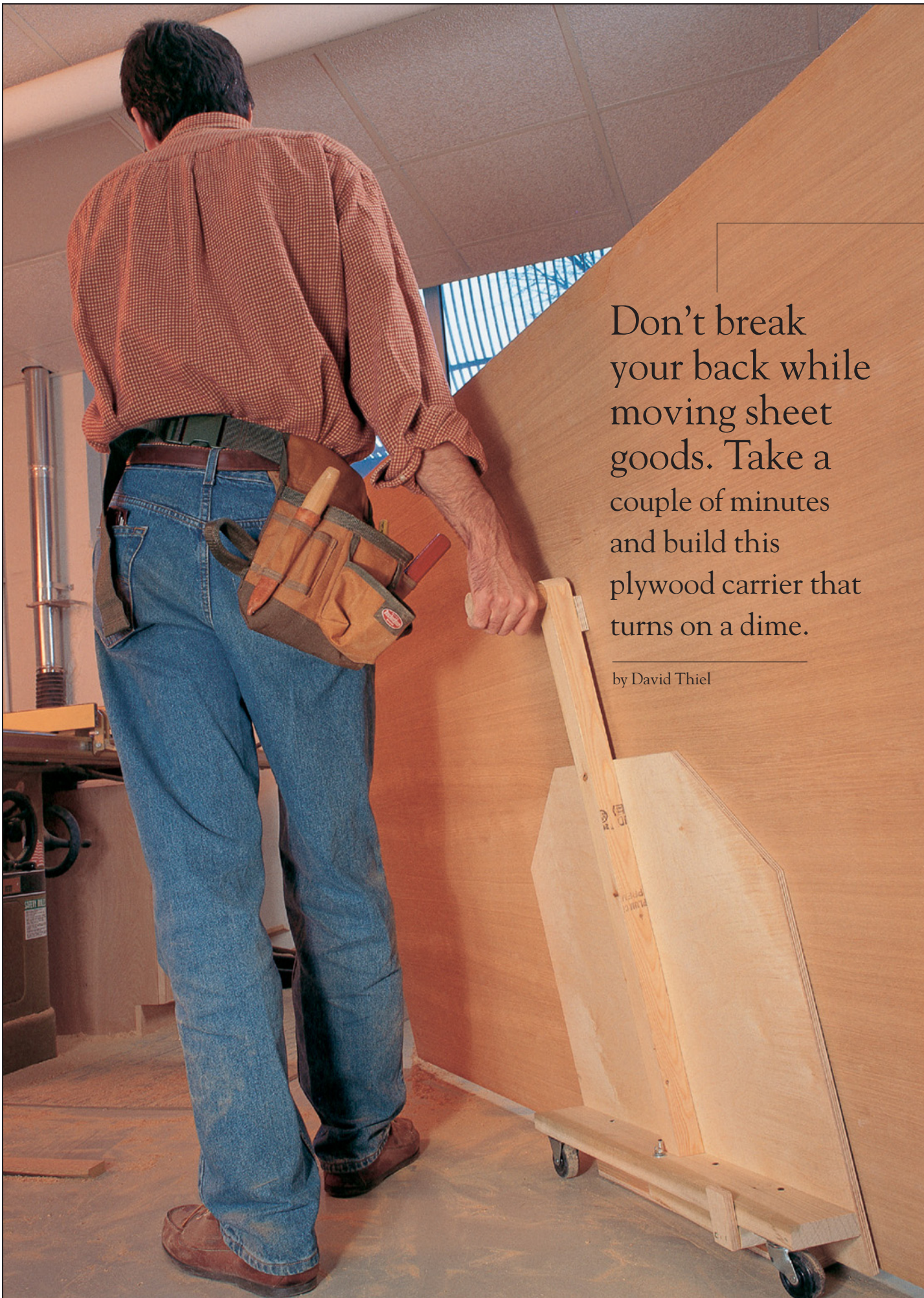


The door section bottom is a half-lapped frame and panel. Seen from the ends, the two frame pieces show the center groove for the panel, and the half-lap cut. Seen below the pieces is the assembled frame ***(left).***

Happy that I got everything glued up on the case by myself, I'm ready to mount the drawer runners on the inside of the center drawer section ***(below).***

The finish itself is one I use on all my pieces. I start with a water-based aniline dye. I used Moser's Early American Cherry (Woodworker's Supply, 800-645-9292, item #W14304, $11.70) on the piece shown here. Once the dye is dry, lightly sand the entire piece to remove any raised grain, then spray the piece with sanding sealer and five coats of lacquer.

The hardware that I like for this piece is simple brass (unless someone wants glass.) I used two H-97L 1¼" knobs for the doors and four K-12 1¼" knobs for the drawers. All are available from Horton Brass (800-754-9127). Of course, if you prefer a nice glass knob, there's nothing wrong with that. The customer is always right. **PW**



Don’t break your back while moving sheet goods. Take a couple of minutes and build this plywood carrier that turns on a dime.

by David Thiel

Plywood CARRIER

The big problem in a one-man shop is there's only two hands and one back. And that one back gets tired after years of lugging sheets of plywood around (or worse, particleboard). I was flipping through an industrial material handling catalog (I really need to get a life) when I saw a metal cart designed to carry sheet goods. The light bulb went off, and I headed to the shop.

After two tries I came up with this design that moves sheet goods easily, has a tight turning radius (for small shops) and a kickstand to hold the sheet in place while I get into a non-back-injuring position to throw it up on the saw.

The idea is simple, made from shop scraps and glued and screwed together. It all rolls on one fixed caster and one swivel caster for super maneuverability. I purchased the casters from a home center store right off the rack. They shouldn't set you back more than $10. To make the swivel caster swing properly, the entire rack is canted 10 degrees, so you only need to tip the carrier a degree or so to make movement possible.

Begin construction by cutting the mounting block and support block to size, beveling one edge to 10 degrees on each piece. In gluing and screwing the pieces together, I recommend pre-drilling clearance holes to avoid splitting the wood, and to generally make things easier. Screw the two pieces together, centering the support block on the mounting block as shown in the diagram. Next, attach the carrier lip to the support block. You will find that beveling or rounding over the back edge of the carrier lip will keep it from dragging while the carrier is in motion. Use a router or block plane to soften this edge.

Now mount the casters to the mounting block as shown. The closer to the back edge, the easier the "tip" will be. Next I trimmed 6" x 6" corners off the top of the back panel to reduce the weight. You're now ready to screw the back panel in place to both the support and mounting blocks. It's not a bad idea to run a couple of nails up through the carrier lip into the back panel as well.

With the back panel in place, cut a 10-degree bevel on the bottom end of the handle and, if you choose, round over the top to match the shape of the dowel-stock grip. Attach the handle to the center of the back panel, then mount the grip to the top of the handle. Use a long and heavy screw to support the grip, as this is where much of the stress occurs.

You're almost ready for a test drive, but first, add the little spacing block to the front side of the handle at the top. This will keep a full 4' x 8' sheet from trying to "walk" off the leading edge of the carrier lip.

The last step is to add the kickstand. This is simply a piece of poplar radiused at one end and bolted to the underside of the mounting block. A small "handle" is attached to the opposite end of the stand so the stand can be reached and extended easily.

You're ready to roll. It might take a little practice to get the feel of the proper "tip" angle for best performance, but after a sheet or two you'll get a handle on it — get it? The handle. Sorry. Anyway, enjoy your project and save your back. **PW**

SCHEDULE OF MATERIALS: PLYWOOD CARRIER

No.	Let.	Item	Dimensions T W L	Material
1	A	Back panel	½" x 24" x 24"	P
1	B	Carrier lip	½" x 3½" x 18"	P
1	C	Spacing block	½" x 1½" x 2"	P
1	D	Support block	1½" x 2" x 18"	S
1	E	Mounting block	1" x 3½" x 24"	S
1	F	Handle	1½" x 1½" x 32"	S
1	G	Grip	1½" dia x 4"	S
1	H	Kick stand	1" x 1½" x 9"	S
1	I	Kick handle	½" x 1½" x 2½"	S

P=plywood • S=solid wood

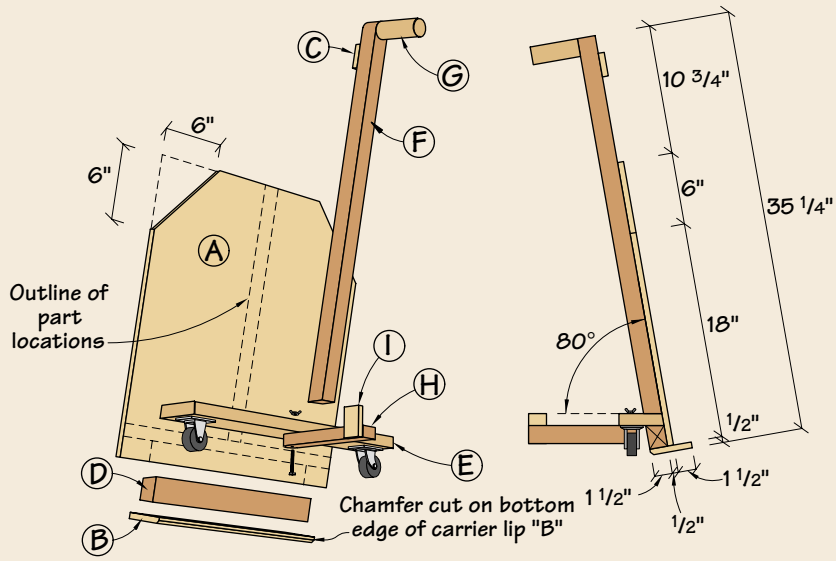


Photo by Al Parrish

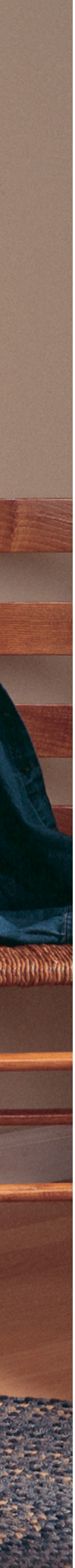


Photo by Al Parrish

frame & panel dresser

Learn to build this case piece using web-frame construction and traditional drawer guides. The result looks great stuffed with your cable-knit sweaters.

Stylistically, this dresser is a bit of a chameleon. It tends to take on the look of the environment you put it in. Dress it up or dress it down, it will work in either a country or city setting. Even if you don't plan to build this piece, read on to learn how to build a case piece with web frames, a sturdy way to build furniture with drawers.

I built this project using yew, a beautiful wood with pin knots that add character. It's dense, strong, tight-grained and finishes spectacularly. That said, it will be tough to find if you don't live in the Pacific Northwest. Because you're unlikely to find yew at a traditional lumberyard, you might want to use alder or cherry instead. And if you do find yew for sale, bring your moisture meter to ensure it has been dried properly.

Begin construction by cutting out the parts according to the Schedule of Materials. Glue up a top and set it aside. If you're using yew, it would be wise to make the top from three or four boards to reduce warping.

by Jim Stuard

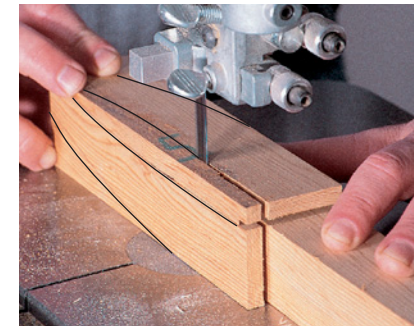
End Assemblies

The next step is to make the legs. While the legs finish out at 1½" square, they need to start out close to 2" square to accommodate the curved foot. Using ⅝ lumber should yield 2" x 2" stock for the legs. If not, don't worry, a little smaller than that is OK. Follow the photo and caption at right to first shape the foot on each leg and pare the leg to 1½" square.

Next, rout ¼" x ½" rabbets in the back inside corners of the legs to receive the back. With that step complete, lay out the stopped-groove and dowel locations for the side rails and panels according to the diagram. The grooves are made with a router, and they are a little deeper than required to let the panel float in the frames created by rails and legs. The dowel locations (two per rail) are directly in the center-line of the rails.

The easiest way to make the rails for the sides is to run out longer rail lengths, then cut the ¼" x ¼" panel groove according to the diagrams. The top and bottom rails only get a groove on one side of the rail, so make one length for the top and bottom rails, and another length for the center rails with two grooves. Before cutting the rails to length, glue your drawer guide stock to the rail stock. Then cut this assembly to consistent lengths according to the schedule. The rails are positioned flush to the inside of the legs, so lay out the dowel locations accordingly and begin drilling the ¼" dowel holes into the rail ends and the legs. To run the grooves, set up a ¼" mortising bit in a plunge router. Using a fence on your router, plunge rout the ¼" x ¼" grooves in the legs, between the dowel locations.

To form the panels, first cut them to size, then simply rout the edge profile on a router table. I used a ¼" cove bit, running the panels up on edge and taking off just enough material to leave a ¼" lip that fits into the grooves in the legs and rails. Incidentally, the drawer fronts are routed in the same manner, so don't change the setup yet. I found that a curved-edge scraper works well for cleaning up the profile.



Make full-size patterns of the leg profiles in the diagram. Lay out the pattern on the leg ends. Use a table saw to cut the straight sections of the legs to 1½" square. Use a hand saw to cut off the waste and finish the cuts on a band saw. Clean up the curved feet with a spokeshave and scraper.

You're now ready to glue up the two ends. Make sure that the inside of the rails and drawer guides are flush with the inside face of the legs. This makes for tighter joints when the web frames are attached.

Web Frames

The web frames pull the entire carcase together and also serve as drawer runners. They're attached between the two end panels using screws run into pocket holes on the underside of the web frames.

To build the web frames, attach the front and back rails to the web ends and center support using biscuits.

What You Should Know About Yew

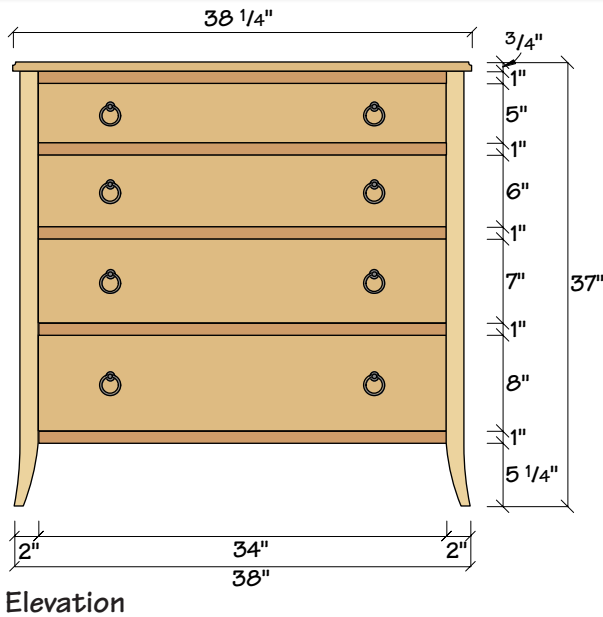
Yew *(Taxus brevifolia)* is also called Pacific yew or Western yew and grows all the way from southeastern Alaska down to central California, according to Woods of the World. It's commonly used to make bows, furniture, musical instruments, paddles and in turning.

Yew has a close grain that varies from straight to irregular. The heartwood is bright orange after it's cut, and the wood polishes nicely. Avoid using oil finishes on yew because oil is reported to turn the wood a chocolate tan, instead of the deep orange achieved with film finishes, according to Woods of the World.

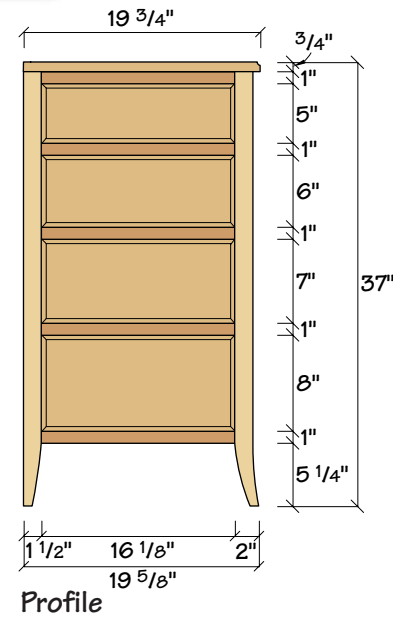
Yew takes a screw well, but it tends to split when nailed. The wood is weather-resistant and can be used in outdoor projects that are left unfinished.

Sawdust causes nose irritation and swollen hands in some woodworkers. Most parts of the tree are poisonous, including the seeds and foliage. Ingestion can result in death.

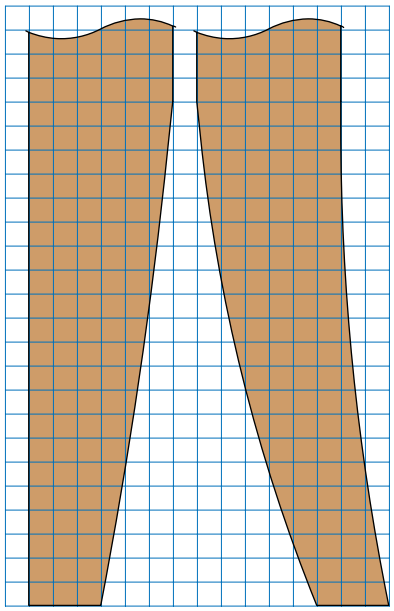
European yew (*Taxus baccata*) grows in Europe, north Africa and the Himalayas. It was used for centuries by the bowmen of England. Its veneer is prized for paneling, cabinetwork and marquetry.



Elevation



Profile



Rear Leg, Side View (1 sq.=1/4")

Front Leg (both views), Rear Leg, Front View

First cut the web frame pieces to size. Then drill three pocket holes into each frame end. These accommodate screws to attach the frames to the panel ends.

It's important for the web frames to be square, or the whole carcase assembly will go badly. Try this simple trick. Make the front and back rails 1/8" long. After assembly, the web frame can be squared-over and then cut to length by crosscutting on the table saw. This ensures consistent widths and squareness and won't affect assembly.

Carcase Assembly

With the web frames glued up and the end panels ready to go, you're ready for assembly of the carcase. Mark the locations of the web frames on the end assemblies as shown on the diagrams. Then follow the photos on the next page to glue and screw the carcase together. Set the carcase upright and check for square. Any adjustments can be made by placing a clamp across the carcase at an angle that will pull it square. When the carcase is dry, clean up any glue that may have collected in the corners next to the drawer guides and tack in the back to hold everything square.

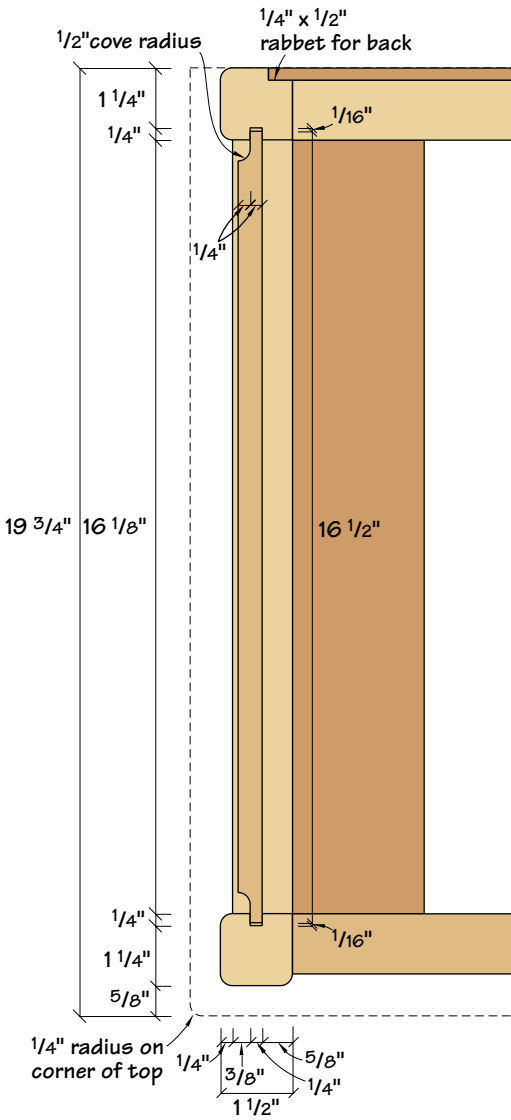
Now you're ready to dry-assemble an end panel. After checking the fit of the panels, do it all over again with glue. Make sure to check the assembly for square after it's clamped together.

The Top

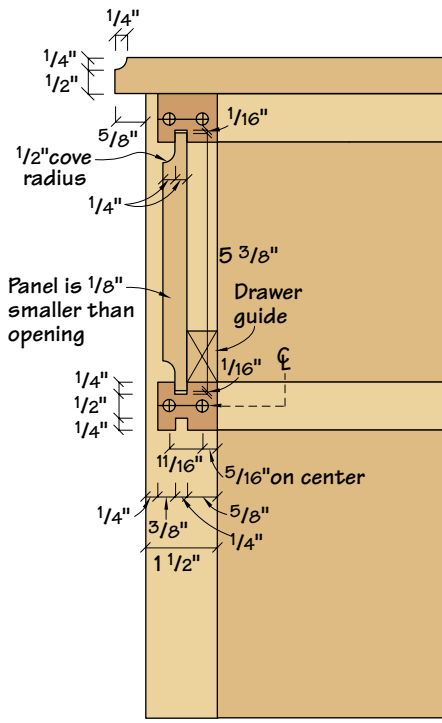
After cutting the top to size, radius the front corners with a 1/2" roundover bit. With a 1/4" cove bit, rout a 1/4" x 1/4" cove in the top edge, on the ends and front.

When you attach the top, you'll see that the web frames don't allow enough room to get at the screws easily. So turn the carcase over and drill three 1/2" clearance holes each in web end and center piece of the second web frame down from the top. You'll only be able to drill your clearance hole at an angle, but that's OK because the hole is used only to get at the screws that attach the top to the web frame.

I used a couple four-way screwdrivers to run the screws in. The trick is to remove the barrel from one screwdriver and attach



End Panel, Plan View

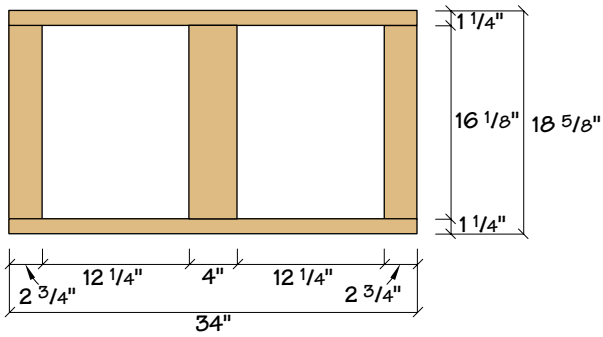


End Panel, Elevation

Schedule of Materials: Frame & Panel Dresser

No.	Item	Dimensions T W L	Mat.	No.	Item	Dimensions T W L	Mat.
1	Top	3/4" x 19 3/4" x 38 1/4"	P	1	Drwr front	3/4" x 4 15/16" x 33 15/16"	P
2	Front legs	2" x 2" x 36 1/4"	P	2	Drwr sides	1/2" x 4 15/16" x 17 5/8"	S
2	Back legs	1 1/2" x 2" x 36 1/4"	P	1	Drwr back	1/2" x 4" x 33 7/16"	S
10	Web ends	1" x 2 3/4" x 16 1/8"	S	1	Drwr front	3/4" x 5 15/16" x 33 15/16"	P
5	Frt web rails	1" x 1 1/4" x 34"	P	2	Drwr sides	1/2" x 5 15/16" x 17 5/8"	S
5	Bk web rails	1" x 1 1/4" x 34"	S	1	Drwr back	1/2" x 5" x 33 7/16"	S
5	Web centers	1" x 4" x 16 1/8"	S	1	Drwr front	3/4" x 6 15/16" x 33 15/16"	P
10	Dividers	1" x 1 1/4" x 16 1/8"	P	2	Drwr sides	1/2" x 6 15/16" x 17 5/8"	S
10	Drwr guides	5/8" x 1" x 16 1/8"	S	1	Drwr back	1/2" x 6" x 33 7/16"	S
2	Panels	1/2" x 5 3/8" x 16 1/2"	P	1	Drwr front	3/4" x 7 15/16" x 33 15/16"	P
2	Panels	1/2" x 6 3/8" x 16 1/2"	P	2	Drwr sides	1/2" x 7 15/16" x 17 5/8"	S
2	Panels	1/2" x 7 3/8" x 16 1/2"	P	1	Drwr back	1/2" x 7" x 33 7/16"	S
2	Panels	1/2" x 8 3/8" x 16 1/2"	P	4	Drwr botts	1/4" x 17 1/2" x 33 7/16"	Ply.
1	Back	1/4" x 35" x 31"	Ply.	10	Drwr stops	1/4" x 1 1/2" x 1 1/2"	Ply.

P=primary wood; S=poplar



Web Frame, Plan View

Assembling the carcase is a simple matter of setting an end panel on its side and screwing the web frames in place with glue. Make sure the back edge of the frame is flush with the inside of the rabbet on the panel leg. The bottom edge of the web frame end is also flush with the bottom edge of the rails on the end panel ***(top).*** *Lay the top, bottom side up and place the carcase, upside down, on the top. Line up the carcase, flush to the back and centered on the top and mark the location. Tap a nail into the screw slot centers, marking the screw location. Remove the carcase and drill pilot holes into the top. Place the carcase on the top again and attach the top with #10-1 1/2" pan-head screws* ***(left).***

it to the bit from the first, making a extra-long screwdriver. Use this "super" driver to mark a point on the top web frame, positioning the screw location as close to the end of the top as possible.

With the location marked, lift the carcase off the top and make clearance-screw slots to accommodate wood movement in the top. Drill out the 3/4"-long elongated slots in the top web frame by using a 1/4" bit. Drill three holes and connect them, forming a slot, by wiggling the bit back and forth. Also, drill four countersunk clearance holes in the front rail of the top-web frame. This keeps the top indexed to the front of the dresser. Now attach the top.

Drawers

Measure the drawer openings in the carcase and compare them to the drawer front sizes in the Schedule of Materials. If all went well, your drawer openings shouldn't be more than 1/16" larger than the length and height of the fronts. The drawers are held together by dovetail joints, and unless you want to hand cut the drawer dovetails, I recommend Troy Sexton's method for cutting half-blind pins that uses a router and a custom template you can make quickly with your table saw (September 1999 issue). After cutting and fitting the tails, cut a 1/2" x 1/4" rabbet in the back end of the drawer sides to accommodate the back piece, which will be nailed between the sides. Then cut a 1/4" x 1/4" groove 5/8" up from the bottom edge of the drawer sides and front, to accept the bottom.

To make the drawers match the side panels, rout a 1/4" cove profile on the drawer fronts. The final preparation before assembly is to take a 1/16" jointer cut on the top edge of the drawer sides and back for clearance in the drawer opening.

Assemble the drawers by gluing the dovetail joints together and nailing the backs between the sides into the rabbets. Fitting is a matter of taking material off the sides or the edges of the front with a sharp plane. When the drawers are fit and the stops installed (see story below), remove the back. Sand everything to 150 grit and apply two or three coats of clear finish. Clear finish produces a distinctive warm, orange tone. Oil finishers beware. Oil finishes can turn yew a chocolate brown. So you might want to try a sample board and make sure it's what you want. **PW**

PLACING AND INSTALLING DRAWER STOPS

Where you put your drawer stops is critical. Here's the right way to do it.

Set the drawer stops by measuring the thickness of the front at both sides of the drawer.

Mark these distances on the web frames with a sharp pencil. Make an additional mark 3/4" away from the drawer guide to provide clearance for the drawer side.

Apply glue to the stop and set it on the web frame up to the pencil marks. Nail it in place and check the location by sliding a drawer up against it. If it's too far forward, do some fitting with a chisel. If it's too far back, it's not too soon after shooting it into place to remove it and try again.

SUPPLIES

Van Dyke Supply Co. Inc.
800-843-3320
Traditional 1 5/8" x 1 7/8" pull • set of eight • item # 60030 • $4.45 each

SHAKER-STYLE Rocking Chair

If you've ever wanted to try your hand at traditional chairmaking,

here's how you cut the power cord and get started on this hand-hewn classic.

The first thing to say about making chairs is they are hard to do. Chairs need to be strong because they get moved around a lot. There isn't always a lot of wood thickness to make the joints, and if you don't get them right, sooner or later the chair will break or fall apart. Aside from the structural demands, comfortable chairs need to conform to and support the human body in a balanced posture. Having taken care of all this, good chairs should be attractive because they stick out into a room and generally get looked at a lot.

Chairs don't design well on paper, especially post and rung chairs. The critical elements that make a well-balanced chair can't really be understood until you've sat on what you've made. For this reason I usually start my students off by suggesting that they plan on making half a dozen chairs rather than expecting to get everything right the first time. There are curves and bends that I don't even measure; I just know what feels good and where it should go. This comes only with practice.

I made my first rocking chair about 18 years ago working from measured drawings from the rocking chairs at Mt. Lebanon's Shaker community. I was not at all pleased with the way my first chair sat. So, through a process of trial and error that lasted about four years, I finally got to a point were I was well pleased.

If I haven't scared you off, and you would still like to try your hand at making a good rocking chair, I'll give you my best advice and the necessary information on how to make one of my Shaker-style rocking chairs.

Selecting the Wood

For the necessary strength in a chair, I use hardwoods with a good straight grain. White oak, hickory and sometimes ash. Maple would make a nice chair but it doesn't grow well here in Arkansas. The size of the growth rings make a difference, too. Slow growth wood is weak and brittle, and

by Owen Rein

Owen Rein has been making chairs professionally in this manner for 15 years and teaches chair making. You can write to him at P.O. Box 1162, Mountain View, AR 72560

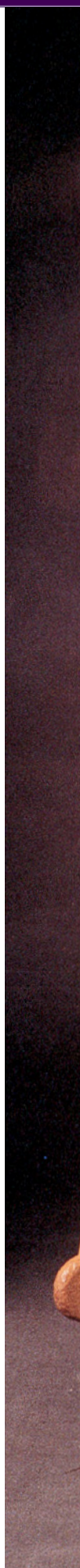


Photo by Larry McSpadden

wood that grows too fast is sometimes hard to work and has a greater tendency to warp and check while drying. Because of this I don't like to use wood that has growth rings much smaller than 1/16", or larger than 3/16".

I always make my chair pieces from green wood and let them season before they are assembled. Along with other advantages in this process, it's important to assemble the chairs while the wood in the legs is a little green, but the spokes should be very dry. If done right the joints shrink tight and the spokes won't ever come loose. If green wood isn't convenient, dried wood can be used if properly glued.

The jigs I use are fairly simple 2x material with blocks added to space and shape the pieces. Two sets of back rails are shown. The jigs for the back legs are even simpler.

Making the Pieces

I split out my green pieces from the log and shape them with a drawknife. If this is too rustic for you, you could use a table saw to cut pieces from milled lumber and shape the pieces on a lathe.

I start by making the back legs, starting with 1 5/8" square by 48"-long stock, tapering the square pieces on the inside and front faces. Orient front and back on the legs so that the growth rings run side-to-side, not front-to-back. Start the taper 20" up from the bottom and end with the top at 1 1/8" square. Then bevel the edges on the whole leg so that it is an even octagon in cross-section (this brings you halfway to being round, but still leaves you with sides).

Make the front legs about 24" long and 1 5/8" square with the edges beveled to also form an octagonal shape.

Now prepare all the spokes. If you're working green wood, make the spokes longer than necessary and trim them to length later. The front seat spoke and the top and bottom spoke for the back need to be the thickest, about 1 1/8" in diameter. The other seat spokes can be from 1" to 7/8", with the rest of the spokes finishing not less than 3/4" in diameter. All these pieces have their long edges beveled to an octagon shape.

Care should be taken when making the two side rails for the back because they will receive a compound bend. Make these two pieces about 5/8" x 1 1/8" x 26". The extra length helps during bending. The growth rings should run parallel to the width (which will end up being the front and back faces of the rails). Selecting the wood for pieces that will be bent is important. The grain should be clear and straight with no small growth rings. Bevel these as octagons as well.

The two back legs and the two side rails for the back are put in the bending jigs right after I make them. The green wood bends easily and I don't need to do any preparation other than follow the grain and keep the dimensions even. The back legs are placed in the bending jig so the growth rings are perpendicular to the sides. The top of the legs are bent back about 5"- 6". Use the scaled diagram to lay out and build a jig for the back side rails.

I mark the date on the pieces after they're in the jigs and set them aside for a month. Even after this time, the wood will be green enough to contract on the tenons and form a solid joint. If you use milled lumber, I would suggest steaming the pieces to be bent for about 20 minutes before putting them into the jigs.

Most woodworkers don't list a hatchet as part of their tools, but when I'm chopping out the shape for the top slat it's my best friend.

Now turn to the other pieces. Cut the arms, the top slat and the two rockers. Again use the templates to shape the rockers and the top slat.

Making the Joints & Assembling the Frame

Start by taking the two extra thick spokes for the back (H) and taper the ends starting about 2½" from the end down until the end is a little more than ⅝" (this is done so the thick spokes will be more graceful where they meet the back legs).

Next, cut a ⅝"-round tenon on both ends of each of the other spokes. On all but one of the spokes these tenons are 1" long. The top spoke for the back panel has ¾"-long tenons to accommodate the taper in the back legs. Chamfer the ends of the tenons, bevel the shoulders and cut a "locking ring" (see photo) around the middle of the tenon. My favorite way of cutting these tenons is on a foot-operated reciprocating lathe.

Fitting the back together is tricky and needs to be done carefully because the joints are small and there isn't a lot of wood to work with.

First, drill ½" centered holes 4" from each end in the bottom spoke. Drill the holes as deep as you can without poking through the other side. With a ¼" mortising chisel cut out the corners and make the hole square (this is done to help keep the side rails from twisting).

Take the side rails out of the bending jig. Adjust the curves to match and trim the tops if necessary. Measuring down from the tops, cut the rails to 19½" long. Cut square tenons on the bottom end of each rail to fit the mortises cut into the bottom spoke. Mark each side rail and each mortise so that you will know which goes where.

Repeat this process with the top spoke and the top ends of the side rails, drilling the mortises in the top rail 3½" from the ends.

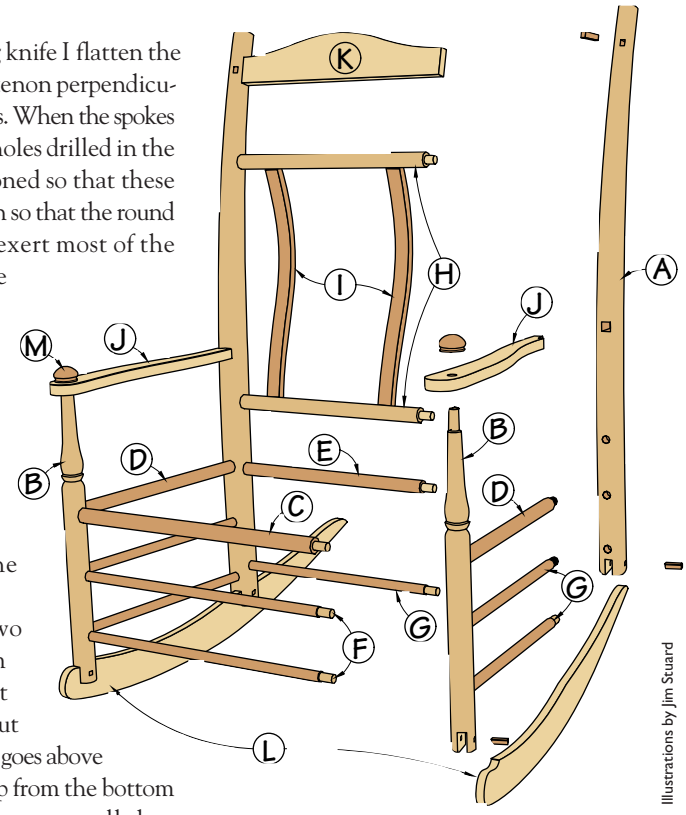
After the joints are made I round off all the spokes with a half-round spokeshave. The side rails I round off with a carving knife. With the seat spokes and the back it is important to do a good job rounding the pieces because sharp corners will cause increased wear on the weaving. I taper the spokes that go below the seat slightly towards the ends leaving small, even shoulders.

With my carving knife I flatten the sides of each round tenon perpendicular to the growth rings. When the spokes are driven into the holes drilled in the legs they are positioned so that these flats run up and down so that the round parts of the tenon exert most of the pressure towards the top and bottom of the leg, to avoid splitting the leg. Lastly, all the spokes that will be exposed are rubbed down with a handful of shavings to burnish the spokes.

Now take the two front legs and trim their bottoms flat. At this point I rough out the vase turning that goes above the seat. Mark 15" up from the bottom and cut a ¼"-deep saw cut all the way around the leg. While holding the leg in a draw-horse, I use a push knife to carve a valley about 1" wide with the saw cut at the bottom of the valley. Next, I use a drawknife to taper the top end of the leg down to about ⅞", trying to leave a pleasing "bulb" look above the valley.

Decide which leg will go on which side of the chair. Then, with the legs side by side, orient the grain so that the growth rings are at an angle to each other (not parallel or perpendicular) and the youngest growth rings are on the outside corners where the seat will be. This is done to help prevent splitting.

Measure up from the bottom 12½" and make a mark for the top (seat) spoke. The middle spoke goes at 8" up from the bottom. The bottom spoke goes at 3½" up from the bottom.



Illustrations by Jim Stuard

Schedule of Materials: Shaker Style Rocking Chair

No.	Letter	Item	Dimensions T W L	Material
2	A	Back legs	1⅝" dia. x 48"	W. Oak
2	B	Front legs	1⅝" dia. x 24"	W. Oak
1	C	Seat front spoke	1⅛" dia. x 22"	W. Oak
2	D	Seat side spokes	1" dia. x 18"	W. Oak
1	E	Seat back spoke	1" dia. x 18"	W. Oak
2	F	Front spokes	¾" dia. x 22"	W. Oak
5	G	Side and rear spokes	¾" dia. x 18"	W. Oak
2	H	Back top & bott. spokes	1⅛" dia. x 18"	W. Oak
2	I	Back side rails	⅝" x 1⅛" x 26"	W. Oak
2	J	Arms	¾" x 4" x 20"	W. Oak
1	K	Top slat	⅜" x 3½" x 18"	W. Oak
2	L	Rockers	⅝" x 5" x 34"	W. Oak
2	M	Cookies	1¾" dia.	Walnut

Dimensions are rough shaped sizes and include tenon

The tenon on each of the spokes includes a "locking ring." The depression cut around the circumference of the tenon allows the wood from the leg to expand into the ring as it dries, locking the tenon in place.

Cut the top off the leg about 23" up from the bottom, and for a 5/8" round tenon about 1 1/2" long with a beveled shoulder. Chamfer the end, but don't flatten the sides.

Take the back legs out of their jig, adjust the bends to match if necessary, then trim their bottoms. On the insides of the legs measure up from the bottom and put a mark at 11" for the seat spoke. The bottom spoke goes at 3 1/8" up from the bottom. The bottom spoke of the back panel goes 5 1/2" above the seat at 16 1/2" up from the bottom. Don't mark for the top of the back panel. The center of the mortise for the top slat is at 42" up from the bottom. Here I chop out the 2"-long mortise for the top slat with a 1/4" mortise chisel, cleaning up the sides with a 1" flat chisel. Make the mortise deep and square and straight, without going through the side of the leg.

To determine the proper drilling depth for the spokes in the legs, I use an adhesive bandage wrapped around the base of the drill bit as a depth stop. I use a drilling shelf to keep things straight, (see photo below), though I still use my eyeballs to find the center of the leg. Drill 5/8" holes as deep as you can for all the spokes. To determine where to drill for the top spoke of the back panel, assemble it without glue and snug the bottom spoke into its hole. I even drill the top spoke hole just a hair low to get a squeezing effect on the back panel assembly.

When all the holes for the front and back spokes have been drilled (we haven't done anything for the side spokes yet) round off all four legs with the spokeshave, trim the valley of the vase turning with the carving knife, then rub the legs down with wood shavings.

Shape the top slat and fashion tenons on its ends to fit the mortises chiseled in the back legs. Make sure the slat is good and smooth and that all corners are rounded.

Glue and assemble the back, taking a second to look it over for squareness. Put glue in the mortises, but not on the tenons. Likewise, glue and assemble the front and the back of the chair, making sure to keep the flats of the spoke tenons running parallel to the length of the legs. The tenons should fit tight. A heavy neoprene mallet knocks the pieces together quickly.

Now it's time to drill the holes for the side spokes. The centers for all but two of these holes are drilled 9/16" above the centers for the back and front spokes. The back holes for the two bottom side spokes go 9/16" below the bottom back spoke. I do it this way so that I'll have more wood for the rear rocker joint.

These side holes will not be at right angles to the front or rear spokes. Being that the seat is a trapezoid, the front angle will be less than 90 and the rear angle will be greater. A template of the seat makes a good drilling guide.

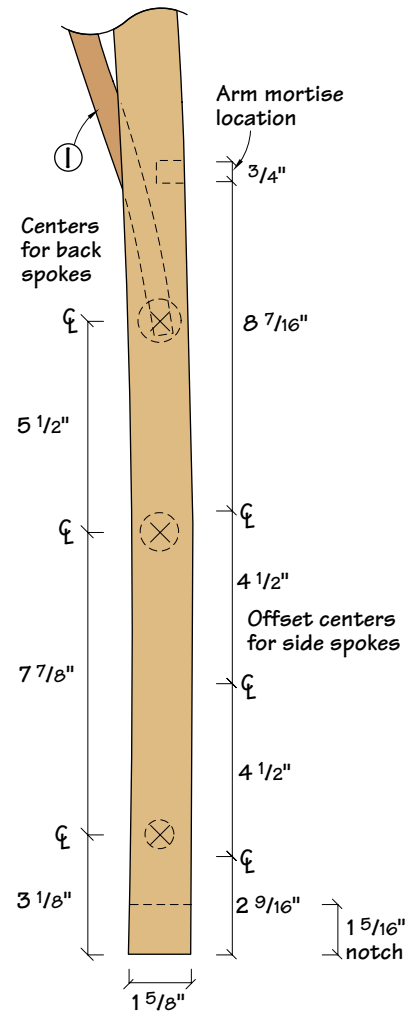
I drill the side holes the same way I do the front and back holes. The only difference is that this time when I put the leg on the drilling shelf, the leg on the other side is sticking up in the air in front of my face. If this is the front leg, I move it towards me 2" before securing the bottom leg. If it is the back leg I push it away from me 2".

When drilling the side holes, also drill 5/8" holes 1" up from the bottom of each leg for the beginning of the rocker joint. The back holes for the rocker joint need to be drilled at an angle to match the top of the rocker pattern. Drill the rocker joint holes all the way through the legs. Also, this is when to drill the holes in the back legs where the back end of the arm will go.

Glue and assemble, and there you have the basic frame. Eye-ball the frame and if it's out of whack, you can usually improve the situation by pushing on the frame or using a rope and turn buckle.

While drilling the mortises, holding the legs firmly in place is all important. I use a 6" wooden shelf where the legs are held against a back-stop by driving a wedge between the leg and a large wooden peg placed in a 1" hole drilled in the shelf. Scribing a perpendicular line on the shelf keeps the drill bit square with the leg. Keeping the drill bit level with the shelf keeps the holes in line with each other.

Profile of back leg

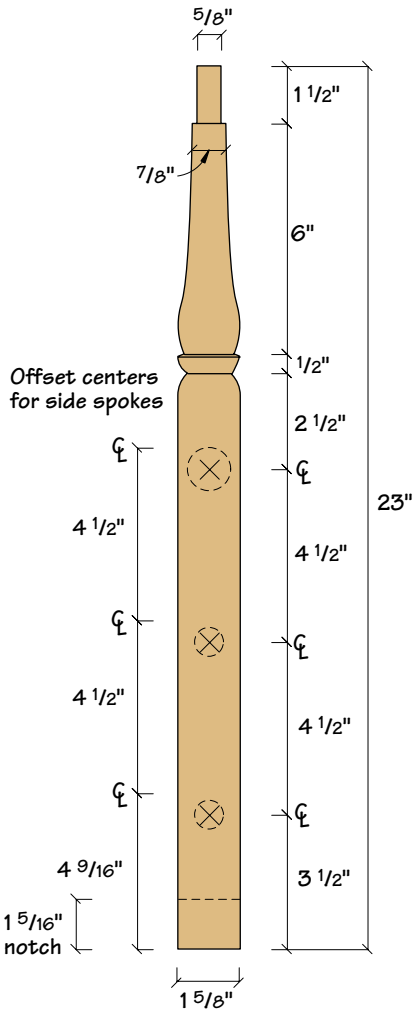


Completing the Frame

The sides of the rocker joints are cut with a hand saw. The corners are then squared with the 1/4" mortising chisel, and the sides are trimmed with a carving knife. Use a scrap piece of 5/8" board to check the fit and alignment front to back. The fit should be snug without splitting the joint.

Next square up the mortises in the back legs for the arms with a 1/4" mortising chis-

Profile of front leg



el. This keeps the arms from twisting.

Now drill 5/16" holes and peg the top slat. I carve square-headed pegs out of walnut. Then cut the top of the back legs off where they look good and trim the ends with the carving knife.

Fitting the Arm

On one of the arm blanks draw the shape of the arm and cut it out. Use this arm as the pattern for the other arm. Drill a 5/8" hole in the front of the arm to receive the tenon on the top of the front leg. Smooth and shape the arm with a drawknife.

Fit the back tenon and bevel all exposed corners of the arm with the carving knife. On the underside of the arm counter sink the hole to match the bevel on the shoulder of the front leg tenon.

Assemble the arm dry and mark the tenon at the top surface of the arm. I use a "cookie" to cap the front leg tenon. The cookies are made out of walnut and have a dome shape with a diameter of about 1¾". I rough them out on a lathe and finish them off with a carving knife. A 5/8" hole is drilled in the bottom of each to fit the tenon. Check the depth of the hole in the cookie, then trim the top of the tenon if it is too long.

Remove the arm and make a saw cut to form the wedged tenon in the front leg. Make the cut perpendicular to the side spokes and cut down past the mark that you made earlier by about 1/8" or so.

Now, out of some dry hardwood, make a wedge to fit this slot. Make sure it isn't too long or it'll hang up the cookie, not too thick or it may split the cookie, and not too thin or it won't spread the tenon enough to keep everything together tight.

Glue the mortises, assemble the arm with the wedge in place, then carefully drive the cookie home with the mallet. As the cookie covers the tenon it will force the wedge in place.

Scrape or whittle off any unsightly marks and put a coat of finish on the frame. I like using 100 percent Tung oil (make sure it says this on the label). It is non-toxic and can be left to soak in overnight before being rubbed down. Also this kind of finish is

Drying Green Spokes

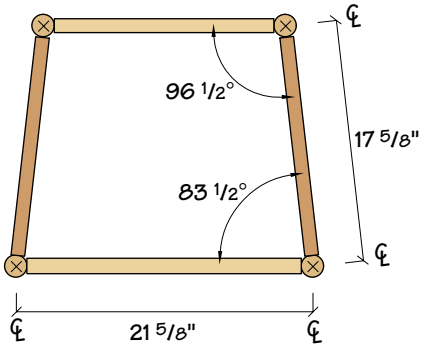
As mentioned earlier, using a combination of dried wood and green wood improves joint strength. While air-drying works well with the legs, to have the spokes dry enough to be captured by the shrinking green wood of the legs, they must be dried further. But it's important to dry the spokes correctly to avoid splitting, warping and checking.

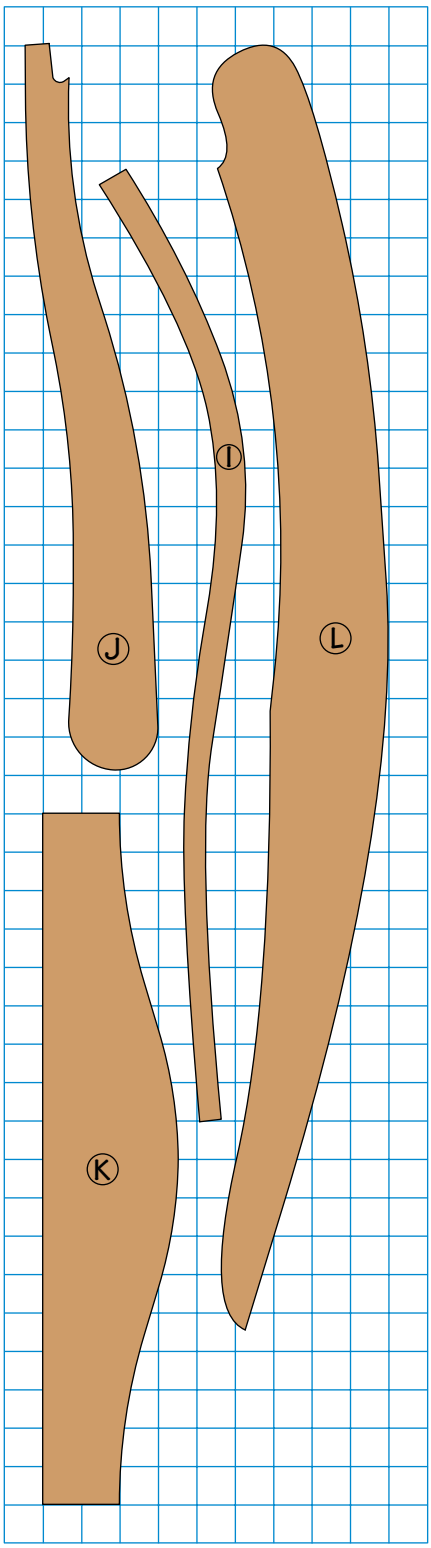
In my shop, the spokes are stacked up on my counter so that each spoke will get plenty of air circulation around it. After the spokes have air dried like this for a month or more I take them home and bake them in the oven to get them "kiln" dried. With the spokes spaced out on the oven shelves I set the dial on warm (my oven door naturally stays ajar without a 2x4 against it). The oven is left on for a few hours and then turned off for a few hours. This cycle is repeated several times and sometimes I even leave the oven on overnight.

Spokes are easy to dry and there are lots of ways of doing it. In previous houses I stored the spokes in the space above the water heater and in a box on top of a gas refrigerator where I kept the air-dried spokes for a week. The key to drying spokes is to do it slowly, in stages, with lower temperatures and lots of air movement.

After drilling the starter hole and cutting out the waste, I clean up the rocker notch in the legs with a chisel.

Plan of seat frame





Patterns of chair parts

One square = 1"

The arm shown with the wedge in place in the front-leg split tenon, waiting for a cookie. A finished version is shown behind ***(at left).***

At an early part of the weaving process, the herringbone pattern becomes evident ***(below).***

very easy to maintain.

Weaving the Seat

To weave the seat and back on my rocking chairs I use hickory bark or Shaker tape. I usually weave a two-twill herringbone pattern, or a variation thereof.

The procedure for weaving most materials is about the same. The warp is put on first, running front to back. The tension comes from weaving side to side so, to accommodate this, a little bit of slack needs to be cut in the warp. My general rule of thumb is when wrapping the warp, snug up each run without pulling it tight.

Also, never nail anything to the chair. Not only might you split a part of the chair, you might also split that which you want to nail to the chair. There is a much better way. Simply loop the material around the back spoke and tie it, or in the case of Shaker tape, loop it and stitch it.

When weaving the back panel, lay the warp in running top to bottom. Extra slack is needed in the warp to accommodate the curve in the back panel. Knowing how much slack to leave takes practice, and if you find that you didn't do the warp right while weaving, I wouldn't be ashamed to start over and do it again.

A few short pieces are added into the weave at the front corners of the seat to fill up the empty places left by the seat's trapezoidal shape.

Making the Rockers

Trace the rocker pattern onto a 5/8" thick board trying to match the sweep of the rocker and the sweep in the grain. Cut the rockers out with a band saw. With the two rockers held together with a vise or clamp, finish the edges with a rasp. Pay close attention to the bottom edge, running your hand back and forth along the length of the arc to make sure that there won't be any bumps in the rocker.

Bevel the corners with a carving knife and scrape the surfaces smooth. With the chair upside down, the final fitting of the rockers is done using chisels to make adjustments to the notch.

Glue the rockers in place. While the glue is setting up, cut four 3/8" dowels about 2" long. I split these dowels out of scraps of straight-grain walnut. After roughing out the pieces with the carving knife, I drive them through a dowel reamer (a piece of plate steel with a wallered-out 3/8" hole drilled in it) to get the exact size.

After the glue in the rocker joint is set, drill 3/8" holes and glue the dowels in place. Saw the excess off.

More coats of Tung oil go on the frame of the chair, and before I call the chair done I give it one last coat of oil and wet sand the whole frame with 400 grit wet/dry sandpaper. This is the only sanding I do.

Making chairs is a lot different than making tables or cabinets. Accuracy is important in different ways. Good results don't come form a lot of fastidious measuring or planning. Good chairs are born of expe-

Paint and Varnish Removers

Learn the differences between the six types of strippers on the market.

No step in refinishing is as messy and unpleasant as stripping off old paint or finish. Though stripping can't be made clean and enjoyable, it does help to know something about the stripping products available so you can choose intelligently among them.

Fortunately, in the case of strippers (unlike other finishing products), the primary ingredients are almost always listed on the container, so it's possible to make sense of the products by separating them into types.

There are four types of strippers that are solvents and one type that is lye. You also can buy a stripper that combines two of the solvents, so there are actually six types of strippers on the market today:

- Methylene chloride (MC)
- Acetone, toluene and methanol (ATM)
- N-methyl pyrrolidone (NMP)
- Di-basic esters (DBE)
- A combination of methylene chloride plus acetone, toluene and methanol (MC/ATM)
- Lye

MC, ATM and MC/ATM are available in various thicknesses, ranging from liquid to semi-paste. The thickness makes a difference in how well the stripper clings to vertical surfaces, but not in its strength or effectiveness.

Lye is available in both a powder form, which you have to mix with water, and in paste form, which is ready for use.

Methylene Chloride (MC)

The strongest and fastest-acting of the five solvent types is methylene chloride. You can identify this stripper in two easy ways: by the statement it's "non-flammable" on the can, and by the listing of only MC and methanol as the solvents. (A little methanol is always added to MC as an activator.)

Methylene chloride is very effective at removing all types of coatings, and even though it is moderately expensive, it has been the primary solvent used in strippers for the last four decades. About 15 years ago, the Environmental Protection Agency listed MC as a probable human carcinogen, though the evidence for such a listing remains highly controversial.

Some manufacturers add acids or alkalies to their MC strippers to increase their strength, but these additives are seldom listed on the container. Almost all manufacturers add wax, which rises to the surface and retards the evaporation of the MC.

The wax residue must be washed off before finishing the wood, or the finish may not bond well. Manufacturers misleadingly call this washing step "neutralizing."

Acetone, Toluene, Methanol (ATM)

This is the cheapest solvent stripper and is essentially nothing more than lacquer thinner. It's effective at removing shellac and lacquer, but is slow on all other coatings.

When manufacturers add wax to slow evaporation, they call the remover a "stripper." When they don't add wax, they call it a "refinisher." To use refinisher, you must work on very small sections at a time due to the fast evaporation of the solvents.

Other members of the three solvent families — ketones, petroleum distillates and alcohols — are sometimes added to or substituted for acetone, toluene and methanol to change evaporation rates, but the stripper is still in the ATM category. All of the solvents used in this category are extremely flammable, and mention of this is made on the can.

MC/ATM

By combining MC and ATM in varying proportions, manufacturers produce a stripper that is in between in both effectiveness and cost. Combination strippers list a number of solvents, including methylene chloride, and also warn of flammability. These strippers are effective on all but the most stubborn coatings.

N-Methyl Pyrrolidone (NMP)

The possibility that MC could cause cancer and the high flammability of ATM and

PAINT AND VARNISH REMOVERS: STRONGEST TO WEAKEST

Stripper Type	How to Identify	Description	Potential Problems	Comments
Lye	Contents list sodium hydroxide or caustic soda. Available as powder or paste. Warns of severe burns if it comes in contact with your skin.	The most effective stripper.	Damages wood. Darkens many woods and can cause finish problems.	Very dangerous to use because it causes severe burns to skin and eyes. Keep clean water close by for washing.
Methylene chloride/Methanol (MC)	Contents list methylene chloride and methanol. Non flammability is usually mentioned.	The strongest and fastest-acting solvent stripper.	Contains wax which must be removed before applying a finish.	Fumes are a health hazard. Work outside or in a room with cross ventilation.
Methylene chloride/Acetone, Toluene, Methanol (MC/ATM)	Contents list methylene chloride, methanol, and a combo of acetone, methyl ethyl ketone, toluene, xylene.	The weakest and cheapest methylene-chloride stripper.	Contains wax which must be removed before applying a finish.	Fumes are a health hazard. Fumes and liquid solvent are a fire hazard.
Acetone, Toluene, Methanol (ATM)	Contents list some combo of acetone, methyl ethyl ketone, toluene, xylene and methanol	Almost as effective as MC/ATM but without methylene chloride.	Contains wax which must be removed before applying a finish.	Fumes are a health hazard. Fumes and liquid solvent are a fire hazard.
Acetone, Toluene, Methanol (ATM) "Refinisher"	Contents list some combination of acetone, MEK, toluene, xylene and methanol	Very inefficient as a stripper because no wax is included to slow evaporation.	Too slow on everything except shellac and lacquer.	Fumes are a health hazard. Fumes and liquid solvent are a fire hazard.
N-methyl pyrrolidone (NMP)	Contents list n-methyl pyrrolidone and possibly one or two additional ingredients	Effective on most finishes, but two or three times slower and more expensive than methylene-chloride strippers.	Trying to rush it.	Fairly safe to use because of slow evaporation rate and non-flammability.
Di-basic esters (DBE)	Contents list "ester" or names of solvents ending in "-ate," which are esters.	The slowest of the strippers.	Trying to rush it. Included water may blister veneer and warp thin wood.	Fairly safe to use because of slow evaporation rate and non-flammability.

MC/ATM strippers opened the market to two alternative solvent strippers. The more effective of the two is n-methyl pyrrolidone (NMP). It is non-flammable and is thought to be less toxic than MC and ATM.

It's not that NMP is safe to work with, but that it evaporates so slowly that the air in a room has time to replace itself several times over before toxic concentrations are reached.

Slow evaporation translates into reduced effectiveness (consider that these strippers are usually packaged in plastic containers), but an NMP stripper will remove all but the most stubborn coatings if you give it enough time — overnight in many cases.

The reasons NMP strippers haven't caught on better are their expense (about three times that of MC unless other solvents are added to reduce the cost) and the misleading claim listed on most containers that the stripper works in 30 minutes.

Claiming too much for a product may get a customer to buy it once, but rarely a second time.

Di-Basic Esters (DBE)

The first of the alternative strippers to appear on the market is based on several esters, called di-basic esters, combined with 50- to 70-percent water. These esters are very slow-evaporating, and thus weak as strippers.

DBE strippers work even slower than NMP strippers, especially on shellac and lacquer, but just as with NMP strippers, manufacturers exaggerate the speed. The problems this has caused, in addition to the damage the included water causes to veneer and wood, has led to the virtual disappearance of this stripper from stores.

Lye

Though it's rarely used, lye (sodium hydroxide) is both cheaper and more effective than the solvents discussed above. The problem with lye is that it will burn you severely if it gets on your skin, it can cause significant damage to the wood by making it soft and punky, and it may darken the wood and cause finishing problems.

You can buy lye in powder form at paint stores and sometimes at supermarkets, and mix it with water, about ¼ pound of lye to one gallon of warm water. Pour the lye into the water, not the other way around or it may boil over and burn you, and use a steel container like a coffee can, not aluminum, plastic or glass. The heat that is created by the chemical reaction of the lye and water will heat the container, so don't hold it while mixing.

You can also buy lye in powder or paste form packaged with a cloth that you can apply over the lye to aid in the removal of paint or finish.

Conclusion

For difficult coatings such as paint, polyurethane and catalyzed (two-part) finishes, you should use a strong MC or lye stripper. For weaker shellac, lacquer and oil finishes, any of the strippers will work, given enough time. Next issue, I'll tell you how to use these strippers effectively. **PW**

Bob Flexner is a nationally known finishing expert in Norman, Oklahoma, and the author of "Understanding Wood Finishing."

POPULAR WOODWORKING PASSED JUNE 2000

Delta's Series 2000 Saws

When I bought a Delta 10" contractor saw for my shop at home I was suspicious of the shiny and oddly shaped Unifence. Here in our shop at *Popular Woodworking* the table saws are equipped with Biesemeyer fences or clones of this workhorse fence system. So I wasn't sure if I was going to get along with this aluminum thing.

However, after a year of hard use on about a dozen major projects, I'm convinced the Unifence is an outstanding fence system for the home or professional woodworker because it is accurate, reliable and performs some excellent tricks other fences just aren't built to do.

But before I get into the fence in detail, let's talk about the entire saw, which is now being sold as the "Platinum Edition" contractor saw for about $850. Without a doubt, the Series 2000 saws are the easiest contractor saws to assemble. With almost every other brand you have to assemble the base with about 40 bolts. Delta's goes together in about 10 minutes with just a few screws. And it's just as sturdy.

Almost everything was in perfect alignment out of the box, and adjustments are easy to do with simple tools and the outstanding instruction manual.

As with all table saws, there are a few things you should do to tune up your machine. First, replace the throat plate with a decent zero-clearance insert to reduce tearout. Replace the saw's drive belt with a link belt to reduce vibration. And do something about that miter gauge. Build or buy yourself a sled for crosscuts.

Finally, get familiar with your Unifence. The fence has two positions that can be changed in less than one minute. The tall side of the fence is 3½" high, which is taller than the Biesemeyer fence (at 2⅜") or Jet's XACTA fence (at 2"). This is great for when you are cutting tenons on your table saw because it gives you more bearing surface so you're less likely to tip your work into the blade. The result: square joint cuts. The short side of the fence is great for cutting thin stock, or for ripping material that has a veneer facing on either or both sides. The fence can be quickly adjusted so the veneer hangs over (or under) the short side and the substrate rides on the fence.

If you can't afford a sliding crosscut table, the Unifence will be your best friend. Here's why: The fence can be used like a stop block with your miter gauge to produce long crosscuts. First loosen the two lock knobs on the side and slide the aluminum section toward you until it is in front of the saw blade. Lock the fence down to the desired crosscut length. Then use your miter gauge and the Unifence as a cutoff gauge to make your crosscuts.

The fact that the Unifence slides forward and back can also be used to your advantage when ripping plywood. You can slide the fence a bit towards you to give yourself more bearing surface at the beginning of the cut.

Finally, one of my favorite features is that you use the arbor wrench to adjust the fence parallel to the blade, though it rarely goes out of alignment. The only downside to the fence is you have to get used to the way it locks down. If you turn the handle as you move the fence, it will sometimes hop out its groove. However, that's a small price to pay for this outstanding fence system. **PW**

—Christopher Schwarz

About Our Endurance Tests

When a new tool hits the market we do our best to tell you what the benefits and pitfalls are with that tool. While this is good information, we know that the question you really want answered is, "How long will the tool last?" That's what this column is for. We regularly pick a tool we've used in our shop for at least a year that has stood up to our regular use. We make sure the tools we've tested here are virtually unchanged from the versions in the store today. So when you see a tool written up in here, it has passed the *Popular Woodworking* Endurance Test. —*David Thiel, senior editor*

Results

Series 2000 Contractor Saw

Nice Features
- Versatile fence
- Quick assembly and setup
- Great customer service

Recommended Modifications
- Better throat plate
- Link belt
- Replace the miter gauge
- Longer power cord

Delta International 800-438-2486
www.deltawoodworking.com.

How We Rate Tools

We test a lot of tools at *Popular Woodworking*, and while we don't often test tools until they fall apart, we do give them an honest, real-world workout. Each issue we share the results of our hands-on experience with you and offer insights to help guide your shopping decisions. The ratings reflect the opinion of the magazine's editorial staff.

Here's how our rating system works. Performance: A rating of "five" indicates we think this tool is a leader in its category — for now. (You won't likely see performance ratings of "one" or "two" in these reviews because we wouldn't publicize an inferior tool.) Value: "Five" is a great tool for the money; "one" isn't the mark of a value. However, a low "value" rating shouldn't prevent you from buying that tool. Some tools might be worth a little more because they're one-of-a-kind or just a really great tool.

If you have a question about a tool — whether it's been reviewed or not — you can contact me at (513) 531-2690, ext. 255, or by e-mail at DavidT@FWPubs.com.

And by the way, many of our past tool reviews appear on our website at www.popwood.com, including data on entire categories of tools (such as table saws). Check it out.

—David Thiel, senior editor

Porter-Cable's New Sliding Compound Miter Saw

You might think the Porter-Cable model 3807 sliding compound miter saw looks familiar, and you wouldn't be all wrong. This new tool is the result of a closer working relationship with Porter-Cable's sister company, Delta International. Though some of the parts are similar, this tool is designed more for the professional, with upgraded features and tougher materials.

Performance: ●●●●○
Value: ●●●○○

Porter-Cable: 800-487-8665, or www.porter-cable.com

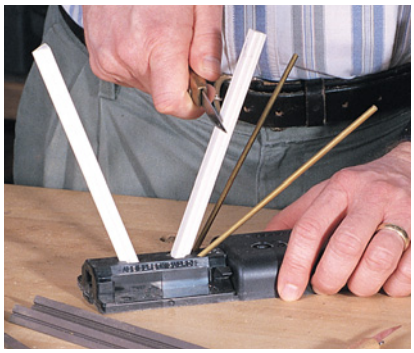
Selling for about $530, the 3807 features a 15-amp, 5,000 rpm motor with electric brake, which is standard in this category. The saw's business end slides on two rods guided by ball bearings, which move smoothly and easily. And the saw will miter a 2 x 12 when set at 90 degrees. Unlike the Delta 36-240 sliding compound, the 3807 has die-cast metal feet rather than plastic, a cam-locking miter handle rather than a pressure release lever, a riveted metal bevel scale rather than an applied label and nine positive miter detents where the similar Delta model offers none.

We're pleased to see this tool in Porter-Cable's line and expect to see it on job sites everywhere. The 15-amp motor and dual support rails match the best features on the market. We do have a couple quibbles. The cut quality was rough with the blade that came with the saw, but after switching to a high quality chop saw blade, the cut was superb. The blade-lowering spring tension was stiff, making the tool feel clunky, though this may loosen up with use. The markings on the beveling and mitering scales could be finer in detail and dust collection could be improved, but beyond these points Porter-Cable has a nice horse to enter in the sliding compound race.

For more information, circle #160 on the Resource Directory Coupon.

Portable Sharpening for Knives and Other Tools

We normally review products that have an obvious woodworking connection, but after seeing this sharpening rig at last year's hardware show in Chicago, we had to try it out. Spyderco's Tri-Angle Sharpmaker (SP 204MF) is a compact and portable system that has a variety of uses, including woodworking. Its primary purpose is to sharpen knives. For delivering an accurate, sharp edge to pocket knives and kitchen knives, it excels beyond any stone system we've seen. But beyond knives, the included video shows you how to sharpen everything from knives to scissors, router bits and woodworking chisels.



The 'V' configuration sharpens knives fast (left). Touch up hand tools with the sticks flat (right).

Knife Performance: ●●●●●
Tool Performance: ●●●○○
Value: ●●●○○

Spyderco, 800-828-1925, or www.spyderco.com

The kit consists of a case with a plastic base and top, two triangular, coarse ceramic stones, two fine ceramic stones and two finger guards. The stones mount in the base at opposing angles, forming a "V." The first grinds the back bevel of a blade and the second grinds the primary edge. For the non-knife operations, the stones are mounted in the underside or end of the base (see photo) and used in tandem. The stones clean up with a mild abrasive and scouring pad in water.

This is a great sharpening system, (priced at $64.95) but if I'm in the shop I'd likely opt for a more traditional oil or diamond stone to sharpen my woodworking tools. If I were out in the field or needed a quick touch-up on a chisel or plane blade, I wouldn't hesitate to use this product.

For more info., circle #161 on the Resource Directory Coupon.

Great-Value Jigsaw From Grizzly

When I picked up Grizzly's new model G8994 jigsaw, I had a sudden feeling of deja vu. It had been a while, but it was a very familiar and friendly remembrance. This jigsaw is very similar in function, features and feel to the jigsaw that put Bosch at the top of the jigsaw market. However this one costs only $59.95! This 5.2-amp tool features variable speed control up to 3,100 strokes per minute, a four-position orbital cut action, a built-in blower, an adjustable footplate and it uses Bosch-style bayonet blades, which are changed with a long screwdriver.

Performance: ●●●●○
Value: ●●●●●

Grizzly 800-523-4777
www.grizzly.com

This is a sturdy saw that functions well (once you discard the blade that comes with the tool), and it will provide years of use for most woodworkers. While it doesn't offer the trendy feature of toolless blade change, this Grizzly tool is an amazing bargain for the performance and features you get. Our only regret is that it isn't available in a barrel-grip model — yet.

For more information, circle #162 on the Resource Directory Coupon.

New Accuset Air Gun Fires Both Brads and Staples

Continuing to add to its successful line of affordable air tools, Accuset has introduced a new dual-function brad nailer/stapler. The A2N125 ($129) fires 18-gauge brad nails ranging in length from $\frac{5}{8}$" to $1\frac{1}{4}$", and 18-gauge $\frac{1}{4}$" crown staples from $\frac{1}{2}$" to 1" in length. The tool offers the standard Accuset features of a soft grip handle, quick-open fastener clip, exhaust at the rear and a window that lets you see when it's time to reload.

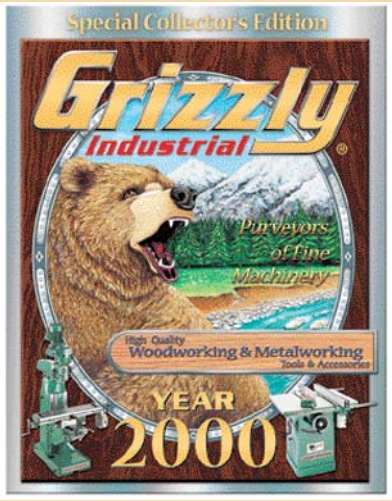
While this is a quality addition to the product line, Accuset's 2-in-1 tool suffers from the same difficulty as its competitors. If the air pressure in your compressor is left at the same level used to drive staples, the steel driver leaves an oversized indentation in the wood when you switch to brads. If the air pressure is reduced to allow the brad to seat without leaving a mark, it will not fully drive a staple. While this problem is overcome easily by regulating air pressure, it's inconvenient. The first manufacturer to add depth-of-drive control to its combination nailer/stapler will be the clear winner. **PW**

For more information, circle #163 on the Resource Directory Coupon.

Performance: ●●●○○
Value: ●●●○○

Accuset, 888-222-8144
or www.accuset.com

Tool Scoop



Great Finds in the New Grizzly 2000 Catalog

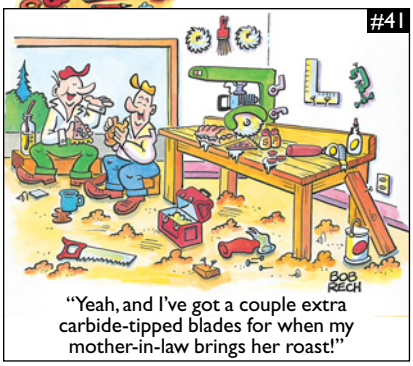
The new Grizzly Industrial catalog is chock full of bargains on reliable woodworking machinery, and we think you should take a look at what this mail-order company has to offer. Check out the 3 hp cabinet saw with a Biesemeyer clone fence for $775 on page 11, or the variable-speed jigsaw for $60 (shown at left). This 354-page catalog surprised us with what else Grizzly sells: welding rods, trammel points, stains, screws, router bits, knee pads, Japanese chisels, first aid kits, clamps, calipers and shop aprons. This is a comprehensive catalog, and that's before you get to the bargains on woodworking machinery. If you haven't received the Grizzly catalog, we suggest you give them a call at 800-523-4777, or visit the company's website at www.grizzly.com.

Makita To Introduce Four New Routers

Sometime before August, Makita plans to unveil four new routers. Two will have the traditional base with two handles, and two will have D-handles. Each style of router will be available with either a single-speed or variable-speed 11-amp motor. The single-speed models will operate at 24,000 rpm, and the variable speed models will operate between 8,000 and 24,000 rpm. The D-handle bases will have an on-the-handle switch, as well as a separate power switch on the motor. All models will offer a plunge depth from 0 to $2\frac{3}{16}$", $\frac{1}{4}$" and $\frac{1}{2}$" collets and replaceable brushes. We expect to have some pre-production models to test soon, so look for a review in the August 2000 issue.

Cartoon

Illustrated by Bob Rech
www.bobrech.com



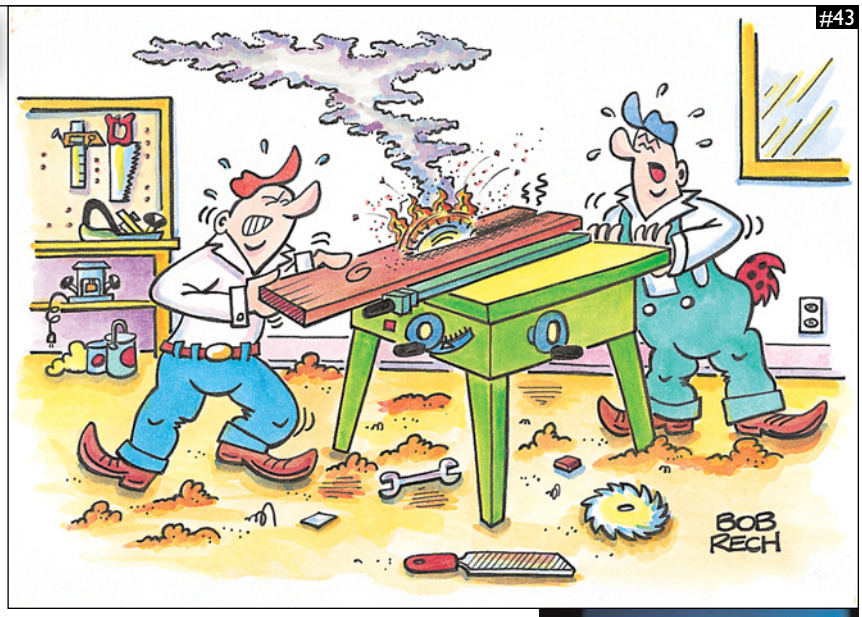
"Yeah, and I've got a couple extra carbide-tipped blades for when my mother-in-law brings her roast!"

Thomas Hargraves, from Magnolia, Texas, is the winner of our Cartoon Contest from the February issue and recipient of the fine set of Quick Grip clamps. The following runners-up each receive a one-year subscription to *Popular Woodworking*:

"This is what I call a power lunch."
Richard Lukenbill, Saint Peters, Missouri

"Well heck Ralph, they told you when you bought the saw it was great for 'deli-cut' work!"
Buck Drakes, Girard, Pennsylvania

"Next time let's use one of those thin-kerf blades. Less waste, more food!"
Bill Hobbins, Evans, Georgia

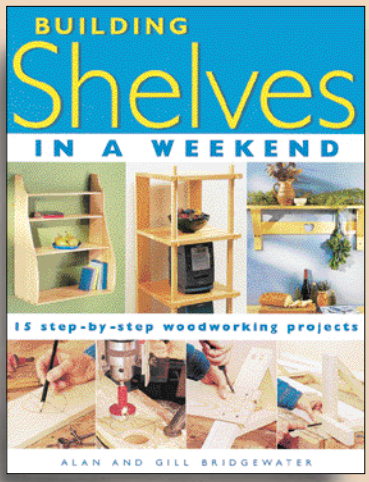


Submit your caption(s) for this issue's cartoon on a postcard to *Popular Woodworking*, Cartoon Caption #43, 1507 Dana Ave., Cincinnati, OH 45207 by June 16. Winners will be chosen by the editorial staff.

The winner will receive a selection of Quick Grip clamps from American Tool Co. Inc. Newly redesigned, these one-handed clamps are a must-have tool. Winners will receive five 12" clamps and five 24" clamps. A $170 value!

The runners-up each win a one-year subscription to *Popular Woodworking*.

Sponsored by AMERICAN TOOL COMPANIES INC.



Alan and Gill Bridgewater show you how to build 15 different shelving units—Shaker-style hanging shelves, shelves on wheels, plate display shelves, designer bookcases and more. Projects are suitable for all skill levels and include easy-to-follow plans and tools and material lists. There are also style variations for each project that will allow you to customize every piece.
#70478/$16.99/80p/225 color images

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From Woodpile to Woodshop

Thanks to an awful prank my grandpa played on me, I became a woodworker.

My first experience with woodworking was nearly my last.

As a part of the baby boomer generation and a lower-middle class family, woodworking was done primarily as a necessity rather than a hobby. My father had the tools you'd expect to find in a garage of that era: a couple hand saws, a claw hammer, a block plane, chisels, screwdrivers (one big and one small), brace and bit, assorted wrenches and some pliers.

These were all kept in a wooden caddy that could be carried to the next "repair." No power tools at all. I, however, had no interest in tools or woodworking. I was an all-American teenager: a sports fanatic with raging hormones.

This all changed abruptly one summer day at my grandparents' house. I was staying the weekend with my grandparents while my folks took a getaway vacation to Las Vegas. My grandfather asked me to follow him up to his attic. He showed me a small wooden end table that he said my grandmother absolutely hated. He said the only reason he hadn't burned it up was because my grandmother thought that my grandfather loved it.

He said that actually he hated it too, but he kept it just to needle her since she had put a large scratch in it years ago. He said he had gotten his fun out of it and now he would like me to carry it down to the back yard and use an ax to turn it into kindling. He would give me a dollar for my effort.

Grandpa left for work, and I set off to do my chore. About halfway through my chopping, I heard my grandma scream at me.

"What the hell are you doing!" It seems that my grandpa had set me up, and this end table was actually an antique given to her that my grandpa really hated. Anyway, by the time that my folks heard the story, I was in deep doo-doo.

My grandpa slipped me an extra 10 bucks, but he never told anybody the truth. My dad was really mad. It wasn't good enough that I apologized. He said I had to replace the table, too! And not only replace it, but make it myself so I could find out how much time was involved.

It took me weeks and weeks to build that table. During that time my dad showed me how to do everything. From basic saw cuts to dovetail joinery, I learned an enormous amount of woodworking skills in what I realize now was a very short period. I can't say I enjoyed it while I was doing it, because I had to do it. But when I finished it I was as proud of it as anything I had ever done before.

The next year I got to take woodshop in school and have been hooked on woodworking ever since. I've made many things over the years. Some good, some not so good. But none was more satisfying and inspiring as that end table. **PW**

Fred Atkinson works wood in Carson City, Nevada.