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NOVEMBER 2006
ISSUE #158

POPULAR Woodworking

Learn How ■ Discover Why ■ Build Better

BATTLE OF THE BAND SAWS

We Test 6 Sleek, Supercharged Steel-body Saws

Lost Stickley Side Table

We Discover a Discarded Design

PLUS

- Sand Less to Sand Better!
- Complete Guide to Dyes

EXTRA: New Tools for 2007

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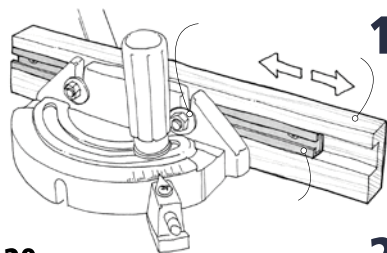


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Learn How • Discover Why • Build Better

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Cover photo by Al Parrish

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Tool manufacturers offered a sneak peek of the new tools that will be in catalogs and stores this fall. Before you buy your next tool, be sure to check out our up-to-the-minute report on the latest products.

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Milling stock: What you do, how you do it and in what order you do each operation will influence your projects from start to finish.

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Popular Woodworking's Blog

Our blog finally went live, and we're having a lot of fun with it—all those random wood-working (and other relevant) thoughts that don't make it into the magazine are easily added to the blog (you'll find a link on the home page).

For example, Bob Lang has posted additional pictures and technique instruction to make the keyed through mortise-and-tenon and angled-dovetail joints for the Stickley table project in this issue.

You'll also find a link from the blog to our new Popular Woodworking logo items, available at Café Press (cafepress.com/popwood). We're sure you'll agree that nothing makes



The new Popular Woodworking T-shirt, mug and other items are now available at cafepress.com/popwood.

a sartorial statement quite like a Popular Woodworking T-shirt. Or, hoist the logo aloft on what's sure to become your favorite coffee mug! (psstt ... each mug design will be available only for a limited time.) PW

Inside Online

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Every month, we simply give away some of our most popular project plans.

Article Index

Looking for a specific technique or project, or all the articles from your favorite author? Look no further than the magazine's online article index! And when you find what you need, it's a simple click to order a back issue.

Magazine Extras

Here, you'll find article corrections (yes, it's true—once in a while we make a mistake), expanded project plans, 18th-century shop inventories and other curious items. In short—stuff we thought was important and interesting, but just couldn't fit into the print magazine.

Tool Reviews

From miter saws to metal-bodied spokeshaves, you'll find a selection of tool reviews you need to outfit your shop with the machines and hand tools that best fit your needs and price range.

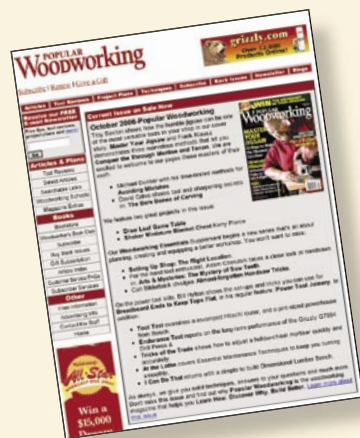
Writer's Guidelines

Got a great idea for an article? Here's how to submit your proposal.

Contact the Staff

If you have a question about Popular Woodworking, about woodworking in general ... or even a complaint about the magazine, we want to hear it. You can contact us directly through our web site—and we even give you our direct phone numbers.

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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.

The Perfect Saw is Still in My Head

When buying tools, it's easy to either romanticize the past or be blinded by something shiny and new. Case-in-point: My long-standing effort to find the right band saw for my shop at home.

I inherited my first band saw from my grandfather. It was a late 1930s Craftsman – completely solid but completely worn out. I considered restoring it, but one day I saw a beautiful steel-frame machine in a catalog and ordered it on impulse.

Two days after it arrived, I sent the saw back. The machine's table simply wasn't sturdy. In fact it wobbled under the slightest pressure, unlike the table of my old Craftsman, which was stiff enough to perform chin-ups on—I think it was the design of the saw's trunnions that made the difference.

So I bought a new traditional cast iron-frame band saw. It was sturdier than the steel-frame saw, but not as stout as my grandfather's machine. The new machine was fine. And this is where things stood for many years, until I got a call from a friend.

He'd found an old Rockwell band saw (likely from the 1970s) that had never been assembled or used. In fact, the base of the machine was still in the box. The trunnions and wheels were beefy. It was, in essence, a new saw but an old design. I was sold.

This weekend I brought the saw into my shop and took it apart to lubricate it and set it up for use. And that's when I started to notice some problems. The screws that secured the guides were rusted, a thrust bearing was frozen, the top needed to be cleaned of rust, the tires needed to be replaced and the list is still growing.

In short, I'm back where I started about eight years ago – with an old saw that needs

some restoration. When it's done, it's going to be a nice machine, I'm sure. (In fact, check out the blog on our web site for more details and photos of the restoration).

But now I just have to make sure that history doesn't repeat itself. In this issue we review steel-frame band saws, and all six of them are lined up in our shop right now. Last week I caught myself checking out the trunnions of the shiny beasts



Good News and Bad

This is Senior Editor David Thiel's last issue with *Popular Woodworking*. David started working for the magazine 11 years ago, right after F+W Publications, Inc. acquired it. I have worked side-by-side with David since I walked in the door here in 1996 and he is one of the reasons this magazine has come so far in the last decade.

That is the bad news. The good news is that he hasn't gone far away. David has become the executive editor of *Popular Woodworking Books*, where he will be shaping the content of our company's line of woodworking books. Expect great things. I do.

Our office is a little quieter now that he's moved upstairs, a little less raucous. But rest assured that we're working on finding a replacement and that we remain committed to providing a blend of power- and hand-tool techniques on every page. We're not about to knock down something we've all worked so hard to build. **PW**

Christopher Schwarz
Editor

CONTRIBUTORS

BILL STANKUS

Before Bill Stankus began woodworking more than two decades ago, he was an oceanographer and fine-arts photographer. In addition to building custom fine



furniture, Bill specializes in museum-quality restoration of antique furniture. He has taught woodworking and given woodworking seminars throughout the United States, consulted with

major tool manufacturers, and written numerous articles and books on woodworking – including “How to Plan and Build Your Ideal Workshop” (*Popular Woodworking Books*). For this issue, he's written the *Woodworking Essentials* supplement (you'll find it in the center of the magazine) on lighting and electricity for your shop.

TROY SEXTON

Troy Sexton built his first project – an end table – in high school for his girlfriend. He didn't have a lot of tools and ended up rigging a table-mounted jigsaw to do the



job. It was the start of something big. Troy married the girlfriend, became a successful cabinetmaker and has developed a passion and knowledge for power tools that few wood-

workers can match. Sexton's cabinet-making career was launched by working as a subcontractor for The Workshops of David T. Smith in Morrow, Ohio. He later struck out on his own and now specializes in building reproduction American pieces and custom kitchens in his well-equipped shop in Sunbury, Ohio.

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Dust Collection: What Tubing is Best?

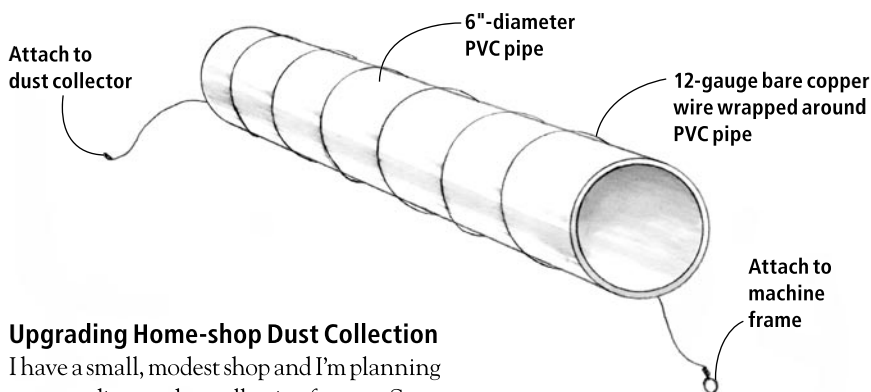


Illustration by HayesShanesy

Upgrading Home-shop Dust Collection

I have a small, modest shop and I'm planning on upgrading my dust collection from my Sears wet/dry vacuum to the Grizzly G0548.

What's the best tubing: metal or clear plastic? Also, what automatic blast gate system do you recommend?

Robert Davis
Somerville, New Jersey

Either metal or plastic pipe will work – it's all a matter of your budget and particular situation. Metal is more commonly used in industrial situations. The advantage is that it is more durable, and it won't need to be grounded to prevent the build up of static electricity.

I would go with metal if I could afford it, and schedule 40 PVC pipe if I wanted to do it on the cheap. Some people will tell you that you run the risk of an explosion from static electricity with plastic pipe, but this has never been documented. The problems you will have with static electricity are: 1) it can give you a shock when you touch the pipe and 2) it will cause dust to cling to the interior of the pipe, reducing the air flow and efficiency of your system.

If you use plastic pipe, run a bare copper wire around the outside of each run, and connect it to the metal frame of each machine, and to the dust collector. Some suggest that the wire should go inside the pipe. I've done it both ways and didn't notice a difference in static buildup, but running the wire inside is more difficult, and wood chips tend to catch on the wire, clogging the entire system.

The dust collector you mention should be a significant step up from your shop vacuum, and there is some good information on planning your system in the Grizzly catalog. Keeping the runs of pipe as short as possible will have a significant effect on your system's efficiency.

We have a system here in our shop that automatically turns on the dust collector when a machine is turned on. There are some systems that will turn the system on and off as you open and close manual gates, but I don't have enough experience with any of them to recommend one over the other.

If we were to do it over, I think we would use manually opening gates and a simple on/off remote control to turn the system on. One of the disadvantages to the automatic system is the continual on-and-off cycling of the motor on the dust collector, which could shorten the lifespan of the motor. If you're working by yourself, it isn't that big an issue to manually open and close the gates before you turn on a machine. What you want to avoid is walking the length of the shop to turn the dust collector on and off.

— Robert W. Lang, senior editor

Avoiding Swirl Marks from Sanding With a Random-orbit Sander

I recently got a 5" random-orbit sander and I notice that I am getting swirl marks in my

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wood – especially soft wood. I tried finer sandpaper and even got one of those erasers to get the pitch and dust out of the grit but still I get swirls. The real bummer is that sometimes I can't tell they are there until I stain. What do I do?

John Lewing
via the Internet

Random-orbit sanders do a good job, but they won't create a perfect surface. I suggest following up the machine sanding with hand sanding with the next finer grit. For example, if you machine sand to #150, hand sand with #180. This should take care of the swirl marks, and it won't take very long. A good way to judge the surface before staining is to wipe it down with a rag dampened in mineral spirits or paint thinner. Look at the surface from an angle, and you'll have a better view of any defects. For more expert sanding advice, see Troy Sexton's article, "Superior & Speedy Sanding" in this issue on page 62.

— Robert W. Lang, senior editor

'Moving Fillister' Explanation

I read with great interest the article on the libella in your August 2006 issue (#156), by Samuel Peterson.

I would greatly appreciate your clarifying something for me. On page 73, Peterson refers to a "moving fillister" being used to make a slight rabbet. It states that, "The moving fillister will do the job in no time—it controls the depth of cut and even scores the wood before the cutter slices off the desired amount."

If you would clarify this for me I will be most grateful.

Karl King
Norwood, New York

A moving fillister plane is a classic plane that is used to cut a rabbet; sometimes it's a wooden-bodied plane and sometimes it's a metal one, such as the Stanley 78. One English term for rabbet is fillister. The reason the plane is called a moving fillister is because the plane has a fence that moves and allows the plane to cut rabbets of various widths. There also are planes called standing fillisters that cut a rabbet of one width only ($\frac{3}{8}$ ", $\frac{1}{2}$ " etc.).

The reason the moving fillister can score the work before cutting it is that it has a spur or nicker – essentially a small knife that is posi-



A British moving fillister plane made by C. Nurse. The fence is secured by the two screws.

tioned in front of the plane's cutting iron. The nicker slices the shoulder of the rabbet joint and then the plane iron removes the waste next to the joint's shoulder.

— Christopher Schwarz, editor

Table Pins a Continuing Mystery

I just read the letter by Steven D. Buckley about Queen Anne tabletop pins allowing conversion of the tabletop to a slanted writing desk (August 2006, issue #156).

While writing the article (April 2006, issue #154), I consulted with two of the country's top experts on American antique furniture about why so many of these tables had removable tops. The answer I was given from both of them was basically the same ... no one really knows. One thought is that they allow easy replacement. Another is that it's an aid in moving. Yet another is so the top can easily be taken outside to give it a good cleaning.

I have worked on at least 20 antique tables (and I have built at least six variants), ranging from 20" x 36" tops to 40" x 72" tops. None of them had extra holes with longer pins in the rear and none of them would allow the top to tilt just by removing the rear pins. If you look at the geometry of the front pin locations, it is usually physically impossible to tilt the top more than an inch or so. Maybe Clara's table was modified at a later date to perform this function but I would say that it is an anomaly.

Craig W. Bentzley
Chalfont, Pennsylvania

Wood Selection for Salad-bowl Set

I am planning on turning a salad-bowl set—a large mixing bowl and eight smaller serving bowls. I have a couple of questions that I am

hoping you or one of your editors can answer for me. What type of wood is best for this project, and what type of finish should one use on salad bowls?

Bill Jordan
Andalusia, Alabama

Almost any sound hardwood is fine for salad bowls, though walnut could conceivably impart an unpleasant flavor to food; and poplar, which is botanically a hardwood, is nonetheless a bit soft to turn well and wouldn't be very durable. But all the common domestic woods are great: oak, ash, maple, cherry, hickory and many others. Maple is probably my favorite, and is readily available most places. A large bowl will need to be roughed out and allowed to dry before final turning, but smaller ones could be made from dry lumberyard stock.

Any finish is safe for food once the solvents have evaporated completely. I would not use a hard surface finish (such as lacquer or varnish), because it will deteriorate in use and will soon look quite ratty. Penetrating finishes will seal and protect the wood, and most can be renewed if desired. I use an oil and wax mixture; the oil serves to carry the wax deeper into the wood fibers, and it imparts a bit of a sheen (but not a hard gloss) to the wood.

Many commercial varieties of this finish are available and will be labeled as suitable or intended for salad bowls; you may want to try several to see which one(s) you prefer.

— Judy Dittmer, PW contributor

"I Can Do That" Column and Online Manual are Both a Hit with Readers

Thank you for the "I Can Do That" section and especially the ICDT manual (available at ICanDoThatExtras.com). I was so impressed with the no-nonsense approach for each topic that I subscribed online to *Popular Woodworking* before the printer was even finished printing out the manual! The manual is a must-read and is so well written that anyone at any level who is interested in woodworking will find themselves saying, "I Can Do That, Too!"

DeNault Schwartz II
Fayetteville, North Carolina

Drill Press Purchase Recommendation

I am looking for a drill press for my shop. In looking at Jet machines (models JDP-17MF

and JDP-17FSE), I noticed a difference in the motors. One motor is labeled “TEFC” and the other motor is not. What is the difference between the two?

Tom Robb
Mount Pleasant, North Carolina

The TEFC stands for “Totally Enclosed Fan Cooled.” It means the motor has a fan built in that assists in cooling the motor fins. This can help extend the life of the motor. The “totally enclosed” part means that the motor is sealed against dust and even most moisture. This can also help extend the life of the motor, especially in a dusty environment. While a TEFC motor costs a little more, it’s a reasonable investment in the future of your machine.

—David Thiel, senior editor

Make Easy Curves with Minimum Fuss

I recently read and thoroughly enjoyed “Complementary Curves” (Power-tool Joinery, June 2006, Issue #155). I recently built a number of boxes for a craft show and I did something similar to the box shown in the photograph on the opening page of the article. I thought maybe some of your readers might be interested in the method I used, which was quite different but accomplished the same result with a minimum of fuss.

Stacking the material and using a band saw to cut the line (much like the method used in laying vinyl) produces a very nice joined panel. I sometimes had to very lightly sand the joint line to produce the tight fit that I was looking for but the result was that all the boxes shown in the craft show (12 in all) sold within the first two hours of the show.

If planning to build only a single box, to minimize waste, offset the boards to just slightly overlap along the layout line then make your curved cut.

Randall Nelson
Jefferson, North Carolina

Kudos for Self-releasing Collets

I just finished reading your article on trim routers in the June 2006 issue (#155). I could not find any reference to one of the most important features of the Bosch PR20EVSK router: It has a self-releasing collet. Frozen bits are one of the biggest problems with these marvelous little machines! This self-releasing collet eliminates this problem.

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LETTERS

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I don't know whether any of the other routers in your test have this feature, but it certainly is a very big one.

Ron Abel
Brunswick, Ohio

I don't know if I share your enthusiasm for the importance of a self-releasing collet for a trim router, but it is a nice feature for both trim routers and the full-size tools.

As you correctly identified, the Bosch does have a collet that keeps the bit from getting "stuck." It was the only router in the test with such a collet, and as such continues to earn our highest marks. I spoke with Jim Stevens at Bosch not too long ago about router collets and he mentioned that throughout the tool industry self-releasing collets are now close to standard on every machine.

He was speaking about 2-horsepower and larger routers, but I would guess that the standard will trickle down into trim routers during the next few years.

—David Thiel, senior editor

Rust Protection for Long-term Storage

I am a member of the United States Air Force, and I'm being transferred to England for the next four years. The houses are small there, and they use a different type of power supply. So, I'll be storing all of my larger machines. They will not be stored in a climate-controlled environment. What can I put on my cast iron tops to protect them from rusting?

Tech. Sgt. Garrett Pearce
Little Rock AFB, Arkansas

I've had to store machinery for long periods, and the best way I found to protect the cast iron was to smear on a thick coat of paste wax on all the cast iron surfaces. Don't bother trying to buff it out or make it shiny, just put on a liberal amount. You can remove it with mineral spirits when you return. The other thing to consider is to remove the belts from the motors of your machines. If you store them with tension on the belts, you can actually create flat spots on the bearings over a long period of time. PW

—Robert W. Lang, senior editor

QUESTION? COMPLAINT? WRITE TO US

Popular Woodworking welcomes comments from readers about the magazine or woodworking in general, as well as questions on all areas of woodworking. We are more than happy to share our woodworking experience with you by answering your questions or adding some clarity to whatever aspect of the craft you are unsure about, and if you have a complaint, we want to address it whenever possible.

Though we receive a good deal of mail, we try to respond to all correspondence in a prompt manner. Published correspondence may be edited for length or style. All correspondence becomes the property of *Popular Woodworking*.

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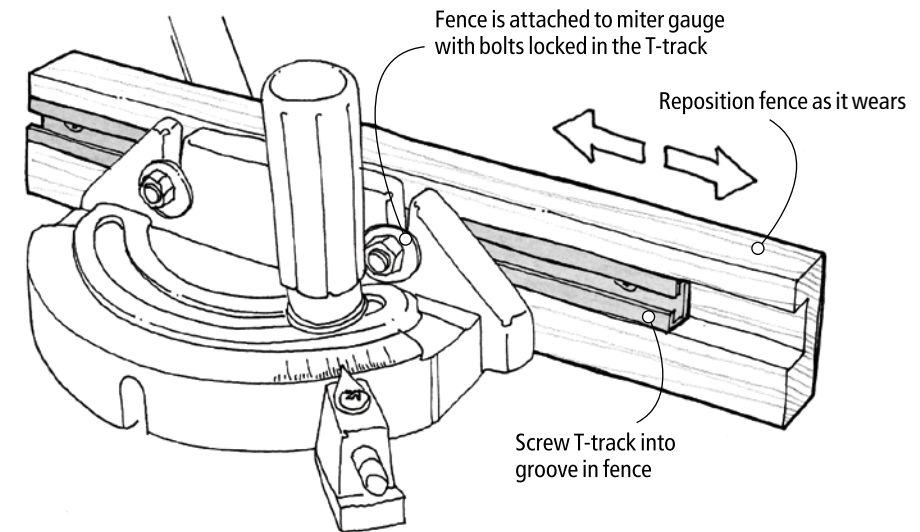
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Popular Woodworking
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Cincinnati, OH 45236

Adjustable Miter-gauge Fence

THE WINNER:

Like many woodworkers, I attach an auxiliary fence to my table saw's and band saw's miter gauge. In addition to providing greater bearing for a workpiece, an auxiliary fence can support a workpiece right up to the blade, backing up the cut to minimize tear-out. A fence that reaches the blade also allows you to conveniently set up a cut by simply aligning the workpiece to the end of the fence.

Unfortunately, after using different blades, the end of my fence gets over cut, and no longer abuts some of my blades. I've found that the best solution is to make an auxiliary fence that adjusts side to side by means of a short section of aluminum T-track screwed into a groove in the back of the fence. The T-track (commonly available from various woodworking suppliers) accepts the heads of a couple 1/4" bolts that extend through my miter gauge and are fixed in place with nuts. Now when the fence wears, I simply reposition it and recut the end. One other great benefit is that I can temporarily clamp or screw a finger-joint jig to my auxiliary fence, and I have built-in micro-adjustability for setting the precise distance from the finger



joint jig pin to the blade, ensuring perfectly fitting finger joints.

Aluminum T-track can be cut to length easily with a standard carbide blade. You can also easily drill it to create screw holes for attachment into its groove. It's wise to use brass screws when there's a chance that you might hit them accidentally with a blade.

*Robert Collins
Snyder, New York*

Efficient Stock Dressing

When dressing rough-cut stock to final size, there is a real efficiency to be gained in how you move your workpieces from machine to machine. For example, one common approach to milling stock begins at the jointer, where one face is dressed flat. Then the workpieces are moved to the planer for dressing the opposite face while bringing the stock to final thickness. After that, the stock moves back to the jointer to square and straighten one edge, then to the table saw for ripping to final width. To complete the process, the stock is crosscut to final length.

The issue here is that, when jointing and planing, the stock should be oriented correctly for cutting in the direction of the grain to minimize tear-out. You can save yourself a lot of confusion and grief by keeping the pieces organized in the same orientation as a group as they move from machine to machine. That way, the grain on all the pieces rises or falls in the same direction, so you don't have to re-check for grain direction every time you prepare to joint or plane a piece. It also ensures that you don't confuse a jointed edge with a sawn edge, or a squarely crosscut end with its yet-to-be-squared opposite end.

Paul Anthony, PW contributor

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CASH AND PRIZES FOR YOUR TRICKS AND TIPS!

Each issue we publish useful woodworking tips from our readers. Next issue's winner receives a sharpening set from Veritas for traditionalists who prefer sharpening chisels and plane blades by hand. The set includes a MKII Honing Guide, Skew Registration Jig, Camber Roller Accessory, 1,000x and 4,000x/8,000x Norton Water Stones, a Veritas Stone Pond and a Bevel Gauge. The total value of this prize is \$250.

Runners-up each receive a check for \$25 to \$100. When submitting a trick (either by mail or e-mail) you must include your complete mailing address and a daytime phone number. If your trick is selected for publication, an editor will need to contact you. All entries become the property of *Popular Woodworking*. You can send your trick by e-mail to popwoodtricks@fwpubs.com, or mail it to Tricks of the Trade, *Popular Woodworking*, 4700 E. Galbraith Road, Cincinnati, OH 45236.



veritas® Tools Inc.

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Jig Adds Accuracy to Routing Lock-miter Joints

I find that routing lock miter joints for drawer corners can be a problem. For the joint to fit well, it must be cut consistently along its length on the router table, with one workpiece fed horizontally, and the mating workpiece fed vertically. Unfortunately, even when using a pusher board, the horizontally fed workpiece can “waggle” somewhat past the bit, while the vertically fed workpiece tends to dive into the bit opening, compromising the cut.

My router table jig solves these problems. It consists of a “pusher unit” that slides between two guide rails on a backboard that attaches to my stock router table fence. (Alternatively, you could devise a simple base of some sort for the backboard to create a stand-alone fence/jig.) The pusher unit feeds workpieces both horizontally and vertically across the bit, and consists of two pusher panels, a gusset and a reinforcement block, all of which connect to a sliding center rail.

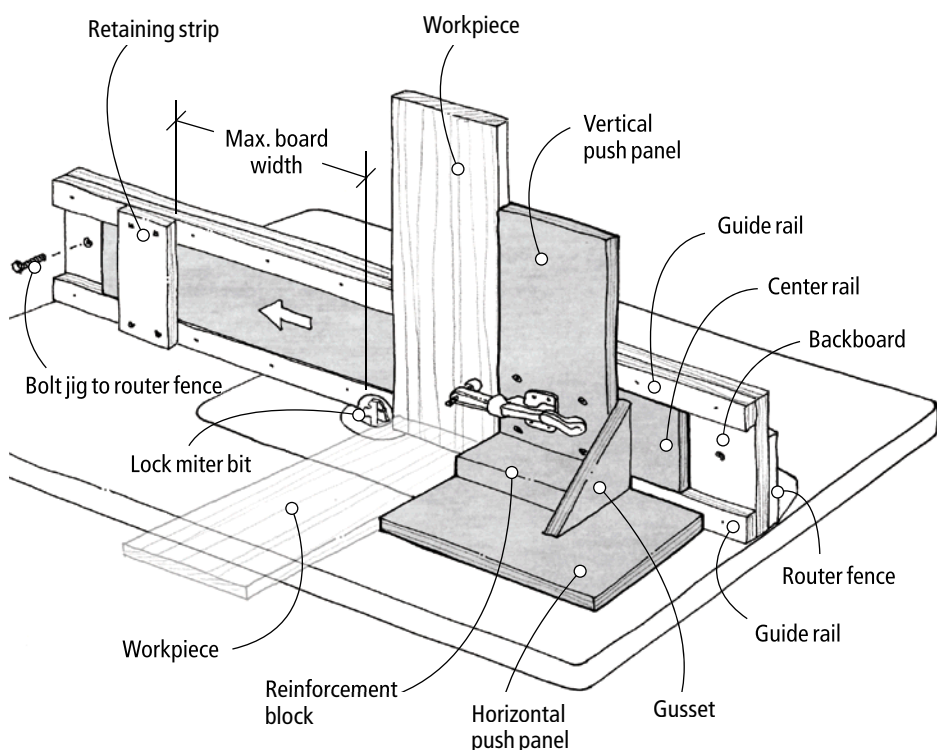
The sizes of the parts aren’t critical, and depend somewhat on the size of drawers you typically make. My fence is about 10" high, with a 6"-wide center rail. I made the whole

thing from 1/2"-thick Baltic birch plywood scraps that I had on hand. It’s easy to build from the drawing, but here are just a few construction tips:

Screw the bottom guide rail to the backboard, then attach the backboard to your fence. Adjust the bit to cutting height, and rotate the fence into the bit to create a zero-clearance opening. Make the pusher unit parts and assemble the panels, gusset and reinforcement block together, carefully squaring the panels, and gluing them without screws (which would be in the bit path.) Rest the center rail in place, and screw and glue the pusher unit to it. Screw the upper guide rail in place, shimming it above the center rail with a playing card to prevent binding. Attach the retaining strip, which helps keep the pusher unit solidly against the fence. Insert a playing card between the strip and each rail to prevent binding. Finally, attach a toggle clamp to the vertical pusher panel to help stabilize your workpiece during the cut.

Jim Lancaster
Dallas, Texas

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TRICKS OF THE TRADE

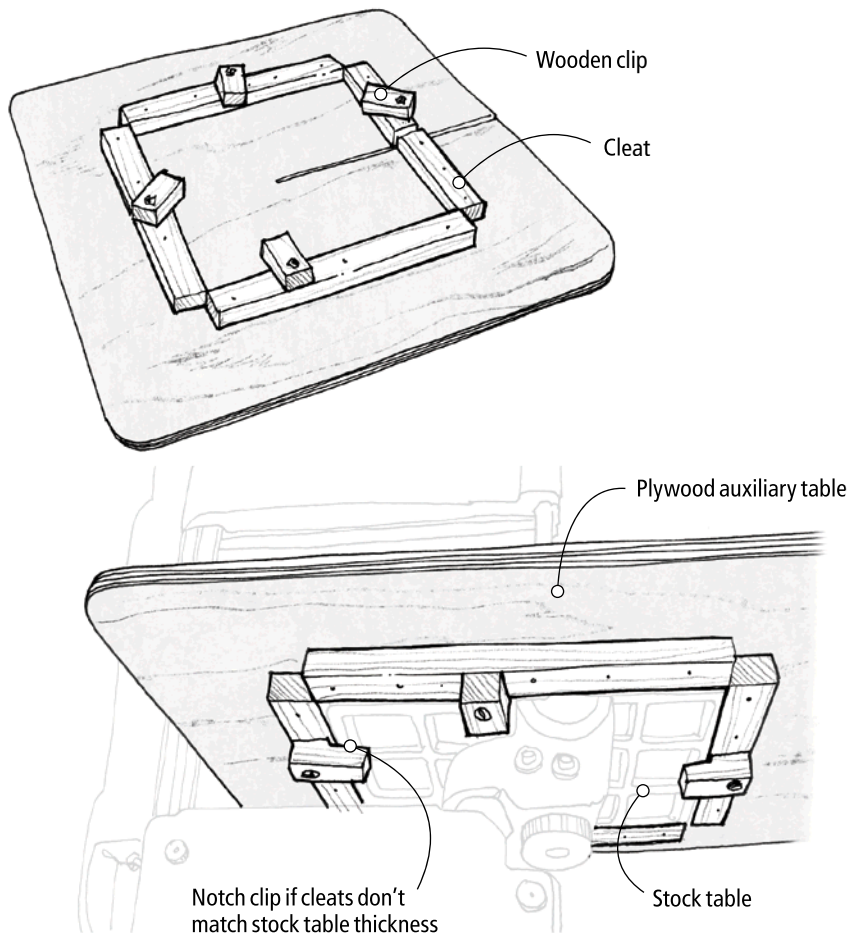
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Quick-change Band Saw Table

I find my stock band saw table too small to support many workpieces, so I outfitted it with a larger, auxiliary table. However, I wanted to be able to remove it quickly when I needed to utilize my saw's maximum cutting height.

The solution was easy. I simply cut a plywood table to the desired size, then used a square to mark the location of the intended saw kerf that extends to the center of the panel. After band sawing to the line, I held the panel in place and carefully traced the outline of my stock table onto the underside of the panel. I removed the panel and glued wooden cleats in place along my lines, just rubbing the glued parts together. (No need to use screws or nails here.) After the glue dried, I attached a wooden clip to each cleat with a single screw, notching the underside of each clip as necessary to accommodate the thickness of the stock table. By pivoting the clips out of the way, I can remove the table in about five seconds.

*Craig Bentley
Chalfont, Pennsylvania*



Installing Threaded Inserts

Threaded inserts can be useful for jigs, fixtures and even furniture when certain parts need to be removed and reinstalled. An insert is a metal sleeve with a threaded interior to accept a bolt, and a threaded exterior for installing the insert itself into a pilot hole. Installation typically involves threading a couple nuts onto a bolt, jamming them against each other, then threading the bolt into the insert until the jam nuts contact the top edge of the insert, which allows you to then drive it into its hole. The problem is that inserts have a tendency to cock as you try to install them into their holes, and once the threads start grabbing, they're hard to correct.

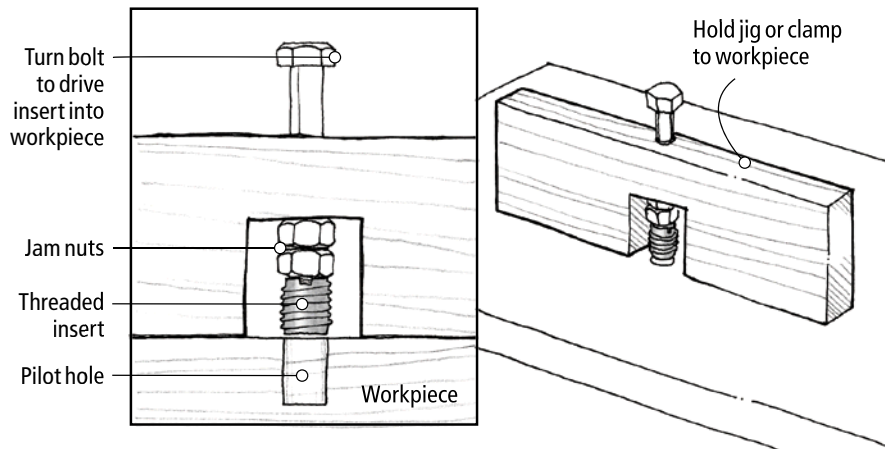
To help hold the insert vertically for installation, many woodworkers hacksaw the head off the installation bolt, chuck it in a drill press and hand-turn the chuck to install the insert. This works fine for smaller parts, but not for items too big for the drill press table. In those cases, I use a simple notched wooden block to serve as a vertical guide.

The jig can be made from any piece of thick scrap wood. Cut the notch deep enough to

accommodate the threaded insert and the two jam nuts. Drill a hole that matches the shank diameter of the installation bolt, and make sure that it passes through enough wood to keep the bolt from wobbling. To use the jig, simply thread the bolt through the hole, screw on the jam nuts and the insert, then place the jig over your pilot hole and drive the insert

in place using a wrench. You can make sure your pilot hole is square to the work surface by drilling it using a block with a guide hole that was made on the drill press.

*Jon Rouleau
Geneseo, New York
continued on page 26*



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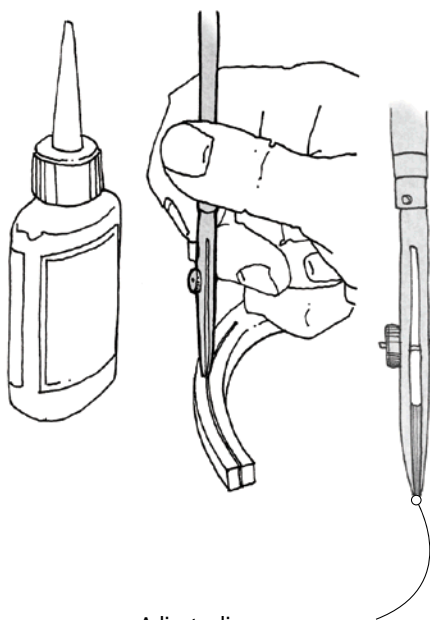
A Super Applicator for CA Glue

There are times when I need to apply very narrow mouldings, carvings or other work pieces with cyanoacrylate (CA) glue. Unfortunately, I've found that it's a problem to lay down a narrow rivulet of this stuff because the applicator tip is either too wide, or it's clogged.

To lay down a precise bead of glue, I reach for the ruling pen from my drafting set. A ruling pen (available at most art supply stores) is a tweezer-like tool with a screw for adjusting the amount of space between the legs. It is designed to hold a drop or so of ink, which clings to the legs by virtue of surface tension. The amount of space between the legs determines the amount of ink that discharges in a line when the tip of the tool is dragged across the target surface.

Got the idea? Now just substitute the words "thin CA glue" for the word "ink" above. You'll find that you avoid getting messy globs of glue all over the workpiece. Just make sure to submerge the pen tip in a jar of acetone immediately afterward to prevent gluing the legs together.

*Jean Darling
Boston, Massachusetts*



Adjust ruling pen screw for size of glue bead

From Ze Mouth of Babies

I'm the grandfather of a 13-month-old, Renaud. I try to see him as often as I can, and each time we have fun and exchange a few tips.

The last time I saw him he told me, "Hey Papi, since you don't have running water in your workshop, why don't you use those unscented wipes Mom uses to clean my bottom when she changes my diapers? It would be useful to clean up a mess, squeezed-out glue, dirty fingers and even wipe your water-base finish cans." I told him this was a great tip and asked him if I should share it with my buddy woodworkers. He said "Yeah, go ahead!" (in French, of course – he's too young to have learned English yet.)

*Serge Duclos
Québec, Canada*

A Clothes Iron in the Shop

The next time you spot an old electric clothes iron at a garage sale, you may want to pick it up. I find mine to be pretty useful around the shop as an alternative to a heat gun. For one thing, you can use it in repair work to remove old veneers and plastic laminate.

Just set it on "medium" and apply heat to the material to be removed. It will soften contact cement, white and yellow glues, and hide glue, among other adhesives. (I usually cover the surface with thick paper to protect the iron from softened finish or other gunk.)

Using the same technique, you can remove spent sandpaper that's held in place with adhesive on a disk sander. You can use it to flatten curled or crumpled patterns or drawings, and even to soften strips of wood and plastic for easy bending.

*Jason Haug
Missoula, Montana*

Fine Brush Care

I've noticed that using a wire brush to clean partially hardened paint from my high-quality paintbrushes tends to damage the natural bristles. I've found that using a stiff-bristle nylon scrub brush works just as well without hurting the paint brush.

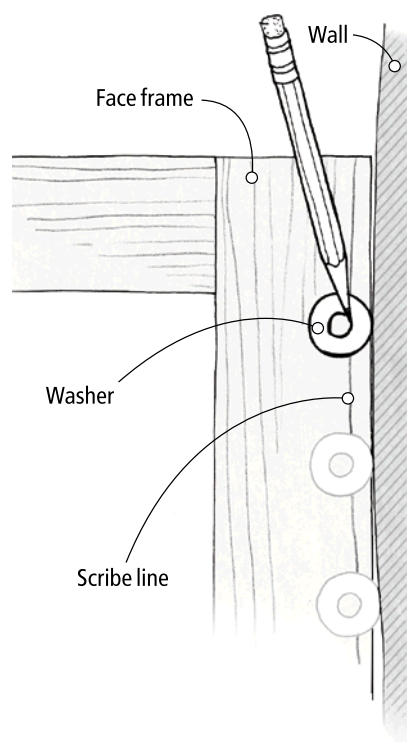
*Tom Jessups
Springfield, Missouri*

Scribing with Washers

While on the job site and installing cabinets, I was preparing to scribe a face frame to fit against an irregular wall when I realized I forgot to bring my compass. I was wondering if I had time to go retrieve it when I remembered that an old finish carpenter once showed me how to scribe using regular hardware washers, which I always seem to have on hand. I tried it, and it worked well.

First place the trim to be scribed as close to the wall as possible. Then select a washer whose ring thickness equals the widest section of the gap you need to close. Place the washer on the trim, with its edge pressed against the wall. Insert the tip of a pencil inside the washer against the edge of the ring closest to the wall. While holding the opposite edge of the washer down with a finger, trace the scribe line all along the gap. Cut to the scribe line and check the fit of the scribe. To refine the fit, you can repeat the scribing process using a smaller-diameter washer. **PW**

*Mark Weller
Vineland, California*



Firestorm Plunge Router a Great Value for Home Woodworkers

I'm going to surprise a few of you by recommending an \$80 router in this column. Frequently, less expensive routers are lacking in features and performance to the point that I think your money is better saved until you can afford the tool you need.

But in this case, the new Firestorm plunge router has performance and features that rival the more expensive routers. Don't get me wrong – this isn't a router I'd recommend for use in a production shop, but for the occasional home woodworker (or for those who think they could use an extra router) this tool is a great bargain.

The general consensus in the *Popular Woodworking* shop is that the DeWalt DW621 is one of our favorite routers. The Firestorm is an economy version of the DeWalt and offers many of the same features, including through-the-column dust collection and a really solid and useful depth-control mechanism.

No, this isn't as good a router as the DeWalt, and it's a little larger than we'd prefer for convenient handheld use, but for \$80 it's hard to find much to pick on.

During our shop tests we were pleased with the power provided by the Firestorm router. Again, this isn't a tool for a production shop, but in running rabbets and plunging $\frac{3}{8}$ " mortises in red oak, the router performed well, and without motor hesitation. The base will accept

up to a $1\frac{1}{16}$ "-diameter bit and that will get you through many a woodworking task.

The plunge action on the router is a little tight and it's our hope that it will loosen up with some more time in the shop, which it is sure to get. Wobble in the plunge mechanism (leading to accuracy problems) was noticeable, but not unacceptable.

The ergonomics of the router are decent, but again, it's larger than its DeWalt cousin. For the price and features, however, we're willing to work with that. — David Thiel

For more information, circle #168 on Free Information Card.



SPECIFICATIONS

Firestorm FS1200RP

Street price: \$80

Motor: 12 amp

Speed: Variable, 11,000 - 28,000 rpm

Collets: $\frac{1}{2}$ " and $\frac{1}{4}$ "

Performance: ●●●●○

Price range: \$

Black & Decker: 800-54-How-To or
firestormtools.com

Ryobi Drill Press Has Features Beyond the Bells and Whistles

At first glance, the new "Digital Drill Press" from Ryobi seems like a run-of-the-mill machine tricked out with a laser alignment system and a digital readout. Under the top cover, however, is a great way to change speeds. I've always hated looking at the chart and fooling around with the pulleys to change drilling speeds. And if I don't guess right the first time, I have to go through it all again.

By adjusting the lever on the left side of the drill press, one pulley gets smaller in diameter as the other one gets bigger. It's just that simple, and the digital readout lets you know exactly how fast the chuck is spinning. The downside to this system is that the slowest possible speed is just under 500 rpm. Our old-fashioned drill press goes down to 215 rpm, and for running a large Forstner bit or drum sander, that turtle mode is necessary.

The cast iron table is made with a thin rim around the perimeter that makes clamping to the table much easier. The fit and finish on all parts of this machine is comparable to most equipment on the market today – not

great, but certainly serviceable. The operating handles are a good length and angle to provide plenty of leverage without getting in the way. The lasers functioned well for locating the center of the bit, but this really isn't a difficult task to do manually.

On the whole, this is a nice little machine; the controls make sense and function as they should. If it were possible to reduce the speed to 200 rpm, it would be more versatile.

— Robert W. Lang

For more information, circle #169 on Free Information Card.

SPECIFICATIONS

Ryobi DP121L

Street price: \$180

Speed: Variable, with digital readout

Motor: $\frac{1}{3}$ hp, 110 volt

Laser: Adjustable alignment system

Performance: ●●●●○

Price range: \$\$\$

Ryobi: 800-525-2579 or
ryobitools.com



A Small Digital Fractional-readout Caliper – Finally!

Accurately measuring (both wood and machinery) in the shop is important for every woodworker, and most woodworkers have cursed their caliper on more than one occasion when they have to translate the decimal reading to inches.

In the *Popular Woodworking* shop we've come to a consensus that the perfect caliper is a 4"-long digital caliper that will measure in fractions (to $1/64$ "). We're happy to announce that the perfect tool is now available for the first time, at an affordable price.

The Craftsman Gallery is now offering either a 4" or 6" digital caliper for \$38. The caliper can be switched to read in millimeters or inches, in either decimals or fractions (with accuracy to $1/64$ ").

We're particularly pleased that the calipers are well-manufactured and easy to use. The 6" version is great for your bench, while the 4" model is the perfect size for dropping in your shop apron or work belt.

—DT

For more information, circle #170 on Free Information Card.



SPECIFICATIONS

Digital/fractional Caliper

Street price: \$38

Readout: Reads in millimeters, and decimal or fractional inches.

Accuracy: $1/64$ ", .001"

Length: 4" or 6"

Performance: ●●●●○

Price range: \$\$\$

The Craftsman Gallery: 513-233-9019 or
craftsmangallery.com

Veritas Ruler Stop: Pint-sized Accuracy

The combination square is standard equipment for many woodworkers, but it is overkill for most jobs. Most woodworkers need a well-marked ruler and a stop on it so measurements can be transferred or a line scribed parallel to an edge. Rarely is a combination square's miter face, bubble level or scribe necessary.

Veritas' new Ruler Stop is an inexpensive and elegant way to perform these common operations without a bulky (or expensive) combination square.

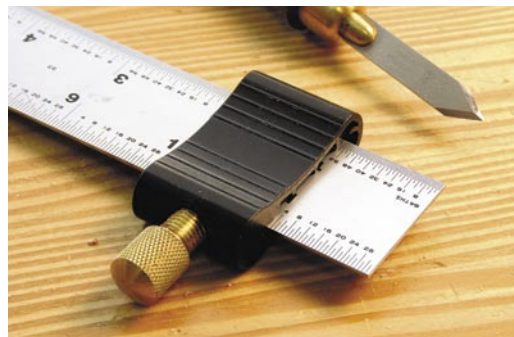
The stop slides over a ruler (not included) and cinches down accurately on any ruler, as

long as it's 0.05" or thinner and between $7/8$ " and $1 1/8$ " wide. The Ruler Stop is fantastic on my Shinwa 12" ruler, but it really shines on our 40"-long machinist ruler. The long rulers for the combination squares are shockingly expensive. The stop won't work on our shop's 6" rules, which are $3/4$ " wide.

The Ruler Stop is well made and accurate. It has an edge over competing stops in that it completely encases the ruler, making it less likely to fall off when you loosen the knob.

—Christopher Schwarz

For more information, circle #171 on Free Information Card.



SPECIFICATIONS

Veritas Ruler Stop

Street price: \$12.50, ruler not included

Materials: Brass knob, aluminum body

Size: 1" wide x $1 3/4$ " long (plus knob)

Performance: ●●●●●

Price range: \$

Lee Valley Tools: 800-871-8158 or
leevalley.com

BOSCH I-DRIVER

I've never understood the "bigger must be better" philosophy in cordless screwdrivers. Yes, you need the power to get the job done, but I'd rather have a tool that will fit into tight places, and won't strain my wrist and forearm every time I pick it up to use it.

The new PS-10-2 Litheon I-Driver is a tremendous addition to my power-tool arsenal. This new battery technology delivers power to spare in a compact, lightweight package. It performs comparably to a standard 12-volt cordless drill, and the five-position articulating head allows it to go where larger drivers won't fit. A button on the side allows the head to pivot from a right angle to an inline position.

I found it most comfortable to use with the head at 90° to the motor. I don't need a right-angle driver every day, but when I do, this is a great tool. Most on the market aren't comfortable for everyday use, but this little guy has become my "go to" driver for most applications. It's comfortable, powerful and versatile, and it's nice to have five ways to point it.

The kit includes the driver with seven clutch settings, two batteries and a charger with a soft-sided case. It costs about as much as a 12v drill kit. After years of seeing more of the same in cordless drills, it's nice to see a product that obviously has some thoughtful engineering behind it.

—RL

TOOL RATINGS

Performance is rated on a one-to-five scale. You won't see a low rating ("one or two") because we don't publicize inferior tools. "Five" indicates the leader in the category. Five dollar signs indicates highest price in the category. Three indicates an average price. If you have tool questions, call me at 513-531-2690 ext. 1407, or e-mail me at chris.schwarz@fwpubs.com. Or visit our web site at popwood.com to sign up for our free e-mail newsletter.

—Christopher Schwarz, editor

Build a Wooden Handplane – in a Day

Making your own woodworking tools can be rewarding—but it can also be time-consuming and thus takes you away from building furniture. Several years ago I felt exactly this way when I built five metal planes from kits.

However, you can have the best of both worlds: building furniture and the occasional useful woodworking tool. Hock Tools sells a wooden plane kit that you can assemble in less than a day if you please.

The \$98.50 kit comes with pre-cut parts—a maple body and a jarrah sole—plus a sweet 1½"-wide iron and a beefy chipbreaker made by Hock. The kit is designed to make a low-slung plane like the ones popularized by craftsman James Krenov, but because the body is wood, you can make any plane you please.

I used the kit to make a Roman-style plane, with its unusual through-the-body grips, and the kit worked brilliantly for that.

To build any style plane with this kit, here's what you do: First glue the two maple sidewalls to the two center blocks using four included dowels to keep the parts in line. Then glue the

sole to the body and add the cross dowel that secures the cutter with the wedge (which is included).

Then comes the fun part: Shape the 11"-long body using a band saw, rasps and knives. Sharpen up the cutter, open the plane's throat with a pocket knife, flatten the sole on some sandpaper and go to work. Honestly, most of the time invested in making this handplane is in allowing the glue to dry.

Building your own plane—even from a kit—is a fast way to learn a lot about plane mechanics. You don't need to do much tuning on the plane, but the work you do have to do is quick (because the body is wood, not metal) and enlightening for any handplane user.

My Roman-style plane came out great and is a blast to use. —CS

For more information, circle #172 on Free Information Card.



SPECIFICATIONS

Hock Tools Plane Kit

Street price: \$98.50

Iron: High-carbon steel, 3/16" thick

Body: Maple and jarrah

Performance: ●●●●●

Price range: \$\$\$\$

Hock Tools: 888-282-5233 or

hocktools.com

Craftsman Digital Readout Plunge Router

Adding a digital readout to a plunge router is more useful than adding a laser, but this digital feature alone might not be reason enough to give up your old plunge router. The Craftsman #17517 allows you to set the depth of your cut in 1/64" (or 0.1mm) increments and see the results in a lighted LCD window on the front of the tool.

This clever function is surprisingly accurate and easy to learn to use. You simply touch the router's cutter to your bench, press a button to zero out the digital scale and then turn a dial to set the depth of cut you want. (The readout is in fractions or in millimeters.) You then lock the setting and start routing. One warning on this feature: the millimeter scale on this tool actually is finer than the imperial scale so you might be tempted to "go metric."

The digital function works best with the router used handheld—it's less than perfect with the router mounted in a router table. Also, I think it's too easy to accidentally "zero" out your setting when you intend to simply turn off the digital readout. And while the router holds its setting fairly well in use, you

can knock it loose by plunging with excessive pressure. So take it easy.

Regarding the router's other features, I liked the soft-grip handles and the soft boot for the dust collection hose—too bad the dust chute clogged immediately every time I used it. The router offers a nice 10'-long cord, a spindle lock for one-wrench bit changes and a motor that ramps up gradually and is variable in speed from 15,000 to 25,000 rpm. The 10-amp motor itself is gutsy enough for most workshop tasks, and is (like most routers) too loud to be used without ear protection (89 dB up to 100 dB). The router comes standard with both 1/2" and 1/4" collets.

For me, the router would be more appealing if the digital readout could be switched to decimal fractions, the router were more friendly in the router table and if the dust chute functioned well. However, for the first digital-readout router I've ever used, I can say that I'm intrigued by what's next. **PW**

—CS

For more information, circle #173 on Free Information Card.



SPECIFICATIONS

Craftsman Digital Router (#17517)

Street price: \$140

Motor: 10 amp

Speed: Variable, 15,000 - 25,000 rpm

Collets: 1/2" and 1/4"

Performance: ●●●○○

Price range: \$\$

Craftsman: 800-549-4505 or

craftsman.com

Period Sharpening

An experiment uncovers cutting edges of the past.

“How did they sharpen their tools back then?” I’ve asked this question myself and I have been asked the question, and I’ve never felt comfortable with any answer. We know that 18th-century woodworkers had grindstones and natural whetstones and that’s as far as any answer I’ve ever heard or given goes. I assume that the average 18th-century craftsman could produce an edge on his tools as sharp as modern woodworkers get. But is that true? Exactly how did period craftsmen sharpen their tools? What kind of edges did they get? To find out, I decided to purchase old whetstones and an old grindstone, make a period frame and give it a try.

Period Sharpening Gear

Old inventories of workshops often include grindstones. They’re encountered so frequently we can safely assume they were typical.

In addition to grindstones, craftsmen may have used sandstone or other abrasive “rubb stones” as coarse abrasive hones. Long before the widespread distribution of Arkansas oilstones, craftsmen had access to fine local, as well as imported, whetstones. André Roubo, an early French chronicler of woodworking, mentioned that his stones came from the Levant, an area presently identified as Israel, Palestine, Jordan, Syria and Lebanon. As this area was then controlled by the Turkish empire, such stones were also known as “Turkey stones.” From Roubo’s 1774 volume *“L’Art du Menuisier Ebeniste:”*

These stones come from the Levant; the best are those which are of fair color, of a tight grain, plain and very uniform: this stone has the defect to have small whitish veins, either in length, or in thickness, which are as many hard spots which prevent it to sharpen well ... these stones are not [of] a very great size, and besides that they are fragile.



Photos by the author

One way to learn how tools were sharpened in the 18th century is to try it. I experimented with period sharpening for nine months and was surprised by what I learned. Joseph Moxon describes this method of holding a plane iron: thumbs under, fingers on top. This is a good grip for freehand honing – especially when you are pushing a treadle 100 times a minute!

One hundred years later, in “Construction, Action and Application of Cutting Tools,” Englishman Charles Holtzapffel wrote:

There are three qualities of Turkey Stone, a dark blue to black variety and a lighter blue grey stone, both of which go to London ... the third

quality is much softer, almost white in color and easy to work, but it is very brittle, and consequently difficult to get in large and even pieces; this quality of stone is shipped principally to France.

When present in period estate inventories, grindstones and whetstones were highly valued. Oilstones in the Charles Plumley inventory (available at popularwoodworking.com under Magazine Extras) were given a similar value to his handsaws, which were several

by Adam Cherubini

Adam makes reproduction furniture using the tools and techniques of the 18th century. You can contact him at adam.cherubini@verizon.net.

times the value of a smoothing plane. Plumley's grindstone rivaled his plow plane and his prized "yellow jaunders" jointer plane as the most expensive tool in the shop. It is not at all clear that period craftsmen had (or could afford) a range of whetstones of varying grits from which to choose. Rather, it seems that workmen were lucky to have a grindstone and one good whetstone – unless of course the workman happened to be French.

Technique

Between Roubo and Joseph Moxon, whose "Mechanick Exercises" was the first English book on woodworking, we have a pretty good picture of how things were sharpened in the 18th century. And that's important because we shouldn't assume they did things the way we do. But I was actually surprised by how similar their methods were to ours. See if any of this sounds familiar:

According to both authors, the basic process was to shape the edge with a grinder or coarse rubstone, then hone the edge until smooth. Moxon recommended 12° bevels for plane irons that work softwoods, 18°-20° for hardwoods. He believed lower bevels cut bet-



Formerly a rustic garden ornament, this stone appears to be rather primitively made and probably dates to the mid 19th century. Though inconsistent and difficult to work with, it has not been damaged by sitting in water. The other side of it is painted brown, no doubt a decorative touch. Oddly enough the paint may have preserved it.

ter, and higher bevels strengthened the edge. Moxon was also a fan of hollow grinding. This seems a sophisticated approach for 1687:

When you lift the Iron off the stone, to see if it be ground to your Mind; if it be not, you must be sure you place the Iron again in the same position on the Stone it had before; for else you will make a double basil (bevel) on your Iron: But if it be true set on the Stone, and steddily kept to that Position, your Basil will be Hollow, and the smaller your

Grindstone is, the hollower it will be.

Later he talks about using a flat rubstone to grind:

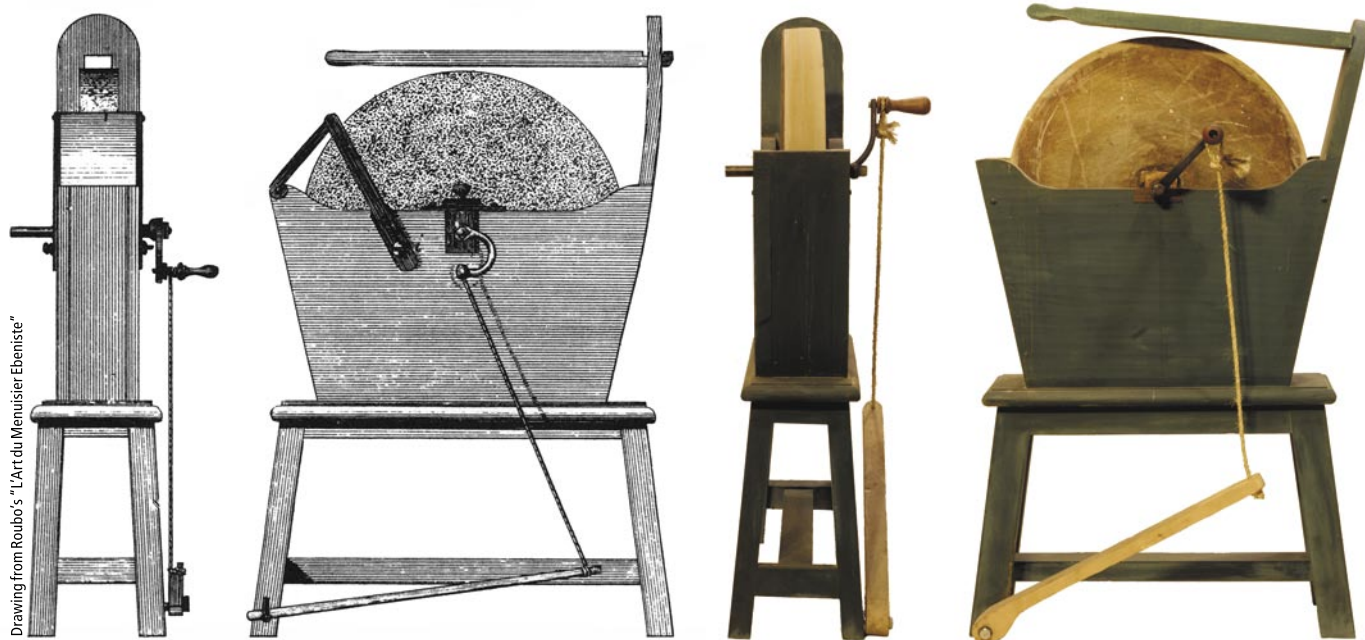
And this they do so often, till they have rubbed the hollowness of the Basil to a flat, and then they grind it again upon the round Grind-stone.

Roubo felt it was important to hone with oil and keep the stone clean:

Oil is useful to sharpen tools on these stones, and it is good that they are always saturated, and that they are always very clean, because the dust which sticks forms to it a grease which spoils them, and prevent tools to take an edge.

Grinding

Operating my grindstone was surprisingly effortless. But the wheel was out of round, nearly impossible to fix and it wobbled from side to side. No tool rest worked, so all my grinding was freehand. Wet grinding, though messy, was nice because I could grind without risking the temper of my precious steel. The sandstone wheel is a slow-cutting abrasive but seems to cut better when soaking wet. Still, a dull 1/2" chisel took at least 20 minutes to grind. Sandstone left a surprisingly smooth edge. Theoretically, my 20"-diameter wheel



Drawing from Roubo's "L'Art du Menuisier Ebeniste"

Roubo's grindstone has several advantageous features only recently available to us. It features an integrated tool rest, water cooling, low speed yet plenty of cutting power via its high inertia, and a large-diameter wheel to produce a nice shallow hollow grind. The wide face of the wheel allows a nice straight edge to be ground without moving the tool whatsoever. Fantastic ... until you actually try using it.

When I built my version, I skipped the tool rest. My wheel wobbles from side to side and is out of round about 1/4". My biggest concern, the effort required to turn the wheel at a usable speed, quickly became the least of my worries. This wheel easily spins at 120 rpm and will coast for over a minute! I was shocked. The brown half-bearing is *lignum vitae*.

should produce a little less than .003" of hollow in a 1/4"-thick plane iron ground at 30°. I never saw any hollow on any tool I ground on it. My tools came off the grinder smoother than I thought they'd be, with flat or slightly convex bevels.

Honing

After the grinder, I took my tools to one of the many whetstones I used for this project. None was perfectly flat, but that didn't seem to matter for the beveled side. All of the plane irons I sharpened were cambered and the chisels were too narrow to care about a little dish in the stone. But I quickly realized that none of these old whetstones was coarse enough, or cut fast enough to refine the ground bevel. I couldn't practically remove the camber in the bevel.

Without the ability to hollow grind, and without the ability to fix the grind with a whetstone, period craftsmen probably had no choice but to grind low and hone a secondary bevel (as I did). Maybe this explains Moxon's low angles.

The dished whetstones presented ever-increasing problems with my tools' backs. I tried to do as little as possible to the backs, but creating some amount of back bevel was inevitable. I have seen many old tools with this sort of sharpening (and have lapped out many such problems). In use, I found no disadvantage in this sort of edge. The big advantage of flat-backed tools seems to have more to do with sharpening them than using them.

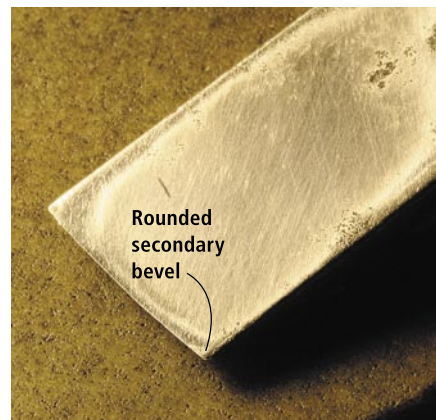
Conclusions

Despite a few problems with crumbling edges (possibly caused by insufficient polishing), I had little trouble with the tools I sharpened using the old gear. In general, they felt like tools I had sharpened on modern equipment and used for a few days. Not at their peak, but OK. I think it's generally true that period craftsmen had tool steels every bit as hard as our own, but lacked the abrasives to hone them as we do today. As a result, I suspect they worked with tools that were not quite as sharp as ours and had edges that resembled a double-beveled knife.

Not all of these experiments have value to modern woodworkers. Perhaps this one fits into that category. But I guess if pushed I could say a few things that may help:



Sandstone leaves a surprisingly fine edge. It's easy to see the secondary bevel I honed with a whetstone in this picture. The edge and entire breadth of the bezel is curved—a result of the shallow groove in my grindstone.



Not a great looking edge, is it? It's a bit like the opposite of a Japanese chisel. This chisel had a flat back nine months ago. The dished whetstones I've been using are slowly wearing away the edges. When that dubbed edge is polished it will cut well, though.

1) Our modern sharpening technique is based on good abrasives. We use essentially 21st-century abrasives on 18th-century metals. When our metals catch up to our abrasives (CPM-3V is one possible example of a very difficult modern metal to sharpen) we may need to revisit this article.

2) The shapes we hone may have more to do with sharpening than using. A flat back and hollow grind (the way I shape my edges) certainly isn't necessary for use.

3) Based on this experiment, I'm no longer confident that my old tools sharpened with modern equipment are as representative of tools sharpened in the 18th century as I thought. This has caused me to reconsider the ease with which 18th-century craftsmen surfaced stock for example. Smooth surfaces in difficult woods may have required special attention. Either the craftsmen needed to spend extra time on his blades, or scraping or sanding (gulp) may have been required. **PW**

PERIOD STEEL

The type of steel used would certainly affect one's sharpening experience. It is my understanding that 18th-century craftsmen could have worked with a wide variety of metals including relatively soft, case-hardened wrought iron, inconsistent cementation (a.k.a. blister) steel and cast steel. The latter two were often laminated to soft wrought iron (to save the cost of steel). Both were capable of achieving high hardness (Rc 65), though it's unclear such a hardness was desired or achieved. I found laminated blades much easier to grind. All of the tools I used during this project were "cast" steel. "Cast steel" was not developed until mid-century and its widespread use is questionable after that. But, we know cast steel was commonly available in a wide array of edge tools by the century's end. Cast steel is not cast iron, nor is the tool cast. Rather, the



term refers to the method of manufacture of the steel itself. Iron was melted in clay crucibles, cementation steel was added and the molten metal was cast into ingots. While cast steel was a significant improvement over earlier blister steel in terms of its consistency (specifically carbon content), it's not at all clear that it presented a significant difference in sharpening. —AC

Magazine Rack

Two bits of wood and a jigsaw are what you need to make this magazine rack that converts to a bookstand.

Because you're holding this magazine, chances are you could use a magazine rack by your favorite chair to hold your current crop of periodicals and catalogs.

And because you like magazines, I suspect that you also like books, and you might have need for a stand to hold open your favorite reference book – whether that's a dictionary, "Baking Illustrated" or "Tage Frid Teaches Woodworking."

If you're nodding your head in agreement to either of the above statements, we have one project that can scratch both itches. This simple project has only two parts and they interlock: Slide them together one way and they make a magazine rack; slide them together the other way and they make a bookstand.

And here's the best part: You need only a handful of tools to make this project. Plus, it's a quick job; I built the version shown here in just a couple hours. It's the perfect "I Can Do That" project.

by Christopher Schwarz

Comments or questions? You can reach Chris at 513-531-2690 ext. 1407 or chris.schwarz@fwpubs.com.

Gather Your Materials

As with all "I Can Do That" projects, we buy all our materials from the local home center. So with a construction drawing in hand I hit the lumber section. I wasn't happy with the No. 2 pine in the racks. The poplar was an uninspiring purple. But there were a couple promising red oak 1 x 12s. These were expensive: \$40 for a 6' length. But that was enough to make two racks, so I pulled the trigger.

Make a Simple Jig

This project requires you to set the base of your jigsaw at 35° to the blade, sometimes tilted left and sometimes tilted right. To make these changes quickly and reliably, I made a little jig from a scrap. You don't have to make the jig for this project, but it sure makes life easy.

My blade-setting jig was made from a scrap piece of 3/4"-thick plywood that was about 3" wide and 12" long. I cut one end at 90° on my



Photos by Al Parrish

miter saw. Then I set the saw to make a 35° miter and cut off about 3" of the plywood. The piece that falls off is the jig for setting the blade.

By placing the jig on the saw's base you can tilt the base to 35° left and right quickly. And you can use the square edge of the jig to return the saw's blade to 90°.

Make Your Straight Cuts

Use the drawing to lay out all your cuts. Then, with the blade set at 90°, make the cuts that define the two feet on one piece and the single foot on the other piece.

Then make the square-shaped cutouts on each piece. Here's how: Drill a couple 3/8"-diameter holes near the corners of the square-shaped cutout. Then use your jigsaw to remove the waste and square up the corners.

Make Your Bevel Cuts

Tilt the jigsaw's base to 35° left and make all the cuts you can with the blade tilted this direction. Then tilt the blade the other direction and make the remainder of the cuts on the two pieces. In the end you'll have some



This scrap of wood acts as a reliable way to set your jigsaw's base to 35°. I found a protractor difficult to balance on the base and not nearly as accurate.

waste hanging onto your work that needs to be removed with a coping saw. It's simple work. If you don't have a coping saw, use a chisel and a mallet to pop out the waste.

Clean up all your cuts with a rasp, file and sandpaper. Then fit the two parts together



You can rotate the blade in its frame with a coping saw to make a tricky cut like this very easy.

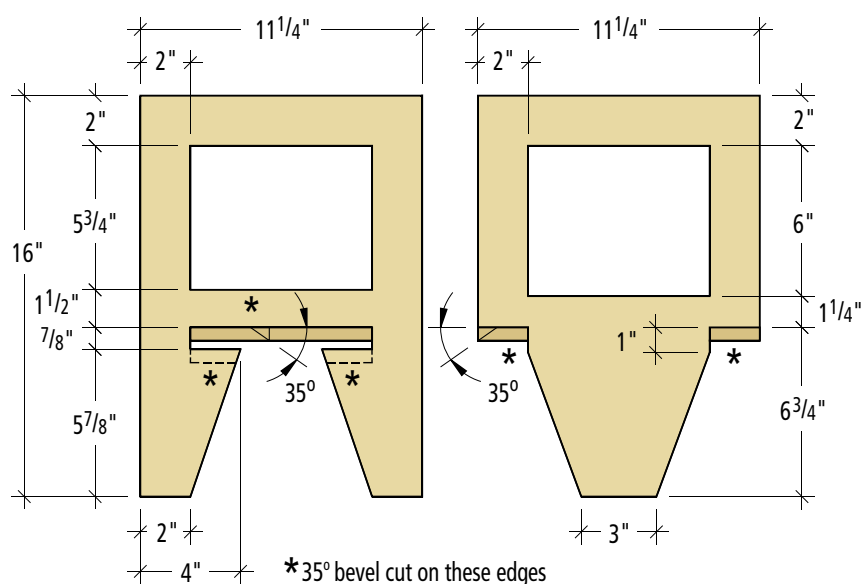
— you might have to adjust a few edges with a rasp to get a good fit. If the part with the single leg is just a little too thick to fit through the slot in the other, reduce the thickness of the single leg with your block plane until everything fits. Sand all your parts and add a clear finish (or stain or paint).

In our office, we have far too many magazines for this project to be useful to us. So we're going to use it as a stand for our office dictionary, which settles our debates on word usage. But if we ever need a magazine stand, it's just a flip of the pieces away. **PW**

ABOUT THIS COLUMN

Our "I Can Do That" column features projects that can be completed by any woodworker with a modest (but decent) kit of tools in less than two days of shop time, and using raw materials that are available at any home center. We offer a free online manual in PDF format that explains all the tools and shows you how to perform the basic operations in a step-by-step format. You'll learn to rip with a jigsaw, crosscut with a miter saw and drill straight with the help of our manual.

To download the free manual, visit ICanDoThatExtras.com.



Elevation

MAGAZINE RACK

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL
		T	W	L	
2	Interlocking slabs	3/4	11 1/4"	16	Red oak



LAGUNA 14 SE

G0457

AFT

ON

Photo by Al Parrish



14" Steel Frame BAND SAWS

You might be asking yourself, "Why are they testing such a specific saw category?" Good question. The general consensus is that steel-framed saws are more rigid than traditional cast-iron saws and allow more tension to be loaded on the blade. There are cast-iron saws that can stand the tension, but they usually are of a much older design or larger throat capacity. High tension is a good thing when you're using your band saw for resawing. The tension offers a cleaner, straighter cut – important for waste reduction when working with expensive lumber.

We anticipated that all of these band saws would be good machines for general curves and joinery work – and they are. Our greater question was whether these steel-frame 14" band saws actually lived up to the potential of operating as resawing machines – or whether they just looked cool. And that's why we decided to put them to the test.

Our experience is that a good resawing machine will have an adequately sized motor to match the resaw capacity of the saw. It should be able to handle at least a 3/4"-wide blade, and have a resaw capacity (the space between the table and the upper blade guide) very close to 8". We also want the table size and support structure (the trunnion design) to adequately support a board of conventional resawing size.

Our test includes six machines that vary in resaw capacity from 7" to 13" and range in price from \$479 to \$1,195. Some saws are pre-

They're all the rage.
But are they ready to resaw?

wired for 220-volt (v) power, while others can be converted to 220v or 110v modes. The motor sizes varied, and other features (including single or dual speeds) helped to differentiate the machines.

Tables: Firm or Flexible?

To test the machines we first checked the amount each table

flexed by loading the front right corner of the table with a 25-pound weight and measured how much the tables sagged.

We then resawed 7"-wide oak boards (removing 1/4"-thick slabs) to test motor performance of each saw. For the machines capable of wider resaw capacity (the Rikon and Laguna machines) we also

repeated the resaw test using 11"-wide oak boards. In all the resawing tests we used identical 3/4"-wide, three-teeth-per-inch blades from Grizzly Industrial.

As an aside, the blade lengths required on all of these machines are not standard and in some cases may require custom-made blades, especially if you're looking for a particular tooth design.

Features: Lean or Loaded?

We also looked closely at the features offered by each machine. A stable base was considered a good thing (with little assembly required even better). If the base included storage, that was also an asset.

We also examined the different blade-guide designs and offered our opinions of the variations in the individual comment sections. Table size and design, as well as trunnion design were also considered. Larger is better, but not as important as stability. While we noticed significant differences in table stability, all of the machines passed our 25-pound weight test and should be adequate for the weight load during basic resawing. Ease of use when changing blades was another consideration, as well as overall ease of use in general operation.

In the end, we were able to identify two machines worthy of praise. The feature-laden Craftsman saw performed well at a very good price, earning our Best Value award. A redesigned Rikon saw surprised us in a very positive way, offering features and performance superior to even the much higher-priced Laguna machine.

by David Thiel

Comments or questions? Contact David at 513-531-2690 ext. 1255 or david.thiel@fwpubs.com.



The trunnions on the Craftsman saw are cast aluminum and are adequate to the task, but could provide better balanced support to the table and smoother adjustment.



The General (and Grizzly) trunnions are cast aluminum in a different configuration than the Craftsman. They provide more even support, but could be larger.



The Laguna trunnions are large and of cast iron providing excellent stability and balance to the table. The other manufacturers can learn something from this design.



The Rikon trunnions are stamped steel and do a decent job of support and balance. The rack-and-pinion design adds smooth table adjustment and is a nice feature.



CRAFTSMAN 22401

The Craftsman saw has the lowest sticker price in the test, but it performed well and has nice features.

From the bottom up, the base is sturdy and has storage, but the saw has lots of pieces to assemble, including the worklight. Features that caught our eye on this saw include ball-bearing guides that place the edge of the thrust bearing, rather than the flat of the bearing, against the blade. This is a superior design and allows much better support for the blade. The Craftsman also includes a side window in the upper case for adjusting the blade tracking without opening the case door. The ease of changing the blade was decent, with a front slot in the table making it easier to remove the blade. You are required to remove the fence-mounting bar, but this is fairly simple to do and doesn't require tools. All three of these useful features are also found only on the pricier \$749 Rikon saw in this test. The Craftsman also offers a unique belt-tensioning device for the motor pulleys that ought to be standard on every saw.

In use we found the motor had plenty of power for resawing, but the fence required some complicated shimming to square it to the table. We also wish the table could tilt in more than just one direction.

Overall, this saw is a good bargain for the price and earns our Best Value award.

■ 800-549-4505 or craftsman.com



GENERAL 90-100

The General International saw is solid but basic. It suffers because of a lack of features, some design issues and only adequate performance for the \$700 price.

Positive features include the pre-assembled base that includes storage and a quick-release mechanism for the blade tension at the top of the saw. It is a simple cam-action lever, and to increase or decrease tension slightly, the lever can be rotated under pressure. This is actually easier than trying to turn a big knob.

One immediate concern we had is that the fence design makes it impossible to remove or remount the fence without first removing the blade. Plus, the saw lacks a visual tension gauge, so you're pretty much setting up the blade tension by feel.

While most of the saws in the test include thumbscrews or knurled knobs to assist with adjusting the blade guides, the General requires a hex wrench for those adjustments. We also had issues with the upper guide arm when it's raised to its full height (for maximum resaw capacity). At the highest point, the thrust bearing hits the upper wheel housing, binding the bearing, which can lead to serious problems. Power during the resaw test was adequate, but not impressive. With a slow, continuous feed, resawing was successful. We expected and hoped for more from General.

■ 514-326-1161 or general.ca



GRIZZLY G0457

The Grizzly is a good saw and performed well in the test. While we've come to expect Grizzly products to provide good service at a bargain price, this saw is priced competitively – but isn't what we'd call a bargain. The base arrives assembled (which I learned to appreciate) and offers storage and a solid design.

One annoyance was the difficult task of mounting the motor (only one of two saws requiring motor assembly). Also, the motor is not pre-wired and doesn't come with a plug. That's OK if you're unsure of your preferred voltage, but it does offer one more hurdle to jump before you're able to cut wood.

During the resaw test the Grizzly performed well, with no-bog down during the cut. We found the Grizzly to be a stable saw overall, but we found heavy vibration in the table. During our flex test we found the Grizzly's table gave $\frac{3}{64}$ ", which was comparable with most of the saws in the test, but when grasping the table and wobbling it, there was much more movement.

It's our suggestion that the trunnions on this machine (and the way they are supported by the saw's frame) could be beefed up, improving the performance and eradicating what was really the only real disappointment with the performance of this saw.

■ 800-523-4777 or grizzly.com



LAGUNA LT14SE

We've come to expect a lot from Laguna (a larger Laguna is a mainstay in our shop); maybe we're expecting too much. The LT14SE was designed as a smaller version of larger Laguna machines, with the intention of retaining capacity and performance. To be sure, the capacity is there, but the performance fell short of what we expected.

During the 7"-board test the saw did OK, but started to slow in the cut. When we stepped up to the 11" board we were able to stall the machine. For \$1,200 we were a bit disappointed.

There were also ease-of-use issues that surprised us. To change the blade, upper and lower blade guards need to be removed entirely from the saw (requiring a wrench). The throat insert is a mix of good and awkward. Alignment screws allow it to be leveled flush to the table, but a spring clip mounted below the plate (to hold it tight to the table) makes you fumble awkwardly under the table to release the clip.

The ceramic guides are unique and of Laguna's own design. They do a nice job of guiding the blade, but adjusting the side guides required finesse (balancing the spacing) that seems more complicated than necessary. The table height (measured from the floor) is the highest in the test and when the mobile base is added (a little tippy and an extra expense), it's a little too tall for comfort.

■ 800-234-1976 or lagunatools.com



RIKON 10-325

This is a brand-new version of the 14" saw from Rikon and the designers have done a great job on the upgrades. The saw includes a stable base (assembly required), a worklight, and windows in the side of the upper case (for adjusting blade tracking) and in the front to view the tension gauge.

Rikon (along with Craftsman) uses a superior edge-bearing thrust-guide design. The guides are pretty easy to adjust, but different enough in design that there is a learning curve. Another shared feature with Craftsman is the user-friendly front-of-table slot for blade changing.

A unique feature on the Rikon saw is a rack-and-pinion table adjustment that feels better, though in reality functions about the same as the usual gravity adjustment. Because the saw is pre-wired for 220-volt power (which is good for performance in our opinion), it does cause a slight power issue. The included light is a 110v fixture, so you'll need to run both 110v and 220v power to the saw (or rewire).

In testing, this saw was impressive. It moved through the 7" oak without a problem or a hesitation. Even more impressive was that the performance in the 11" oak was just as smooth. This saw's performance beat out that of the Laguna. That earned our respect – and our Editor's Choice award.

■ 781-933-8400 or rikontools.com



YORKCRAFT YC-14WBS

The Yorkcraft comes with a decent five-piece base that is quick to assemble, but offers no storage. The saw uses decent bearing guides that are easily adjustable with thumbscrews. We found the visibility difficult when adjusting the lower guides because of the position of the trunnions and trunnion handles.

While running the Yorkcraft during testing we found it had good power for resawing, but we also experienced the most vibration of all the saws tested. The vibration was not just in the table but throughout the entire machine. Our supposition is that the clever base design actually provides much less stability than the other bases in the test, exacerbating the vibration issue.

This saw required the motor be installed after delivery (as with the Grizzly), but we found the process easier on this machine because the motor installs on the base, not on the lower wheel housing. One person can handle the task on the Yorkcraft, while the Grizzly requires a friend. The included fence was adequate to the task and adjustable for drift, but not remarkable. While the overall performance of this saw was good (but for vibration) and the price is also good, when compared to the features, performance and price of the Craftsman, it fell short.

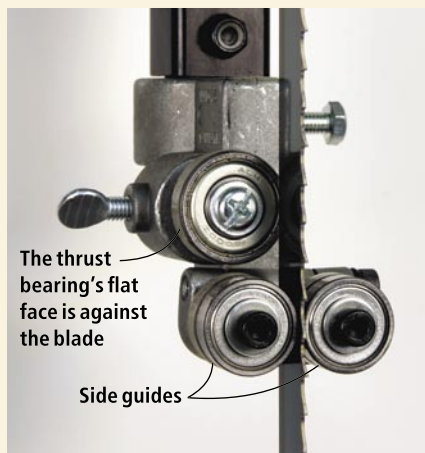
■ 800-235-2100 or wilkemachinery.com

14" STEEL-FRAME BAND SAWS

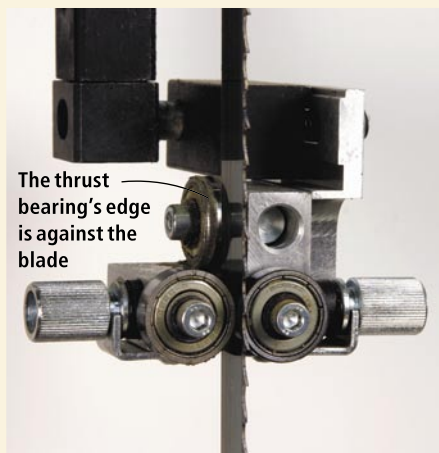
	Craftsman 22401	General 90-100	Grizzly G0457	Laguna LT14SE	Rikon 10-325	Yorkcraft YC-14WBS
Price*	\$479	\$700	\$775	\$1,290 **	\$749	\$499
Amps	11/5.5	11/5.5	20/10	20	7	14/7
Pre-wired voltage	120v	115v	220v	220v	220v	110v
Speed (fpm)	1,620/3,340	2,300/3,250	3,000	3,350	1,445/2,950	3,177
Tension quick-release	No	Yes	Yes	No	Yes	Yes
Blade length	99 ³ / ₄ "	101"	106"	112"	111"	100 ⁷ / ₈ "
Blade range	1/8" to 3/4"	1/8" to 3/4"	1/8" to 3/4"	1/16" to 1"	1/8" to 3/4"	1/8" to 3/4"
Rack & pinion guide	Yes	No	Yes	No	Yes	Yes
Throat depth	13 ⁵ / ₈ "	13 ³ / ₄ "	13 ¹ / ₂ "	13 ¹ / ₄ "	13 ⁵ / ₈ "	13 ³ / ₈ "
Resaw capacity	8"	7"	10"	12"	13"	8"
Table size	20 ³ / ₈ " x 15 ³ / ₄ "	14" x 14"	19 ³ / ₄ " x 14 ³ / ₁₆ "	15" x 15"	15 ³ / ₄ " x 21 ¹ / ₂ "	14" x 14"
Table height	43 ³ / ₄ "	43"	42 ¹ / ₄ "	44"	39 ¹ / ₈ "	41 ³ / ₄ "
Table material	Cast iron	Cast iron	Cast iron	Cast iron	Cast iron	Cast iron
Table tilt	0° to 45°	-10° to 45°	-8° to 45°	-15° to 45°	-10° to 45°	-10° to 45°
Table flex	3/64"	3/64"	3/64"	1/64"	1/16"	3/64"
Wheel material	Cast iron	Aluminum	Cast iron	Cast iron	Cast iron	Aluminum
Dust port(s)	2 1/2" & 4"	2 1/2"	4"	4"	4"	4"
Weight (lbs)	241	210	251	242	251	215

*Prices from Amazon.com when available. ** Includes optional mobile base.

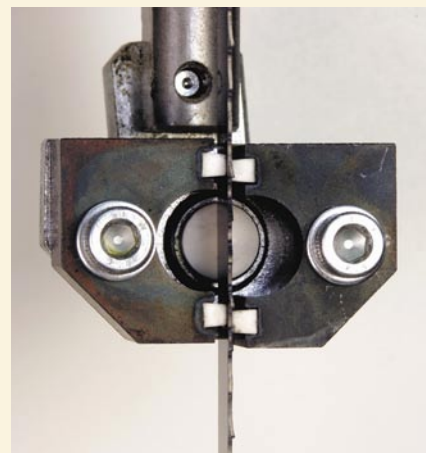
A FEW GUIDING PRINCIPLES



Above are the guides on the Grizzly band saw. They are the traditional bearing style, with the side guides positioned on both sides of the blade to keep the blade from moving left or right during the cut. The Grizzly's side guides are actually two pairs of guides (four guides total) that give broader support for wider blades. The thrust bearing (behind the blade) is also a bearing, but the blade pushes against the flat of the bearing. This design has worked for many years, but the guide at right is a more efficient thrust design.



Above are the guides from the Rikon band saw. As are the guides on the Grizzly, they are all of bearing design. The side guides in this case are single guides, which will be fine, but the double bearings on the Grizzly will provide better support for wider blades. The thrust bearing on this saw is mounted so the rear of the blade rides on the edge of the bearing, using the bearing in the way it's designed. This will actually allow the blade to ride against the bearing for excellent support.



The guides on the Laguna (above) are unique in the test. They use ceramic blocks to guide the blade both at the sides and at the rear. Ceramic guides are a good guide material as they pull heat away from the blade and extend the life of the blade. One drawback is that they will wear and will have to be adjusted more often than bearing-style guides. While there are other ceramic block guides on the market, this configuration is designed specifically for Laguna saws.

PW —DT

WOODWORKING ESSENTIALS

BY BILL STANKUS

CHAPTER

2

Setting Up Shop: Lighting & Power

When the workshop has proper lighting, sufficient electrical power and plenty of outlets it is a safer and better work environment.

Whether you are building a new free-standing shop or adapting a garage or basement for your woodshop, determining a plan for your electrical needs is one of the most important steps. Here is where to begin.

Evaluate Your Electrical Needs

Check the electrical service panel and circuit breakers to the workshop location and note the breakers' amp values. If there's only one 15- or 20-amp circuit for the workshop or if the service to your home is 100 amps (or less), then the service will need upgrading.

How you upgrade or install adequate electrical service for a workshop location is dependent on whether you're remodeling or building a new room. Installing wiring and outlets in a new construction is fairly straightforward compared to remodeling.

Warnings About Electricity

Never attempt electrical work if you have doubts about the wiring layout or the consequences of your effort. Start with your local building departments (usually city and county) and the utility company. Building departments have electrical inspectors who can explain local codes and requirements concerning permits for the work and

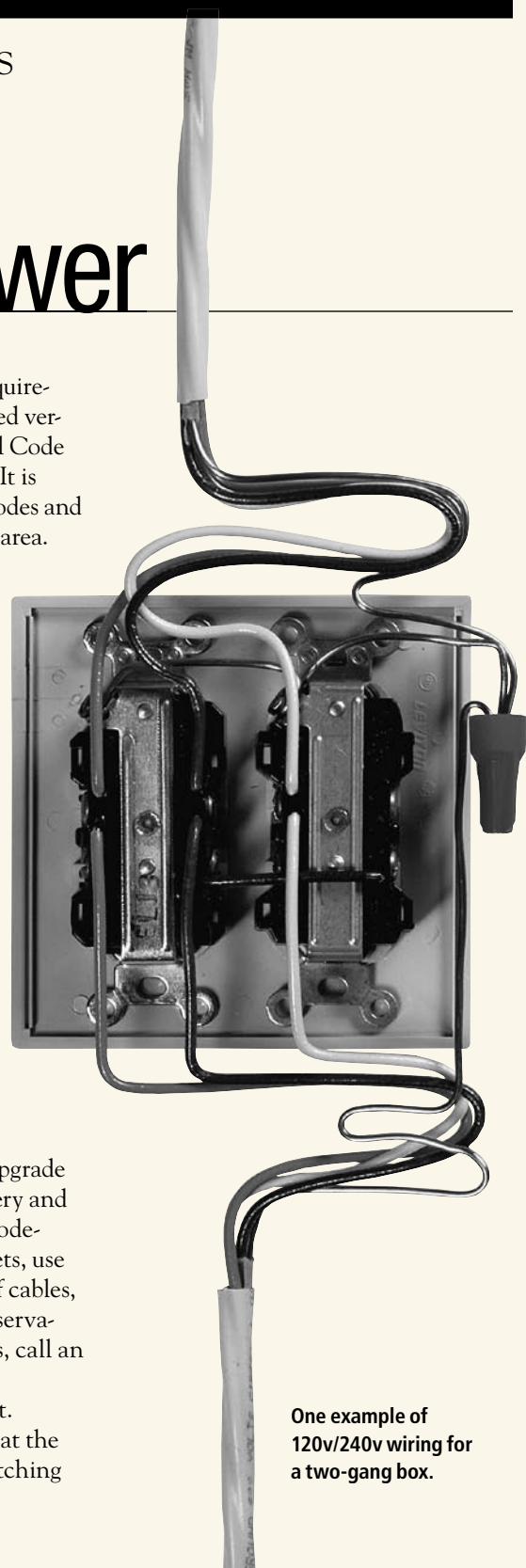
any necessary inspections. Requirements, regulations and amended versions of the National Electrical Code (NEC) vary from area to area. It is very important to follow the codes and guidelines established for your area.

The local utility agencies can assist in the location of underground cables and will recommend the correct approach to any electrical-service upgrades. Find a recommended licensed electrical contractor. Often, it's less time-consuming, more economical and safer to have an expert install new wiring, electrical service panels or other custom work than to try it yourself.

Safety Rules

Upgrading a workshop generally consists of information, common sense, proper tools and supplies. To safely complete an electrical upgrade requires knowing the machinery and tool electrical requirements, code-compliant installation of outlets, use of the proper types and sizes of cables, outlets, etc. If you have any reservations about any of these points, call an electrical contractor.

Never work on a live circuit. Always disconnect the circuit at the service panel. That means switching



One example of 120v/240v wiring for a two-gang box.

the circuit breaker to “off” or removing a screw-in fuse. Remember that the electrical power is still live to the service panel from the power utility lines (either below or above ground), so even if you switch off the main power, the power is still live to the service.

Be certain that the circuit is off by first turning on a light that’s plugged into that circuit. If it goes out when the circuit is switched off, proceed with your next steps.

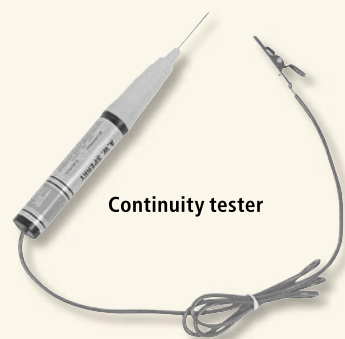
Tell others that you are disconnecting a circuit. This is important when working at some distance from the service panel. Tape a note to the service panel warning others that you are working on the service.

Never work on the service panel or wiring when there are wet spots, moist conditions or standing water. Dry the area as much as possible. Open windows and doors to aid in drying damp basements. If there is moisture on the floor, construct a platform of dry boards over the wet areas.

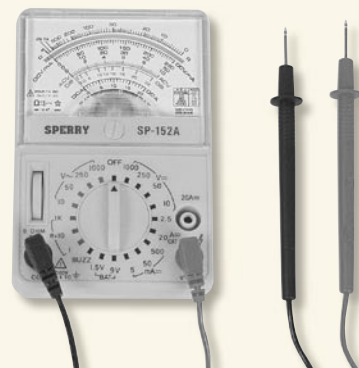
Common Electrical Tools

The following is a list of specialized tools that are typically used for electrical work. Most are commonly available at a local home center.

- **Lineman’s pliers** – Use to twist bare wires together and then cut the last 1/8" off so that the twisted wires fit into a wirenut.
- **Diagonal cutting pliers** – For cutting wire; fits in confined locations.
- **Needlenose or snipe-nosed pliers** – For working small parts in confined locations.
- **Wire strippers** – Adjustable to different wire gauges for removing insulation.
- **Multipurpose wire tool** – Combines wire stripper, wire cutter, crimper and bolt cutter.
- **Insulated screwdrivers** – coated with insulation, except for blade tip.
- **Conduit bender** – Use to bend metal conduit.
- **Fish tape** – Thin metal line for pulling cable through enclosed areas.



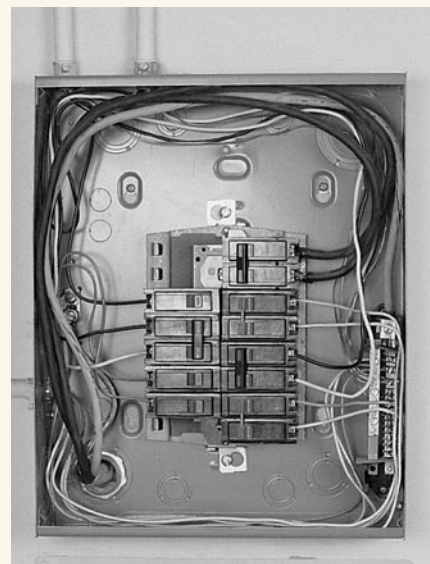
Continuity tester



Multitester

- **Cable ripper** – For slitting cable sheathing.
- **Electronic metal and voltage detector** – Use to locate metal objects and detect AC voltages within a wall.
- **Continuity tester** – Use to determine if an electrical path is complete. Simple to use when checking fuses, switches and plugs. Only use when the power is off!
- **Voltage tester** – Use to determine if power is present. It is used with the

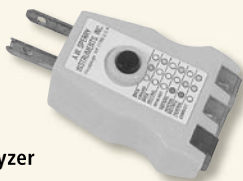
At right is a typical subpanel installed above the main circuit breaker panel. Below the main panel is a Gen/Tran unit – used for connecting a portable generator to the main panel in the event of a power outage.



This subpanel cover is removed for a better look at the breaker switches and wiring.



Voltage tester



Circuit analyzer

power on. The probes are touched to a hot line and the ground, causing the indicator to light. Also for checking DC/AC voltage, outlets, motors, appliances and fuses.

■ Volt-ohmmeter, or multitester

– Use to test a variety of conditions, including voltage, low-voltage current, resistance to ohms and continuity. Also for checking outlets, fuses, wires, plugs, motors and electronic circuits.

■ **Circuit analyzers** – Use to determine if there is power to a receptacle, proper grounding or if the wiring is correct. There are more sophisticated circuit analyzers that can check from the receptacle back to the service panel for voltage drops or for current leaks.

Electrical Supplies

Be certain that the electrical supplies you select are approved or meet local building codes. If you aren't sure about this, then it would be best to consult certified experts. There are too many choices – guessing which part or wire size to use is the wrong approach.

The term “wire” typically refers to a single strand of conductive metal enclosed with insulation.

The term “cord” is used to refer to stranded wires protected by insulation. It can consist of two or three stranded wires within the insulation and is used for appliances, lamps, etc.

“Cable” has two or more color-coded insulated wires that are protected by

sheathing. In the United States the colors of the individual wires are: black or red is the power, or hot wire; white or gray is the neutral; and green (or green with a yellow stripe) is the ground wire. Sometimes the ground wire is a single uninsulated copper wire.

Wire Size and Type

Use the correct wire size and type when upgrading an electrical system. Local codes will specify the types of cable and cable conduits permitted in your area. Here are the common wire types:

■ **Type NM** (nonmetallic), has thermoplastic insulation and is capable of withstanding a wide range of temperatures. It's used for most household circuits.

■ **Type UF** (underground feed) is waterproof and is used for damp and outdoor locations.

■ **Type USE** (underground service entrance) is used for underground or overhead service entrance and direct burial to garages and workshops.

■ **Type THW** is used for outdoor hanging or indoor conduit as service-entrance cables and for conduit to a subpanel.

Of the above types, NM cable is the most common plastic-sheathed cable. It's often referred to as Romex, a trade name. The sheath is usually moisture-resistant and flame-retardant. Normally, there are insulated power wires and a bare ground wire inside of the sheath.

Armored cable, also referred to by the trade name BX cable, has an outer armored layer, usually flexible galvanized steel, that often contains two or three wires wrapped in paper.

Conduit is usually either galvanized steel or plastic pipe. It's generally available in 1/2", 3/4", 1" and 1 1/4" diameters. The correct size to use in your woodshop depends on the diameter and number of wires inside the conduit.

Wire Size

Wire size is extremely important when upgrading an electrical system. Standard reference numbers, usually printed on the outside of wire insulation, are

based upon the American Wire Gauge (AWG) system. Gauge numbers are inverse to their size; that is, the smaller the number, the larger the wire diameter. The maximum current that a wire

Typical Tool Amperage Draw

10" Cabinet saw	8.3 @ 240v
10" Contractor saw	12.8
14" Band saw (1/2 hp)	9
10" Radial-arm saw	11
12" Miter saw	13
6" Jointer	9.5
12" Planer	15
Drill press	6
Edge sander	8.4 @ 240v
2-hp Shaper	16
12" Lathe (3/4 hp)	11.4
Scroll saw	1.3
Dust collector (2 bag)	16
Dust collector (4 bag)	17 @ 240v
20-gal. Shop vacuum	10.5
3 1/2-hp Air compressor	15
Router, 1 hp	6.8
Router, 3 hp	15
Belt sander	10.5
Plate joiner	6.5
Random-orbit sander	1.7
Spindle sander	3.5
3/8" Drill	4
Bench grinder	6
Strip sander	2.6
Jigsaw	4.8
Circular saw	13

For tools not included on this list, the National Electrical Code sets minimum amperage capacities:

- Small appliances – 20 amperes
- General lighting – 15 or 20 amperes
- Stationary tools – multiply the machine's amperage by 125%. (A 15-amp planer will require $1.25 \times 15 = 18.75$, or a 20-amp circuit.)

Common copper house wire and its ampere ratings

No. 18	7 amperes
No. 16	10 amperes
No. 14	15 amperes
No. 12	20 amperes
No. 10	30 amperes
No. 8	40 amperes
No. 6	55 amperes

can safely manage is stated in amperes (amps). Wire diameter and the amount of amperes are directly related. Smaller-diameter wires have greater resistance to electrical current flow; consequently, as the current flow increases so do friction and heat.

Calculating Electrical Usage in the Workshop

When electrical circuits or subpanels are added to an electrical service, the total load must not exceed the service rating. Generally, older homes have 100-amp service and newer homes have 200-amp service. If you are not certain about the service, look at the main circuit breaker in the service panel. If you have 100-amp service, consult with both the utility company and a licensed electrician regarding upgrading to a 200-amp service.

The woodshop is probably going to have machines and power tools, unless, of course, you're taken with the joy of working only with hand tools. Generally, home woodshops will have one woodworker using no more than two machines at one time (table saw and dust collector, drill press and vacuum). The advantage of this is that the electrical system isn't going to need to support the simultaneous operation of all the woodshop's machinery. As you plan the electrical layout of your shop, make a best guess as to the frequency of use of tools and machines.

Not only will this aid in determining circuit requirements, but it will also aid in planning the placement of outlets. The reality of upgrading woodshop

electrical systems is that it's often easier to install separate outlets on separate circuits than to have one circuit with multiple outlets. For example, in my woodshop I have three machines requiring 220v service: the table saw, jointer/planer and band saw. Rarely, if ever, are two machines running at the same time. So it's possible for the three machines to have their outlets wired to the same circuit.

However, these machines are located in different areas of the woodshop and it was much easier to install outlets at each of the machine locations and route wires through one or more conduits. Since there was adequate space in the subpanel, it was a straightforward addition of circuit breakers and wire. The exception to this is the dust collector, which is also 220v. Because it's operated simultaneously with each of the stationary machines, there was no choice – it required its own circuit.

The National Electrical Code sets minimum capacities for circuits regarding use and amperage:

- Small appliances – 20 amperes
- General lighting – 15 or 20 amperes
- Stationary tools – multiply the machine's amperage by 125 percent.

The 125 percent factors the electrical surge that occurs when a machine

is first switched on. For example, a 12" planer rated at 15 amps ($1.25 \times 15 = 18.75$) will require a 20-amp circuit.

Outlets, Switches and Plugs

Until the day comes that we can use tools powered by wireless electricity, woodshops will need outlets and switches. When designing a new electrical layout, placement of outlets and switches requires planning, guesswork and a bit of luck. The reality of woodshops is that work projects, new machines, relocation of cabinets, stacks of lumber and other fluctuating events will block existing outlets and switches from access. Often, well-thought-out



On the left are 120v, 20-amp receptacles; on the right, 240v, 20-amp receptacles.



Installing outlets near your tools is not only more convenient, it's safer, too. If, for example, the plug is located near your router table, you're more likely to disconnect it when changing the router bit, which is the safest way to work.

locations aren't that handy once the woodshop is actually used. The ideal situation is never having to use extension cords because you have outlets wherever you work. This can be accomplished simply by locating outlets 3' to 5' apart throughout the woodshop, including the ceiling. This may seem excessive, but it's not. There are too many work conditions that occur away from the workbench area: Using a vacuum, sander, plate joiner, rotary carving tool or heat gun are but a few of the applications possible.

If the workshop area is a new construction, cables should be installed within the wall framework. If wall coverings are already in place, outlets can be installed on the outside of the wall. Always check your local electrical codes concerning external installations. External conduit adds flexibility to designing and locating outlets because conduit can be routed just about anywhere. Metal conduit pipe can be bent to a variety of shapes and angles and conduit pipe can be cut to length whenever necessary.

Outlets

There are four acceptable plugs for home woodshop use:

- Grounded three-prong, 120v, 15 amp
- Grounded three-prong, 120v, 20 amp
- Ground fault circuit interrupter, 120v, 15 amp and 20 amp
- Grounded three-prong 220v/240v

Ungrounded two-prong, 120v receptacles are unacceptable in workshops. If an existing workshop has ungrounded two-prong outlets, turn off the main power and replace them with grounded outlets. If there isn't a ground wire to the outlet, attach one from the outlet to the receptacle box or the nearest cold water pipe. Check that the ground is functional by using a ground tester. To accommodate most tools, use grounded three-prong 20-amp outlets.

Ground fault circuit interrupter outlets (GFI) are designed to protect you from shock. GFI outlets monitor current; if the incoming and outgoing currents aren't the same, the GFI instantly cuts off the electricity (in $\frac{1}{40}$ second). A GFI outlet will trip if there is a ground fault of 0.005 amps. These outlets are

generally in bathrooms and outdoor locations where someone may have wet hands and feet. Install GFI units outlets in damp basements or around sinks.

Switches

There are four basic types of switches:

■ **Single-pole** switches have two terminals: one for the incoming hot wire and one for the outgoing hot wire. The switch toggle is imprinted with ON/OFF.

■ **Double-pole** switches have four terminals and are used primarily for 240v circuits. The switch toggle is imprinted with ON/OFF.

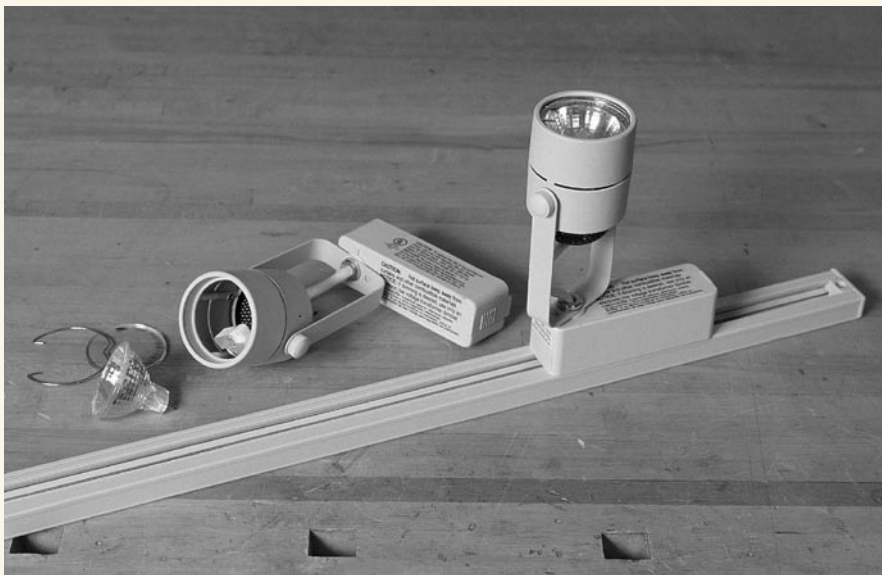
■ **Three-way** switches have three terminals. One terminal is labeled COM (common), and the hot wire is connected to this terminal; the other two terminals are switch leads. Two three-way switches are used to control a circuit from two different locations. The toggle has no ON/OFF imprint.

■ **Four-way** switches have four terminals and are used with two three-way switches to control a circuit from more than two locations. The toggle has no ON/OFF imprint.

Switches are rated according to amperage and voltage, so choose the correct switch for compatibility with circuits, wire and outlets.

Plugs

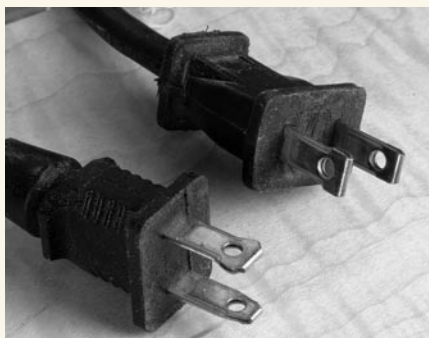
Despite the proliferation of battery-powered tools, there are still many tools and machines that have AC plugs. Usu-



In locations that need more direct and less diffused light, I have replaced fluorescent lights with halogen track lighting. This type of light gives a brilliant white light, lasts about three times longer and uses 65 percent less energy than a standard incandescent light. This particular halogen light requires a 50-watt reflector bulb that is equivalent to the light of a standard 150-watt reflector bulb. It has a built-in transformer that converts 120v to 12v.



A dead-front plug has no exposed wires or screws, and the prongs are surrounded by smooth plastic. Use this type to replace worn plugs on your equipment.



Polarized plugs, commonly found on smaller woodworking tools, have one prong with a wider tip so they fit but one way into a socket.

ally these plugs receive quite a lot of use and wear, often because of the neglectful act of pulling the cord and bending the prongs. When plugs need replacing, replace worn plugs with dead-front plugs. This type has no exposed wires or screws, and the prongs are surrounded by smooth plastic. If there are screws, they are recessed and are only for securing the plug body together.

When attaching wires to a three-prong 120v plug, connect the black wire to the brass terminal, the white wire to the silver terminal and the green wire to the green or gray terminal.

Polarized plugs have one prong with a wider tip. This type of plug is designed to fit into an outlet in only one direction. You'll commonly encounter this kind of plug on smaller appliances and woodworking tools.



A Regent 300-watt halogen shop light suspended above my table saw provides bright, shadow-free lighting at the saw blade. The housing is 36" in length and features diffused tempered lenses, safety screens and a pull-string on/off switch. This lamp augments the workshop's fluorescent lighting.

Lighting Your Workshop

There are two types of lighting in most woodshops: fluorescent and minimal use of all other types. Fluorescent lighting fixtures are probably used the most because they are inexpensive and commonly available. Other lighting types are thought to be useful as house lighting and not for woodshop lighting. While there is some truth to the generalization that fluorescent lights are useful in the woodshop, it is my opinion that their limitations are overlooked.

Woodshop lighting is woefully neglected in today's woodworking. There's a cornucopia of aftermarket improvements to almost everything electric within the woodshop except lighting. Lighting stores and hardware stores usually have jumbled lighting displays, making it nearly impossible to view and judge lighting fixtures one at a time. The one exception I've found is a General Electric display of different fluorescent lamps. This display is a set of identical photographs, individually set in a series of recessed boxes, each lit by a different fluorescent lamp. This display nicely reveals the color-rendering differences of fluorescent lamps.

Unfortunately, few light fixtures



A single 50-watt halogen spot light on the ceiling augments the workshop's fluorescent lighting and provides focused brightness at the band saw blade.

Workshop Lighting Tips

- Use long life, reduced-wattage bulbs whenever possible.
- If color is important, use bulbs that approximate daylight (5,000 K).
- Use zone lighting so that areas in frequent use will be well lit.
- Paint walls, ceiling and other surfaces light colors for maximum light reflection.
- Place incandescent spot lamps at drill press or band saw.
- Put drop lights over workbench if you need spot lighting and less diffused lighting.

seem to be designed specifically for woodshops. Those that are tend to be either sterile-looking white metal devices or cheap-looking clip-on reflector hoods. This simply means that it's up to the woodworker to solve shop lighting questions through both personal experience and research. Trial and error may seem like a difficult path to follow, but it does allow you to customize your woodshop.

When evaluating lights and fixtures, consider that there are several key elements to using light: color, shadow, contrast and reflection. These are the products of lighting that we see in both dynamic and subtle ways. They give usefulness, meaning and emotional connection to woodworking. Many artists refer to the process of their work as "painting with light." Woodworkers should also control and use light for both acceptable room lighting as well as artistic and aesthetic reasons.

Good workshop lighting is more than having a shadow-free environment. Lighting should also assist in artistic and aesthetic evaluations of wood and the subsequent project.

Color is perhaps the most subjective and difficult aspect of light. Fixture location and light source will change color values. For example, an apple in the glow of sunset will look different (warmer) than when it's sitting on a workbench under fluorescent lights



These fluorescent bulbs are rated for 5,000 Kelvin, a color temperature generally referred to as "daylight."

(cooler). And a green light will make the apple appear grayish. Imagine the effect that lighting will have if a dark cherry workpiece is subjected to warm or cool lights. Will that "golden oak" stain look yellowish or greenish?

Fluorescent lights and incandescent lamps color objects differently. The cool and warm color differences are a function of wavelength variations.

Warmer light is often thought of as the light at sunset or the light from an incandescent bulb. Cooler light is the light of mid-day, an overcast sky or fluorescent light.

Degrees Kelvin (K) is the term commonly used for light temperature. The Kelvin scale is invaluable for selecting light to match your needs. Generally, lower degrees Kelvin represents a warmer appearance and higher degrees Kelvin represents a cooler look.

Shadow, Reflection, Contrast

The amount of light required to perform a task is directly related to a person's age. At the age of 40, the light requirement is three times greater than that required for a 10 year old. At the age of 60, the light needed is 15 times

that needed for a 10 year old.

In some shops, work-area illumination requires careful light placement so that the area is shadow-free. Generally, it's best to locate light fixtures so that light falls directly over a work area. If there are numerous fluorescent lights throughout a work area, the diffuse light should limit shadowing. Flat lighting can be beneficial to a cabinetmaker wanting to see layout lines clearly. However, flat lighting isn't as useful for woodcarving. Lighting that is 45° to 90° to the carving will create better and more useful shadows that enhance the carving process.

A simple way to brighten the workbench is by clamping an articulated lamp on the corner of the workbench. This gives a spotlight effect, which is ideal for detail work.

Remember: the closer light is to the work area the stronger the shadows. The opposite is also true: the more dis-

tance between light and work area, the weaker the shadows.

Types of Lamps

There are three main workshop types of lights: tungsten-filament bulbs, halogen lamps and fluorescent lighting.

Tungsten-filament Bulbs

These come in clear, frosted or tinted glass producing warm natural tones. Clear bulbs produce bright and more contrasting light. Frosted bulbs produce diffuse light and tinted bulbs add diffuse warmth to the environment. Spotlights and floodlights are also tungsten bulbs. They are cone shaped with front lenses that either focus or diffuse the light. Light travels outward from spotlights and floodlights in a cone-shaped form and the area of this cone of light with the greatest candlepower is referred to as the beam angle. Generally, beam angle is 15° to 25° for spotlights and



This articulated lamp fits into dog holes on Editor Chris Schwarz's bench and can be moved as necessary for detail work.

Degrees Kelvin Ratings

Daylight at sunrise	1,800 K
Daylight at noon	5,000 K

30° to 75° for floodlights. So, for more pin-point lighting, spotlights provide a narrower beam than floodlights.

Halogen Lamps

Halogen lamps are actually tungsten-halogen lamps in two basic types: low voltage and standard-line voltage. Low-voltage halogen lamps require a transformer and operate at both lower voltage and lower wattage than standard-line voltage halogen lamps. They are usually designed as reflectors, allowing them to be directed at specific work areas. Low-voltage halogen lamps are relatively small and lend themselves to use in recessed fixtures. Generally, beam angle from the reflector is 5° to 30°.

Standard-line-voltage halogen lamps are more efficient than standard incandescent tungsten lamps but they have the disadvantages of expense and high temperatures. Line-voltage halogen lamps should be kept away from any flammable materials. Follow the manufacturers' use recommendations.

Fluorescent Lamps

Fluorescent lighting is generally low-cost and efficient. Tungsten bulbs have an average life of 750 to 1,250 hours and fluorescent lights have an average life of 20,000 hours.

Fluorescent lamps come in different color sensitivities, ranging from cool to

warm white. Before purchasing, make sure that the lamp and the fixture are compatible by checking the size and shape of the end-pins. Also check the lamp's wattage with that of the ballast.

There are at least eight different types of fluorescent lights. Product packaging should furnish lamp designations, including references to color rendering, degrees Kelvin, watts and lumens.

High-intensity-discharge Lamps

This type of lamp wasn't mentioned earlier because it is fairly new and is not commonly used. High-intensity-discharge (HID) lamps include metal halide lamps, mercury lamps and high-pressure sodium lamps. These have primarily been used for industrial purposes but are slowly being accepted for other uses (mostly for architectural and security purposes).

There are disadvantages to using HID lamps: They require warming up and cooling down periods when they are turned on and off, and they produce a bluish light that gives an unfamiliar coloring to most things, including woodworking projects.

Currently, metal halide lamps are the only HID lamps that approach normal colorization. HID lamps, even though they are energy efficient, aren't useful for the woodshop because of their color rendering and fixture configuration. **PW**

Typical 48" Fluorescent Lights

BULB NAME	°KELVIN	LUMENS*	WATTS	CRI**
Sunshine	5,000 K	2,250	40	90
Daylight Delux	6,500 K	2,250	40	84
SP-35, moderate white	3,500 K	3,200	40	73
SP-41, cool white	4,150 K	3,200	40	42

*A lumen is a unit of measurement that expresses the total quantity of light given off by a light source. For practical purposes, fluorescent lights use much less energy than incandescent bulbs and still produce similar or better light levels.

**Color rendering index (CRI) is a measurement of color shift when an object is illuminated by a light. CRI ranges from 1 to 100, with natural daylight and incandescent light equal to 100. Therefore, lights with a higher CRI produce more natural colors.

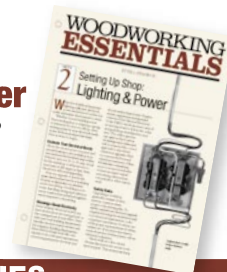
NOTE: Foot-candles is a measure of lumens per square foot, as measured on a working surface or floor area. For an office, the general working range is 15 to 70 foot-candles. If you are doing precise work, 100 to 200 foot-candles is recommended. On a cloudless sunny day, the sun gives off 1,000 foot-candles.

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REFINING THE EDGE

A master class in honing carving tools.

In the last issue, we looked at a basic set of carving tools and how to refine the shapes with grinding. In this article, we'll take a look at getting the edges sharp for carving by honing. German woodcarver Frederick Brunner made me aware of an important key: the necessity for an absolutely flat bevel. We want a straight line from the micro edge back on the tool steel, so there is no resistance when carving. Having a round bevel is like driving down the road with your emergency brake on. The rounded curve gives inherent drag to the activity.

We establish the outside bevel first on the grinder (see "Bare Bones of Carving," October 2006, issue # 157). The angle you grind on the bevel is based on the thickness of the tools. The first rule is that you do not want a long, thin bevel. I always tell my students, "A shaving razor blade is sharp but it is lousy in woodcarving." You need the shoulder to ride on.

So, let's step into the apprenticeship here and learn the basic strokes of hand sharpening, Brunner Style. For starters, I use Japanese water slipstones. This is the only change I made from the oil slipstones that Brunner used. The Japanese culture is hand-oriented and the feel of the tool in the hand is important as a reference point.

The first rule of sharpening is that to get a flat bevel you need a flat sharpening surface. Two waterstones of the same grit will

by David Calvo

David has been a professional woodcarver since 1979, and operates Calvo Woodcarving School. For information, visit his web site at davidcalvo.com.

Photo by Al Parrish



Senior Editor Robert W. Lang tries David Calvo's sharpening techniques.



Hold the stone in your writing hand, with your forearm vertical. Hold the gouge in your other hand with the bevel flat against the stone. Your arms should be at a right angle to each other.

Lay the heel of the bevel down on the stone and rock it toward the toe until the bevel is flat. When sharpening, move the stone back and forth and swivel the gouge.



resurface and flatten each other when rubbed together, creating an absolute flat surface.

Many times I have been given old oilstones from people whose father had been a woodworker and the stones look like a mountain range. I appreciate the thought but the stones are useless. They just won't work if they aren't dead flat. Easy resurfacing is a great advantage with water slipstones, plus using water as a lubricant instead of oil makes it easily approachable and not a messy process at all. They are a perfect match for the woodcarver.

Sharpening Technique

Start with the #1,000-grit waterstone and then use the #4,000 grit. After the waterstone has soaked in water for five minutes, pick up the 2" x 4" rectangular stone with your writing hand. You want to anchor your body and drop your weight onto the foot underneath your writing hand. Hold the stone to the far end with your fingers on the thin side and the thumb on the heavier side. The gouge is horizontal to your writing arm holding the stone at 90°. The gouge goes in the free hand and will lay on the stone (bevel flat) diagonally heading toward your writing hand's shoulder.

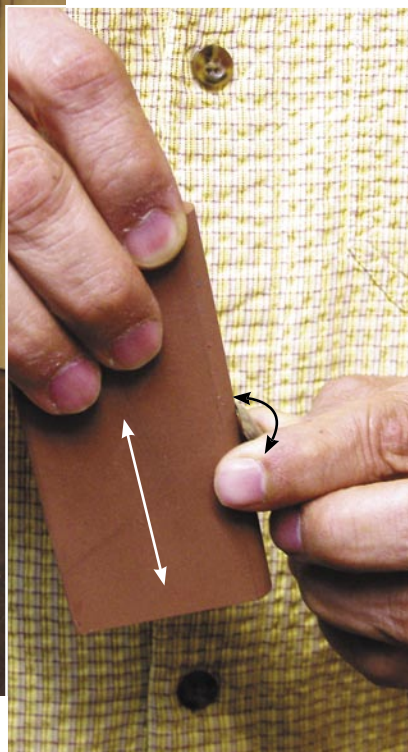
The way we lay the gouge onto the stone is heel-to-toe, meaning the back of the bevel lays down first and rocks forward until you touch the toe or front edge. Sight this so that you have a visual reference. The fingers of the hand holding the gouge are wrapped close to the cutting edge as if you were going to spin a pencil.

The tool should remain stationary and is lightly spun back and forth like a pencil. The hand holding the stone will go back and forth, with the elbow stationary as if your arm was an upside-down clock pendulum, as shown in the



To hone the inside bevel, hold the stone vertically with your hand over the top.

Hold the tool stationary and move the stone up and down. You can re-shape the waterstone if necessary to match the shape and size of the tool.



photos. You never want to move the tool more than two-thirds up and down the stone. Always start with the tool's bevel laying flat on the stone.

There is a drag to the water slipstone that allows you to feel what is going on at the point of contact with the tool. Start to move the stone back and forth toward your opposite shoulder. Keep your feet anchored with your weight on one foot. This will allow you to feel more what is going on in your hands. The elbow below the stone should be like a plumb bob, directly under the action.

Keep the action as close to your eyes as possible so that you can shift back and forth from sensing the feeling in your hands to seeing what you are doing. This style of sharpening can accommodate very large gouges to very tiny veiners with the same approach.

The inside of the bevel is done in a different manner. The same hands hold the gouge and stone, but instead, hold the stone upright (in length) with your hand over the top. The hand holding the tool is stationary, almost vertical and the stone goes up and down like an old oil rig pump. As with the outside bevel, you always want to lay the tool down heel-to-toe. The slipstone has opposing large and small rounded sides; use the appropriate side for your tool's radius. The great thing about water slipstones is that they can be reshaped into many different forms.

Straight chisels are also easy to sharpen with this method; the stance is the same, but you hold the chisel stationary and move the stone, working one side and then the other. V-tools are the most difficult to sharpen, and I will address them in a future article.

The Barbershop Strop

The last process in sharpening is honing the tool (either with a

leather strop or an #8,000-grit stone). This is taking off the micro scratches on the edge left from the sharpening stones. The desired result is to be able to move the tool through wood like butter. The less the tool resists, the more effortless woodcarving becomes.

I made my own strops from old woodworking machine leather belts, but any thick leather will do. I cut them into 12" lengths and cut a variety of gouge sweeps in the leather running the length of the strop. The strops are soaked in oil or glycerin for a couple weeks.

I made a little shaker bottle filled with carborundum powder, equal parts #220 and #320 grit. Before honing, I lightly put some oil cut with kerosene on the strops and then sprinkle the carborundum mixture on top of the oil.

Start by placing the tool on the far end of the strop. Then set the tool bevel so that it lays flat in one of the contours and pull it toward you two or three times to preserve the flat bevel.

However, stropping the tool can have a tendency to round over the edge if you are not careful. A method to avoid this is to instead continue honing with the water slipstones by going up to #8,000 grit and skipping the strop. The hard, flat surface of the waterstone guarantees a flat bevel and the #8,000 grit produces a flawless surface.



Thick leather soaked in oil is used for a strop. Grooves cut in the leather give the strop the exact shape of the tool.

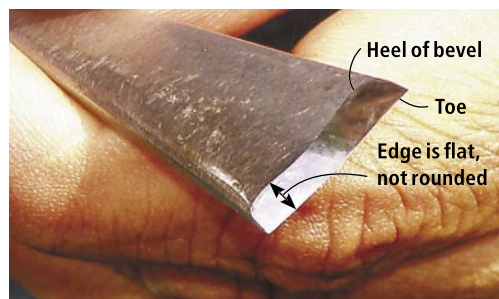
The Proof Is the Edge

When I start to carve, I find that the tool itself continues to sharpen because the wood will burnish the tool edge as it cuts through the wood's tubular fiber. Even now, after all these years of carving, I am fascinated with the thought that as I carve, the tool gets sharper.

With some experimentation, you now have in your woodworking technique toolbox an approach to carving-tool design and sharpening. A picture is worth a thousand words so use the photographs as a reference. Your mantra is: practice, practice, practice.

It's a little like playing the violin: awkward at first, but the positioning will settle into place and soon you will be making marvelous music. The main thing is that you now are gaining an educated beginning point in the skill of woodcarving. In the end, the quality of how the tool is shaped and sharpened is determined by how it feels when it goes through the wood. Wood will always be the silent teacher and remember ... your tools can be read like a set of tea leaves.

Next time, I will start with the study of body mechanics and hand technique in woodcarving. **PW**



The resulting edge is flat from the cutting edge back to the shank of the tool. The polished edge will move through wood like butter.



The inside edge is also flat and polished from the cutting edge back.

The Lost Stickley

A one-of-a-kind table reappears after 100 years.

by Robert W. Lang

Robert W. Lang is the author of several books about furniture of the Arts & Crafts period of the early 1900s. His latest book, "Shop Drawings for Greene and Greene Furniture," has just been released by Fox Chapel Publishing. More information about his books is available at craftsmanplans.com. Comments or questions? Contact Bob at 513-531-2690 ext. 1327 or robert.lang@fwpubs.com.

Most original Gustav Stickley furniture can be easily identified by model number. This was, after all, factory-made furniture and pieces were designed to be made in multiples. When you come across an antique, you can look it up in an old catalog to identify it. However, the only known example of this small table appeared at a Sotheby's auction in late 2004.

This uncataloged piece was likely a prototype, never put into factory production. What makes it unique is the front and back splay of the legs. It's this slight angle that gives this table more character than straight-legged versions that were mass produced. It's also

the likely reason this piece never got beyond the prototype stage.

This table features many of the Stickley design elements that appear in other pieces. There isn't much material in it, but there is a good deal of labor-intensive, head-scratching joinery involved. This probably made it too expensive to be marketed at a reasonable price, but that does make it a great project on which to practice and develop joinery skills.

The anonymous cabinet-

maker who built this prototype lived when it was a great time to be a woodworker. Hand-tool skills had not yet been forgotten, and machinery was in use to make life in the shop easier.

As I planned how I would make this piece, I realized it made sense to do some of the work with machine methods, while on other parts it would be quicker and easier to make some joints by hand.

First Things First

Before cutting any lumber, I made a full-size section drawing on a piece of plywood. This helped me plan the sequence of building, and the sizes of the joints. It also established a reference to the exact size and shape of the parts.

While I was building this table, I referred to this drawing rather than relying on calculations, numbers and measuring. My CAD program tells me that the angle of the legs is 3.56° and that the length of the bottom edge of the rail between the legs is 15¹⁷/₃₂". Neither of those pieces of information is needed, and trying to build to the numbers instead of

referring to the full-size drawing only slows things down and invites mistakes.

I made the legs by laminating two 1³/₁₆"-thick pieces together, then covering the edge seams with 1/8"-thick veneer that I resawed from the same boards I used for the other parts of the legs. This is the method originally used by Gustav Stickley to show quarter-sawn figure on all four edges of a leg. To keep the thin pieces flat, I glued and clamped all of the legs together at one time.

After trimming the edges of the veneer flush with my smoothing plane, I cut the angles at the top and bottom of each leg. I then returned to the full-size layout to locate the mortises. The mortises in each leg are in different locations, so I marked each leg's position in the table on its top. As I made other pieces, I marked which leg they joined to with a red lumber crayon.

The mortises on the back of the front legs, and the front of the back legs are parallel to the top and bottom of the legs. I put an angled block of scrap on the bed of the hollow-chisel mortiser to make these mortises.

The Best Made Plans

I planned on making the remaining mortises in the legs with the

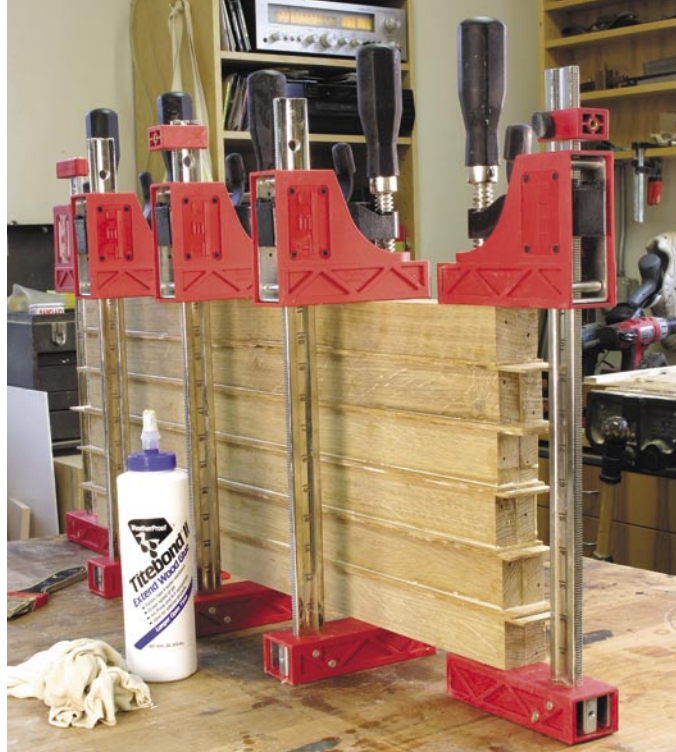


Using a full-size section drawing is essential; it lets me set angles and shows the exact sizes of parts without any of the risks of measuring.

Table



Photo by Al Parrish



Thin veneers tend to buckle when clamped. Gluing them in a stack applies even pressure to keep them flat.

mortiser, but on the second mortise, the machine broke down. Faced with a deadline, I switched to plan B and made these mortises with my plunge router.

The through mortises that pierce the lower front and back rails are at an angle to the face, and I'd planned to use an angled block on the bed of the mortiser to make them. Instead, I used a similar setup on the drill press. I removed most of the waste with a Forstner bit, then cleaned up the openings with chisels and rasps.

I made the straight and standard tenons on the ends of the lower rails on the table saw. I used a miter gauge to cut the tenon

shoulders, and a jig that rides on the fence to cut the cheeks.

I considered making the angled cuts on the remaining tenons on the table saw, but realized each angled setup would need to be done twice: One to the right and one to the left. I decided to make a guide block that could be reversed for my handsaw, as seen in the photos at bottom left and center.

This was a quick and accurate method, and I was able to make all four saw cuts for each joint in sequence. This helped to keep the parts in order, and prevented making any miscuts by machine.

I dry-fitted the front and back legs with the top rails, and checked



An angled block of scrap wood tilts the leg to cut an angled mortise parallel to the top of the leg.



The angled mortises on the lower rails were roughed out with a Forstner bit on the drill press. A tapered block under the workpiece makes the holes at the correct angle.



After squaring the corners of the mortise with a chisel, I use a rasp to finish smoothing the inside of the angled joint.



The quick and easy way to make the angled cuts for the through tenons is with a handsaw, guided by an angled block of wood.



These angled shoulder cuts would be tricky to make with power tools.



After fitting the through tenon, the location of the second mortise is laid out, keeping the back of the hole just behind the face of the rail.

this assembly against my full-size layout. The angles matched, so I knew I could determine the length and angle of the lower stretcher directly from the full-size drawing. The critical length on this part is the distance between the shoulders of the through tenons. The angled parts of these tenons are short, but they need to be exact. I didn't want to risk a miscut on the table saw, so I used another angled block to guide my handsaw.

The Key to a Good Fit

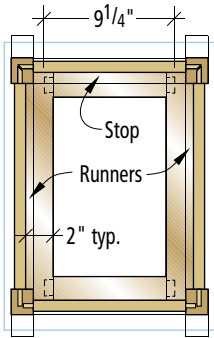
I did use the table saw tenoning jig to cut the wide cheeks of the through tenons on the lower stretcher, and the band saw to cut the edge cheeks. I made all of these cuts a hair big. Through tenons always demand some hand fitting. I used chisels, rasps and a shoulder plane to fit the tenons, checking the fit frequently as I came close to the finished size.

With the through tenons fit, there were only two mortises remaining: Those for the keys that hold the lower stretcher to the lower rails. These look difficult, but are actually the easiest joints to make in the piece. With the tenon fit in its mortise, I made a pencil mark at the intersection.

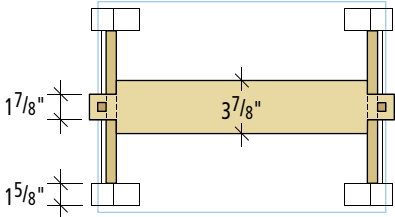
STICKLEY SPLAYED-LEG TABLE

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL	COMMENTS
		T	W	L		
1	Top	13/16	15 3/8	21	QSWO	
2	Top aprons	13/16	4 1/4	17 7/8	QSWO	1 1/4" ATBE
2	Lower rails	7/8	5 1/4	13 5/8	QSWO	1 1/4" TBE
1	Lower stretcher	3/4	3 7/8	22 1/4	QSWO	1 13/16" BSTBE
4	Legs	1 5/8	1 7/8	27	QSWO	Angle both ends
1	Back apron	13/16	4 1/4	13 5/8	QSWO	1 1/4" TBE
1	Rail below drawer	13/16	13/16	12 5/8	QSWO	3/4" TBE
1	Drawer front	13/16	3 1/2	11 1/8	QSWO	Bevel both edges to fit
2	Tenon keys	1/2	5/8	2	QSWO	Taper to fit through tenons
2	Drawer sides	5/8	3 1/4	15 7/8	Maple	
1	Drawer back	5/8	3 1/4	11 1/8	Maple	
1	Drawer bottom	1/4	10 1/2	15 1/4	Maple	
2	Web frame stiles	3/4	2	17 1/4	Poplar	Notch around legs
2	Web frame rails	3/4	2	9 3/4	Poplar	3/4" TBE
2	Drawer runners	11/16	9/16	15 3/4	Maple	Fit between legs & beside drawer
2	Drawer stop	11/16	9/16	6	Maple	Fit behind drawer

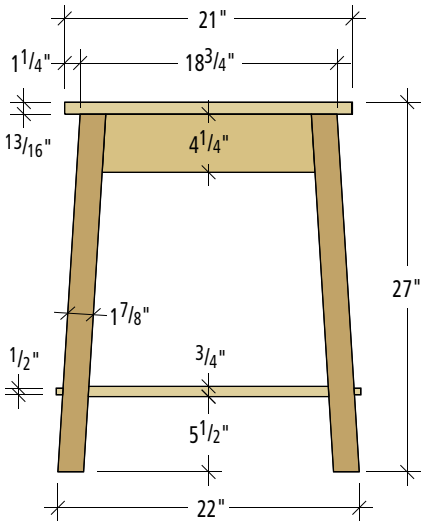
QSWO=quartersawn white oak; TBE=tenon both ends; BSTBE=beveled shoulder tenon both ends; ATBE=angled tenon both ends



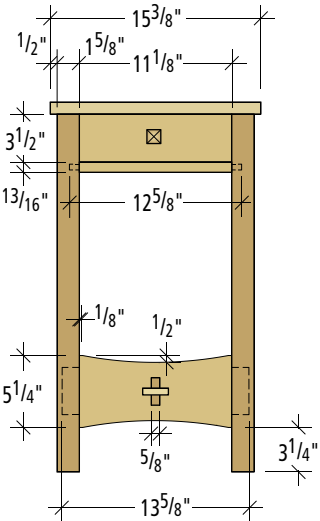
Web frame plan



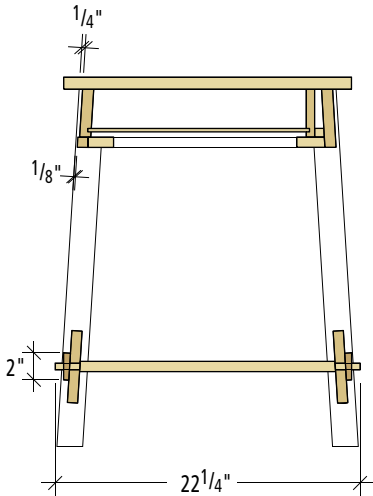
Lower rails, stretcher & tenon key plan



Profile



Elevation



Section



The mortise is cut with one plunge of the hollow-chisel mortiser. A piece of scrap below the cut supports the tenon, keeping the wood from breaking on the back side.



As the tenon key is fit, the length above and below the through tenon changes. I leave the key long and mark the length once I have a good fit.



After cutting the key to length, I round the edges above and below the completed joint.

Taking the pieces back apart, I made another line slightly behind the first one. This puts the mortise just behind the intersection, and ensures that the key pulls the two lower rails tightly together. Luckily a repair part for the mortiser arrived, and I could cut these mortises with one stroke of the $\frac{1}{2}$ " chisel. I used a piece of scrap under the tenon to support it while the cut was made.

In most pieces with a keyed tenon, the mortise is angled slightly to allow the key to wedge in place. Because the rails are tilted back and the stretcher is horizontal, the angle of the rail allows the key to wedge in a straight mortise. To make the keys, I cut a few long pieces of scrap to slightly more than the $\frac{1}{2}$ " width of the mortise by $\frac{5}{8}$ ". I cut pieces about 6" long, and cut the taper on the band saw. I used my block plane to remove the saw marks, and bring the keys down to a snug fit.

This method let me get a good fit without worrying about the length of the keys. When I was happy with the fit, I marked $\frac{3}{4}$ " above and below the protruding tenon to get the finished length of the keys.

The last parts to be made were

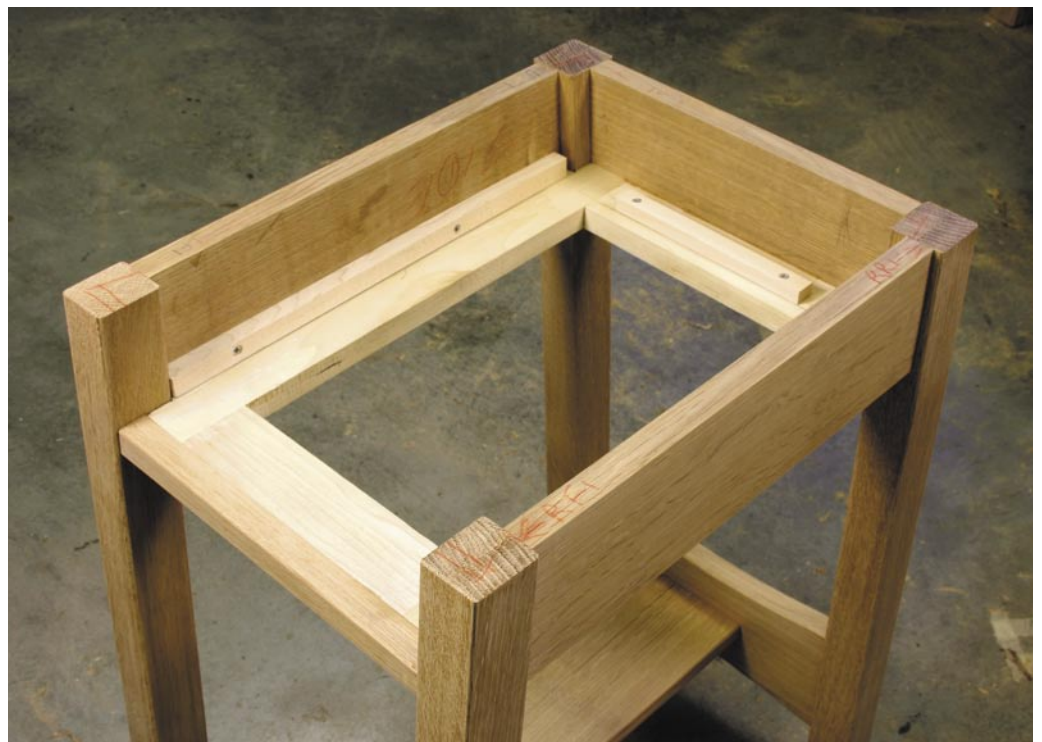
the narrow rail below the drawer and the web frame. The rail is thin so that it can be turned 90° to show quartersawn figure on its face. It is also beveled to be parallel with the front faces of the legs. The web frame is made from poplar, and is mortise and tenoned

together. When I had all the joints fit, I made a dry assembly of the table. Then I took the pieces back apart so I could plane, scrape and sand all of them before gluing the entire table together.

I glued in stages, making sub-assemblies of front and back legs,

and the top aprons. I cut some angled blocks and attached them to the top of the legs with masking tape so that the clamps would pull straight on the angled legs.

After letting the glue dry on these, I put one of the leg assemblies flat on my bench. I put glue



The assembled web frame is notched around the legs. After fitting the drawer runners between the legs, they are screwed in place, and the drawer stop is also attached with screws to the frame.

in the mortises, and put in the upper-back rail, the small rail below the drawer, and the lower rails, with the stretcher in place between them. I then brushed glue on the tenons, and placed the second leg assembly on top. Turning the table upright on my bench, I clamped the joints and began to worry about the drawer.

Half-blind dovetailed drawers don't bother me, but I'd never made one with the face tilted back at an angle. I decided to lay out the tails with the same angles they would have if the drawer front were vertical. This makes the top and bottom angles of the tails different in relation to the slanted drawer front which made the layout tricky, but it looked right when the joints were completed.

After cutting the tails by hand, I laid out the pins on the ends of the drawer front, and removed most of the waste with an upcut spiral bit in my trim router. This speeds things up, and gives a perfectly flat surface where the back of the tail rests on the bottom of the pin. I then used a chisel to pare down to the layout lines.

The pull was made from a cut-off piece from one of the legs. I trimmed it down to $1\frac{1}{4}$ " x $1\frac{1}{4}$ " by about 3" long. The pull finishes at $1\frac{1}{8}$ " but the extra length gave me something to hold on to while cutting it to shape. I laid out the



After routing most of the waste, I use a chisel to pare the pins down the rest of the way. The router quickly establishes a consistent depth.



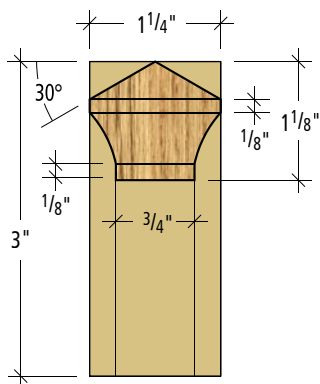
I laid out the tails with the same angles from horizontal that I would have if the drawer front were vertical. The knob is cut with the band saw, and shaped with a rasp.

shape of the pull on two adjacent faces, and cut it out on the band saw. I didn't worry about the exact size of the radius below the pyramid shaped top; that would come from the shape of my rasp.

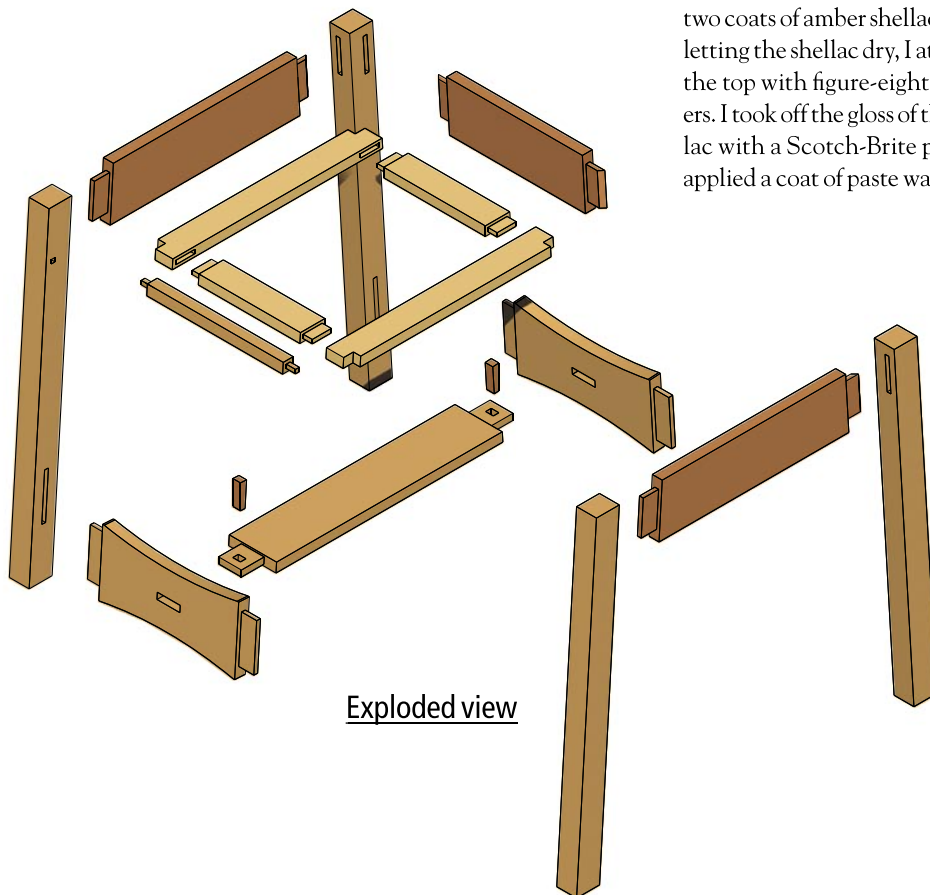
After cutting one face, I taped the scraps back on the block with

clear packing tape and cut the adjacent side. With the rough cutting complete, I clamped the extra length in my vise, and finished shaping the pull with a rasp. The finished pull is held to the drawer front with a #8 x $1\frac{1}{4}$ " screw from inside the drawer.

I wanted an authentic looking finish, but didn't want to go to the trouble of fuming it with ammonia. I used W.D. Lockwood Dark Fumed Oak aniline dye (wdlockwood.com or 866-293-8913) diluted with alcohol. I brushed on the dye, and wiped it with a rag. I then brushed on two coats of amber shellac. After letting the shellac dry, I attached the top with figure-eight fasteners. I took off the gloss of the shellac with a Scotch-Brite pad and applied a coat of paste wax. **PW**



Drawer pull



Exploded view

Superior & Speedy **SANDING**



How to get the maximum results in the minimum amount of time: A slightly unorthodox approach from a 23-year cabinetshop veteran.

The difference between a project that looks OK and a project that looks stunning is the finish.

And the difference between a finish that looks OK and a finish that looks stunning is – hands down – the sanding job you did before you applied the stain and the topcoat finish to the project.

Though most woodworkers dislike sanding and finishing, during the last 23 years and 4,000 projects of my professional cabinetmaking career, I've learned that nothing else separates the wheat from the chaff like the quality of a woodworker's sanding and finishing efforts. Sanding (or old-style surface preparation with planes and scrapers) is the most important step to becoming a good finisher.

by Troy Sexton

Troy designs and builds custom furniture for Sexton Classic American Furniture in Sunbury, Ohio, and is a contributing editor to Popular Woodworking magazine.

The following advice is what I've learned as I've perfected my own power sanding routine, and it is honed by the fact that I've had to teach more than 25 of my employees how to sand like I do. Everybody who has worked for me immediately learns two things: how to clean up the workshop and how to power sand.

These sanding methods are fast and no-nonsense – I need to make money at this; it's my profession. And, my techniques produce quality results. Since I started in this profession, only one customer – one – has complained about the quality of a project's finish.

Basic Equipment: Safety

Because sanding is dusty and nasty work, you have to protect yourself. I've tried different dust-collection systems that attach to my sanders; none has been satisfactory. They get in the way of my work or they fail to actually collect much dust. As a result, here's what I do to combat sanding dust.

- I always wear a dust mask. After trying many brands, I have settled on the 3M-brand 8210 "Plus" N95 face mask. These masks aren't cheap (a little less than \$1 each) but they work. They really work. Here's the proof: I'm quite sensitive to dust (sanding oak and walnut will give me a headache), but I recently had my lung strength and capacity tested by a physician. After 23 years of sanding with a mask, I came in second place compared with every person they had ever given the test to. Please, wear a dust mask.

- To carry dust away from my work, I use box fans that I've taped furnace filters to. Don't bother buying the fancy filters with the pleated paper-like fabric – you can't blow the dust out of those to clean them. Get the very inexpensive filters that look like they are made of spun insulation.



This 3M mask is great, especially because it really covers my beard. They are quite durable, too – you're more likely to ruin the mask by storing it user-side up (so the inside becomes clogged) than you are to rip it or clog it through standard use.



A couple box fans with furnace filters taped in place can work wonders in your shop. When the filters get clogged, blow them out with compressed air.

These work great (I use them on my furnace, too).

- I also use a simple bench brush to whisk away dust that has accumulated in the cracks and crevices of a workpiece. It also removes grit that has loosened from the sandpaper. If you don't remove this grit, it can scratch up your surface while working at the next higher grit, which is a real problem. Every month or so, I'll also open all the shop doors and windows and blow out as much dust from my shop as possible using compressed air. A home-shop woodworker can do this a lot less frequently. Hearing protection also is essential; sanders are noisy critters.



A simple bench brush removes dust and grit from your work. Always brush off your work before you switch grits to remove errant grit left from the paper.

Sandpaper and Pads

I use four grits of sandpaper for everything I build: #100, #120, #150 and #180. I used to sand to #220 grit, but I found that it burnished the surface of the wood and reduced the amount of stain penetration. And if you are going to paint your project, you can stop at #120 grit.

When you order sandpaper, be sure to order twice as much #100-grit paper as the other grits. The #100-grit stuff does all the heavy



Here you can see my four pneumatic sanders and the job-site lamp I use at my sanding station. The lamp rakes light across my work, pointing out flaws.

lifting, mostly removing milling marks. You'll burn through a lot more of it than the other grits because about half of your total time sanding will be taken up with the #100-grit stuff.

While there are a lot of good brands of sandpaper out there (Klingspor, Norton 3X, etc.), I have settled on the Mirka brand. For my work, it's ideal. Like other premium sandpapers, it's made with thick paper and it holds up well even when it heats up.

The pad you use on your sander is critical as well. In general, the pads that attach to your sander come in firm, medium and soft. I use the medium pad (usually the tool's standard pad) when sanding at #100, #120 and #150 grits. I have one sander with a soft, spongy

pad that I use with my #180-grit sandpaper. It allows me to get into slight hollows and in mouldings that other pads won't.

To sand complex mouldings, I also use sanding sponges. These soft sponges are available in the same grits as my sandpaper and flex to get into the ogees and arrises common on custom furniture. Whenever they get clogged up with sanding dust, you can rinse them out to renew them.

Because I have four sanders in my shop, I can keep each tool loaded with a single grit of paper. As a result, I have found the peel-and-stick paper to be the best for me. The paper itself is cheaper and it adheres better (the hook-and-loop paper tends to fly off the pad on occasion).



The soft pad on one sander flexes quite a bit to allow me to get into hollows that stiff standard pads won't.



A sanding sponge easily gets into tight crevices and complex moulding profiles.



Keep your sanding pads clean. Paper will stick better and there will be no little hunks of debris between the pad and paper to scratch the work.

If you use the peel-and-stick paper, here's some good advice: Every time you change the paper, clean off the sander's pad, even if this means simply wiping it clean on your shirt. Any little piece of gunk on the pad will transmit its shape to the sandpaper itself, resulting in extra and deep sanding scratches that you have to work hard to remove.

And when it comes to changing paper, do it often. Sandpaper is cheap, and your time in the shop is not. If you have to switch paper once for every door you sand, do it. How do you tell if your sandpaper is worn? It will stop cutting rapidly, the edges will get frayed slightly and the disc will get discolored a bit. Pull the disc off and set it aside (it still can be used for some hand-sanding chores).

One of the biggest mistakes that beginning sanders make is trying to conserve sandpaper. What they end up doing instead is wasting time.

A Word on Sanders

I've tried many electric random-orbit sanders in my long woodworking career. They work well, but I prefer the pneumatic sanders. This is a fairly standard sentiment among all the professional woodworkers I know.

I really like the pneumatic tools because they have fewer moving parts to burn out (I've had my Dynabrade sanders for 10 to 12 years each), as long as you keep water out of your compressor's air-lines. The pneumatic tools also are slung lower to the work than the electric tools, which gives them better balance, in my opinion.

However, you do need a large compressor to run pneumatic sanders and they have hoses that are bulkier than an electrical cord. Whichever type of sander you choose is fine; it's how you use it that's far more important.



A simple and inexpensive magnifying glass helps me train employees to see sanding scratches. After a short period of time, you won't have to use one of these except in difficult situations.

Other Important Tools

Before we plunge into procedure, there are a couple other tools you need. One is a magnifying glass. As you learn to sand, you will find it invaluable in helping you see the planer marks and sanding scratches you want to remove.

Learning to sand properly is, after all, teaching yourself to see defects – to differentiate between what is wood grain and what is a coarse sanding scratch.

The other bit of essential equipment is a shop light. These inexpensive yellow job-site lights can be raked across your work to

SUPPLIES

3M

800-243-4630 or 3M.com

• 3M-brand 8210 "Plus" N95 face mask, available from many industrial suppliers and amazon.com

Mirka Abrasives Inc.

800-843-3904 or
mirka-usa.com



A scraper removes the beads of glue. If you sand off these glue beads, you risk heating them up and gumming up your sandpaper or work. Use a light touch with the scraper.

make defects leap out at you. Don't underestimate the importance of lighting where you sand. The sanding area of my shop is also the most well-lit part of my shop.

What type of surface should you sand on? I use carpet remnants and router pads. (These are simply repackaged pads commonly used under throw rugs; you can buy them at any home store.)

Sanding a Door

When I teach someone to sand, I'll typically start them out by sanding two or three poplar raised-panel doors, with me looking over their shoulder and pointing out their mistakes. The principles

in sanding a door apply to almost any frame-and-panel construction, which is stock-in-trade in my furniture business.

Before assembling the door, sand the panel itself and the moulded section surrounding the field. Sand the back of the panel and the field with #100-, #120-, #150- and #180-grit paper. To sand the moulded edge around the field, put #150-grit paper on the sander with the soft sanding pad and sand the moulded edges; then switch to #180-grit paper with the soft sanding pad. If the moulding is complex, use a sanding sponge instead of the sander.

Assemble the door with yellow

glue. When the glue has cured, you want to first scrape off the beads of squeezed-out glue with a scraper. Don't get aggressive with the scraper. If you do, you can remove chunks of wood.

Load some fresh #100-grit paper on your sander and start sanding. Keep the sander flat on the work. Do not tip it to work a small area with an edge of the pad. Keep the center of the sander against the work at all times. Keep the sander moving at all times; do not stop in any place to try to sand a difficult spot.

Never press down hard on the sander. You think that this will increase your sanding speed, but it won't. It slows the pad down, which slows the work. It also increases the number of swirls scratched into the wood—and the swirls are deeper. Instead, rely on the weight of the tool and the light amount of pressure required to keep the tool under control.

Also, using lots of downward pressure will increase the chance that you will roll the sander off the edge of the work, which can quickly ruin a workpiece.

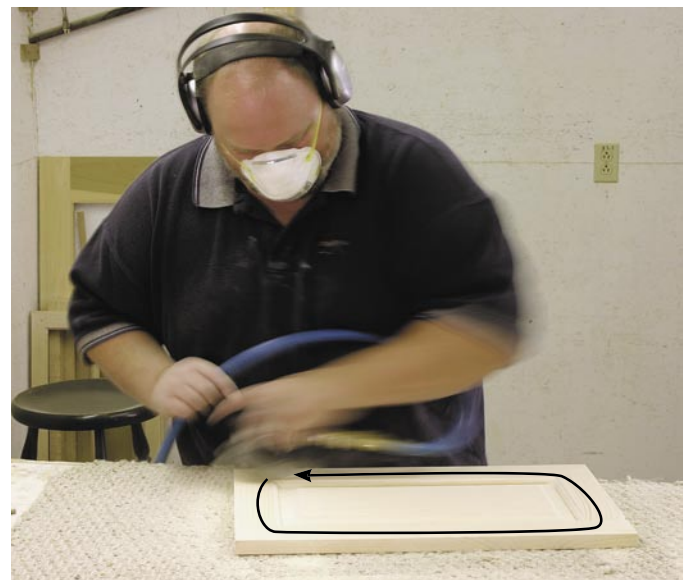
A word on the speed of your work: Some manufacturers recommend moving the sander slowly—too slowly for my tastes. I move the sander about 12" in a few seconds. This works well and always has. I was surprised to hear how slowly some manufacturers recommend their tools move on the wood. I will slow down my work when the wood is quite hard (oak or maple) and speed up when it's soft (poplar or pine).

First, I work the four corners of the door. I'll use 6"- to 10"-long strokes across each joint-line of the door to flush up the joints and remove extra glue. If you're not sure if you removed all the glue, wipe the joint line with a little water or saliva—glue will show up readily as a white splotch.

Once the joints are level and the planer marks are gone, I then move the sander all around the perimeter of the door on the rails and stiles. Take long, sweeping motions and keep the sander moving. When you think you have removed all the planer and jointer marks, dust off the door and look at it with your magnifying glass.



On a frame-and-panel assembly, work the corners first to remove the glue and level the joints. Then move on to sanding the assembly as a whole.



Now move the sander all the way around the perimeter of the door. Keep the tool moving.

Sand the other face of the door in the same manner and then switch grits. With the #120-grit paper, immediately begin moving the sander all around the perimeter of the door. Do not work a localized area. Switch to #150-grit on your sander and start working the perimeter of the door.

If I am going to stain a project,

this is when I stop for a moment and wipe down the workpiece with water. The water raises up any dents or imperfections that have been mashed down into the work by my machines. I like to use hot water because it dries more quickly, but any water will do.

Once the water is dry, I switch to #180-grit paper and finish the

job. As a rule, I'll spend 20 minutes on a door that's the size shown in the photo (which is 12" x 21"). The first 10 minutes are spent with the #100-grit paper. The #120-grit paper gets five minutes on the door. The #150 gets three minutes; the #180 gets two.

Sanding Edges

Once the two faces are done I'll sand the edges. Some people opt to clamp their work upright in a vise. I much prefer to lay the work flat on my bench and hold the sander so its pad is at 90° to the floor. I find this is more accurate, overall.

If the door is going to be inset into a face frame or carcase of the project, its edges won't get much scrutiny. So after I trim the door to

its finished size, I'll sand the door's edges with #150-grit paper only, then break the sharp edges of the assembly with whatever used-up sandpaper disc is handy, usually #150 or #180.

If the door is an overlay door – where the edges will overlay the carcase or face frame – I'll sand the edges up to #180 grit because the edges will be quite visible. When you work the edges, take extra care. Because there isn't a lot of surface area there, it's difficult to balance the sander on the edge and it's easy to roll the edge and ruin your crisp corners.

When sanding rounded edges, the approach is different. I'll sand with the same grits, but there is more motion. I start with the sander nearly flat on the work and then move it so its pad is 90° to the floor, up and down the edge. Then I flip the work over and repeat the same process to work the other side of the rounded edge.

Sanding Panels

Sanding glued-up panels is an art unto itself, though many of the same principles you learned from sanding doors apply. My approach is a bit unorthodox compared to what you read in many woodworking textbooks, but it works quite well and is fast.

When working a panel, I still use all the same sandpaper and the same techniques I described above, but the pattern in which I move the sander is important. There are three kinds of sanding patterns I use for each grit.

First, I sand the panel by moving the sander along the grain of the board back and forth and concentrate on one board at a time in the glue-up. For example, if the panel is made up of three boards, I'll work the first board back and forth, then the middle board, then the third board. My strokes are pretty short, usually



Put your workpiece so its edge hangs off your workbench. Hold the sander so the pad is 90° to the floor and then work the edge. This is easier than trying to balance the door on edge with one hand and sand with the other.

Used-up sandpaper discs can be folded up and used to break edges. Hold the paper flat against your hand and approach the work at an angle. A couple strokes breaks the sharp corner.



When dealing with an edge with a bullnose profile, begin with the sander just about flat to the face of the work (left). Then twist the sander down so the pad is 90° to the floor (right). Up and down, all along the edge.

about 12" right and then 12" left, back and forth.

As with sanding doors, keep the center of the pad over the work at all times – otherwise you could easily roll the tool off the panel and ruin the crisp edge.

Second, I sand the panel by moving across the grain of the entire panel up and down the panel and all along its length. These strokes should overlap slightly. As always, keep moving and don't press down to try to remedy problem areas.

Third, I sand the panel by using long, overlapping strokes with the grain that run the entire length of the panel. (If the panel is too long for one long stroke with my arm, I'll do this pattern in sections.) When I've completed these three patterns, I dust off the panel and examine the surface with a magnifying glass. If all the planer marks are gone, I'll move to the next-higher grit and repeat the three patterns.

Learning to Like Sanding

Few people claim to actually enjoy sanding. I don't mind it so much because I like paying close attention to the fine details of the job. It's also a skill that almost anyone can learn – there has only been one person I really couldn't teach to sand to my standards. Sanding doesn't require the high level of hand-eye coordination that some complex joinery does. All it requires is patience and close attention to the work.

Here's how you'll know when you've become a good sander: Walk into any high-end store that sells manufactured furniture. It does not matter how expensive or fancy the work appears from a distance. Get up close and take a good look at the wood – its clarity especially.

If you don't like what you see, you're there. **PW**



Pattern 1:
Work each board in the glue-up separately. Work along the grain in short strokes, back and forth.



Pattern 2:
Now work across the grain. Overlap your strokes and work all along the grain, then back again.



Pattern 3:
End up your work with long sweeping strokes all along the grain of the panel. Overlap your strokes all across the width.

New Tool

A quick look at some of the best new tools we saw in Atlanta.

It isn't every day that you see a new tool company appear out of nowhere with a complete line of high-quality wood-working machines, but that's almost exactly what happened in late August as Steel City Tool Works unveiled an impressive battalion of heavy-duty machinery at the International Woodworking Fair in Atlanta.

With more than 30 machines in its stable (so far), Steel City's line of tools is a warning shot across the bow of the big manufacturers: Delta, Powermatic, Jet and Grizzly. That should come as little surprise after you learn that the people who thought up Steel City are people who worked for many of those major manufacturers and importers. After years of working in the trenches, they struck out on their own.

"We are building these machines the way we always wanted to build them," says Scott Box, a principal of Steel City. "For years (when we were employed elsewhere) we had to find ways to cut costs and quality. Castings got thinner. Things got cheaper."

Box shrugs his shoulders and looks around at the new gray and black machines around him that are branded Steel City. Then he smiles. Of course, the real question is if the customers will be smiling when they turn these machines on. I spent more than an hour examining the machines in the line, and as someone who has seen a lot of machinery in the last 10 years, I was impressed.

Steel City paid attention to the details both big and small as it built these machines in Taiwan and China. Big details: The cast iron trunnions on the company's flagship cabinet saw are massive, like something off an old table saw (or battleship). And small details: The knobs on many of the machines are metal where you expect to find plastic. The table saw fences move with a feather touch. The

upper wheels of the steel-frame band saws are held in tension with two massive springs.

My first impression (which I hope will be backed up by our testing in the future) is that Steel City has a line of tools that omits all the gizmos you don't need and piles on all the stuff that makes machinery work well, such as cast iron, steel and well-machined parts.

I know you're wondering about the price of the stuff. That's good too. I found the prices to be an impressive value once I got my hands on the tools. For example: a 17" drill press with a huge 6" stroke, three bearings on the quill and a split-cast head (which allows you to eliminate runout during the long term) for \$469. It's well-manufactured equipment at a fair price.

Steel City will be sold only through the company's

line of distributors. For more information on the line (or to find a dealer), visit steelcitytoolworks.com or call 615-225-9001.

Freud Launches the Single-blade Solution

Every year a tooling manufacturer (or two) introduces a general-purpose table saw blade that's supposed to be the do-everything blade for rips, crosscuts and dealing with veneer plywood.

Every year, the blades get a little better. But this year, it looks like Freud has made a blade that is a good deal better. The Freud 40-tooth Premier Fusion table saw blades will sell for \$99 and might very well be the only blade you need on your table saw for your daily chores. Company officials cut samples in oak and oak plywood and passed them around to the woodworking press. Even to my "I like hand planed surfaces" eyes, the results were flawless.

After many years of experiments, Freud says this new blade makes perfect rips and crosscuts.



Steel City offers a wide range of cabinet saws, including this deluxe model with a titanium nitride-coated top that resists rust and scratches.



Torben Helshoj demonstrates the Laguna Tools Circle Master accessory, which allows you to quickly turn logs into round bowl blanks.

ALERT

The secret to the saw blade is the combination of several factors. The tops of the teeth are ground with a steep alternate-top bevel, which reduces chipping. The sides of the teeth have a tiny secondary bevel up at the cutting aris, which burnishes the cut edge without burning it. The blade has wide polymer-filled anti-vibration cuts in the sawplate. And the blade is coated with Freud's red non-stick Perma-SHIELD that resists corrosion and pitch.

Most times these do-everything saw blades stop performing like champs once we have a 100 hours on them or so. I cannot wait to put this horse in the race. More information: freudtools.com or 800-472-7307.

Good News for Bowl Turners And Band Saw Lovers

If you have ever been frustrated by roughing out blanks for turning bowls, Torben Helshoj of Laguna Tools has invented an accessory that will speed your production and simplify your life.

It's called the Circle Master and it's an accessory for a band saw that is dead simple to use. It's basically a band saw circle-cutting jig that captures a workpiece at the top and bottom (circle-cutting jigs contact the work only at the bottom). Then you move the stock into the blade and spin it slowly. And voilà, you can cut a perfect cylinder – or if you tilt your band saw's table – a tapered cylinder.

Helshoj also showed off the company's Drift Master band saw fence accessory. Here's the one-word review: Wow. It is the smartest band saw fence I've ever encountered. The way you adjust for drift is so simple and easy, you'll want to chuck all those hex wrenches most people use. Plus the micro-adjustment features lets you dial in veneer of consistent thickness. More information: lagunatools.com or 949-474-1200.

Inventor Arra David (right) shows off the Hoverpad and how you can move machines with one finger.



The Veritas Pullshave is one of the many chairmaking tools unveiled by Lee Valley.

New Chairmaking Tools From Lee Valley

The hardest part of making Windsor chairs has typically been finding the tools you need to do it. Many tools have been worn out or lost in time. Lee Valley Tools has greatly expanded its line of chairmaking tools under the company's Veritas line. And here's a bonus: they are very reasonably priced.

The most radical tool is the company's take on a travisher, which scoops out wooden seats. The Veritas Pullshave (\$129) is like a curved-bottom spokeshave that has been married to a paint scraper's handle. I played with the Pullshave a bit and it looks like it really is more ergonomic than traditional travishers.

Also, there are three tapered reamers (\$12.95 to \$34.50) and five matching tapered tenon cutters (\$18.50 each) for joining legs to seats. There are three chair

devils and a scraper shave (\$59 each) for refining spindles or details, and a special chairmaker's scraper (\$76.50 with four blades) that allows you to scrape flat and unusual shapes with finesse and gusto. This scraper is based on a tool I used in a chairmaking class with David Fleming a couple years ago and I can vouch that it's an excellent idea. More information: leevalley.com or 800-871-8158.

And a Glimpse at the Future

This covers only a small portion of what we unearthed in Atlanta this summer. Look for more reviews in the coming months (and check out our blog at popularwoodworking.com for more on the show). Meanwhile, we would be remiss if we didn't share one of the eye-popping inventions of the show: a mobile base for your machines that works like a hovercraft.

Arra David has invented the Hoverpad, which allows your heavy machines to be moved on a cushion of air with the oomph of one finger. The Hoverpad connects to any compressor (even tiny ones). And when you open a valve, your machines rise up – as much as 1/2" off the ground. We tried it. It's amazing. The Hoverpad is sold through General and comes in two sizes and prices (\$169 and \$249). It might be a bit expensive for a mobile base, but you could give the neighborhood children a ride on your cabinet saw and charge a quarter to offset the cost. More information: hoverpad.com, general.ca or 514-326-1161. **PW**

by Christopher Schwarz

Christopher is the editor of Popular Woodworking magazine.

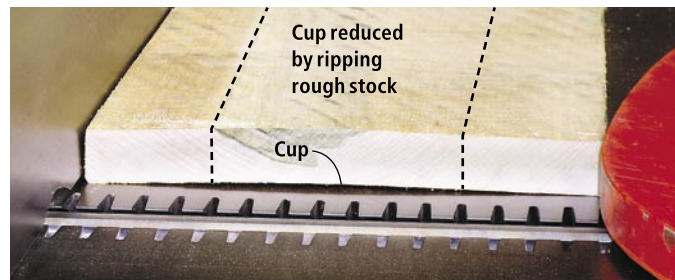


Get to meet many woodworkers around the country at woodworking schools, seminars and while answering e-mail messages. I find that one issue pops up repeatedly: "What is the correct method for milling lumber?" You might be familiar with the basic steps that are required to bring the lumber to working order. But what you do, how you do it, and in what order you do it will influence the project from start to finish, and will make your projects run smoother.

To properly mill your stock using machines you will need to have a jointer, a thickness planer and a table saw. In my opinion, these are the three most important tools in your shop. They don't need to be the "Cadillac" examples. I have been able to work with a number of benchtop models that perform extremely well. Just having and using them correctly will put you light years ahead in building your projects.

Do you look back fondly at the many articles in the woodworking magazines on how to "tune up" your tools? Probably not. You may have even tired of these articles, but they are important. The accurate milling of your lumber is partially dependent on the accuracy of your machines. If your planer and jointer knives aren't level with one another, your cuts will not be level. Having the tools set properly is half the battle. The correct procedure is the other half.

You may be tempted to bypass a few of these steps and purchase lumber that has some of the milling complete. I'm not a fan of buying lumber that is S2S (surfaced two sides). This wood, for the most part, comes through a double-sided thickness planer to the selected thickness. These machines exert so much pressure on the board that they flatten the stock as it enters the cutters. After it passes the knives, the board springs back to



Rough cutting the width of any cupped board closer to the size needed will eliminate unnecessary milling and produce less wasted stock.

the original shape. This machine does a good job with flat boards, which we seldom see. However, if your pieces are cupped, warped or twisted they will be that way as they exit the machine – even though they are now a consistent thickness throughout. I suggest buying rough lumber and milling the stock yourself.

Start With Smaller Pieces

Some woodworkers start milling the lumber in its full length and width as it is pulled rough from the rack. If you work this way you are trying to flatten a 6' to 8' length of wood that may be 9" or more wide. As you may have experienced, this

can turn a large portion of your lumber into shavings.

For example, if you have a bow over the length of the board, by the time you flatten one face at the jointer you might reduce the board below your target thickness. The same holds true with wide boards that are cupped.

Also, it's not possible to accurately flatten a wide piece of lumber by running half the width on the jointer and then reversing the piece to complete the milling on the remaining half of the same face. I've seen many woodworkers attempt this feat.

The correct procedure is to first cut your pieces into a rough size

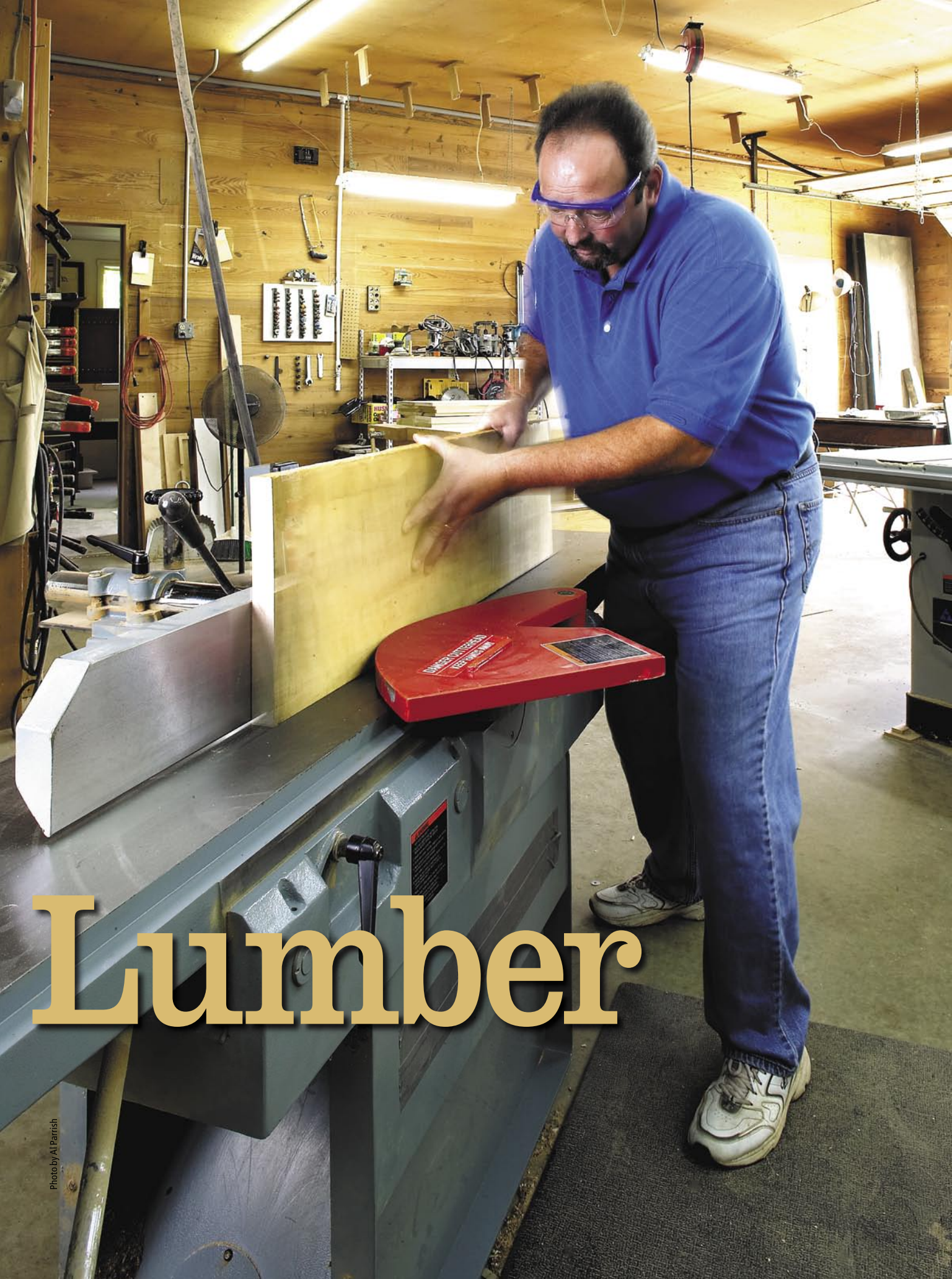
the right way to

Prepare

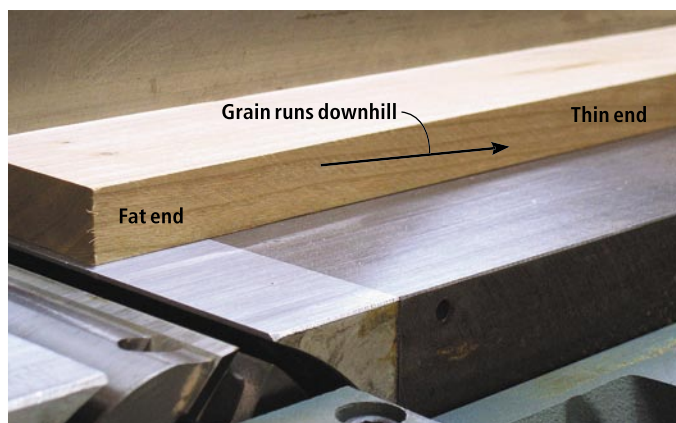
To true your wood with machines, the steps you follow are critical. This time-tested procedure is the best way we know of.

by Glen Huey

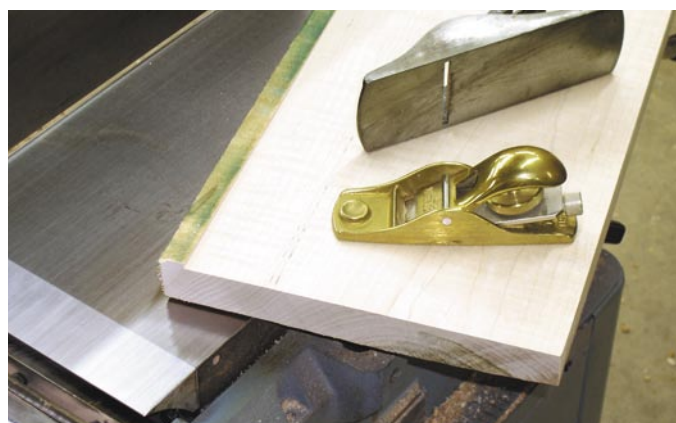
Glen is a contributing editor to Popular Woodworking. You'll find more information about Glen, his books and his DVDs at woodworkersedge.com.



Lumber



You will get a smoother cut if you start the piece with the "fat" end leading into the knives. Some say the grain is running "downhill."



Squeeze an extra inch or two from your jointer by using it as you would to create a rabbet, then remove the unsurfaced area with a plane.



Flattening stock at the jointer does not mean to completely surface the face. This piece will sit flat and stable when it is sent to the planer.



Angling your stock to the blades at either the jointer or planer will provide a smoother cut and lessen the wear on your knives by starting the cut at the point of the corner instead of the blunt end of the board.

that is slightly longer and wider than their required finished dimensions. Cut the boards to where they are about 1" longer and at least $\frac{1}{4}$ " wider than the finished sizes. As you rough-size the boards, cut off checks on the ends.

Begin by crosscutting the rough pieces to size. I do most of my rough crosscutting with a chop saw. If you have a large shop, a chop saw with an oversized support table works well. However, you also can use a jigsaw and make the cuts on your bench. Just lay out the lengths, slide the section to be cut off the end of your bench, and cut the pieces you need.

One True Edge for Ripping

With the rough pieces crosscut, you will want to rip them to width. However, you shouldn't run a rough edge against the fence of your table saw. It's too dangerous.

So the jointer is our next stop. We are interested in obtaining one true edge that will run against our table saw's fence. Here, we can deal with the variations in our stock, such as a bow over the length of our stock (this is a common problem that appears in a good portion of our rough lumber).

I begin working with any crook in the boards by placing the convex crooked edge up as shown in the opening photo for this article. Work the two ends that will touch your jointer's bed, leaving the center above the bed. If you experience a large crook as you begin to push the stock into the blades, the board might ram the edge of the outfeed table and come to a stop. Do not force the piece of wood forward. Simply pull the stock back from the blades and make a second attempt at jointing the edge. You may have to run

the piece a few times if the crook is extraordinary.

Once the lead end of the board clears the edge of the outfeed table you will probably find that the piece will not hit the jointer knives again until you approach the trailing end of the board's edge. This is the time to study your board to determine the best path to take.

You have three choices. First, you can run the lead edge repeatedly over the knives until the board's edge touches the blades over the entire length. This will result in the front portion of your board being narrower than the rear area of the board.

I would select this option if I had a problem area on my stock, either at the bottom corner of the board's leading edge or at the upper corner of the board's trailing edge. If it's a problem at the

leading corner, I remove that area at the jointer. If it's on the trailing edge, I cut it away as I rip the board parallel at the saw.

Another option is to take the majority of the cuts at the trailing end of the board's edge. This would be accomplished by placing the lead end past the jointer knives and onto the outfeed table, then running the remainder of the board – cutting only the trailing end of the edge.

Working in this manner would help remove defects at the lead end's upper corner, or the trailing end's bottom corner when the board is ripped to final width at the table saw.

Third, if there was no problem area or blemish to cut away, you would take equal amounts of material off of each end by running the piece completely over the knives with each pass. If the

THE “FAT-TO-THIN” TECHNIQUE

Flipping your stock end over end works double duty. It will keep the proper milling orientation in line and keep any moisture levels consistent from face to face. — GH

crook is excessive you may find it helpful to remove a few passes of material at the leading edge and then a few passes at the trailing edge just to keep from running the entire length over the knives with each pass. This will keep the stock equally wide at the ends while removing the crook.

Next turn to the table saw. Place that jointed edge against the fence and rip the pieces to width, cutting them $\frac{1}{4}$ " oversize. Some woodworking schools require that you rip all rough boards at the band saw to eliminate any chances of kickback. This is a good idea if your lumber is especially bowed or twisted. Leave yourself even more width if you are roughing your piece using this method—say about a $\frac{1}{2}$ "—unless you are confident on the band saw.

Now Flatten One Face

With the pieces cut to rough size, the next step is to flatten one face of each board. While it's best to surface a board that is equal to or less than the width of your jointer knives, there are tricks that will help to expand that limit somewhat. But we'll start with the standard method.

First hold the piece on the bed so that the convex face is up. You should have two points of your piece resting on the jointer's bed. This will keep your stock from shifting around as much as you push it over the knives. If you were to place the convex face down on the jointer bed, you could rock the piece from side to side as you make a pass over the knives, spoiling your accuracy.

You need to look at the grain in order to determine the correct direction to run the stock before making a pass over the knives. To determine the grain direction of a board's face, you need to examine the grain along the board's edge or the area that is at 90° to the

working face of the board.

Generally, the piece will have grain lines that begin somewhere up the end cut of the lumber and run downhill (I call this the “fat” end) to the bottom face or the “thin” end. (See picture at far left.) Using this terminology, you should run the board from “fat to thin” as you make the cut.

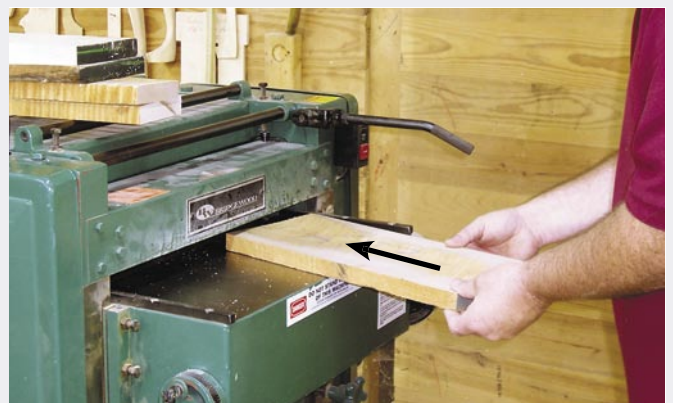
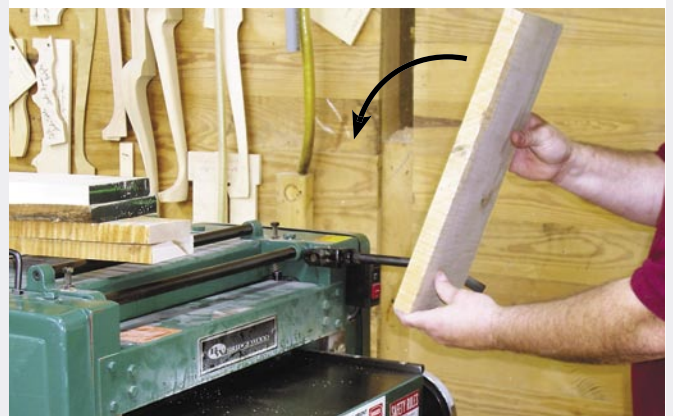
Set the depth of cut of your jointer to $\frac{1}{16}$ " and run the piece over the jointer knives so that one face is flat or surfaced. If you were to run the piece in the opposite orientation you might see areas that are being torn from the stock because the knives pick up the thin, tailing-off edges of the grain that have a tendency to tear.

If you have material that is slightly wider than your jointer, you do not need to rip the piece in half in order to complete the milling. See your owner's manual on how to remove the blade guard on your jointer. Make a pass over the knives. There will be a rough area left along the edge that the knives didn't hit. This can be easily removed with a handplane before going to the thickness planer. Be sure to then replace the guard according to your manual.

Plane to Thickness

The planer is the next stop and it will bring all the stock to the same thickness, essentially smoothing the opposite face from that surfaced at the jointer. The knives on the planer are above the table and your stock, so you will need to orient your piece to again run from “fat to thin” by looking at the edge grain in relation to the top face. Here is the trick: Keep your pieces in the same orientation as they were run over the jointer knives, because generally the last end over the jointer is the first end into the thickness planer.

Adjust the cut by $\frac{1}{16}$ " with each pass through the planer.



When you get the second face surfaced nearly flat (it will not wiggle if placed on a tabletop) you need to begin to flip the board so that passes are taken from each face. This should be done while maintaining the appropriate orientation to the knives, meaning to keep cutting with the “fat-to-thin” technique. To accomplish this, the boards need to flip end over end after each pass.

The reason that this is so important is because as you remove material from your stock, you are exposing areas that have more moisture than the outermost surfaces of the rough boards. If you take more material from one face than the other, the board will tend to dry unevenly and is more apt to cup or warp. Run the pieces while incrementally adjusting the planer cut to the desired thickness.

Jointing an Edge (Again)

When the two faces of the board are flat and the board is the correct thickness, we need to return to the jointer to run an edge. Wait a minute! Didn't we already do this before we cut the stock to rough sizes? You are correct, but that edge was run before we had the two faces parallel and flat. If you decide to use that edge, I can assure you that it will not be at 90° to either face of your board. Remember that it was created when the two faces were in the rough. That will cause problems in many areas.

If you decide to glue these pieces into a panel you will not get a tight, square glue joint which could cause the panel to not be flat. If this is to be part of a door frame your mortise-and-tenon joint might be problematic.

To alleviate any of these scenarios, run the edge at the jointer now. This should be done while holding a face of the stock against the jointer fence and making a

pass over the knives in the same “fat to thin” grain-orientation technique. This guarantees that the edge is at 90° to both faces.

Cut to Finished Width

We now have our pieces at S3S and are ready for the next step in milling, which is at the table saw. Choosing a blade for this operation can be mind numbing. You can select a ripping blade that has 24 teeth or choose a combination blade that has 40, 50 – even 60 teeth. There are blades designed for plywood and melamine, and some blades are Teflon coated. You may decide to use a different blade for each material – but I don't.

I don't like to spend the time in my shop changing blades on my tools. If I am doing that I am not “making sawdust.” I also don't use my table saw to crosscut very often.

I found that it's best to use a 50-tooth combination blade. It will produce a nice cut when ripping, can handle crosscutting if I choose, and will not have to be changed out for most jobs.

Once you have selected a blade, set the blade's height for ripping the stock. I bring the carbide teeth just above the thickness of my material. This allows the waste material to be cleared from the cut, helps keep the blade cool and lessens the chances of burning the stock as it is ripped.

Here is where you will find that the first step we took, cutting our pieces to slightly oversize, really helps. If you attempt to rip a wide board down the middle and it is not entirely stable, you can get movement that causes the stock to burn. This is less likely to happen with the pieces cut to just slightly over the final width.

That's because the amount of material on the off fall side of the blade will not have enough force in movement to bind the blade.



With the faces surfaced and parallel, a stop at the jointer ensures a 90° edge in relation to those faces – even if you cleaned that edge at the beginning.



Push sticks can help guide your stock as well as hold it tight to the fence and table. They are invaluable tools in your shop.

Hand Placement and Push Sticks

Some woodworkers are fine working around the blade while others can barely place their hands flat on the table. As your experience using the table saw grows you will become more comfortable with your hand placement, as well as with the width of boards that you will cut without using any push sticks. A common rule of thumb is that stock less than 6" wide requires a push stick.

Position your stock at the saw and let your left hand hold the piece at the edge and against the fence with light pressure. Use a push stick to guide the piece through the blade. As you move forward, allow your left hand to continue moving with the piece until you reach the edge of the table saw's throat plate. At that point, stop the forward progress of your left hand and allow the stock to slide on as it is cut.

One thing that is important to remember is to allow the push stick to completely pass the blade prior to releasing the push stick from the stock.

The last step in milling your lumber is to crosscut the piece to its final size. The accuracy of a miter saw is certainly a good bet. But if you have the 50-tooth blade, the table saw can be used quite effectively.

From the jointer, to the thickness planer, then back to the jointer and finish at the table saw. Milling wood with the grain orientation set correctly will help to improve your woodworking abilities and your projects. You will begin to wonder why your experience with the less-than-flat panels has disappeared and has been replaced with easy glue assemblies and more completed projects coming from your shop. You know the saying: “It's the little things that make the difference.” **PW**

Modernica

21st-century beauty
from Baltic birch and
bent lamination.

As I looked at the “Modern” furniture coming to life in the Modernica workshops of brothers Frank and Jay Novak in Los Angeles, Calif., I couldn’t help comparing it to the work of another set of brothers, half a continent away, and a century ago. The Stickley brothers (all five of them) were the modernists of their era. Their Craftsman style rebelled against the ornate neoclassic and Victorian styles favored at the beginning of the 20th century. Their quartersawn oak furniture incorporated overt structural details such as corbels, stopped and through mortises, and exposed tenons. Their rectilinear shapes were free of any excess ornamentation except for what occurred naturally in the material, design and construction. The finished products revealed not only the craftsmanship that went into each piece, but also the beauty, simplicity and utility of the design.



Brothers Frank and Jay Novak discuss the alchemy involved in translating a classic 1950s steel furniture leg into a modern bentwood lamination for a bed they produce.



The Modernica storefront (above) on Beverly Boulevard in Los Angeles is one of the Novak’s three retail outlets (Chicago and New York City are the others). The Los Angeles warehouse-district setting for their production facilities (right) offers proof that a sylvan setting is not a prerequisite for woodworking.



What’s old is new again, and at the beginning of the 21st century, the Novaks continue to spread the gospel according to Modern. But they’re not religious fanatics or martyrs to their cause. The skill level of their workers is matched to their tasks and the full spectrum of woodworking machines, from Computer Numeric Control (CNC) routers to card scrapers, is employed. The Novaks make no apologies for straying from a totally handcrafted product. Like the financially successful Leopold and John George Stickley brothers, they use the most efficient combination of people and tools to produce a quality product. Although they hold woodworking

purists in the highest esteem, they are, after all, running a business. Gustav Stickley, the “purest” of the Stickley brothers, lacked his brothers’ business acumen and eventually declared bankruptcy.

Where the Stickleys used quartersawn oak, now almost an elitist material, Modernica furniture is all about Finnish or Baltic Birch plywood and bent laminations. Rather than relegating it to drawer interiors, Frank and Jay celebrate the inherent beauty and strength of the material. In a towering antique press, positioned just outside the workshops (this is sunny California), sheets of plywood are laminated into still thicker slabs on their way to becoming tabletops and legs. While I was there, orders for one of Modernica’s latest

by John Hutchinson

John is an architect and Popular Woodworking’s technical illustrator. Comments or questions? John can be reached at jhutchi2@columbus.rr.com.



The pressing matter of plywood glue-up into still-thicker slabs is handled by this Goliath. Outdoors? Hey, it's California.

designs, the Tenon Table, were being filled. At first glance, the Tenon Table is a deceptively simple arrangement of a slab top and four rectangular legs. Closer inspection reveals the structural beauty of the joinery. The legs meet and engage the top with a slightly corbelled tenon housed in a progression of stopped- and through-mortises. It's something like five Arts & Crafts tricks rolled into one rock-solid joint with no glue or mechanical fasteners. The last trick occurs where the legs meet the floor and seems to have been borrowed from California wine-country barrel makers. The vertical plies are gathered and bound with a horizontal "hoop" consisting of multiple horizontal layers of through-mortised plywood. Although it's patent-pending joinery, Jay graciously allowed me to take some measurements and docu-



A "classic" car destined for restoration, tented material storage rack, industrial-strength dust collector and sunbathing dog all peacefully coexist in Modernica's back lot. The privacy screen provided by some gently swaying trees makes it a true urban oasis.

ment the design for this article (see "Inside the Tenon Table" on page 82).

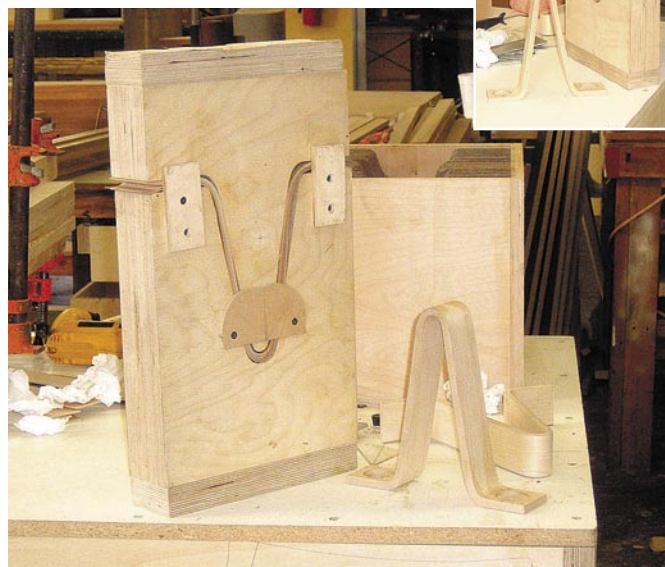
Bent laminations are another mainstay of Modernica woodworking. Arm/leg bents for their C-Chair, with the appearance of bleached ribs unearthed in an archeological dig, are stacked on dollies around the shop. In their prototypes workshop, a little bit of bent-wood de-evolution is going on. The brothers currently offer a platform bed with V-shaped, steel rod legs. They want to provide the option of laminated wood legs with the same classic

shape. A simple bending jig and a few pipe clamps (backed up by ingenuity, know-how and an eye for design) spits out sample legs that will later be produced in a more automated manner.

A simple bending/ gluing jig and a stack of micro-plyies are all it takes (combined with a large dose of talent and ingenuity) to produce a bent leg prototype.



Modern sculpture? Yes and no. A pallet of C-Chair bent lamination arms/legs wait patiently for assembly, finish and upholstery.





The Smithsonian Institution in Washington, D.C., is known as our country's attic. When it comes to mid-20th century modern, however, the Modernica Props warehouse (left) is a viable contender. We might chuckle at some of the artifacts in hindsight, but they were the stuff of dreams to the designers. Modernica's Los Angeles showroom (above) displays the wide variety of skills needed to bring a complete line of furniture to market. The Novak's rainbow collection of glass objects lining the walls are the fortunate survivors of more than one earthquake.

We all come to woodworking from different directions. For me, it was drafting board architectural design followed by a longing to see parts come together in my own hands. The Novaks first set hands to hammer and circular saw building props and sets for the film industry. Additional "former lives" in acting, screen writing, painting and sculpture helped develop the artisan/craftsman/businessman skills needed to make their latest venture a success.

When I'm looking for inspiration for a Modern piece, I begin my search on the Internet. Not Frank and Jay. They run a "small side business" with the name Modernica Props. It's not a stretch to say that they warehouse

at least one of every conceivable artifact that filled the childhood homes of baby boomers. I think I found my parents first 7" Philco television sitting happily below a starburst clock and flanked by a pair of black ceramic panther lamps. Ah yes. (For the full nostalgic tour, check out modernicaprops.net.) In addition to the kitsch, the Novaks have assembled what must be the most extensive collection of classic Mid-Century Modern furniture on the planet. Their for-rent-to-the-film-industry library is housed in a multi-story building adjacent to the Modernica factory. When I asked Jay to name the film that best displayed their collection, he instantly responded, "Men in Black." So the next time you see a rerun of

the movie, you can tell your friends that you read an article in *Popular Woodworking* by a guy who knows the guys who

Rather than the sylvan setting usually associated with woodworking enterprises, the Modernica workshops are located on an alley in what used to be a light-industrial and warehousing section of Los Angeles. The intimidating, intentionally rusted steel door that guards the entrance opens to a comfortable, airy interior. As I moved through various fabrication and shipping-and-receiving departments, I was surprised to find oases of outdoor space amid a series of buildings. One was the outdoor employee lunchroom, furnished with some of the company's classic fiberglass chairs. Another held a fenced area apparently guarded by their "junkyard dog." But it wasn't a guard dog after all; it was the matriarch of Modernica's Downtown Dog Rescue program. To date, Dog Rescue has adopted out hundreds of stray dogs and puppies, and more important, spayed and neutered hundreds of pets belonging to homeless and low-income people in the surrounding community. But what about cats? Frank's taken care of them too with his Kitty Couch – basically a chunk of laminated recycled cardboard with a wide groove down the middle. It looked a little too firm to be translated into a human-size version, but the office cats love it.

Like most successful workers of wood, the professional lives of Frank and Jay Novak are 99 percent perspiration and 1 percent inspiration. Fortunately, for the lovers of "Modern," they keep "keepin' on" for the magic in that 1 percent.



C-Chair



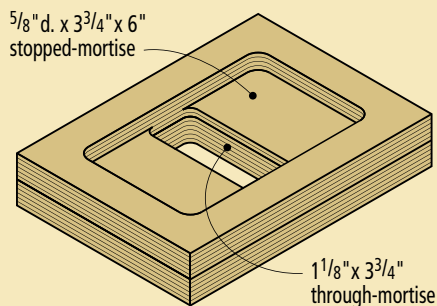
For a look at more Modernica pieces, visit modernica.net.

Grasshopper Chair and Ottoman set

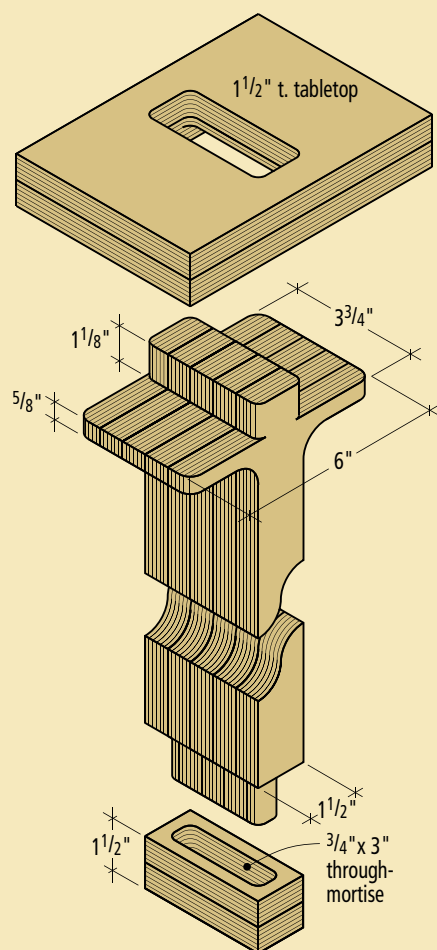
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INSIDE THE TENON TABLE

No closely guarded production techniques here. The majority of activities in the Modernica production facilities are something you might see in any woodworker's shop.



Leg-receiving mortise on bottom of table



Exploded view – leg & table top



In a modestly equipped shop, an artisan pattern-routes the mortises for a Tenon Table leg.



Time is money, and the laborious task of cutting Tenon Table pieces from 4"-thick plywood is left to the Computer Numeric Control (CNC) router. Some hands-on refinement is needed before these chops are ready for market, but 90 percent of the battle is over.



Photo courtesy of Modernica

As seen in the Pasadena Museum of California Art (PMCA) California Design Biennial Exhibition, the bold statement of the Tenon Table plays well against the delicacy of Modernica's Wire Chair with Pad.

PW

— JH

Making Sense of Dyes

Don't allow the packaging to cause you confusion.

When I opened my furniture making and restoration shop 30 years ago, there were two types of dye in wide use. I made great use of both, but for different situations.

These two types are still the most widely available and useful today, but packaging has introduced some confusion, so a discussion using brand names is warranted. Before launching into comparisons, however, I need to explain what I mean by “dye,” because packaging makes the understanding of this term confusing also.

Understanding Dye

There are two common colorants used to color wood: dye and pigment. The difference is simple. Dye is a colored chemical that dissolves in a liquid. Pigment is a solid substance (sometimes earth) ground into very small particles that suspend in a liquid. Dye is like coffee or tea; the color stays in solution. It doesn't settle. Pigment is the colorant in paint; it settles and has to be stirred into suspension before using.

When you apply a solution of dye to wood, the color penetrates along with the liquid. Very dense woods such as maple and the dense areas of oak can be colored as dark as you want without muddying the wood.

When you apply a suspended pigment to wood, the pigment stays on the surface. Wipe off the excess stain and some pigment remains lodged in recesses created by the grain of the wood (think of the coarse grain of oak and how dark it gets) and sanding scratches. The coarser the sanding scratches the more pigment lodges and the darker the result.

Confusion about dye in stains is caused by the different ways it is packaged. Dye can be used together with just a solvent or it can be used, usually in combination with pigment, together with a solvent and a binder,



Photos by the author

The two types of dye discussed in this article, in three types of packaging, are (left to right) concentrated liquid NGR, methanol-thinned liquid NGR and four containers of water-soluble powders.

as is typical in the cans of stain you buy at home centers. (See “Understanding Stains,” issue #155.)

The binder is a finish used to glue the pigment to the wood so the particles can't be wiped off after the solvent evaporates. All oil, varnish and water-based stains contain a binder. Oil stains contain oil; varnish stains contain varnish; water-based stains contain water-based finish.

The stains at home centers usually contain both pigment and dye. Some contain only pigment. A few contain only dye. But they all work the same because of the included binder, and provide limited flexibility for controlling color.

You can thin the stain with the appropriate thinner (mineral spirits for oil and varnish stain, and water for water-based stain) to make the color lighter, or you can apply an extra

coat or two after the stain has dried to make the color darker. But because each coat builds on top of the previous, each additional coat muddies the wood a little and can introduce a weakness in the film that might separate if knocked.

In contrast, dye in a solvent with no binder doesn't build. Each additional coat simply dissolves into the previous coat making it darker and creating the same effect as if you had used a more intense dye color in the first place. Dyes in a solvent with no binder can create much deeper and richer colors in wood than dyes or pigments packaged with a binder.

Stains that contain only dye and a solvent (no binder) are called dyes or dye stains.

Dye has one big downside compared to pigment. Dye fades in sunlight and fluorescent light. So you shouldn't use a stain that contains dye outside, and you should think carefully before using the stain on objects that will be placed near windows or in offices.

You can mix all brands of dye that thin with the same solvent. So as long as the dye is dissolved in water, for example, you don't have to stay with one brand.

by Bob Flexner

Bob is the author of “Understanding Wood Finishing” and a contributing editor to Popular Woodworking. In 2007, he'll be teaching three finishing classes at the Marc Adams School of Woodworking.



A dye stain is dye dissolved in a liquid. When applied to wood, the dye penetrates along with the liquid (left). An oil, varnish or water-based stain is dye and/or pigment in a solvent and binder. The binder limits the versatility of the stain, keeping most of the colorant on the surface of the wood. So the wood doesn't get as dark when you wipe off the excess stain (right).



Apply a dye the same as an oil, varnish or water-based stain. Apply a wet coat of the dye to the entire surface using any application tool then wipe off all or most of the excess before the dye dries.

Applying Dyes

Apply a dye stain the same as oil, varnish and water-based stains. Apply a wet coat using any tool (rag, brush, paint roller, spray gun) and wipe off the excess, or most of the excess, before the stain dries. As long as you have prepared the wood well – that is, sanded out all the machine marks – and as long as the wood isn't naturally prone to blotching, you will always get an even coloring.

Clearly, the evaporation rate of the solvent in the dye is critical for determining the time you have to remove the excess. Water-soluble dyes provide the most time. All other dyes are difficult to remove quickly enough.

Fortunately, dye stains are more forgiving than oil, varnish or water-based stains. A wet coat of dye tends to spread out and level better so streaks show less. With practice, you can usually wipe, brush, roll or spray a dye onto wood and it will spread well enough to produce an even coloring without wiping off the excess.

You can always get a second person to wipe right after you apply if you want to get the excess removed from a fast-drying dye.

Types of Dye

There are four types of dye – but you would rarely use two of them: powdered dyes that dissolve in alcohol and powdered dyes that dissolve in petroleum-distillate solvent (called “oil-soluble dyes”). Alcohol-soluble dyes are used primarily by people doing touch-up on furniture, and oil-soluble dyes are used pri-

marily by manufacturers who add them to oil-based stains.

The two types of dye you will almost always use are powders that dissolve in water and dye already in liquid form. In fact, this is the easiest way to separate and identify them: water-soluble powders and liquids.

Water-soluble powdered dyes have the longest history for use on wood. These dyes (often called aniline dyes because the first dyes were made from aniline) were developed in the late 19th century for use in coloring textiles. By the end of the century, they were used in factories to color wood.

In the mid-20th century, ways were found to modify (by “metalizing”) the dyes so they are more fade-resistant. The emphasis is on “more” because these dyes still fade far more rapidly than pigment.

Metalized, or “metal-complex” dyes are

almost always packaged in liquid form because they are usually dissolved in a solvent that isn't widely available – glycol ether. The dissolved dye can then be thinned with water, alcohol or lacquer thinner (not mineral spirits or other petroleum distillates).

These liquid dyes are widely available to the professional finishing trade as “non-grain-raising” (NGR) stains. If you shop at woodworking stores or from catalogs, you may be familiar with this stain as Solarlux from the finish supplier Behlen.

NGR dyes sold to the professional trade are thinned quite substantially with methanol. They are ready to spray or add directly to any finish that thins with water, alcohol or lacquer thinner.

Throughout my woodworking and restoration career I've found these two types of dye (water-soluble and NGR) extremely



These are typical oil, varnish and water-based stains. They are widely available and easy to use, but they can't produce the rich, intense colors that a dye stain can.

useful. I've used the water-soluble dye powders to stain wood because these dyes provide enough "open time" for removing the excess and getting an even coloring, and they are easier to manipulate on the wood and available in many more useful wood-tone colors than NGR dyes.

I've added liquid NGR dyes to shellac and lacquer to make toners for tweaking the color on the wood when my staining didn't give me exactly what I wanted. Good wood finishers and refinishers find toners extremely useful for matching colors.

DYES AND AVAILABILITY

W. D. Lockwood (water-soluble powders)

- W. D. Lockwood
212-966-4046 or
wdlockwood.com
- Tools for Working Wood
800-426-4613 or
toolsforworkingwood.com
- Olde Mill
717-755-8884 or
oldemill.com
- Woodworker's Supply
800-645-9292 or woodworker.com
(Privately labeled: J. E. Moser)
- Lee Valley
800-871-8158 or leevalley.com
(Privately labeled: Lee Valley)

Arti (water-soluble powders)

- Highland Hardware
800-241-6748 or
highland-hardware.com

TransTint (concentrated NGR) and TransFast (water-soluble powders)

- Homestead Finishing Products
216-631-5309 or
homesteadfinishing.com
- Woodcraft
800-225-1153 or
woodcraft.com
- Rockler
800-279-4441 or
rockler.com

Methanol-Thinned NGR

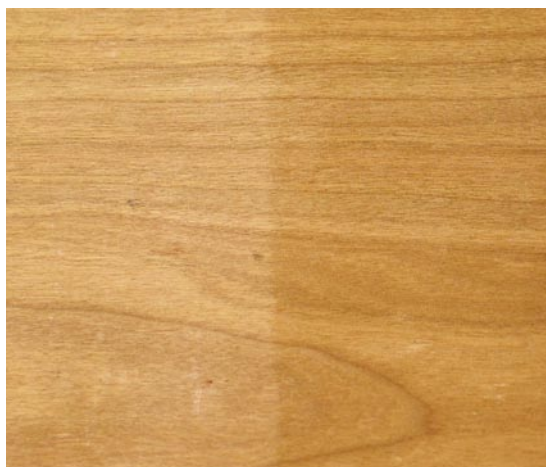
- Many woodworking stores and most stores that supply the professional finishing trade



To dissolve water-soluble dye powders, begin by measuring out the amount of dye and water you want to use. Suppliers recommend ratios for achieving their standard colors, which are reproduced in their catalogs or on their web sites. But you can use any ratio to produce whatever color intensity you want. Combine the water and dye powder in a non-metal container, adding the dye to the water. Then stir until the dye is totally dissolved. If there is any possibility of clumps of dye powder remaining, strain the solution. If you want to make an intense color, it's better to use hot water because you can get more dye to dissolve. I've never had a problem using tap water.



Manufacturers rarely tell you what colorants they use in their oil, varnish or water-based stains. To determine this, let the stain sit undisturbed on a shelf for a week or more. Then insert a stirring stick (left) into the can. If the stick becomes colored near the surface, the stain contains dye. If you have to go to the bottom of the container to pick up colorant, the stain contains pigment. If both, as in this example, the stain contains both dye and pigment.



Water raises the grain of wood, making it feel rough and look dull (right side of this panel). There are three ways to deal with raised grain: Let it happen with the water-soluble dye, then carefully sand the wood smooth with #400-grit sandpaper before applying the sealer coat; "bury" the raised grain with the sealer coat, then sand smooth; pre-wet the wood with water, let the wood dry, sand it smooth, then apply the stain.

The Confusion

Non-grain-raising (NGR) dyes are now available to woodworkers in concentrated form – that is, with the glycol-ether dissolving solvent but without the methanol thinner. These dyes are very versatile because they can be thinned with water and used the same as a water-soluble powder dye, or they can be added to water-based finish, shellac or any finish that thins with lacquer thinner, to make a toner.

The packaging can cause confusion, however. These concentrates are exactly the same as the widely available NGR stains. In other words, thin a concentrate with methanol and you have Behlen Solarlux. So there are still just two very useful types of dye to choose from – even though you might find three packaging options at the store.

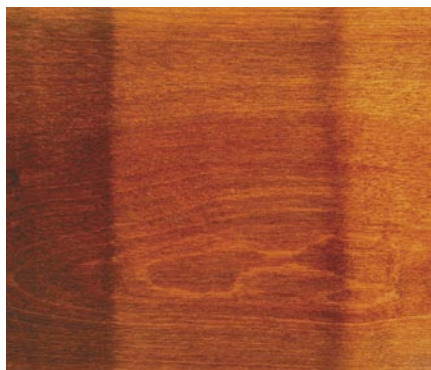
Choosing Among Options

If you are making a toner using shellac or any other finish that thins with lacquer thinner, the NGR type, whether concentrated or thinned with methanol, is the only one you can use. Personally, I find myself using the methanol-thinned NGR because a toner almost always has to be thinned a great deal anyway to maintain control. Otherwise, you risk building the color on the wood too fast and getting it too dark.

If you are making a toner with water-based finish, you can use either of the NGRs or the water-soluble powder. The NGRs are easier to use because you don't have to do the dissolving. Only if you want one of the colors available in powder form should you choose that type.

For staining wood by hand (not spraying), I find the water-soluble powders, especially those from W. D. Lockwood, far more useful than either of the NGRs for two reasons. First, the powder dyes are much easier to lighten right on the wood if you get the color too dark. Second, the dyes from Lockwood are available in a much larger choice of colors, including a great many that reproduce very accurately those colors we associate with traditional furniture. (See story at right.)

I find the ability to easily lighten or change the color after the dye has dried invaluable when trying to match the wood color to something else – for example, a “paint chip,” an existing piece of furniture or an already fin-



I stained this maple board with a Lockwood water-soluble dye. After letting the stain dry, I applied a second coat to the left side and wiped the right side with a wet cloth. Two applications deepen the color significantly without muddying the wood. Wiping with water removes a significant amount of color, lightening the wood. I find the Lockwood brand of dyes the most versatile because they are the easiest to lighten.



Though “metalized” dyes used in NGR stains are more fade resistant than water-soluble dyes, they still fade rather quickly. The lower half of this board was exposed to sunlight for six months through two panes of glass in a west-facing window. From left to right: TransTint concentrated NGR, Lockwood water-soluble, Arti water-soluble and methanol-thinned NGR. Clearly, you wouldn't want to use any of them in sunlight exposure.

ished object when replacing a part. Changing the color means applying another color that, when combined with the original, gives you what you want. Doing this darkens the original color, however, so you often have to lighten it first, or lighten the result.

The downside of using a powder dye, of course, is that you have to go through the extra step of dissolving it in water. Both types of NGR dye are ready to use. (Keep in mind that though “NGR” is the acronym for “non-grain-raising,” this dye raises the grain of wood

if it is thinned with water.)

Also, if you are brushing water-based finish over a water-soluble dye that redissolves easily in water, you have to apply a barrier coat of another finish (shellac, varnish or lacquer) or you will drag the color and cause unsightly streaking.

For more information about the dyes available in most woodworking stores and catalogs, go to the web sites of the two principal suppliers at homesteadfinishing.com and wdlockwood.com. **PW**

W. D. LOCKWOOD AND THE HISTORY OF WOOD DYES

Dyes were developed in the late 19th century for use in the textile industry, but it didn't take long for furniture manufacturers to realize they could use the dyes also.

Early American and British reproduction furniture was very popular at that time. But the colors of the new wood didn't match the colors of 100- or 200-year-old oxidized wood. The easiest and most transparent way to make the new wood the color of the old was with dye.

W. D. Lockwood was started in 1895 in New York City by a chemist, a practicing wood finisher and a business entrepreneur, none of whom were named W. D. Lockwood. The company has always been located in lower Manhattan and may have been the first to adapt the textile dyes for use on wood.

Lockwood's business model was (and still is) to buy dye powders from the large dye manufacturers such as BASF and blend them to the color specifications of furniture manufacturers, many of whom were making reproduction furniture.

Hundreds of wonderful wood-tone formulas dating back to 1895 are contained in Lockwood's files, with about 85 water-soluble examples available to wood finishers. Examples of the colors include: Tudor Oak, Flemish Brown, Jacobean, Antique Cherry, Sheridan Mahogany and Phyfe Red.

Lockwood also has many alcohol- and oil-soluble colors blended to imitate traditional wood tones. None are “metalized” NGR dyes.

—BF

Grumpy Old Men

When properly trained, curmudgeons have many uses.

It's easier to care for exotic pets than grumpy old men. You try to keep them in a safe, climate-controlled environment, but given a chance they'll stray into the woods with a gun or chain saw, drive to the hardware store in a blizzard to buy sandpaper, or climb up on the roof to fix shingles.

A grumpy old man will spend four hours and five dollars worth of gas driving from one store to another, trying to save \$2 on a \$19.95 circular-saw blade. "I remember when you could get one of these for \$3.95," he complains, as if it were your and your generation's fault.

Properly trained, a grumpy old man has many uses. He can tell you the best car to buy (a 1953 DeSoto). He can tell you to get a riding mower so you'll never have to mow your own lawn again. "Kids these days are too lazy to use push mowers," he grumbles as he adjusts the blade height.

A grumpy old man will make one identical bookcase for each child, then one for each grandchild. "I ought to charge for the lumber, but kids want everything for free," he complains. Once everyone has a bookcase, he'll turn out grandfather clocks. "It's time your kids learned to read a real clock instead of those electronic things," he mutters. He will paint your house, fix your car (when did they start putting engines in sideways?), sharpen your knives, planes and chisels – all the while telling you how lazy his children and grandchildren are (his dad taught him to sharpen tools at age 6).



Watch out if your grumpy old man has his own chain saw (a 40-pound 1962 model). He'll want to borrow your 40 oz. "plastic toy saw" to cut down all the trees in your yard. "See that moss growing on your shingles? Too much shade," he warns.

A grumpy old man ages about seven years for every one of your own. You are lucky to have one for more than 12 or 14 years. My own dad died when I was a teenager so I never got the chance to raise my own grumpy old man, but I've enjoyed meeting many older woodworkers during my years selling lumber. When middle-aged men buy lumber from my business, they sometimes bring their elderly fathers with them.

A customer opens the door. "Hey Bob," I say. "You leave your hair at home today?"

"Ha ha, Pete," he replies. "Yours looks fuller and thicker than last time. What's your secret?"

"Titebond III."

Bob is still holding the door open.

by Peter Sieling

Peter owns Garreson Lumber Co., a hardwood supplier, in Bath, New York.

"Watch your step, Dad," he says.

Behind him shuffles a wrinkled old man with eyes sparkling behind thick trifocals. His pants are pulled up to his rib cage with suspenders. Bob buys what he needs and we carry it out to the pickup. Dad tries to help. I worry he'll trip and hurt himself or slip on the ice outside.

The old man turns to me. "I ran a mill back in '47. 'Forty-seven to '53. No wait ... '46 to '52 ... shucks, don't make no difference. If I had one of these new band mills I'd get a lot more wood out of those logs. I'd get one if I could still roll the logs. Stupid tickler's going on me." He thumps his heart with his fist, then jerks his head toward his son. "Bob's into computers." He sounds disappointed. "I ran a 24" ironwood log through the mill once. You don't see 'em that big very often. You ever see one that big?"

"Almost," I nod.

"It pulled the motor right off the mount." He laughs.

"Come on, Dad." Bob beckons Dad into the truck and drives away. I think to myself, "That looks like fun, having an old man to tote around." Then I go and pet my dog. **PW**