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AUGUST 2002
ISSUE #129

Popular Woodworking

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Popular Woodworking



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Build a workbench that works as hard as you do. This stout bench is an outfeed table, an assembly bench and is great for all sorts of hand work. Best of all, you can build it for a fraction of what you'd buy in the stores.

Cover photo by Al Parrish.

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See You at the Show...

WoodWorks 2002, That is

Growing up in farm country you develop a taste for large get-togethers. When I was a kid, the state fair was as eagerly anticipated in summer as the Christmas holidays were in winter. That first trip down the midway and through the livestock barns was a feast for the eyes and the imagination. Spending time at the fair, you couldn't help but catch up on the latest, from farming know-how to the latest in new equipment—even gossip among friends and neighbors.

That's another reason the fair was so appealing. It gave you a chance to spend time with folks who were like-minded, people you knew well and gave you the opportunity to make new acquaintances. I guess this all speaks to the solitary nature of rural life.

In at least one sense, farming is a lot like woodworking: You usually work alone. Knowing how much we all work alone in our shops, I'm really excited to announce our participation in a series of woodworking events called WoodWorks 2002 that will prove as fun and informative as a state fair. And just like a fair, there will be special activities for kids that make these special events an honest-to-goodness family affair.

And because there will also be major woodworking manufacturers demonstrating and selling equipment (as well as hard-to-find specialty suppliers), you'll be able to take home an armful of tools at bargain prices if you're in the market. If you're not looking for tools, free demonstrations and seminars will teach you more about woodworking from a who's who list of woodworking experts.

While at the show, make sure you stop by the *Popular Woodworking* booth so you can meet the editors who work on your magazine. During each show, we'll be busy building a rock-solid workbench using a basic set of tools. While there, be sure and register for our special drawing. If you're the lucky winner, you'll be parking the bench we're building in your shop as soon as the show's over!

Just like a big fair, there'll be lots going on all the time. Here's a run-down: The shows

will be held at three different locations and will draw woodworkers from up to a couple hundred miles away. The first event is in Novi, Mich., at the Novi Exposition Center in the Greater Detroit Area. It will be held on the weekend of Sept. 27-29.

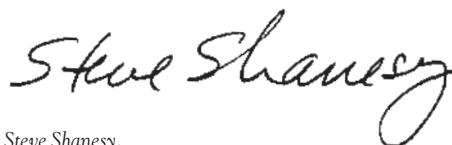
The second show will be held the weekend of Nov. 1-3 at the Fort Washington Expo Center in Fort Washington, Penn., which is near Philadelphia. The third event will take place on Jan. 24-26, 2003, and is for all you West-coast woodworkers. It will be held at the Ontario Convention Center in Ontario, Calif., which is east of Los Angeles.

Of special note, the Pennsylvania and California events will be held in conjunction with a "must attend" pre-event for turners. The two-day Whole Earth Turning Conference will offer a full slate of two-hour lectures and demonstrations by woodturning legends and internationally recognized turners. Don't miss a chance to see David Ellsworth, Judy Ditmer and Stuart Mortimer in action, to name a few.

At the WoodWorks events, you can take in free demonstrations (20 in all) by leading woodworking experts. You can also sign up to attend lectures and hands-on workshops. You won't want to miss nationally known woodworkers like Frank Klausz, Toshio Odate, Michael Dresdner, Ellis Walentine, Fred Matlack, Paul Anthony, Wayne Barton and Andy Rae, plus many others.

You can also help local woodworking guilds raise funds for charity by participating in the Make-A-Memory Workshop, or Top-a-Thon (turn a top with a son or daughter). There's lots more scheduled, and you can check out all the details at the WoodWorks 2002 web site, www.woodworks2002.com.

See you at the show! **PW**



Steve Shanesy,
editor and publisher

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Editorial Offices 513-531-2690

Editor & Publisher **Steve Shanesy**
ext. 1238 • steve.shanesy@fwpubs.com

Art Director **Linda Watts**
ext. 1396 • linda.watts@fwpubs.com

Senior Editor **David Thiel**
ext. 1255 • david.thiel@fwpubs.com

Senior Editor **Christopher Schwarz**
ext. 1407 • chris.schwarz@fwpubs.com

Assistant Editor **Kara Gebhart**
ext. 1348 • kara.gebhart@fwpubs.com

Project Illustrator **John W. Hutchinson**

Photographer **Al Parrish**

Contributing Editors

Nick Engler

Bob Flexner

Glen Huey

Scott Phillips

Troy Sexton

Senior Vice President **David Lewis**
Editorial Director **David Fryxell**

CIRCULATION

David Lee, Vice President
Jennifer Shaffer, Group Manager

PRODUCTION

Barbara Schmitz, Vice President
Vicki Whitford, Production Supervisor

ADVERTISING

Advertising Director

Don Schroder

331 N. Arch St., Allentown, PA 18104
Tel. 610-821-4425; Fax 610-821-7884
d.schroder@verizon.net

Classified Advertising Sales

Joan Wright, Tel. 800-388-1820
jwrightperry@aol.com

Advertising Production Coordinator

Debbie Thomas, Tel. 513-531-2690, ext. 1219
debbie.thomas@fwpubs.com

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SAFETY NOTE:

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

Errors in Review of Plunge Routers

Makita Router Actually Does Offer Dust Collection, Self-releasing Collet

Regarding "Premium Mid-size Plunge Routers" (June 2002), we would like to correct some errors that were made in the comparison featuring our Makita RP1101 router.

The RP1101 does in fact offer dust collection capability, achieved by simply attaching our accessory dust nozzle adapter (included in our router kit model RF1101KIT).

In the comparison of collets, our router does in fact feature a self-releasing collet for increased convenience when changing bits.

The last point that I would like to make is that the article never really mentions that the other models in the comparison are all dedicated plunge routers while our router is also part of a combination kit with both a plunge and fixed base. While our router may not be able to incorporate all the features of a strictly dedicated plunge, we offer a number of other advantages, number one being of course the ability to interchange the motor in various bases for added versatility.

Vince Caito

Marketing communications manager
Makita U.S.A. Inc.

Editor's note: Our apologies to Makita for the errors regarding the capabilities of the RP1101.

Lessons on Shelving From an Expert

Congratulations to Troy Sexton on his handsomely designed shelving/cabinet piece, and the clear, well-written instructions for building it ("What You Must Know About Shelving," *Woodshop Essentials* special issue and originally appeared in the August 2000 issue). Such shelving is fine for framed pictures and glassware as shown, and for sculpture and many other display items.

But an article titled "What You Must Know About Shelving" should mention that this "bookcase" is not designed for shelving books. I know something about shelving

books – for many years I ran a law library, and I collect books. For bookshelves, these are wastefully deep front to back – 12" deep in the side units and 16" in the center unit. Ten inches would be ample; "Encyclopædia Britannica's" large volumes measure less than 9" deep, and only a few atlases and coffee table books are deeper. As to height, efficient bookshelves should be vertically adjustable in ½" increments (common metal clip supports do this well), so the librarian can conserve height. The adjustability should go all the way from top to bottom, so the librarian can make a shallow top or bottom shelf for an atlas or other oversize book to lie flat, without waste of vertical space and without breaking the general sequence.

Bookshelves should not have a face frame that protrudes in front of shelf space, as these do – fully 52" of the shelving width is behind the protruding face frame stiles. Such framing interferes with good shelving practice. If you pushed the end volumes back behind the stiles, the appearance would suffer, the users couldn't see all the titles and access to the end books would become awkward. Because these shelves are so deep, you could instead push all the books all the way to the back of the shelves – at least that way the end space would be used and the spines of the end volumes could be seen. Nonetheless,

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WRITE TO US

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

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LETTERS

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the appearance of the volumes and ease of removal would suffer as a result.

These shelves would be much better for books if they had no framing that protrudes in front of the shelf space.

*Paul Welsh
Hockessin, Delaware*

Can You Make Your Jack Plane Less Accurate by Flattening the Sole?

In your April 2002 magazine, Christopher Schwarz's informative article talked about setting up a jack plane. He discussed the importance of flattening the sole and the importance of having the sides of the plane 90° to the sole. Being a beginner, my first thought was: Could I flatten the sole in such a way as to lose the 90° alignment? Is there a way to correct this problem?

*Herbert H. MacDonald
Portland, Texas*

Editor's note: There is, of course, a small chance you would alter the angle slightly between the sole and sides. But the alternative is to use a plane without a flat sole that won't work nearly as well as a plane with a flat sole.

If you plan to use a shooting board with your jack plane and you need that perfect 90° angle, here's what to do: Flatten the sole. Then clamp a wooden fence to your flattening medium (I prefer sandpaper glued to a piece of marble) that's 90° to your flattening surface. True the sides by rubbing the sole against the fence. PW

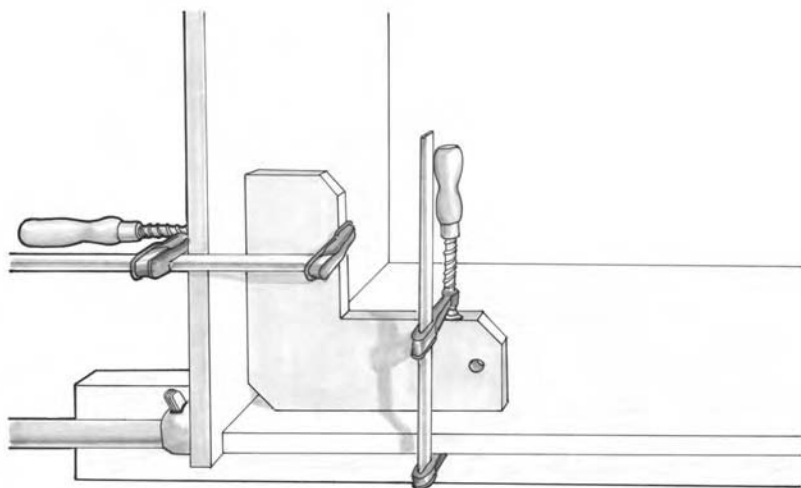
CORRECTIONS AND CLARIFICATIONS

Popular Woodworking corrects all significant errors. For a list of corrections that have appeared in the magazine, visit our web site at: www.popwood.com/features/mag.html

In the article "Resawing with the Band Saw" (June 2002), we listed the wrong tooth configuration for the blade recommended for resawing. The blade is a Lenox $\frac{3}{8}$ ", $\frac{3}{4}$ variable-pitch blade sold under Lenox's Tri-Master line. For information on where to purchase this excellent carbide-toothed band saw blade, call Lenox at 800-628-8810.

In the article "Choosing a Contractor Table Saw" (February 2002), we listed the Ridgid TS2424 as a right-tilt saw. It is a left-tilt machine. Also, in the chart we listed the Bridgewood TSC-10CL as having two cast wings. As stated in the text of the article, it has only one.

It's Hip to be Square in Woodworking



I am thinking of upgrading to a bigger and more powerful Delta. Delta machines, except for the larger cabinet saws, are right-tilting. This isn't something I've thought about until now. Any assistance you can offer will be appreciated.

John Borley
Toronto, Canada

You ask a fair question. When using a right-tilt table saw with the blade tilted to make a bevel cut and using the fence to the right of the blade (which is the standard setup), the waste piece will rest/fall on the blade, making kickbacks possible. A left-tilt saw allows the waste to fall to the table beneath the blade without any kickback concerns. Conversely, if you're using your miter gauge on the left of the blade to make miter cuts, a right-tilt saw is safer. With many of today's rip fences the left/right question has become less important for safety because you can easily work on either side of the blade and fence. All you need to do is consider where the waste falls.

There are two more important points regarding a left-tilt saw's advantages. First, with the fence to the right of the blade on right-tilt saws, cutting a bevel on narrow stock is dangerous because the blade virtually covers the material. On stock that is 2" or 3" wide or less, any tendency of the stock to lift will get ugly quickly because the blade is covering one edge, leading to a serious kickback. Second, on very narrow stock, some bevel cuts become virtually impossible with the fence to the right of the blade.

I have used right-tilt saws for years and still do in my home shop. Ultimately, I've learned to saw "left-handed" at home with the fence positioned to the left of the blade. It still feels a bit awkward but much less so than it did at first. After some practice, I have achieved some competence and a bit of a comfort level while sawing left-handed.

— David Thiel, senior editor, and
Steve Shanesy, editor and publisher

How to Get Square and Stay Square: Good Habits and a Simple Jig

When I build any kind of box, large or small, for cabinets or even a toy box, I try to keep the case square. I've learned the hard way that fitting doors, drawers and lids later is a real problem if the box is out of square. I try to make sure my assembly is square when gluing up, but too often it doesn't square up. What am I doing wrong?

Robert Eddington
Denver, Colorado

Some care and planning before and during assembly will save you time and aggravation. Develop some good habits, and you might just banish out-of-square problems forever.

First, make sure your box parts are sized correctly. Obviously, sides that aren't the same length, or tops and bottoms that aren't the same, will cause a problem. Next, make sure your saw is set to cut a true 90° angle so that mating parts will more assuredly form a square, 90° angle. When gluing up, don't apply so much clamp pressure that you put a bow or belly in any parts.

Another assembly trick I use involves corner squares. I make these from 3/4"-thick plywood and clamp them in opposite corners of any box or case glue up. These handy yet inexpensive squares set and hold the parts correctly so

you can go about your business of clamping the case and cleaning up glue squeeze-out.

To build these clamping squares, use up some 12" square plywood scraps. First, make sure you have two adjacent edges square, then form the two legs of the square so each leg is about 4" wide. Be sure and nip the corner of the square so that glue squeeze-out doesn't glue the square to the box. Of course, when you are cutting the clamping squares, make sure your saw blade is cutting a square edge as well.

To use them, first set a pair of straight 2 x 4s on edge under the assembly to allow clamp placement on the bottom square. By the way, elevating your assembly on 2 x 4s also allows you to easily position clamps under the work. When clamping the squares in place, don't clamp them too tightly while you are clamping the case together. Fully tighten the clamping squares later.

— Steve Shanesy, editor and publisher

Right- vs. Left-tilt Table Saws

I just finished reading your review of table saws (February 2002) and I have a question. You said that you think left-tilt machines are safer, but you didn't elaborate. I'm just wondering what the safety difference is between left-tilt and right-tilt saws.

I currently have a Craftsman contractor's saw, which has served me well for years, but

Am I Suffering From Backlash in My Vintage Hand Plane?

I recently restored a yard-sale hand plane; it's a Craftsman smoothing plane (the equivalent of Stanley's No. 4) from the late 1960s or early 1970s, and it is in great shape.

After cleaning it, flattening the sole and honing the iron, I tried it out only to find the iron slipped backwards into the plane's

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Q & A

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body after one or two passes. Is this a problem that could be caused by backlash?

The lever cap screw is as tight as I dare make it (any tighter and the lever cap won't release). I have noticed slack in the depth adjusting knob and tightened it up to no avail. Also, I have checked the frog assembly and it's staying put. I've flattened the lever cap and cap iron so they mate and checked the iron/frog fit. All seems fine. If I can solve this problem, I'll invest in a Hock iron; please let me know what you think.

William Fuller
Geneseo, New York

You could be suffering from backlash; then again, it could be something else. First, an explanation about backlash.

Backlash is a mechanical issue with things that screw in and out. I first encountered backlash when I learned to play guitar. Whenever I would tune a string that was too high in pitch, I would loosen the tension to get to the right note. After a few minutes of playing, the string would go flat and then require tightening.

But when I tuned a string that was too low in pitch by tightening it, the string would stay in tune for a much longer time. So, I learned that whenever I tuned my guitar, I should first loosen a string and then get to the proper tuning by tightening. The same goes for the depth adjuster in planes. Always adjust an iron to the correct depth by increasing the depth of cut.

*If that's not the source of your problem, I would check the frog-adjustment screw. It also can suffer from backlash. Finally, check the dog that moves the iron assembly forward. If it has become rounded over or damaged, the iron and chipbreaker can slip backwards in use. **PW***

Christopher Schwarz, senior editor

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Draw Accurate Lines Around Corners

THE WINNER:

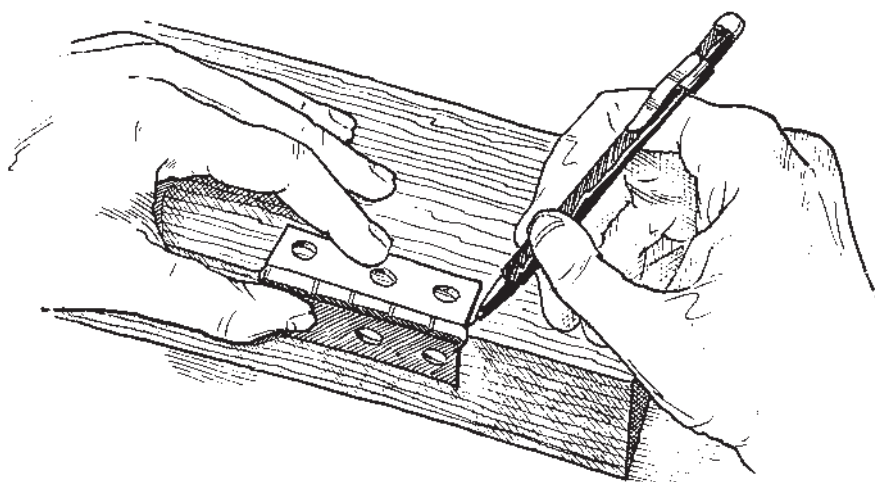
Many years ago my carpenter square mysteriously disappeared at the start of my basement finishing project. So I started using a butt hinge to mark lumber. It worked better than I had hoped. My carpenter square is still hiding from me, but I still use a 3½" x 3½" full-mortise butt hinge for transferring my layout marks for trim work.

The real advantage of using a hinge is that it allows you to bring lines around cor-

ners, such as when you are marking out a tenon, with minimum error. When choosing a hinge for this purpose, select one without a finial (which will get in the way of your line) and one without a lot of slop between the leaves and the hinge pin. The tighter the hinge, the more accurate your layout lines will be.

Milo Meyers
Seattle, Washington

Illustrations by John McCormick.



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CASH AND PRIZES FOR YOUR TRICKS AND TIPS!



Each issue we publish woodworking tips and tricks from our readers that we think are useful. We want to encourage you to share with your fellow woodworkers, as well as reward the most useful and original concepts. Delta has agreed to lend us a hand with that, and the author of this issue's winning trick receives the new 22-580 two-speed portable thickness finishing planer (shown at left). The other trick's authors receive a check for \$75.

To submit your tip or trick, e-mail it along with a daytime phone number to david.thiel@fwpubs.com or mail it to:

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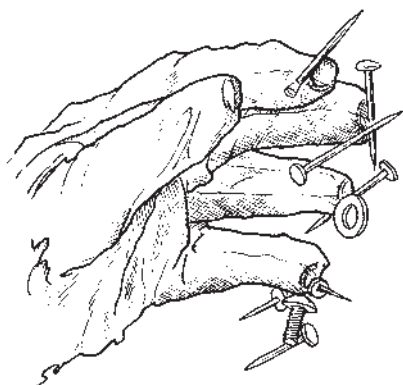
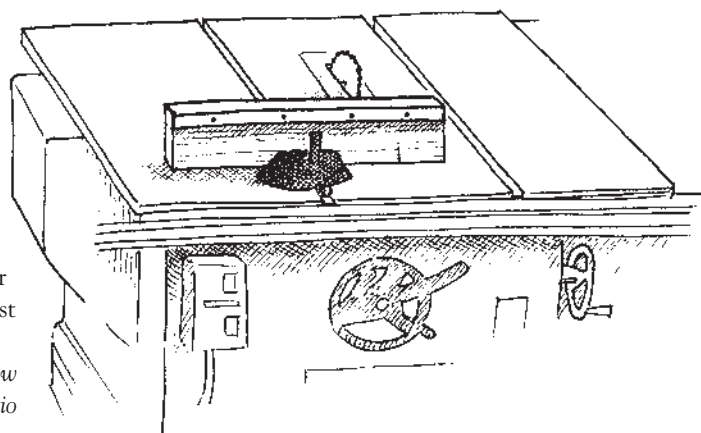
Aluminum Angle Bracket Keeps Crosscuts Accurate

The extended wood fence screwed to my table saw's miter gauge would sometimes flex, making it difficult to keep pieces perpendicular to the saw blade during crosscuts. The situation became even worse after I cut a tall kerf in the fence one day. To solve this, I added a piece of aluminum angle to the backside of the extended wood fence.

My fence is made by laminating two pieces of 1/2" Baltic birch plywood, rounding over the top back edge with a 1/8" roundover bit, hacksawing a 1" aluminum angle bracket to the same length, then simply screwing the

angle to the fence. Now the fence never flexes, regardless of saw kerfs. Make sure that your fence is tall enough so that the bottom of the aluminum angle is higher than the top of your saw blade at its highest setting.

Bill Law
Cincinnati, Ohio



The Easiest Way to Retrieve Objects With a Magnet

Ever spill a mess of nails and try to pick them up? Using a magnet speeds things up, but it takes time and effort to get the nails off the magnet. Next time, wrap the magnet in a small cloth bag, sock or rag. (Editor's Note: You can even put some rare earth magnets in the fingers of a glove.) After the nails are picked

up by the magnet, invert the bag over the nails and pull the magnet off – with the nails held inside. The nails can then be poured into their original container.

Ralph Maurer
Mansfield, Ohio

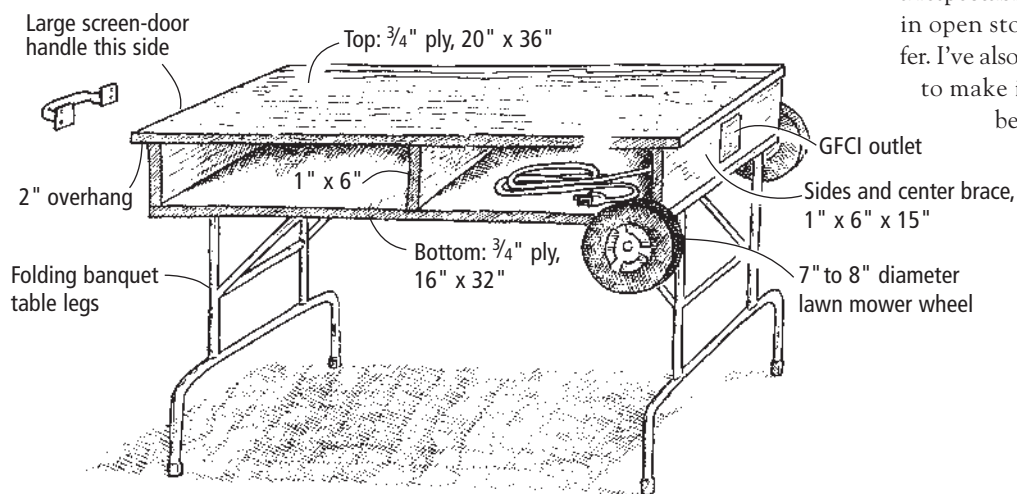
Mobile Workbench Built From Shop Scraps and Metal Table Legs

I've built two of these portable, folding and rolling workbenches for myself and several for friends. It's sturdy (it will support up to 200 pounds), compact (it fits in a closet,

under a bed or in small shop spaces), and is easy to move and easy to build using simple butt joints, less than a sheet of plywood and screws. I've added a built-in GFCI

electrical outlet with a power cord so there's always a plug nearby. Other features include the inexpensive table legs that when added to the work box, bring the height to a respectable workbench height, and built-in open storage, or drawers if you'd prefer. I've also made a 2" overhang on the top to make it easy to clamp things to the benchtop. **PW**

Leroy Lamey
Jacksonville, Florida



Delta's 14" Band Saw

Practically an industry standard, we take this quality 14" machine way too much for granted.

The band saw is a strange machine in the American woodshop. British woodworkers often build their shops around the band saw the way we do a table saw. We tend to use a band saw infrequently, and then for a couple of minutes and for an ever-changing variety of reasons. It may be trimming the tails on some drawer sides one moment, then shaping a cabriole leg the next. It's a versatile machine that sits in the corner of our shops patiently waiting for its next task.

Whenever a reader asks for a recommendation on what type of band saw to buy, we heartily recommend a 14" stationary machine with a 1 hp motor and the ability to add an extension block to increase the resaw capacity. It's what we use every day, and our Delta 28-280 has never let us down in the four years we've owned it.

This solid, stationary machine offers good blade capacity ($\frac{1}{8}$ " to $\frac{3}{4}$ " widths) for fine curves or heavy resawing. The 1 hp motor has proved powerful enough for most tasks, though you should take it easy when resawing dense or particularly wide wood.

The table is solid and easily adjustable, locking tightly at any angle across a 48° arc. The table is also pre-milled flat and tapped for screws on the infeed and outfeed sides. This makes attaching accessories (both shop-made and aftermarket) an easier task.

Changing blades on the Delta 28-280 is straightforward, with relatively easy access to the blade. The dust collection hook-up on the unit is correctly placed, and does manage to collect a reasonable amount of dust. The only annoyance is the size of the port, which doesn't seem to fit any of our hoses.

Though it seems to be a mantra with many woodworkers, we haven't seen any reason to replace the blade guides on this saw. The guides are easily and independently adjustable to a very fine tolerance. While we have replaced the stock steel guide blocks with ceramic blocks, the guides continue to function admirably and precisely.

An inconvenience on this saw and most band saws is the blade-tensioning knob that requires strong wrists and too many revolutions to release and engage. This could be improved.

Another improvement we'd like to see is the addition of a rack-and-pinion adjustment mechanism for the blade guard/guide assembly. While the friction-fit system does the job, we've startled ourselves by accidentally letting the mechanism drop to the table loudly (and this is probably not great for the guides, either).

Though not a huge concern, many band saws now offer wheel-cleaning brushes that reduce the chance of dust buildup on the tires. Most of these systems are short of perfect, but they do keep the tires cleaner so the blades track easier to the center of the wheel.

One accessory we highly recommend is the 6" extension block kit. While the standard saw is a solid performer, by adding the accessory kit you immediately increase the resaw capacity from 6 $\frac{1}{4}$ " to 12". That extra height has come in handy many times. The kit adds \$90 to the cost of the saw, and you'll have to order different length blades (105"), but the money is well spent.

One of the upgrades offered on select models of this unit is a rip fence. We've made a half-dozen different fences for this saw throughout the years, and they've all done exactly what we wanted them to. But if your machinery dealer offers you the stock fence (a \$100 value) for very little increase in the price of the saw, then go ahead.

So, while we have a few things we'd like to see added to the 28-280, we continue to use it frequently (though sporadically) with little fuss and much success. Our sources at Delta indicate that some of our wishes are being addressed on their new 14" saw (model 28-293) in the near future. **PW**

—David Thiel



Photo by Al Parrish.

SPECIFICATIONS

Delta 28-280 14" Band Saw

Street price: Under \$800

Motor: 1 hp induction, 1,725 rpm

Capacity depth: 13 $\frac{3}{4}$ "

Capacity height: 6 $\frac{1}{4}$ "

Table size: 14" x 14"

Table tilt range: 45° right, 3° left

Blade capacity: $\frac{1}{8}$ " - $\frac{3}{4}$ " width

Weight: 224 pounds

Nice features: Solid performance, power and capacity for almost any task, optional riser kit to extend capacity.

Recommended modifications: Add ceramic guide blocks and wheel brushes as standard items. Spend the money to buy the height extension kit.

Available at: Delta dealers nationwide. Contact Delta at 800-438-2486 or www.deltawoodworking.com

ABOUT OUR ENDURANCE TESTS Every tool featured in our Endurance Test column has survived at least two years of heavy use in our shop here at *Popular Woodworking*.

Yorkcraft's Planer an Impressive Cast-iron Bargain

During the past few years there has been a wave of quality, reliable and easy-to-use \$300+ benchtop planers entering the market. These 12" and 13" planers have made it possible for the home woodworker to surface quality lumber at one-quarter to one-third the cost of larger stationary planers.

But deep in our grease-smudged hearts we know every woodworker wants a 15" stationary planer with an induction motor. The problem is most of us don't have the \$900 to \$1,200 for one of these cast-iron machines.

When we stumbled across a Yorkcraft 15" enclosed-stand, 3 horsepower, two-speed planer with bed rollers for \$699, our heavy-metal hearts skipped a beat, and we started to figure out where it would fit in our shops. At less than \$700, the YC-15P is priced \$100 less than other comparable planers.

Though the name Yorkcraft may be new to you, the company isn't. This planer is available through Wilke Machinery, which has offered the Bridgewood line of machines that have been positively reviewed and recommended in this magazine. With the planer's tantalizing price, good specifications and good pedigree, we ordered a unit to test in our shop with great anticipation.

We're happy to report the YC-15P is as advertised. While there are some cosmetic inconsistencies, this Chinese-made machine has all the features you could ask for in a professional planer, at a good price.

Assembly was generally smooth, you'll need friends to help get the machine up onto the base cabinet. There were only a few loose parts to attach, and the planer was ready to run in about an hour. This is a 3 hp, 220 volt, single-phase machine, so check your breaker box to make sure you've got enough juice (Wilke recommends at least 20 amps).

A simple two-speed adjustment switches the feed rate from 30 fpm (feet per minute)

to 16 fpm, providing a smooth and well-finished final pass. We weren't enthralled with the top-mounted motor, making blade changes more complicated.

Other features include: anti-kickback fingers across the entire bed width, jackscrew knife adjustment and a dust hood.

When we put the planer to work, one difficulty was in setting the infeed and outfeed rollers. As the height of these guides directly affects snipe on a board, we found the infeed roller brackets easy to bend and with too little fine adjustment. But the planer did a fine in operation, without extensive snipe and plenty of power for the 100 board feet of white oak we ran to test.

While we need to use the machine for an extended period to find out how it will hold up, our initial testing shows the YC-15P to be an affordable way for home woodworkers to add a professional machine to their shops.

For more information, circle #141 on Free Information Card.



SPECIFICATIONS

Yorkcraft YC-15P

Street price: \$699

Motor: 3 hp, 5,000 rpm

Feed speeds: 16 & 30 fpm

Thickness cap.: 1/4" to 6"

Weight: 427 pounds

Performance: ●●●●○

Value: ●●●●●

Wilke Machinery: 800-235-2100 or
www.wilkemach.com

HOW WE RATE TOOLS

At *Popular Woodworking* we test new tools and products with an honest, real-world workout. We check for ease of assembly and determine how clear and complete the manuals are. Then we use the tool in our shop to build projects that appear in the magazine. Each issue, our editorial staff shares its results and experiences with the tools.

We use a one-to-five scale, with "five" in performance indicating that we consider it to be the leader in its category. For value, "five" means the tool is a great deal for the money, while "one" means we consider it pricey. Though, a unique low-value tool may be worth the price.

If our tool reviews don't answer all your questions, e-mail me at david.thiel@fwpubs.com or call me at 513-531-2690, ext. 1255. You also can visit our web site www.popularwoodworking.com to check out previous tool reviews and sign up for our free e-mail newsletter (focusing on tools) that's sent out every other week.

—David Thiel, senior editor



DeWalt's XRP Line of Cordless Drills Adds a Third Speed for Woodworking

The newest thing in cordless drills isn't more volts, it's more speeds. What does that offer? More control of your speed and torque.

We applaud the growing number of cordless drills that offer two speeds, allowing the user to choose between high speed (for drilling holes) and high torque (for sinking screws in a coordinated and efficient manner). Now DeWalt has added a third option: offering higher rpm for better small-bit performance, and a balance of competent speed that's linked with reliable torque.

The DeWalt-built motor in the DW980 offers 350 inch/pounds of torque, putting it comfortably in the upper strata in the 12-volt category. The third speed also offers a 29 percent increase in rpm, pushing the top speed range to 1,800 rpm.

Another feature is an all-metal $\frac{1}{2}$ " ratcheting keyless chuck to keep a tighter grip on the bit. The drill also sports a 23-position clutch, all-metal gearing, a metal gear case, anti-slip comfort grip and two batteries with a diagnostic one-hour charger.

OK, do you need three speeds? We put the drill in our shop and used it for a variety of projects during the course of a couple of months. Overall the drill performed nicely, but while we worked back and forth through the extra gear we can tell you it was more of a convenience than a life-altering experience. There was at least one time when the benefit was apparent. While sinking brittle decking screws in some tricky wood, the drill's balance of torque versus speed kept the screw heads from snapping off.

We did like the feel of the overmolded grip and even the overmolded strips on the

rear of the motor. They made the drill comfortable to use, even when bearing down on the back of the tool.

While the all-metal chuck is nice, the size and weight of the chuck made the drill somewhat nose-heavy. We also noticed some hesitation in the switch when moving between the three gears, making the process not as smooth as it could have been.

Priced in the middle of the category, the DW980 drill proved to be a nice addition to the workbench with a unique ability. While the benefit of that ability may not always be obvious every day, it hasn't significantly increased the price, so why not? **PW**

For more information, circle #142 on Free Information Card.

SPECIFICATIONS

DeWalt DW980K-2

Street price: \$170

Power: 12 volt

RPM: 0 - 1,800 rpm

Max torque: 350 inch/lbs.

Chuck: $\frac{1}{2}$ ", steel

Weight: 4.9 pounds

Performance: ●●●●○

Value: ●●●○○

DeWalt: 800-433-9258

or www.dewalt.com

TOOL SCOOP

Osborne EB3 Miter-Gauge Upgrades



The newest version of the Osborne Miter Guide (the EB3) is now available. What's different? Read on.

Osborne has redesigned the fence, making it adjustable from left to right, to move the fence closer to the blade during angle cuts (the EB2's fence position was fixed). This reduces vibration and tear-out concerns. The fence now also includes an adjustable extension, allowing crosscutting materials up to 42" long – a big improvement. The flip stop (unchanged from the EB2) mounts on the extension to retain its usefulness on the full length of the fence.

The fence can still be flipped to the other side of the miter bar to allow operation on either side of the blade, but that process has been complicated a little by some of the upgrades.

Also changed is the method of repeating miter settings with the guide. The EB2 had a spring-loaded bearing on the outrigger bar that dropped into detents in the aluminum outrigger bar. The EB3 has done away with the spring and now you push the bearing into the detents to set the angle. While this makes adjustment a little more cumbersome, it does allow for easier setup for "slightly off" settings without having to fight the gauge. In addition, while Osborne officials are confident that the tool is accurate when shipped, end-users wanted a way to tweak the angle setting. The EB3 now offers an eccentric mounting point at the rear of the outrigger arm, allowing fine adjustments to true the angle setting.

The miter bar also has changed, offering three expansion slots versus two, providing a better fit along the length of the guide.

The EB3 will command an extra \$20 in price, selling for about \$180. We like the upgrades. This is an improved, more useful and accurate model.

The Osborne EB3 Miter Guide is available direct from Excalibur at 800-357-4118 or www.osbornemfg.com.

Table Saw Powered by a Circular Saw

A ripping tool for the job site.

I know, I know – what idiot would use a homemade jig to saw when he's got a perfectly good Shopsmith sitting around? Well, the sort of idiot who writes articles about jigs and fixtures, I guess. But there's a good explanation; really, there is. First of all, that Shopsmith just got here. When Al Parrish took these photos in the new Wright Brothers Aeroplane Co. workshop, Shopsmith had just delivered the tools. For a couple months previous while we were building the workshop, this circular saw table was the closest thing I had to a table saw – and it did just fine.

Like any craftsman with a well-equipped shop, I sometimes find myself at a disadvantage when I work at a job site and have to leave my stationary machines behind. And the tool I miss the most is a table saw, especially when I have a ripping operation to perform. So I made this jig to serve as my table saw away from my table saw.

Note that the saw table lays across one sawhorse, so the front and back of the table are parallel to the sawhorse. This keeps the table from sagging in the middle. The other sawhorse, which isn't shown in the photo, is perpendicular to the first and parallel to the sides of the table.

Making the Saw Table

It's an absurdly simple jig, as you can see. The saw table is a large piece of $\frac{1}{4}$ " plywood, braced flat with a hardwood frame. The circular saw mounts to the table near one corner and is held in place by the frame and sev-

The frame, cleats and the cutout all have to be adjusted to fit your particular circular saw.

Notice that the side member of the frame is notched to accommodate the motor for this particular circular saw.



Photos by Al Parrish.

eral cleats. The fence is a large T-square that clamps to the table. The table and T-square are large enough that I can rip to the center of a 48"-wide sheet of plywood.

When you make the table, you have to adjust the frame and the table cutout to fit your circular saw. As shown on the plan view, part of the frame forms a box around the table cutout. The interior dimensions of this box should be the same size as the outside dimensions of your circular-saw base. The base should fit inside this box with little or no room to spare. Important note: Make sure that the frame members run true and are square to the edges of the saw table. When you install the saw, rest the edge of the base against the frame members. If the assembly is square, then the blade will be square to the front and back of the table. This, in turn, will make it easier to align the fence.

Secure the saw base in the jig with three or four L-shaped cleats screwed to the frame members. Because the front edge of a circu-

lar saw base is often turned up to prevent it from catching as you push it over the wood, you might have to shape one edge of the cleat to fit the base. You might also have to cut a notch in a portion of the frame to accommodate the saw motor when the blade is extended for its maximum depth of cut.

Make the cutout using a saber saw after you assemble the saw table and frame. The cutout must accommodate both the blade and the guard. You'll find that this saw table is just as handy upside down as it is right-side up, and you don't want to accidentally set the saw table on the ground while the blade is still spinning. Not only will this dull the blade; it makes your toes very nervous.

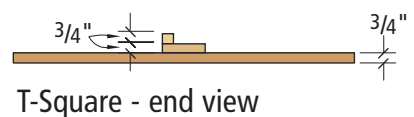
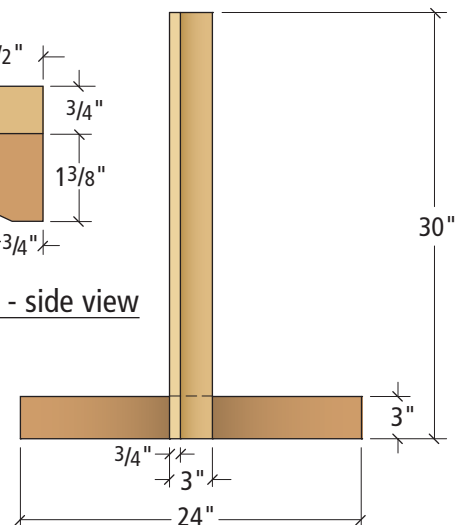
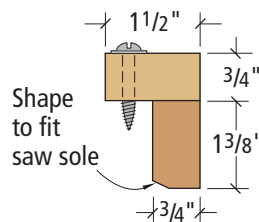
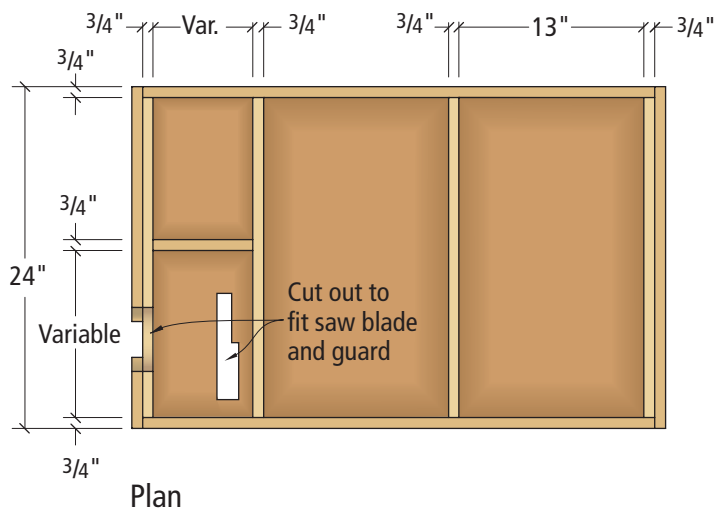
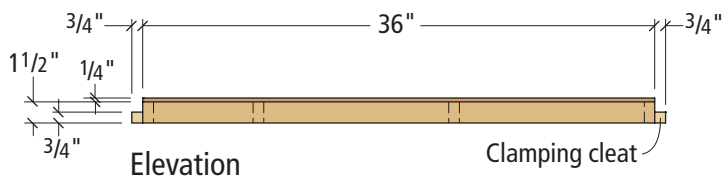
Finally, make the T-square fence. Take care to align the bar square to the head.

Using the Saw Table: Upside Down or Right-side Up?

Each time you use the circular saw table, think through the operation before you begin cutting. Decide whether it would be easier and safer to use this jig as a table saw (feeding the wood into the blade) or as an extended base (pushing the saw and the jig



I use this jig as a saw base as much as I use it as table saw, especially when cutting up large sheet materials.



across the wood; see the photo at right). The smaller the workpiece, the more likely you are to use the jig as a table saw.

To do this, rest the jig on sawhorses. Put the horses together in a T-shape, butting the end of one horse against the side of another. Position the saw table so the long dimension lays across one sawhorse and the edge furthest from the saw rests on the other sawhorse. Clamp the long cleats at the sides of the table to the sawhorses.

Important safety consideration: When using the jig as a saw table, the saw switch will be under the table where you can't get to it quickly. To turn the saw on and off safely, either invest in a shielded foot switch or make a switch box and mount it to the side of the saw table where you can reach it easily in case of an emergency. **PW**

Nick Engler is the author of more than 50 books on woodworking, plus countless articles. Currently, he's helping kids across America build ribs for a full-size replica of the first true airplane, the 1903 Wright Flyer.

CENTENNIAL FLYER UPDATE

As I mentioned in my column, the Wright Brothers Aeroplane Co. now has a workshop where we are assembling the Centennial Flyer – a replica of the Wright Brothers historic 1903 airplane built using ribs made by schoolchildren. While I write this, we have about 45 wing ribs made by young people from the United States (and several other countries) and there are more completed ribs coming in every day.

Wilkie's News, Dayton, Ohio's oldest bookstore, kindly gave us the front third of its store to build the 1903 Wright Flyer replica out where folks can watch. And in another wonderful act of kindness, Shopsmith, another Dayton business, donated thousands of dollars in power tools! Orville and Wilbur Wright would

have been so envious of this workshop and its full complement of woodworking equipment.

If you would like to visit us, Wilkie's is on Fourth and Ludlow streets in downtown Dayton, just a block west of Main Street. We work on the flyer Mondays through Saturdays during normal business hours, except when we've "gone flying." On Saturdays, we run rib-building workshops for kids in the morning and afternoon. Check our home page at www.wright-brothers.org for a schedule.



This is our new workshop at Fourth and Ludlow streets in downtown Dayton. All those curved pieces of wood sticking up are 1903 Wright Flyer wing ribs, made and signed by kids.

The Teaching Shop

Scott Phillips visits the shop of Parkman, Ohio, educator and toolmaker Ernie Conover.

It is my opinion that the recent impressive growth in woodworking in this country can be traced to the American Revolution. My theory is that it's the independent American spirit that inspires woodworkers to dream of new things and to create new projects. One of our country's biggest dreamers is Ernie Conover of Conover Workshops (www.conoverworkshops.com). Conover is a woodworker, turner, tool manufacturer and educator who has made all those things work together in one place: a workshop that most folks would fantasize about.

Located in the bucolic village of Parkman, Ohio, Conover Workshops is in the center of Amish country, surrounded by a peaceful quality that is rural America at its best.



Photos by Ernie Conover.

Two-thirds of the second-floor space is dedicated to many handmade and Ulmia workbenches. Conover limits most classes to eight students for personal attention. The hardwood floors are much easier on the back and feet and make it a comfortable area to work in. The ladder in the background accesses the third-floor attic that stores an eclectic collection of jigs, fixtures and tools.

Conover and his wife, Susan, own a farmhouse and a 3,500-square-foot gable-roofed vintage barn. Throughout the years they have industriously added rooms to the farmhouse and many tools to the barn.

First and foremost, Conover Workshops is a school. In his classes, Conover teaches students first how projects are designed. Next he focuses on hand and power tool techniques used in making projects.

This is a European style of teaching woodworking, and it puts a great deal of emphasis on mastering all the hand and power tool skills required to become skilled. Each project

in the class is designed so students' fundamental skills progress as they tackle each successive project in the course.

Conover's barn workshop is divided into four large work zones. On the ground floor is a small store that sells refurbished old hand planes, chisels, layout tools, books and more.

Next to the store is the lathe area, which is a turner's paradise. Conover is one of the country's leading turners, and has been instrumental in helping to grow the American Association of Woodturners. So it should come as no surprise that 10 lathes (Nova and Conover), with a variety of Sorby and Crown chisels and sharpening aids, are located here.

On the second floor there's one huge room with large banks of windows that is home to more traditional handmade and Ulmia workbenches than I have seen in one well-organized space. The barn's massive hand-cut and hand-fit beams help to inspire an interest in learning things the right way. The workbenches are arranged so that eight to 10 students have their own work area. Various guest instructors, all leaders in their respective fields, share their talents at Conover Workshops, offering courses in a soup-to-nuts, hands-on series of classes leaning towards hand-tool techniques, with a healthy reverence for the safe use of power tools.

The fourth work zone is a smaller room on the barn's upper level that has mostly



Born and raised in Ohio, Conover holds a degree in business administration. During the early 1970s he plied his skills as an intelligence officer in Germany, then during the next 15 years he co-founded and developed Conover Woodcraft Specialties. The company manufactured a unique line of reproduction hand tools and produced the Conover 16" lathe. In the course of this endeavor he identified the need for quality educational woodworking classes, and that eventually lead to Conover Workshops.



The Unisaw in the prep area has a crosscut sled and, when needed, a traditional Unifence. The saw is on a mobile base so students can move it to work with longer or wider work pieces. A drum sander offers an affordable way to surface even highly figured woods such as curly maple. Notice that the central dust-collection piping is carefully tucked in out-of-the-way places for efficient use.



The ground floor work area features one of the classic Conover lathes. I also noted some Nova lathes. Eight-inch bench grinders help students master the art of quick and easy sharpening. The anti-fatigue mats make working on concrete much more comfortable. Ample windows and many banks of lights provide great illumination that leads to less eye strain and better work.

Delta tools, including a Unisaw, band saw and drill press. There's also the standard complement of small power tools. Conover has perfected crosscutting jigs that produce flawless work on the table saw. He has experimented with a number of high-quality table saw blades and has settled on CMT blades.

Tool chests (handmade of course) housing razor-sharp chisels, are located in strategic locations throughout the shop area. Conover has studied many different woodworking traditions and embraces them all for their various strengths. But for sharpening bench chisels he prefers using traditional Japanese waterstones.

Just one of Conover's gifts is the ability to sharpen any tool to perfection. He uses every imaginable sharpening tool, yet he prefers using an 8" grinder with the Wolverine-brand grinding jig system to sharpen lathe chisels. He hones all his spindle turning tools, but he prefers to leave a burr (a fine wire curl)

on the edge of all faceplate lathe chisels, including some scrapers that can be used for both styles of turning.

The woodshop barn is as comfortable as an old hat. The smell of years of woodworking wafts into every niche. Throughout the years, the barn has accumulated jigs and fixtures for cutting every imaginable dovetail. In the third-story storage loft are woodworking contraptions that only a fellow tinkerer could understand. Mortising jigs, finger-joint fixtures, cast-iron workbench legs...stuff every woodworker would love to have.

Perhaps his secret to making this barn so productive is the fact that a second storage barn (much smaller) is linked by a crane to his main barn. When he needs something special he just hoists it into the main barn. It looks like he has enough stationary equipment in the spare barn to sink a ship.

Most shops like Conover's tend to have wood and lumber jammed into every corner. Not here. Conover stocks carefully. I saw only about 1,000 board feet of wood, neatly stored. That's it. When asked, he said that he provides wood for featured projects, but also wants students to feel free to bring their own lumber. Figured hard maple, cherry and walnut are his most frequently used woods.

One interesting addition in 2002 will be the timber-frame post-and-beam "L"-shaped wing that the Conovers are adding to the main barn. This space is going to be built with traditional mortise-and-tenon hand-cut joints. Conover will use this addition to

house a fine collection of metalworking tools, which he inherited from his father, who is one of the most inventive men that I have had the good fortune to meet. It's fair to say Conover is a chip off the old block.

During his three decades of woodworking, Conover has made just about every style of furniture. He has a keen eye for design but prefers to focus on the joy of the woodworking process and sharing that process with his students. I get the impression that there is nothing in the world Conover would rather do than to be working with people who have a passion for woodworking. Maybe that is why he is constantly grinning like a child in a candy store. Maybe that's what makes him a good teacher. **PW**

ONE-ON-ONE CLASSES

Conover also offers private instruction for individuals who want one-on-one attention. And recently added to the school's program is a scholarship fund for individuals who cannot afford to attend the program. To apply for the scholarship, send a letter detailing your need for a scholarship and desire to perpetuate the craft of woodworking to: Conover Workshop Scholarship Fund, 23240 Sageland Drive, Ramona, CA 92065. No phone calls or e-mails please.



AMERICAN WOODSHOPS

Woodworkers love to see the shops of other woodworkers. And few people see as many notable shops as Scott Phillips, host of PBS' "The American

Woodshop." In every issue of *Popular Woodworking*, Phillips takes you inside the shops of some of the finest craftsmen (and women) in America. You will be able to see more about Conover Workshops in the 2003 season of "The American Woodshop" on your local PBS station. Or you can visit Woodcraft Supply (www.woodcraft.com) to purchase a videotape of any of "The American Woodshop" programs.

Power-tool Workbench

You can't buy a bench that does everything this one does: It's a traditional workbench, outfeed table and assembly bench. And even if you could buy one, it would be a lot more expensive than the \$372 we spent on the wood, hardware and vise.

In a world dominated by power tools, it's a wonder that commercial workbenches are still designed mostly for handwork. These European-style monsters are set up more for planing, mortising and dovetailing, rather than routing, biscuiting and nailing.

What's worse, most traditional benches are too big (most are 6' long) for the handwork necessary in a modern garage shop; and they are too small (usually 24" deep) to assemble sizable projects on. Plus, there's the cost. You can buy a decent workbench for \$800, but nice ones will cost more than a cabinet saw.

One of our contributing editors, Glen Huey, found a solution to this problem when he set up his professional cabinet shop years ago. Glen does some handwork, but for the most part, his motto is: "If you can't do it on a table saw, it isn't worth doing."

So Glen set up his bench as part of his table saw. It attached to the outfeed side of his Unisaw and served as:

- a smaller, traditional workbench for handwork
- a spacious and solid outfeed table
- an enormous assembly bench (when you take into account the table saw and its table board)
- and a cavernous place for tool storage in the drawers and on the large shelf underneath the top.

I've watched Glen build dozens of projects with this rig – everything from corner cabinets to a drop-lid secretary – and it has never let him down.

by Christopher Schwarz

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

Photo by Al Parrish.





Drill the $\frac{3}{4}$ "-diameter dog holes into the front edge of your bench before you put the top together. This will save you from making a jig later or having dog holes that wander if you cut them freehand.



I built the top in four-board sections and then glued those sections together. Don't skimp on the glue or clamps – the quickest way to a big old gap in your bench's top.

I took Glen's great idea and tuned it up a bit with an enormous tail vise, bench dogs and an extra shelf. Plus, I built this bench using Southern yellow pine for the top, legs and stretchers, and I used birch plywood for the toolbox. (If you live in the West, you'll have to substitute fir for pine for this project.) The total cost of the wood, hardware and vise was \$372 and change – less than half the price of an entry-level commercial workbench. If that's still too rich, you can make this bench for less. See the story "Build a Bench – Keep the Change" at right for details.

As shown, this bench is designed for a Delta Unisaw equipped with the short 30" fence rails. By lengthening the bench's legs up to 3", you can accommodate any table saw on the market today with the same shopping list and basic bench design.

When completed and attached to your saw, this bench will give you a huge area for project assembly – more than 19 square feet. I call it the "assembly acre."

If you have a contractor-style saw, this bench can be adapted easily to accommodate the motor hanging out the back. If you build the bench without the toolbox,

the legs will clear the motor with no changes to the design for most contractor-style saws. I checked half a dozen right-tilt contractor saws to make sure this is true. If your saw is the exception, all you have to do is shift the top left before attaching it to the base. If you want some storage beneath, I suggest making one bank of drawers for the left side only and leave

the right side open for the motor.

No matter which bench you build, it will change the way you work. You can assemble large cabinets on the saw and bench instead of on the floor or driveway. You will have a dedicated out-feed table for your saw instead of a tipsy roller stand. And you will have a bench for handwork that has all the bells and whistles. With

a set of bench dogs, the excellent Veritas tail vise will handle every common clamping and holding chore. So let's get started.

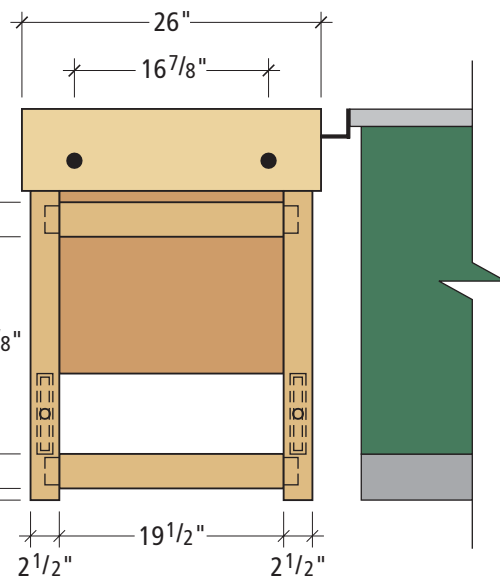
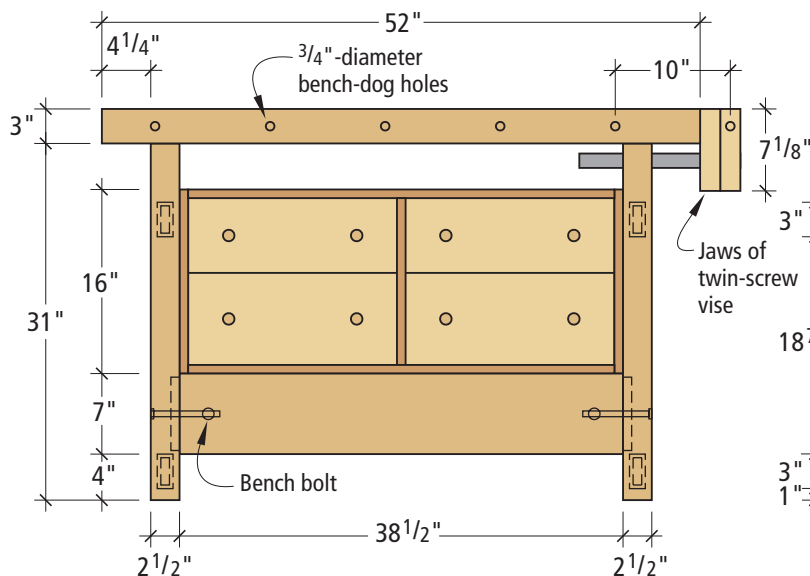
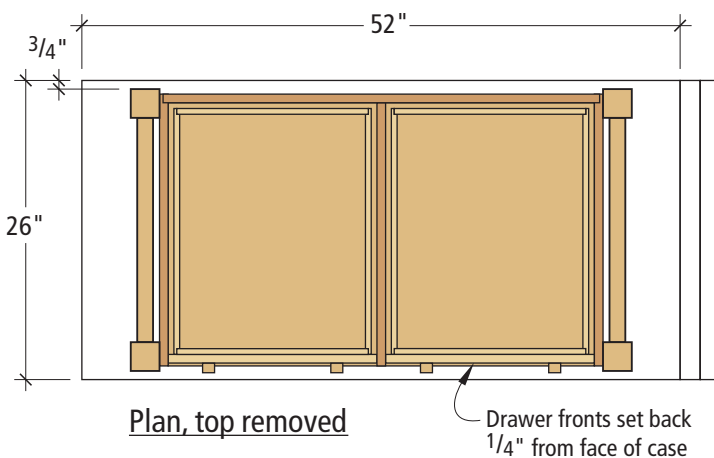
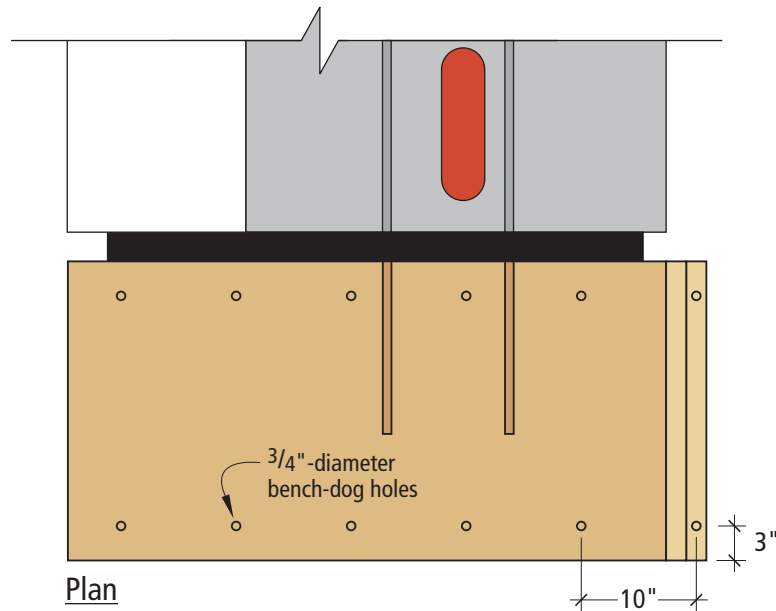
Start at the Top

If you don't have a workbench, build the top first, throw that on sawhorses and construct the rest of the bench there. The first task at hand is to cut down your six

POWER-TOOL WORKBENCH

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL	NOTES
		T	W	L		
❑ 1	Top*	3	26	52	SYP	
❑ 4	Legs	2½	2½	31	SYP	
❑ 4	End rails	1¾	3	22	SYP	1¼" TBE
❑ 2	Frt/bk rails	1¾	7	40	SYP	¾" TBE
❑ 2	Vise jaws	1¾	7½	26	Maple	
❑ 2	Toolbox sides	¾	23⅞	16	Ply	¾" x ½" rabbet for back
❑ 2	Toolbox top/bott	¾	23⅞	37	Ply	¾" x ½" rabbet for back
❑ 1	Toolbox divider	¾	14½	22⅞	Ply	
❑ 1	Toolbox back	¾	15½	38	Ply	
❑ 2	Top drw false frts	¾	6½	18½	Ply	
❑ 4	Top drw sides	½	5½	21½	Ply	½" x ¼" rabbet on ends
❑ 2	Top drw front	½	5½	16⅝	Ply	
❑ 2	Top drw back	½	4¾	16⅝	Ply	
❑ 2	Top drw bott	½	16⅝	21¼	Ply	in ½" x ¼" groove
❑ 2	Low drw false frts	¾	8	18½	Ply	
❑ 4	Low drw sides	½	7	21½	Ply	½" x ¼" rabbet on ends
❑ 2	Low drw front	½	7	16⅝	Ply	
❑ 2	Low drw back	½	6¼	16⅝	Ply	
❑ 2	Low drw bott	½	16⅝	21¼	Ply	in ½" x ¼" groove

* The top is made from 20 individual boards. With most of the 2x material I managed to get 1⅞" of usable thickness, however other boards were a bit corkscrewed and ended up thinner. You should be able to get a 26"-wide top with the material list for this project. TBE=Tenon, both ends. SYP=Southern yellow pine.



BUILD A BENCH – KEEP THE CHANGE

Buying a decent workbench will set you back \$800 to \$1,400. You can build a bench that is just as heavy, useful and bulletproof for a fraction of that price. Here's how much we paid to build this bench and three ways to build it for even less.

Deluxe Bench

- Six 2 x 8 x 12' Southern yellow pine (or fir) boards @ \$10.58 each: \$63.48
- One sheet of 3/4" birch plywood: \$42
- One sheet of 1/2" birch plywood: \$35
- One Veritas Twin-screw vise: \$149
- One set of Veritas Special Bench Bolts: \$19.95
- Four Veritas Bench Pups: \$26.50
- Four pairs of 20"-long full-extension drawer slides: \$37

TOTAL PRICE: \$372.93

More Basic Benches

If that's still too rich for you, it's easy to make this bench for less.

- **Less-Expensive Vise:** Make the deluxe bench with a simpler vise (see Supplies box) and make your own bench dogs. Total price: \$263.93.
- **Nice Vise But No Tool Box:** Make the deluxe bench without the tool box and make your own bench dogs. Total price: \$232.43.
- **Total-Economy Model:** Make the bench with the less-expensive vise, no toolbox and use hex bolts (see Supplies box) instead of the Veritas bench bolts. Total price: \$135.26.

The easiest way to make clean mortises using your drill press is to first drill a series of overlapping holes (right). Then go back and clean up the waste between these holes several times until the bit can slide left to right in the mortise without stopping (far right). Then you only have to square up the ends with a chisel.



12'-long 2 x 8s into manageable lengths. Here's how I did it.

With five of the 2 x 8s, cross-cut them at 54" and 108". Then rip all the pieces down the middle. This will give you the 20 boards you need to make the top. You then can glue up eight of the shorter fall-off pieces face-to-face to make the bench's four legs, and use the remaining two fall-off pieces for the end rails. With the sixth 2 x 8, you can get the front and back rails, a couple more end rails and have some scrap left over for cutting test joints.

If you have a planer and jointer, dress all the wood so it's true and then cut it to final size on your table saw. If you don't have these machines, use your saw to

rip off the rounded edges. Now borrow some extra clamps from your neighbor and make sure you have a lot of glue on hand. It's time to assemble the top.

Here's some hard-won advice for you on these tops: Assemble the top a few boards at a time. Yes, it takes longer, but the result will be a top that has no gaps between the boards and is more likely to be flat in the end. Assemble your top using four boards at a time, using plenty of glue and clamps (I needed almost three 8-ounce bottles for the job). Here's one more important tip: If you are going to flatten the top using a hand plane (as opposed to a belt sander), arrange all the boards for the top with the grain running in

the same direction. This will reduce any tearout when planing.

After the glue has dried on each section, it's a good idea to dress each assembled section of your top with your jointer and planer. This will make assembling the top easier and the end result a lot flatter. If you don't have these machines, be careful during your glue-ups and flatten the entire top at the end. Before you glue all the sections together, pick out the section that will be the front and drill the $\frac{3}{4}$ "-diameter dog holes now for the front edge. It's much easier now than when the top is assembled.

After drilling those dog holes, glue the five sections together, clamp and wait for things to dry.

A Mortise-and-tenon Base

The base of this bench is built entirely using mortise-and-tenon joints. The two ends are glued and assembled using an old-school process called "drawboring," which I'll show you how to do. The ends are attached to the front and back rails using an unglued mortise-and-tenon joint and bench bolts, which essentially are heavy-duty knockdown hardware that is similar to bed bolts. These bolts are better than any glued joint and can be tightened throughout the life span of the bench.

The first step is to make a practice mortise in a piece of scrap that you can use to size all your tenons. I made my mortises on a drill press using a $\frac{3}{4}$ "-diameter Forstner bit and a fence. You can make amazingly clean mortises this way. See the photos above for details. After you've made your test mortise, head to the table saw to make the tenons.

I make my tenons using a dado stack in my table saw. The fence determines the length of the tenon; the height of the dado blades determines the measurement of the tenons' shoulders. Set the height of the dado stack to $\frac{5}{16}$ ", cut a tenon on some scrap as shown in the photos at left and see if it fits your test mortise. If the fit is firm and smooth, cut all the tenons on the front, back and end rails.

Now use your tenons to lay out the locations of your mortises on your legs. Use the diagrams as a guide. Cut your mortises using your drill press. Now get ready to assemble the ends.

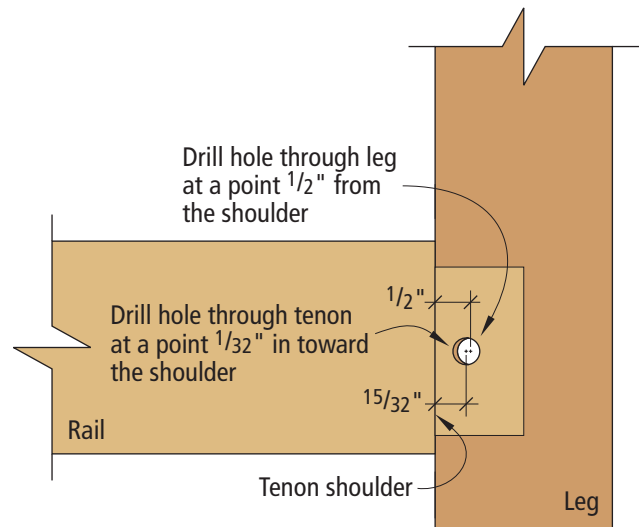
I cut my tenons using a dado stack as shown. I like this method because it requires only one saw setup to make all the cuts on a tenon. First define the tenon's face cheeks and shoulders (right). Then define the edge cheeks and shoulders (below left). Finally, check your work using the test mortise you cut earlier (below right).





Drawboring is an easy way to make a heavy-duty joint.

Begin by drilling a $\frac{3}{8}$ "-diameter hole through the mortise as shown above. Now clamp the tenon into the mortise and mark the center point of the hole using a drill bit and a mallet (right). Now drill a hole in the tenon that's $\frac{1}{32}$ " in toward the shoulder from the mark you just made.



Drawboring the tenons on the end rails

Drawboring Explained

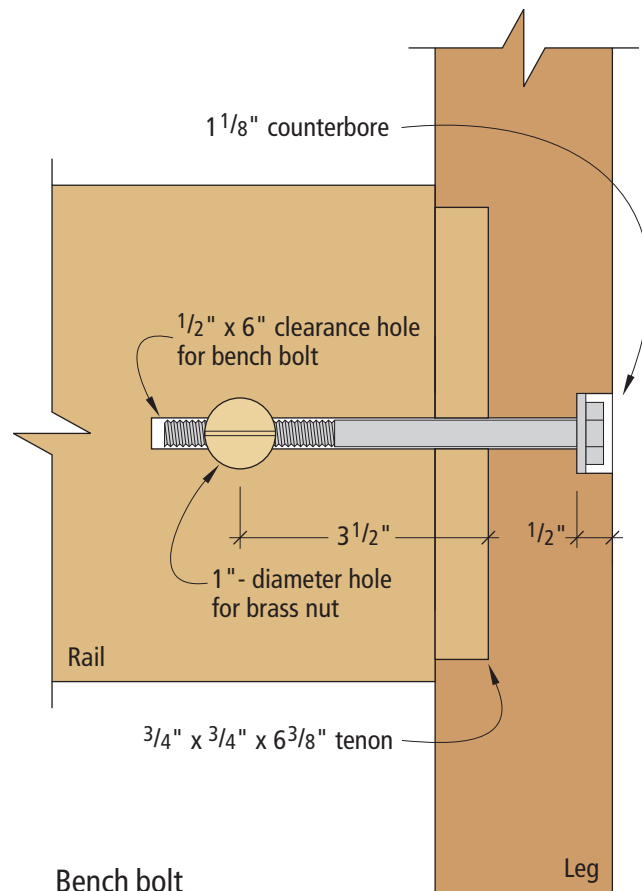
Before glues were as reliable as they are today, 18th-century craftsmen would "drawbore" a mortise-and-tenon joint to get a more mechanical fit. It's not at all difficult to do and reduces the chance of having a gap in your joint, too.

The key to a drawbored joint is a wooden peg or dowel that pulls the tenon into the mortise. Begin by drilling a $\frac{3}{8}$ "-diameter hole for the peg through the mortise only, as shown in the photo above. The hole should be located $\frac{1}{2}$ " from the edge of the leg

and go just a little deeper than the wall of the mortise.

Now assemble the joint without glue and clamp it up. Take a $\frac{3}{8}$ "-diameter brad-point bit and place it in the hole you just drilled. Use a mallet to lightly strike the bit to mark the center of the hole on the tenon's cheek. Remove the tenon and make a mark for a hole through the tenon that's in the same location as the mark you just made but $\frac{1}{32}$ " closer to the tenon's shoulder as shown in the illustration at right.

Drill a $\frac{3}{8}$ "-diameter hole



Bench bolt



Once you've drilled the counterbore and the through-hole for the bench bolt, mark its location on the end of the tenon using a brad-point bit.



Drill a hole for the bench bolt using a doweling jig and a 1/2"-diameter drill bit. It's a deep hole, so you might need an extra-long bit to do the job.



To accurately position the hole for the brass nut shown in the photo, build a simple jig like the one shown here using 1/2" dowel, a scrap of wood and a nail. The nail is located where you want the center of the brass nut to go (top). Insert the dowel into the hole in the rail and tap the nail (bottom). Now drill a 1"-diameter hole there and your joint will go together with ease.

through the tenon at that second mark. When you are ready to assemble the ends you will glue and clamp up the end rails between the legs, put some glue in the holes and then pound in some 3/8"-diameter dowels. The offset holes will pull the joint together instantly. Hold off on this final assembly step until after the bench bolts are installed.

Bench Bolts are Forever

The set of bench bolts for this project cost \$20, but they are worth it. They are easier to install than traditional bed bolts. And they are much easier to install than using off-the-rack hex bolts, nuts and washers.

Begin installing the bench bolts by drilling a 1 1/8"-diameter counterbore in the legs that's 1/2" deep. Then drill a 1/2"-diameter hole in the center of that counterbore that goes all the way through the leg and into the mortise. Now dry-assemble the ends and the front and back rails and clamp everything together. Use a 1/2" brad-point drill bit to mark the center of your hole on the end of each tenon.

Disassemble the bench and clamp the front rail to your top or in a vise. Use a doweling jig and a 1/2" drill bit to continue cutting the hole for the bench bolt. You'll need to drill about 3 1/2" into the rail. Repeat this process on the other tenons.

Now you need to drill a 1"-diameter hole that intersects the 1/2" hole you just drilled in the rail. This 1"-diameter hole holds a special round nut that pulls everything together. To accurately locate where this 1" hole should be, I made a simple jig shown in the photos at left that I picked up from the instruction book for the vise. It works like a charm. Sometimes drill bits can wander – even when guided

by a doweling jig – and this jig ensures your success.

Plane or sand all your legs and rails and assemble the bench's base. Attach the top to the base. You can glue dowels in the top of the legs and drill holes in the underside of the top, or you can use metal desktop fasteners with 2 1/2"-long screws. Either way, be sure to leave some way for the top to expand and contract.

The Modern Toolbox

After all that traditional joinery, I was ready to fire up the biscuit joiner. You can build this toolbox using one sheet of 3/4" plywood and one sheet of 1/2" plywood. I've posted optimization charts for these cuts on the *Popular Woodworking* web site at <http://www.popularwoodworking.com/features/mag.html>.

Cut your parts to size and start construction by cutting a 3/4" x 1/2" rabbet on the back edge of the sides, top and bottom to hold the back. The best way to do this is

on your table saw. Cut biscuit slots to join these four parts, then glue and clamp up the case. Once the glue is dry, cut the case divider to its finished size, position it inside the case and nail it in place. Screw the back into its rabbet and iron on birch edge tape to cover the plywood edges. Screw the toolbox to the front rail and legs of the bench's base.

Build the drawers using 1/2"-thick plywood. Most drawers have 1/4"-thick bottom panels, but because these drawers have to stand up to extra abuse, I chose to use 1/2" plywood instead.

With the drawer boxes built, it's time to hang them in the case. Installing drawer slides is easy if you know a couple tricks. Most professionals simply will scribe a line on the inside of the case and screw the slide there. You'd do it this way too if you installed slides every day. For the rest of us, it's easier to make spacers using scrap plywood that hold the slide in position as you screw it to the



I nailed the divider in place in the toolbox so I could check and double-check its position before fixing it in place.

case. Install the slides for the top drawer first. Put your spacer in place and put the slide on top. Screw it in place using the holes that allow you to adjust the slide forward and back.

Now install the slides on the drawer sides using the holes that allow you to adjust the slide up and down. Put the drawer in the case and check your work. Adjust the slides and, when satisfied, add a few more screws to lock that position in place. Hang the remainder of the drawers.

False Drawer Fronts

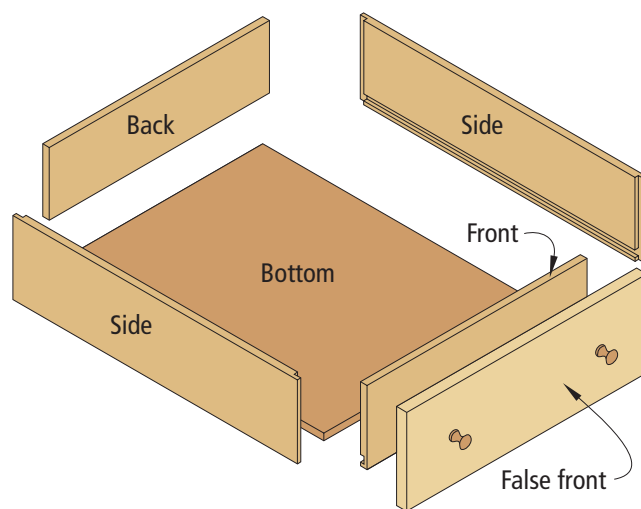
Installing false fronts also can be tricky with inset drawers such as these. The best two tools for the job are some shims that you can buy at any home center and the drawer-front adjusters that install on the back side of the false fronts.

Begin by ironing on edge tape to the plywood edges (if desired) and installing the screws for your drawers' knobs. Now get set to install the false fronts on the lower

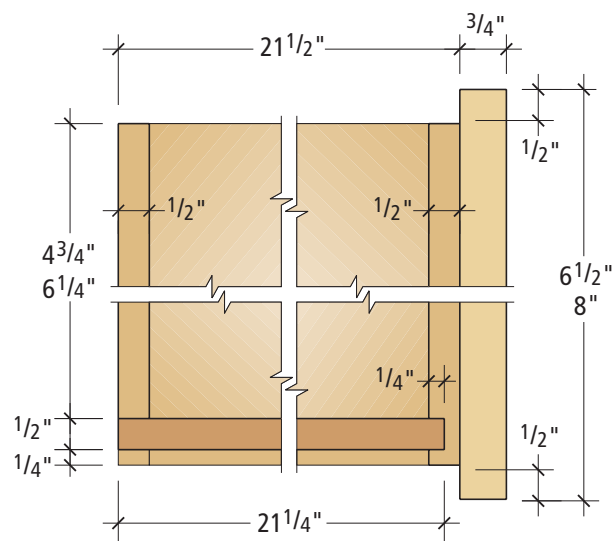
drawers. Remove the drawer boxes from the top of the case and clamp the false fronts to the lower drawer boxes. Using the shims, adjust the false fronts until you have a $\frac{1}{16}$ " gap on the sides and bottom. You might have to trim the false fronts a bit using a plane or sandpaper for a good fit. Once satisfied, nail the false fronts in place, then secure them with a few screws.

Now put the top drawer boxes back into the case. Drill a couple pilot holes into the front of the drawer box and put screws into the holes so the points poke out about $\frac{1}{16}$ ". Take a top drawer false front and carefully put it into position and add shims to get it close. Press the false front against the drawer box until the screw points bite into your false front. Remove the false fronts.

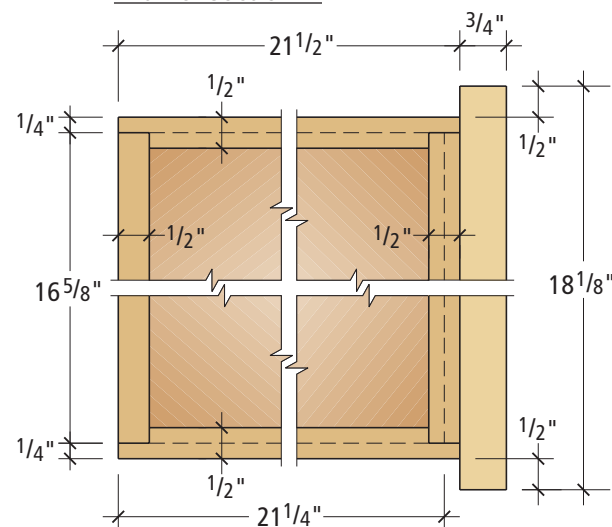
Drill 25mm holes in the back of the false front for the drawer-front adjusters and pound them in place as shown in the photo on the next page. Now replace the screws in your drawer box



Exploded box drawer



Drawer section



Drawer plan



Use spacers to position your drawer slides for installation. They take an extra few minutes to make, but they act like a third hand when securing the slides to the case.



Here you can see a drawer-front adjuster installed in the backside of a false front. The machine screw can wiggle a bit in the plastic housing, which allows you to move the drawer front slightly for a perfect fit. Here's a tip: You can plane the white plastic easily if the adjuster isn't flush with the false front.

with the screws for the drawer-front adjusters and attach the false front. You'll be able to shift the false fronts around a bit until you get a consistent gap all around. When you're happy, add a couple more screws to lock the false front in position.

Details: Dogs and the Vise

The spacing of the $\frac{3}{4}$ "-diameter dog holes on the top of the bench are determined by the type of vise you purchase. If you are using the Veritas Twin-screw vise,

drill your dog holes every 10" as shown in the diagrams and chamfer the openings of the holes. I purchased four Veritas Wonder Pups to use as dogs in this bench. You also could make your own dogs by gluing a $\frac{3}{4}$ " dowel into a small block of $\frac{3}{4}$ "-thick wood.

Installing the tail vise is a project unto itself and requires a long afternoon and some precision drilling. The instructions supplied with the vise are first-rate – as is the vise itself – so there's no need to go into detail here. If you mount this vise as shown, it's remarkably versatile. It excels at clamping boards so you can work on their ends, such as when dovetailing. With the dogs, you can clamp large panels to your bench for sanding. And with the dog holes drilled on the front edge of the bench and vise as shown, you can secure long boards (up to 61" long) to work on their edges.

If your work is both long and wide (for instance, a large cabinet door) you can pull out one of the drawers in the toolbox below for additional support while you work on its edge. The drawer slides are rated to hold up to 100 pounds, so you should be able to tackle all but the heaviest panels.

One of your last acts on this bench is to flatten the top. I removed the high spots with a No. 7 jointer plane, cutting diagonally across the top in both directions. Then I cleaned up my work with a random-orbit sander. Check your progress occasionally using a straightedge or winding sticks. A belt sander will take the place of a jointer plane if you prefer.

Once you load up the toolbox with tools, it's not going anywhere, so there's little need to attach it to the back of your saw. If you do find yourself pushing the bench around, you could add a shelf between the front and back rails of the bench base (below the

SUPPLIES

Deluxe Bench

Lee Valley Tools
800-871-8158
www.leevalley.com

- Veritas Standard Twin-screw Vise
Item # 05G12.21, \$149

- Veritas Special Bench Bolts (4)
Item # 05G07.01, \$19.95 a set

- Veritas Round Bench Pups (4)
Item # 05G04.04, \$13.25/pair

Woodworkers Hardware
1-800-383-0130
www.wwhardware.com

- Waterloo 20" full-extension slides (4 pairs needed)
Item # WW1690B20Z, call for current price, sold by the pair

Basic Bench

Lee Valley Tools
800-871-8158
www.leevalley.com

- Large front vise
Item # 70G08.02, \$66.50

Any hardware store

- Eight $\frac{3}{8}$ " x 16 x 6" hex bolts, 50 cents each
- Eight $\frac{3}{8}$ " x 16 hex nuts, 10 cents each

- 16 $\frac{5}{16}$ " washers, 3 cents each



Drill two pilot holes in the drawer boxes and install screws in them so the points stick out about $\frac{1}{16}$ ". Now position your drawer front where you want it using shims.



Once your drawer front is in position, press it against the screw tips. This will mark the wood for the location of your drawer-front adjusters.

toolbox) and load that up with more tools or sand bags. Or you can cobble up a way to attach the bench to your saw's table board and sheet-metal frame.

Once you get your bench where you like it, you'll want to rout out a couple channels in the bench's top to accommodate your miter gauge's bar. For my saw, these slots measured $\frac{3}{8}$ " deep, $1\frac{1}{8}$ " wide and 10" long. Measure the bar of your miter gauge with the longest bar and add a little extra for good measure.

For me, the only real problem with this new workbench is that it begs the question: What do I do with my old bench? Natural selection just weeded it out. **PW**

SHAPERS & R



Though these two tools look similar, each has advantages and disadvantages that a woodworker must consider when choosing which to buy.

Having trouble deciding between a router table and shaper? I'm sure you've heard many of the arguments: Isn't a table-mounted router really a small shaper? Doesn't the shaper have more power? How about cost? Let's take a look at these issues as well as some of the other pros and cons of each machine so that you can decide for yourself.

Anatomy

Shapers and table-mounted routers do appear similar, and they are in many ways. Both have a broad, flat top with a hole in the center for the cutter. Underneath the top is a motor for spinning bits or cutterheads at high speeds. Additionally, each ma-

by Lonnie Bird

Lonnie Bird (www.lonniebird.com) is author of "The Shaper Book" (The Taunton Press). He builds period furniture and conducts woodworking seminars in Dandridge, Tennessee.

Photos by Al Parrish.

OUTER TABLES

chine has a fence that locks to the table to safely and effectively guide the workpiece past the spinning cutter or bit. In fact, even many of the operating principles are the same. Both machines can produce mouldings, rabbets and a variety of other profiles on straight or curved stock.

But like other stationary power tools, shapers are production machines. The average shaper weighs in at 500 pounds, or approximately one quarter of a ton. This mass, coupled with a large spindle, bearings and motor, enable the shaper to breeze through heavy cuts, such as a raised panel, that bog down even the most powerful routers.

But besides the obvious differences in size and power, there are some other significant differences, too, that will affect the capabilities of each tool and how they will perform in your shop. For example, shaper cutters are bored to fit the spindle of the machine, but router bits have a shank that fits into the collet of a router.

What's the difference? Shaper cutters can be inverted or mounted upside down; the spindle rotation can be reversed and you can feed the stock from the opposite direction. This is an important feature that will allow you to shape profiles on wide, thick and odd-shaped stock. Shaping from either direction also allows you to cut with the grain, rather than against it, resulting in a smoother surface on the workpiece.



Another significant difference between the two machines is that the spindle of a shaper is much longer than the shank of even the tallest router bits. The extra length will enable you to use tall cutterheads for shaping wide, flat profiles such as ogee crown mouldings for furniture and architectural woodwork. In comparison, router bits are vertically challenged by the relatively short length of router-bit shanks. Even so, the largest routers don't have the heavy-duty bearings and horsepower to support and drive large bits through heavy cuts.

Comparing Horsepower

Horsepower obviously has a direct relationship on the size of cut a machine can produce. A typical $\frac{3}{4}$ " spindle shaper comes equipped with a 3-horsepower motor. Although it's true that large routers also have motors rated at 3 hp or perhaps even greater, they're still no match for the same size shaper. Why? The difference lies in the type of motor. Large stationary woodworking machines such as shapers use induction motors that are designed to produce their rated horsepower

continually under heavy loads. They will push large cutterheads through dense stock all day long.

However, most portable power tools such as routers use universal motors that will produce their rated horsepower only for short bursts before they overheat and shut down. Fortunately, today's routers are designed with thermal overload protectors that cut power to the motor before it burns out. If you've ever run large cove cutters or panel-raising bits in your router table, you've probably stalled the motor a few times from overworking it.

Although you can avoid overheating your router by taking multiple light passes until you've reached the full depth of the profile, an average shaper can shape most profiles such as a raised panel in one pass. In contrast, a router table will typically require three to five passes to shape a panel edge, depending on the density or hardness of the wood. When shaping long runs of mouldings or a number of raised panels for kitchen cabinet doors, the time saved with the shaper is significant. And in fact, you'll even notice a difference when shaping



Even the smallest shapers (those with a $1\frac{1}{2}$ horsepower motor) are powerful enough to raise a panel in one pass. Most routers would need to perform this operation in three or more passes.

smaller profiles as well; the shaper powers through any cut more efficiently and smoothly.

With its large spindle and plenty of raw power, the shaper is clearly the best choice for production runs and large, heavy cuts. But a table-mounted router has several distinct advantages over the shaper, too. Let's take a look at some of these advantages.

Versatility

Although a table-mounted router is no match for a shaper in size and horsepower, it makes up for it in versatility. For example, a table-mounted router can be used for plunge cuts when shaping flutes and grooves, whereas shapers can't. That's because shapers use a spindle nut to secure the cutterhead but routers use a collet to secure the bit. In fact, this feature allows manufacturers to produce a whole array of router bits that cut on the end, such as core-box and straight bits.

However, as I mentioned earlier, size is also another important difference between the two machines. Although the smaller scale of a router and router bits is sometimes its greatest weakness, many times it's also its greatest strength. The small size of

router bits and their guide bearings enable you to make a variety of cuts that are difficult or impossible to make with a shaper. Let's look at a few.

Shaping Small Stock

Because of its smaller size, the router table is by far the best tool for safely and effectively shaping small stock. And with the enormous variety of router bits available, diminutive details that are difficult to produce with a shaper are created easily with the router table. If you flip through the pages of any router-bit catalog you'll see dozens of scaled-down profiles that simply are not available for the spindle shaper.

Additionally, the small diameter of router bits allows you to use a much smaller fence opening, which greatly decreases the chance of a short workpiece dropping into the bit and being spoiled.

Remember: Whenever the workpiece is small, it's important to follow all the manufacturer's safety precautions and use the appropriate jigs to distance your hands from the spinning bit. The jig can be as simple as clamping the work to a backup board attached to the miter gauge.



One of the advantages of the shaper is that its motor can run in reverse. This allows you to adapt to wood where the grain runs in a different direction. It also helps with wide, thick or odd-shaped stock.



The tall spindle on a shaper allows it to be used with taller cutters, such as crown moulding cutters. Even with this monstrous stile-and-rail cutter installed, you can see how much spindle is still available.

Shaping Tight Contours

The small size of a router table and router bits can also be a tremendous advantage when shaping curved stock. Although both the router table and the shaper excel at shaping curved moulding, legs and other details, shaping tight contours is where the router table outperforms the shaper. Because of the small cutting diameter, router bits will shape curved edges of tight contours where the large diameter of a shaper cutterhead simply can't reach. In fact, the cutting diameter of many router bits is no greater than the shaper's spindle diameter alone.

Inside Corners

Many furniture details include sharp, distinctive inside corners at the intersection of profiles. And because both shapers and routers leave an inside corner rounded, the shaped detail must be carved by hand to be completed. But compare the small-diameter guide bearings to the large guide bearings on a shaper and you'll see that you'll do far less handwork if you shape the intersection with a router.

That's because the small diameter of the guide bearings on router bits allows the cutting edges to reach deeper into the corner and shape more of the profile.

Comparing the Cutting Geometry

Have you ever noticed that router bits sometimes have a tendency to burn or tear out the surface of the stock? As a general rule, shapers will cut smoother than a router table with less machining defects. And although there are several factors that contribute to surface quality when machining (such as the hardness of the wood, the type of grain and feed rate), the geometry of the cutterhead or bit plays a major role. Because of the large diameter of shaper cutterheads, manufacturers have more room to design the cutting geometry for the best performance. Specifically, the rake angle of the cutting edge dramatically affects the smoothness of the surface. The rake angle is created by

the face of the cutter as it intersects an imaginary line that starts at the center of the cutter and intersects the tip of the cutter. Although there isn't one perfect angle that works for all species of wood, a rake angle of approximately 30°, found on most shaper cutterheads, works extremely well.

However, because of their small diameter, there isn't room on the body of a router bit. As a result, when compared to shaper cutterheads, many router bits cut with more of a scraping action. Besides the surface quality, a key indicator of the cutting geometry is the chips that are produced. While shaper cutterheads produce light, fluffy shavings similar to a hand plane, router bits produce chips and dust. That's why, when all other factors are equal, I'll choose to use my shaper over the router table.

Cost Comparison

For most of us, price is an issue whenever we consider a new tool. In this category, the router table is the winner, hands down. Although in recent years shapers have become more affordable, the machine's cutters can be expensive. And remember, it's the cutters or bits that give these machines their versatility.

Although a combination blade

works well on the table saw for a variety of cuts, each cut you make on a router table or shaper requires a router bit or cutters for that specific purpose.

Making a Choice

Clearly, there is no winner in the shaper vs. router contest. Although the tools are very similar, the router table and shaper each have distinct characteristics that give them advantages over the other. That's why I have both in my own shop. But if you're just starting out, I suggest that you begin with a large router table equipped with a router of at least 3 hp.

By owning a router table, you'll have an extremely versatile tool. At the same time, you'll be learning to use a shaper because the techniques for using the two are nearly identical. Later on, if you want to make large mouldings or need production capacity, consider adding a shaper. **PW**

Editor's note: Coming in the December 2002 issue: The basics of how to safely use a shaper. And in the February 2003 issue, Lonnie Bird shows you how to build simple custom fences for your shaper that make many operations quick, accurate and safe. Also, look for a review of some of the popular smaller shapers in an upcoming issue.




One of the big advantages of router tables is that they can sneak into tight corners a shaper can't touch. The ogee profile on this piece will need to be finished up with a little carving, but this cut would be almost impossible on a shaper.



Another advantage of router tables is that you can cut directly above the bit, such as with this fluting shown here. Making this cut on a shaper requires a trickier setup.

ROUGH LUMBER **CUT-OFF STAND**



One of the most awkward operations with rough lumber is cutting it to length. Here's a fixture that makes it a snap.

Photo by Al Parrish.

Most garage woodworkers put their rough lumber across a couple sawhorses and crosscut it to length using a circular saw or jigsaw. After the cut, something usually falls to the floor – missing your foot if you're lucky. After some thought, we designed and built this cut-off stand to improve the life of the garage woodworker.

Adjustable in height to accommodate almost any cutting location, this stand works with two sawhorses (or your bench or table saw) to keep your lumber fully supported during a cut.

But that's not all this stand does (our philosophy is if it's going to take up space in a garage shop, it better have more than one use). So we added a removable roller stand to the top that turns the fixture into an adjustable outfeed stand for most of your woodworking machines.

The stand is remarkably simple to build. Make the lower support using $\frac{3}{4}$ "-thick hardwood of your choice that's glued and screwed together using butt joints. The slotted post supporting the top section is formed by cutting, then regluing the pieces – no complicated router work. The top is $\frac{1}{2}$ "-thick Baltic birch plywood pieces nailed together to form a torsion box for extra strength.

From the Bottom Up

To make the stand easily adjustable in height, I chose a post-in-sleeve design. Start with the post. The finished size of the post is given in the materials list, but start with a length of wood that is $\frac{1}{4}$ " wider, thicker and longer than the finished size. This leaves room for saw cuts to form the slotted post and fitting room for overall size.

Next, take a look at the square $\frac{1}{4}$ "-20 nut you have for the locking hardware. Measure the width across the nut and add a fraction



To form the post, the rough piece is ripped into three pieces, the center piece is cut to form two small blocks, and then the whole thing is glued back together (left). As you glue up the column, use the post to check the spacing. The post should slip easily into the sleeved column (below). You want the post to move easily, but don't make it too loose or you'll make the stand wobbly.



of an inch to that dimension. This will be the gap that you want to leave in the center of the post. The square nut will need to move freely up and down the gap, but not turn in the space.

Form the post by ripping the board into three lengths, with the two outer pieces being equal in width, and the center piece being the same width as the nut. Then crosscut the narrow piece into two $1\frac{3}{4}$ "-long pieces. Glue those between the long outer sections and your post is almost complete.

Once the glue has dried, remove it from the clamps and run it through your planer to fine tune the thickness. Trim the post to length and move on to the sleeve.

The sleeve is formed by cutting the pieces to size, then simply gluing the four pieces together

to form a rectangular column. Be careful to align the pieces to avoid cleanup and provide a square (and glue-free) center sleeve.

Lock-n-slide

The locking mechanism for the post is a length of threaded rod with nuts, a couple of fender washers and a handle slipped through the column. To make the clearance holes in the column, measure down $1\frac{1}{2}$ " from the top on the front side and make a mark in the center of the column. Take the column to your drill press and, using a $\frac{5}{16}$ "-diameter drill bit, drill completely through both sides of the column.

Now switch to a $1\frac{1}{2}$ "-diameter Forstner bit and, using the $\frac{5}{16}$ " hole on the back side as your center, drill a larger hole in the back.

The rest is hardware. Spin the two hex nuts onto the end of the threaded rod and use wrenches or pliers to tighten the nuts against one another to lock them in place. Then slip one fender washer on the long end of the rod and against the pair of hex nuts.

Now thread the square nut on after the washer and tighten it against the washer and hex nuts. Insert the assembly (long end first) into the larger hole in the back of the column, threading it into the center slot in the post (which you've slipped into place).

When the threaded rod pokes out the $\frac{5}{16}$ " hole on the front side, add another washer and the star handle. You're done. Make sure the square nut is rotated to slip into the slot to make a tight fit.

Add the Feet

The last part of the base is the feet. These are just four boards screwed to the bottom of the col-

by David Thiel

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

umn. I trimmed a long taper on the top of each to make it a little more aesthetically pleasing.

When you drill the clearance holes for the screws, pay attention to where the screws are located, or you'll end up drilling into another screw. Offset them slightly and you'll be fine.

With the feet attached, I added four adjustable leveler feet to make sure the stand would sit solidly on my uneven garage floor.

Torsion-box Top

I wanted to make the top of the stand as lightweight and strong as possible, but still stable. To accomplish this I used $\frac{1}{2}$ "-thick Baltic birch plywood and built an open-front torsion box.

Before making the box, locate the center position on the bottom plywood piece and mark where the top of the post will meet the box. Then screw two $1\frac{1}{4}$ " x $1\frac{3}{4}$ " x 5" solid-wood blocks to the underside of the plywood, centered and on either side of the post's location. Use these two mounting blocks to attach the table to the post after you have completed the table.

To form the box, simply assemble it with a brad nailer, making sure to align all the edges to keep things square. The two tops are held flush to the outside ends, leaving a 3"-wide gap in the center to allow plenty of room for a circular saw or jigsaw blade. The space in "the valley" ends up at a $2\frac{1}{2}$ " depth, which should allow clearance for almost any jigsaw blade and lots of room for the blade of a circular saw.

With the table frame complete, nail $\frac{1}{2}$ " x 2" x $4\frac{1}{2}$ " backs into the spaces at the rear of the box, closing up the opening. The hardwood fence is next. Drill four clearance holes and screw the fence to the back of the box, screwing into the backs.



The feet are attached to the column with flat-head screws (top). Watch the screw alignment or you'll drill into another screw. Some simple hardware from your local home center store allows you to lock the post solidly, but quickly loosen the post and readjust for any height. The hardware is shown at right, resting on top of the column before being attached through the holes.



To avoid any concern of binding a saw blade during the first few uses, cut a notch in the fence 1" wide and as deep as the blade depth you're most likely to use.

You're now ready to attach the table to the base. Drill clearance holes in the center of the mounting blocks under the table, then screw the table to the post.

A Little Something Extra

The roller is really inexpensive, and is quick to put together and attach. Simply drill two $\frac{1}{4}$ " clearance holes in the $1\frac{1}{8}$ " x 2" x $9\frac{1}{2}$ " roller block, $1\frac{1}{2}$ " from each end,

and centered on the block. Use a $\frac{1}{2}$ "-diameter drill bit to countersink the top of the holes to fit the head of a machine bolt and a locking washer. Then flip the block over and use a $1\frac{1}{2}$ " Forstner bit to countersink the bottom of the hole to accept a hex nut.

Before attaching the hardware, place the block in the table valley and use a pencil to mark the hole locations on the table bottom. Then drill oversized $\frac{1}{4}$ " holes at those locations.

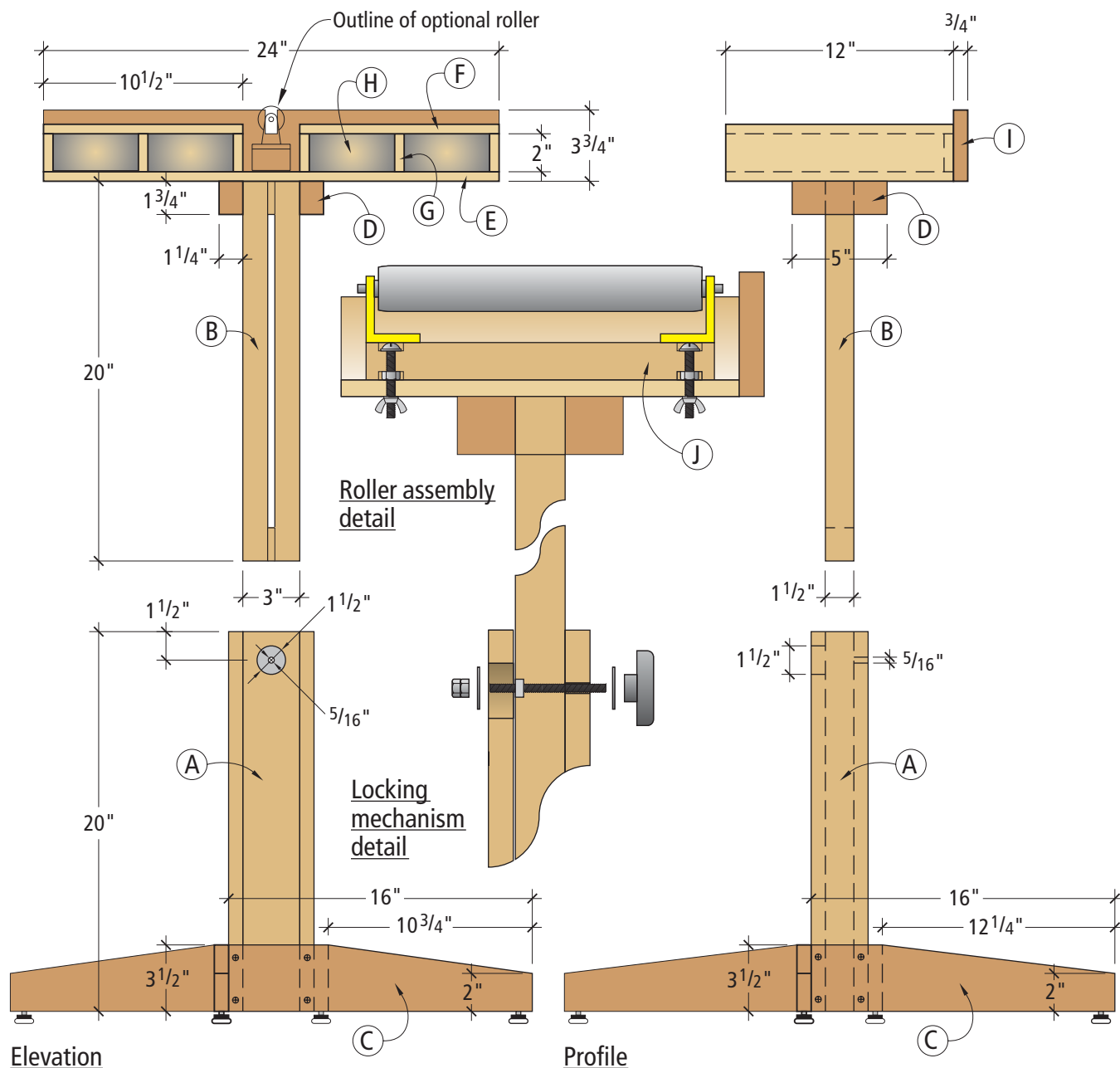
With the bolts inserted and tightened down, screw the roller mounting brackets in place on

the block. The ends of the bolts will slide easily into the holes in the table, and the roller can then be attached using two wing nuts. When the roller isn't needed, it fits snugly inside any one of the open-end spaces in the table.

No matter where you use this stand, you'll find rough-cutting lumber a more pleasant experience. I'm pretty sure there are a few other uses for this stand as well. Just give me some time. **PW**



This shot shows the partially assembled table, with three exposed dividers and the other side covered with the top. You can also see the screws through the bottom that hold the mounting blocks in place. While the box itself is nailed together, the fence is attached with screws to allow for replacement if it gets cut up too much in use.



CUT-OFF STAND

NO.	LET.	ITEM	DIMENSIONS (INCHES)			MATERIAL
			T	W	L	
4	A	Column sides	3/4	3	20	Hardwood
1	B	Post	1 1/2	3	20	Hardwood
4	C	Feet	3/4	3 1/2	16	Hardwood
2	D	Mounting blocks	1 1/4	1 3/4	5	Hardwood
1	E	Bottom	1/2	12	24	Plywood
2	F	Tops	1/2	12	10 1/2	Plywood
6	G	Dividers	1/2	2	12	Plywood
4	H	Backs	1/2	2	4 1/2	Plywood
1	I	Fence	3/4	3 3/4	24	Hardwood
1	J	Roller block	1 1/8	2	9 1/2	Hardwood

NO.	ITEM
1	Star knob, (item# 862214)*, \$1.49
1	Threaded rod, 1/4"-20 x 3 1/2"
4	1/4" - 20 hexagonal nuts
1	1/4" - 20 square nut
2	1/16" x 1 1/2" fender washers
2	1/4" - 20 x 1 3/4" machine bolts
2	1/4" - 20 wing nuts
2	1/4" lock washers
1	10" roller (item #921635)*, \$7.69
1	Bracket set (item #95-505)*, \$3.29

* Items available from Woodworker's Supply, 800-645-9292 or www.woodworker.com



We loved the foot-operated control-lever design on Delta's 50-273 mobile base. This simple approach allows you to make your machine mobile without ever bending down.

Picking the Best **MOBILE BASE**

These heavy-duty devices built to mobilize your machines differ greatly in design, construction and operation.

Many woodworkers' shops consist of machines crammed into a garage or basement. For these valiant, space-challenged folks, mobile bases aren't just an accessory, but a necessity. Built for table saws, band saws, jointers and planers, mobile bases allow you to safely and easily move your otherwise sta-

tionary machines around your shop, making room for new operations or the pickup truck.

Good mobile bases are often taken for granted, while bad mobile bases are frequently cursed. To determine the good from the

bad, we selected and assembled six mobile bases, choosing a cabinet saw as the machine of choice for testing. Then we took 'em for a spin around the shop to see how they performed.

All the mobile bases we test-

ed differ in design, construction and operation. While some mobile bases use lifting mechanisms to get things rolling, others are always rolling and use locking mechanisms to put on the brakes. Here's a quick look at how these different mechanisms work and a breakdown of each mobile base, along with our opinions.

by Kara Gebhart

Comments or questions? Contact Kara at 513-531-2690 ext. 1348 or kara.gebhart@fwpubs.com.

Going Mobile

The goal of a mobile base is to give a heavy machine enough mobility to easily move it around the shop. When positioned, you want it to rest on the floor without any movement. Lifting mechanisms, such as a single foot lever, two levers or a detachable handle that functions as a lever accomplish this.

Another common system involves locking mechanisms. These mechanisms actually stop the base from being mobile and include lock knobs (screws that are turned into the wheel tread), brake knobs (screws that are turned into pads on top of the wheels), retractable feet and locking casters.

All but one of the bases, when set for immobility, rest on two or more of its wheels. Some bases rest on wheels and adjustable feet while others use locking casters to keep the base from moving. Only the Vega allows the machine to rest on the floor without any chance of rolling.

The location and design of these lifting and locking mechanisms determine how easy the mobile base is to use and how stable it is when employed.

Testing

Although mobile bases are designed to mobilize, stability is key. When a mobile base is immobilized it should be able to withstand an accidental hip check and stay in its place when ripping some 8/4 maple.

To test the mobility and stability of the bases, we assembled each one according to its instructions. Then we plopped a 360-pound cabinet saw on each base. Next, we maneuvered the cabinet saw from the center of our shop up against a wall to a precise position – call it parallel parking for saws.

Next, we did whatever was necessary to make the base stationary. With it sitting level on the floor (adjusting to compensate for floor deviations) we gave the base a couple of good shoves to simulate standard use.

What We Found

We’re happy to report that all the mobile bases we tested will do a good job of mobilizing your machines. Some are easier to use, and we gave higher marks for this achievement. Bases also earned points for stability.

Our favorite design is Delta’s single foot lever. When the foot lever is in the up position, the base’s two rubber feet rest on the floor. To compensate for uneven floors, the feet can be adjusted by tightening and loosening two nuts. By pushing the lever down with the foot, the front of the base lifts, the rubber feet clear the floor and the base becomes mobile. This design requires no bending down and we (and those standing behind us) appreciate that.

The HTC2000 mobile base features actuator cams that are kicked up and over for lifting and

lowering, and rubber feet. But unlike the Delta, you have to actually lift up on your machine to get the cams kicked over, an aspect to the design we didn’t like.

We have several problems with bases that feature locking casters. On some you have to orient the swivel wheel before the locking lever on the caster can be pushed up or down with your foot. The locking levers also are much smaller than the single foot pedal, making them more difficult to use. And on one of the bases, the locking caster, when locked down, keeps the wheel from turning, but still allows the caster to pivot, which was a stability problem.

Bases with lock knobs and brake knobs require bending down, which, if frequent, can be tiresome for those not fond of stooping over. The lock knobs have screws that dig into the face of the non-swivel wheels, which could later cause damage to the wheels. The brake knobs have screws that press against brake pads located on top of the fixed wheels – helpful, but ultimately more work than we preferred.

The Shop Fox base features retractable feet controlled by screw knobs. When lowered, the feet serve as brakes and easily compensate for uneven floors. But to mobilize your machine, you must bend down and turn the knobs, which, with a heavy machine on top, can be rather tiresome.

BUILD YOUR OWN, SAVE MONEY

Both Delta and Harbor Freight offer mobile bases with a design we love for \$50 or less. The catch? You supply the hardwood stock and they can hold only 300 pounds.

The Delta 50-345 mobile base utilizes the foot-operated control-lever lifting mechanism, holds 300 pounds, costs about \$50 and is constructed with self-supplied hardwood stock. We noticed one problem: The directions say to add 1/2" to both dimensions of your stock, but we discovered that wasn’t enough room to clear our bolts.

The Harbor Freight 41915-OVGA mobile base also utilizes the foot-lever lifting mechanism, holds 300 pounds, costs about \$30, and is also constructed with self-supplied hardwood stock. We noticed two problems: The base wobbled in use because it had one fewer weld on its corner brackets than the Delta. Also, several of the bolts snapped under less-than-normal tension.

But overall, these bases serve as good, universally sized inexpensive alternatives to get your otherwise stationary machines moving.

Contact Delta at 800-438-2486 or www.deltawoodworking.com, and Harbor Freight at 800-444-3353 or www.harborfreight.com.

The Delta 50-345 mobile base, built using self-supplied hardwood stock, is an inexpensive alternative to the Delta 50-273.



MOBILE BASES						
	STREET PRICE	CAPACITY (LBS)	CAPACITY (SIZE)	LIFT/LOCK MECHANISM (1-5)	STABILITY WHEN LOCKED DOWN (1-5)	GENERAL CONSTRUCTION (1-5)
Delta 50-273	\$90	400	20 5/8" x 20 5/8"	5	4	5
HTC2000	53	400	12" x 12" to 34" x 34"	3.7	4.3	3
HTC HRS-10	95	475	20 1/2" x 20 1/2"	1.7	2.3	3.8
Powermatic 2042336	100	1,000	23 1/2" x 21 1/2"	2.3	2.7	4.7
Shop Fox D2057	70	600	19" x 20 1/2" to 29 1/2" x 29 1/2"	2.7	4	4.3
Vega MMK-1	100	800	13" x 17" to 28" x 29"	4	5	3.8

On the 1-5 scale: 1=unacceptable, 5=excellent. Winners are labeled in red.

The detachable lever handle featured on the Vega base increases its overall stability, as mentioned before. But it can also be a little awkward to use, and we can envision trying to figure out where we put the handle.

We did have one concern that held true for all the mobile bases

we tested. All the bases in our test featured fixed wheels, which don't allow for sideways movement. Though we recognize that swiveling wheels decrease stability, we wish all the wheels could swivel in order to make backing table saws (and other machines) into tight corners easier.

Conclusions

Our "Editor's Choice" award goes to the Delta 50-273 mobile base. We love its foot-operated control-lever design. Perfect for shops where machines are mobilized frequently, the Delta 50-273 is sturdy, easy to use, easy to assemble and glides across the floor. Our

"Best Value" award goes to the \$70 Shop Fox D2057 mobile base. This base, although more difficult to mobilize than the Delta 50-273, is well-built and easier to stabilize, thanks to its retractable feet knobs. The Shop Fox D2057 is best for machines that need stability more than mobility. **PW**

DELTA 50-273: STRONG, SIMPLE AND EASY TO USE

After testing all of the bases, the Delta 50-273 mobile base went back on our cabinet saw and we plan to keep it there. Assembly simply requires attaching the swivel caster to the base. The frame, which is very strong, is made out of welded heavy-gauge steel. But this isn't why we love this base.

The Delta utilizes the foot-operated control lever, our favorite lift-mechanism design. This simple, no-nonsense approach makes the machine mobile with very little effort, and it's the best method we tested. At about \$90, this base isn't cheap, but it's also not the

most expensive in our test. Because of its quick assembly, ease of use, solid construction and excellent performance, we feel it's the best in our test. If you like this base, but want to save a little money, check out the Delta 50-345, described on page 51.

For more information, contact Delta at 800-438-2486 or www.deltawoodworking.com.



HTC2000: ASSEMBLY REQUIRES PATIENCE

We knew the HTC2000 mobile base's assembly would take some effort when its many pieces and parts arrived expertly arranged in what looked to be a nice shoebox. Assembly took some time and left us with a bit of a headache. But your time spent will save you money. This base costs only about \$53.

The HTC2000 is versatile and can be assembled to fit many machines with different footprints. But, versatility and low cost come at a price. Its actuator cams are less convenient than Delta's foot-operated control lever. When kicking the actuator cams up and over to lift the base, you really need to lift up on the machine, something the directions don't mention. Plus, there are two

cams versus Delta's single foot lever.

Like the Delta, this base features rubber feet, which, if your floors are even, require nothing from the operator.

Although assembly is time consuming, the HTC2000 mobile base works and offers an alternative design for those who don't like or can't always be bending down.

For more information, you can contact HTC at 800-624-2027.



HTC HRS-10: LOTS OF BENDING NEEDED TO USE

The HTC HRS-10 features an all-steel frame and seamless welding. Packaged nicer than most, its instructions include labeled sketches and its assembly is fairly simple. Its movability is fine. But \$95 is a lot of money to spend, especially when better designs exist.

We didn't appreciate having to bend down and correctly orient the wheel in order to use the foot-operated locking lever, which, we might add, was too small for the average foot. The base's rear-wheel brake knobs also requires bending down, but we liked the addition of a brake shoe rather than simply allowing the brake screw to grind into the wheel.

We also had some problems with the base's stability. While the back wheels didn't move because of the brakes, the front wheel locked down but was still able to pivot when pressure was exerted on the saw. It's not a major concern, but it's less stable than other bases tested.

Ultimately, the base works. But there are better (and cheaper) options out there.

For more information, contact HTC at 800-624-2027.



BEFORE YOU BUY YOUR BASE

Although a simple device, mobile bases differ greatly in design and construction. Some models make mobility a breeze but are difficult to stabilize. Other models offer features that easily compensate for floor deviations but are difficult to mobilize. Therefore, you should consider how you plan to use your mobile base before you buy.

If you're going to be moving your machine a lot, look for a design that offers a simple approach to getting things rolling. Models that feature foot-operated control levers or actuator cams allow you to quickly and easily mobilize your machine. These designs require shims or repositioning rubber feet to compensate

for uneven floors but, in the long run, you'll appreciate the model's overall ease of use.

If you're lucky enough to have a designated spot for each of your machines and you only plan to move them occasionally, consider choosing a base with a solid lock-down mechanism – even if that base is more difficult to mobilize.

Models that feature retractable feet or detachable handles and levelers easily compensate for floor deviations, serving more as a stand than as a utility to mobilize.

Lastly, consider how easy it is for you to stoop down. If squatting is an act better left in your younger years, choose a base that requires more footwork than handwork.

POWERMATIC 2042336: WELL-BUILT BUT NOT VERSATILE

The Powermatic 2042336 mobile base is specific to the Powermatic 66 cabinet saw – a left-tilt saw with a footprint bigger than most cabinet saws. Our right-tilt cabinet saw caused some stability problems, therefore we recommend you use this base only with the 66.

With that said, the Powermatic base tied with the Vega base for being the most expensive in our test. Upon arrival, the base was completely pre-assembled, which, after the shoebox incident, was really nice. All the corner joints were welded, increasing stability. But we didn't like the base's locking mechanism.

The base's locking lever is bigger than HTC's locking

lever, which is nice. But we like Delta's design better. Bending down to lock the back two wheels is time consuming. And the locks eventually could damage the wheels.

The base works on the right saw but there are cheaper, more versatile bases out there that are faster to use.

For more information, contact Powermatic at 800-274-6848 or www.powermatic.com.



SHOP FOX D2057: HEAVY-DUTY, GOOD FOR UNEVEN FLOORS

The Shop Fox D2057 heavy-duty mobile base is strong. Although the base takes some time to mobilize, its welded joints and four wheels offer increased stability. Assembly took some time, but the directions, which include labeled pictures, were clear.

The Shop Fox's retractable feet knobs require bending down to turn. When locking down the base you must turn the knobs an additional half turn once they touch the floor, slightly lifting the base – an act that's hard on the hands but allows you to easily level the base to an irregular floor. This system isn't great for

those who plan to move their machines a lot. But for those who only need mobility once in awhile, this base offers great stability (no shims required) and, costing about \$70, it's cheaper than many other mobile bases out there. For this, it earns our "Best Value" title.

For more information, contact Shop Fox at 800-840-8420 or www.woodstockinternational.com.



VEGA MMK-1: OFFERS BEST STABILITY BUT EXPENSIVE

The Vega MMK-1, with a street price of about \$100 (which includes the handle, a one-time buy when purchasing multiple Vega bases), was one the most expensive bases in our test. But it also offers the best stability. Unlike all the other bases in our test, the Vega base, when not mobile, rests on its steel framework, on the floor. The wheels don't touch the floor. Vega includes a leveler to compensate for uneven flooring. Its detachable handle, although a little awkward to use, makes this stable design possible.

We liked its stability. We didn't like how you adjust the size of the base. Versatile, this base can be built to fit any number of machines. But to achieve this, stretch-

ers are sleeved into the corner brackets to adjust for the correct size. Then set screws are tightened against the top surface of the inside stretcher. The holes aren't tapped all the way through, giving the base an opportunity to become loose if the stretchers slide, which is worrisome.

For more information, contact Vega at 800-222-VEGA or www.vegawoodworking.com.





THE ULTIMATE HOME WORKSHOP

Getting started in woodworking is always the hardest part. But getting your shop set up right will make everything that follows a little easier. This article will show you how.



Photos by Al Parrish.

When DIY - Do It Yourself Network, asked *Popular Woodworking* to help produce its "The Ultimate Workshop" series, which first aired in May, we sent DIY (www.diy.net.com) a barrage of tips and advice the staff had accumulated over decades of professional and home-shop woodworking.

We took a look at all our advice – enough to fill a book – and boiled it down into an essential guide for anyone planning their own ultimate home workshop.

But what is an ultimate home shop? It depends on you. However, whether you're going to build re-

production furniture using only hand tools, or make plywood shelves for the den, many of the ideas presented here will help you set up your ultimate home workshop the right way, the first time.

Location, Location, Location

Most woodworkers can put their shop one of two places: the garage or (in about half the country) the basement. If you're lucky or wealthy you might have a separate outbuilding to consider.

If you're in a part of the country with basements, they can make handy shops. Basements are usually pre-wired for electrical outlets and lighting, and already have plumbing and heat. But a basement shop poses problems, too. You need to get lumber, large equipment and finished projects up and down steps. The size of your doors, the number and slope of your steps and any corners you might have to turn can make a basement shop impossible.

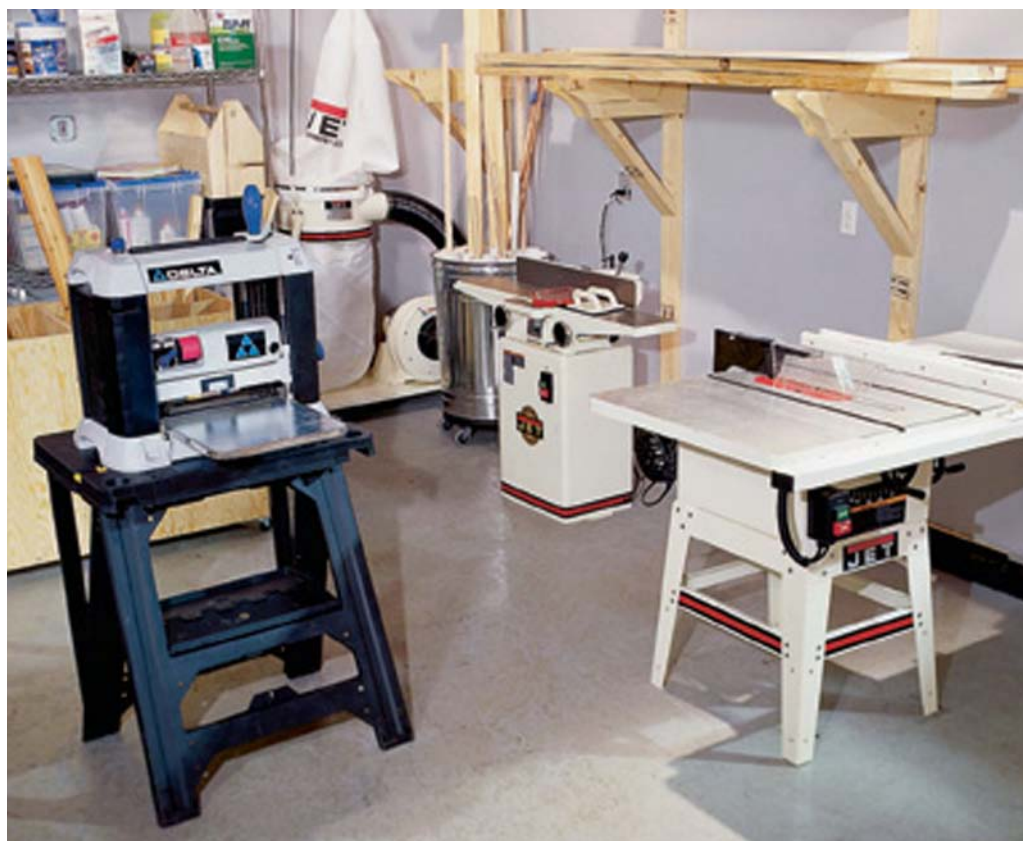
Another basement problem is ceiling height. Older homes may only have 6' or 7' ceilings – less than optimal when working with taller projects.

Finally, basement shops test the patience of your family with the dust and noise. Here's a tip for quieting your basement shop: If there's drywall on the ceiling, add a second layer. If the ceiling is open rafters, so much the better. Add insulation, then add a layer of drywall.

If you don't have a basement, or it's already got a pool table in it, a two-car garage makes a great workshop, offering easy access

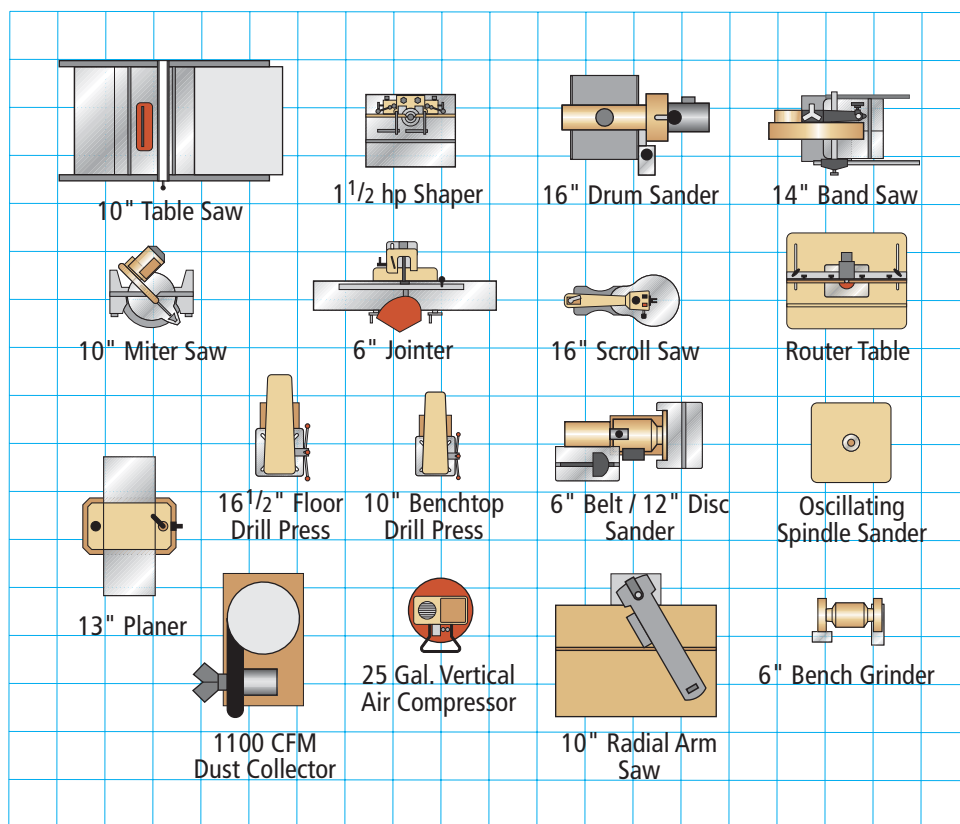
by David Thiel

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



This corner essentially makes up the "machining" area in the shop. Lumber is stored within easy reach above the jointer, with the planer positioned ready to be used by simply turning around from the jointer. With the wood milled, it's a simple step to the table saw to cut the pieces to final size. The stand for the planer is designed to knock down quickly and fold flat against the wall. The planer itself stores under a cabinet, or even under the right-hand wing of the table saw. The portable dust collector is stored in the corner, but it can be attached quickly to any of the three machines in this corner for clean and safe working conditions.

We know that not everyone has the same size workspace, so we thought we'd give you some templates to photocopy and cut out to plan your own shop. The grid is a 1/4" pattern in full size (one square equals 1'), which will work with most graph paper you buy in tablets at the store. (Trust me, paper tools are much lighter to move around.) Also, when organizing your tools, remember to include space for the wood on the infeed and outfeed sides.



through large doors, a solid poured concrete floor and a location that's unlikely to get you in trouble when you make dust.

With a garage shop, your first decision is whether the cars will stay out permanently or just when you're woodworking. If your workshop will include some major machinery, the cars will be experiencing some weather.

Other concerns with a garage shop include: upgrading your electrical system (more outlets and perhaps 220-volt service); plumbing and lighting the shop (and heating in colder climates).

A third option may or may not be available to you. If you have an outbuilding on your property (or the space and funds to build one) they make great shops without the noise and dust concerns. If you're building, this also allows you to get everything just the way you want it.

Once you've decided where your workshop will be, it's time to decide how it will be used.

Not Just for Woodworking

We all know that a lot more happens in a home workshop than just woodworking. Hundreds of home fix-up projects take place there, from painting a closet door to rewiring a lamp.

So even though you're planning on lots of woodworking, don't overlook the needs of other projects. Plan on extra storage for paint cans, mechanic's tools and a drawer or two for electrical tools and supplies. But before we worry about storage, let's pick some tools and machines.

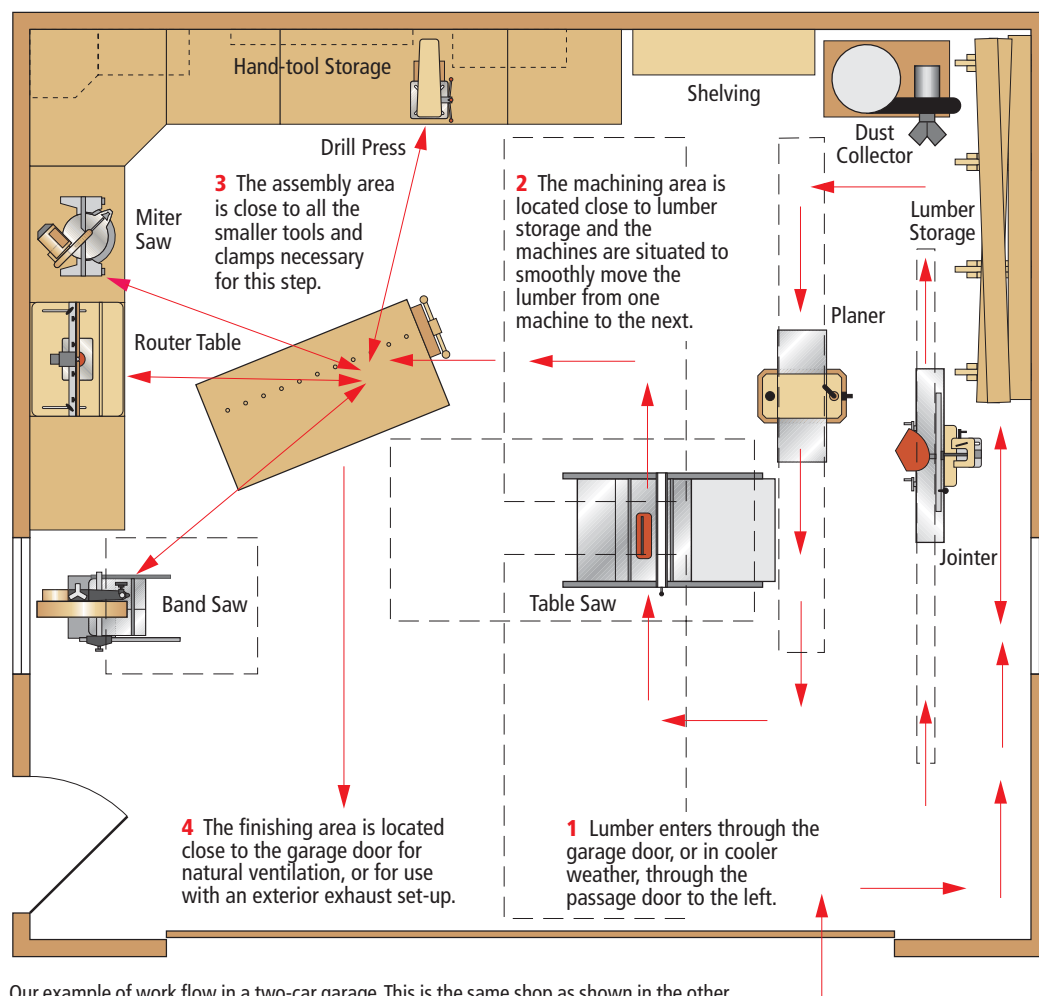
Picking Your Tools

If woodworking will be an occasional activity, or space is at a high premium, consider buying benchtop machines. You can do a lot of work with a benchtop drill press, planer and band saw. While not as versatile as their floor-model big brothers, we recommend them for the small shop.

On the other hand, we don't recommend benchtop table saws for any but the tiniest of shops. While a benchtop saw might be smaller, it's also less powerful and less accurate. Find a way to squeeze a contractor saw or cabinet saw in your shop on a mobile base.

The same goes for the jointer. Like the table saw, benchtop jointers just don't satisfy the needs of most woodshops. We recommend carving out a section of floor space along the wall for a stationary 6" or 8" jointer.

With these five machines (and an assortment of portable and hand tools) you'll be ready to build cabinets and shelves. However, if turning is your passion, a lathe may be at the top of the list, and the jointer and planer may disappear altogether. It's your choice.



Our example of work flow in a two-car garage. This is the same shop as shown in the other photos, so you know it works on more than paper. Just follow the red arrows to the easiest path for woodworking. The dotted lines show approximate infeed and outfeed room for lumber.

There are other tools that you'll want to have (or may own already), including a miter saw, scroll saw and bench grinder, but these can be added as you go along, and they don't take up much space.

Placing Your Machines

Once you know what machines will be in your workshop, you need to determine their location. Allow for infeed and outfeed space and place them near machines they're used with most frequently.

Each machine requires space for itself and space to use the tool. With a table saw, you need to be able to maneuver a 4' x 8' sheet of plywood to the back, front and left side of the saw. This means a pretty big footprint for the ma-

chine when in use (you can overlap the "in-use" footprints of multiple machines). We've added a diagram above that shows the necessary working footprint for each major machine. We suggest you draw up your shop on graph paper, cut out the tools (at left) and start trying different arrangements to see what works.

The trick to positioning your machines in your shop is to create an orderly flow of work from raw lumber to the finished product. The work flow always starts where the wood is stored, or where it enters the workshop. Next, the lumber is prepared for use by jointing, planing and sawing to the proper dimensions. Conveniently, the machines required for these

steps are also the ones that need the most power and create the most dust, allowing you to locate your power and dust collection in a "machining" area, with these machines close to one another.

From the machining phase, the next step is joinery and assembly, usually requiring hand tools, a band saw, drill press and hand-held power tools, such as a router, biscuit joiner and brad nailer. A stable workbench or assembly table are ideal for this step.

The assembly area should be located out of the way of the machining area, but not so far away that you end up carrying lots of milled lumber across the shop. Your hand and small power tools should be easily accessible (stored



The cabinets you choose for your shop can be premade kitchen cabinets, cabinets you make yourself, or cabinets designed for your woodworking needs, as shown in the photo. These cabinets offer simple drop-in platforms for a variety of benchtop tools, with slide-in/slide-out storage for easy access. Storage options include drawers and doors, depending on your needs. Each of the units is capable of easy dust collection hook-up for any benchtop tool, and one of the drop-in panels will allow the cabinet to function as a downdraft table. But don't forget the lowly pegboard for storing hand tools. It still provides the easiest, least expensive and most adjustable hanging storage around.

in handy drawers or on the wall), and quick access to clamps will make things easier as well.

Once assembly is complete, the third phase is finishing. No matter what finish you use, a clean, well-ventilated area is required.

When applying a varnish or shellac finish, the vapors given off as the finish dries are flammable and should be kept away from any ignition points, such as water heaters or space heaters. In concentrated exposure, the vapors can also be harmful to you, so ventilation is important. Also, when storing solvent-based finishes (such as varnishes) a fireproof storage cabinet is a must.

If you're going to use a spray-on finishing system, ventilation is even more critical to move the overspray away from your lungs.

From here, the rest of your shop will fall into place in the space left. Keep in mind that to save space, many tools can be stored under cabinets until needed.

Putting Things Away

While we've talked about where your lumber storage should be in

the work triangle, we haven't talked about how to store it.

There are three types of wood stored in a workshop: sheet goods (such as plywood), rough or full-size lumber, and shorts and scraps. Shorts and scraps are the pieces you can't bring yourself to throw away. Not only are there usually more of these pieces, but they're harder to store than plywood or rough lumber because of their odd shapes and sizes. Let's start with the easy stuff first.

Plywood takes up the least amount of space when stored standing on edge. Most of us aren't storing more than a few sheets of plywood, so this can often be stored in a 10"- to 12"-deep rack that can slip behind other storage or machinery. This keeps it out of the way but accessible.

Rough lumber is best stored flat and well-supported to keep the wood from warping. Keeping it up off the floor also keeps it away from any water that may get into your shop. A wall rack with a number of adjustable-height supports provides the easiest access while keeping the wood flat

and dry. See our "\$30 Lumber Rack" in the April 2002 issue, which is available for sale at www.popularwoodworking.com.

Shorts are the hardest to store, but a rolling box with a number of smaller compartments holding the shorts upright allows easy access to the pieces, and it keeps them from falling against and on top of each other. For plans for a good bin (and 24 other shop projects), get a copy of the book "25 Essential Projects for Your Workshop" (published by *Popular Woodworking Books*).

Carrying on with the storage concept, one category that deserves special attention is finishing materials. While waterborne finishes are gaining in popularity, flammable finishes in cans, bottles and jars should be stored in a fireproof storage box and kept clean and organized at all times. A tall cabinet with lots of adjustable shelf space makes room for the many sizes of finishing supplies. For more details, see the "Flexner on Finishing" article on page 86 in this issue.

Other workshop storage needs

fall into the cabinet and shelving category. Just because there's a tool sitting on the floor against the wall doesn't mean you can't hang a cabinet or shelving above it. In fact, in many cases there are accessories and supplies you need near that tool that belong on a shelf right above it. And don't hesitate to go all the way to the ceiling with storage. Even though the top shelves are harder to get to, we all have things in our shops that don't get used very often.

Many of us have purchased a tool that had a base tossed in to sweeten the deal. It seems like a good idea, but if you stop and think about it, it's truly wasted space. Throw away that stamped-steel base and build a storage cabinet to go underneath the tool.

When choosing base storage cabinets, you'll have to decide whether you need drawer cabinets, door cabinets or both. If you're storing large, odd-shaped items (belt sanders, arc welders) a drawer can be a real problem. They're designed to fit only so much. A door cabinet is a better place to store bulky items.

On the other hand, if you're storing smaller items (door hinges, glue, seldom-used jigs) a door cabinet can be a great place to lose these items. Items seem to migrate to the back of the cabinet; and until you're down on your knees peering into the hole, you won't find them. While drawers can get pretty junky if you're not careful, you'll at least be able to stand up and stare down into the drawer looking for your lost metric tape measure.

Beyond doors or drawers, you have two general choices in cabinets – buy 'em or make 'em. If you make your own cabinetry, you will almost certainly get exactly what you need for the best space utilization. You'll also likely save some money, but it'll take a fair amount of time.

Buying shop-grade cabinets

from a home center can work out well. There are any number of utility cabinets available in all shapes, sizes and finishes.

One other option is plastic or metal storage units, such as the Tool Dock cabinets shown below, designed specifically for a workshop. These units offer features that are set up to maximize tool use and convenience.

Beyond cabinets, open shelves are good for storage, but they're a bit of a trade-off. While you can easily see what you're looking for, so can everyone else – whether it's attractive or not.

Wire-frame shelving is not a good choice for storing small pieces. And knowing the weight limit of the shelves will keep you from picking up all of your wood screws from the shop floor when the shelf collapses. Also, while

you may view deeper shelves as being capable of storing more, (which they are) recognize that smaller items on the shelf can get pushed to the back and get lost.

Where'd I Put That Hammer?

Certain hand tools (hammers, screwdrivers, chisels and hand saws) are always being reached for – frequently when only one hand is free. For that reason these and other hand tools are usually stored hanging within easy reach on the wall.

There are all sorts of ways to hang hand tools on a wall. Some woodworkers build special cabinets for their hand tools. The more common solution is pegboard. It's inexpensive, versatile and easy to mount. With a variety of hooks to choose from, you can make pegboard storage adapt

to almost anything. And pegboard doesn't have to be dark brown. More frequently it's being offered in colored plastic, or you can simply paint your own.

But pegboard isn't the only simple option for hanging tools. You've likely seen "slat wall" in department stores holding up socks and ties. This material is essentially a $\frac{3}{4}$ " board with T-shaped grooves cut in it and a colored plastic laminate on top. It provides much of the versatility and convenience of pegboard, but looks nicer doing it. It'll cost a little more, but it's your choice.

Then there are the workshop experts who mount things right to the wall. By using drywall mollys (or covering your walls with painted particleboard) and a variety of hanging storage accessories available in any home-center

A good workbench is one item you should build into your plans from the start. We've put the bench in this shop so it's central to all the activity. It's just a short step away from the saw and planer, and only a few feet away from all the hand tools and other benchtop tools. And with it isolated in the center of the room, all four sides of the workbench can be used. You can order complete plans for this bench (which costs just \$175 to build) from our web site at www.popularwoodworking.com. The plans are \$9.95.





Here's a little closer look at the interchangeable drop-in panels and dust-collection hook-ups for the benchtop tools.

store, you can make a wall of tools that will be uniquely your own. In fact, many folks add outlines of the tools on the wall (or on pegboard) so they know exactly where it belongs, and more importantly...if it's missing.

Power, Lights, Ventilation

Now that you know where everything belongs, it's time to power it up. While it's one thing to be able to check the tool manuals for the power requirements, it's quite another thing to go about hooking up that power yourself. If you're uncertain about adding new breakers or running wiring, we recommend you get a licensed professional to help you out. But you can help them out by determining the voltage requirements for your tools, whether 110 or 220 volts, and also how many amps each tool requires.

You'll need to provide adequate amperage for each grouping of tools. A contractor's saw will usually require a 110-volt,

20-amp connection, but you can use that same circuit for your planer or jointer because these machines are seldom used simultaneously. Band saws and drill presses can also share a circuit. Another way to improve motor performance and safety is to use a heavier-gauge wire (12 gauge versus 14 gauge) for your stationary tools.

Other things to include in your power requirements are lighting, bench outlets and any ambient air cleaners. Even if you're blessed with lots of windows in your shop, we all work on cloudy days and in the evenings. So proper lighting can be critical. Make sure you have plenty of general lighting throughout your shop, and add task lighting over dedicated work areas such as your workbench and tools that require careful attention to detail, such as the band saw or scrollsaw.

Don't skimp on power outlets. Heck, put one everywhere you can imagine plugging in a tool, radio or fan. Make sure there is a

good power strip with numerous outlets mounted near your bench because cordless-tool battery chargers will use them up fast.

Wood dust is bad for the lungs. By properly using dust collection to keep the larger dust particles out of the air to start, and air cleaners to pull the smaller particles out of the air, the workshop can be a safe and lung-friendly place.

Dust collection is usually set up one of two ways – either with a central collection system using metal or plastic ductwork and a single large dust collector, or with multiple dedicated collectors (though often these can be shared by more than one machine).

A central dust-collection system is a fairly involved topic that entire books have been written about (see “Controlling Dust in the Workshop” by Rick Peters [Sterling Publications]). You need to determine the amount of air movement required to collect from the many different machines, make sure your collector is capable of that performance, and locate and use blast gates in the duct work to maximize the performance of the machine. If a central dust-collection system is your preference, you should spend some in-depth research time on the topic and maybe even consult a professional for advice.

Smaller portable dust collectors are often more affordable and can provide adequate collection for a couple of machines. By using multiple hoses and closeable gates to control which machine is being collected, one machine can do double or triple duty. Each machine is rated by the “cfm” (cubic feet per minute) of air that it is capable of handling. We've included a quick reference chart that rates each machine by the suggested cfm required to extract dust. By using the chart you can easily determine the size and num-

ber of dust collectors you need.

Ambient air cleaners pull the dust from the air that the dust collectors miss. They are designed to exchange a specific amount of air determined by the size of your shop. Choose the air cleaner (or cleaners) to best serve your space, then let them go to work. Air cleaners require less attention than a dust collector, but you do need to clean or change the filters on a regular basis so they operate properly.

Another air-quality decision is finishing. Because of the volatile and harmful vapors given off by solvent-base finishing products, they will be labeled for use in a well-ventilated area. Whether that means a dedicated finishing area with appropriate air-extraction equipment, or just making sure the garage door is open and a good fan is in use, finishing should take place in an area that ensures safety from explosion, or inhalation of fumes. **PW**

MACHINE DUST-COLLECTION STATISTICS

Machine	Req'd CFM
12" Planer	350
13" + Planer	400
Shaper	400
Band saw	400
Radial arm saw	350
Table saw	350
Disc sander	300
Jointer	350
Drill press	300
Scroll saw	300

Static Press. Loss/ft.

4" Duct	.055 in./ft.
5" Duct	.042 in./ft.
6" Duct	.035 in./ft.
7" Duct	.026 in./ft.
8" Duct	.022 in./ft.

A simple
afternoon
project
for beginners
offers warmth
and grace
in any setting.



Photo by Al Parrish.

Fallingwater Table Lamp

by David Thiel

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

For years I'd been hearing stories about the wonders of Frank Lloyd Wright's house built for the Kaufmann family in western Pennsylvania. Fallingwater was a name mentioned in reverence, so when my travels took me into that area I knew I had to make time to visit and see what the fuss was about. Built in the 1930s and combining International and Usonian architecture, the house was built on top of a waterfall, providing spectacular views for the residents and challenging construction issues for the builders. The house itself has the feel of a space designed for entertaining (as it was), with large common areas and a well-appointed guest house. While impressed with the setting, I walked away from my visit with a different image stuck in my mind: A simple table lamp of walnut with a black metal base that threw a soft, warm, indirect glow against the home's walls.

After examining some pictures, I headed for the drawing board and adapted the concept to a working design that replaced the metal base with a painted



Some simple store-bought hardware and some black spray paint turn shop scraps into a dramatic table lamp.

maple base. The scale is a bit different from the originals, but the effect and beauty is still the same. I was shocked at how simple the construction was, and I quickly headed for the workshop. After only a few hours I was ready to add a finish and plug in the lamp.

Picking the Walnut

Probably the most important part of this project is selecting the best walnut for the shade. It doesn't take a lot of wood (in fact, you might be able to build this project from your scrap pile), and I resawn the pieces to get a book-matched shade. If you're a beginning woodworker, this is the trickiest part of the project. First,

select a nice piece of $\frac{3}{4}$ "-thick walnut with a figure that you find pleasing. For some, that might include sap streaks or small knot holes. Cut the piece oversized (4" x 21"). Next, set up your band saw with a $\frac{1}{2}$ " blade ($\frac{3}{8}$ " will work in a pinch). Check the guide blocks and thrust bearings to make sure they hold the blade tight and don't allow too much side-to-side wandering. If you don't have a rip fence on your band saw, you can make a simple one by screwing two pieces of wood together to form an "L." Make sure the fence is square, about 4" high and long enough to easily clamp to the band saw's table. Clamp the fence to the table $\frac{3}{8}$ " from the

band saw blade. This should cut the piece of walnut evenly down the center and leave plenty of wood to clean up the rough band-sawn edge with a planer.

Start the saw and slowly feed the piece into the blade. Let the blade cut as slow as it wants to. If you force the piece, it's more likely to cause the blade to wander off center and give you two uneven finished pieces.

Once the piece is resawn, head for your planer and run the two halves down to the $\frac{1}{4}$ " thickness. Mark the long edges that will be joined together and head to the saw. Crosscut the two pieces to the 16" length, but hang on to the falloff pieces. One will become the bottom of the shade. With the edges that will be joined against the rip fence, cut the two pieces to just over $3\frac{1}{2}$ " wide. Then swing the blade to a 45° bevel and bevel the two center edges. If you're using a good-quality rip blade in your saw and make the cut carefully, you should be able to use the chamfered edge as a glue joint without any further edge preparation.

Cut the shade bottom from



Stopped Holes in the Base

After finding the center of the lower base piece by drawing a line connecting the opposite corners, I set up the drill press to make a 1"-diameter hole, $\frac{3}{8}$ " deep with a Forstner bit (left). A fence and stop block clamped in place held the block just where I needed it. I then replaced the Forstner bit with a $\frac{13}{32}$ " brad point bit (to allow a little clearance for the $\frac{3}{8}$ " threaded tube) and used the same setting to drill the rest of the way through the center of the block (right). I then reset the fence and stop block and drilled through-holes in the upper base block as well.



FALLINGWATER TABLE LAMP

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL	
		T	W	L		
<input type="checkbox"/>	2	Shade halves	1/4	3 1/2	16	Walnut
<input type="checkbox"/>	1	Shade bottom	1/4	3 1/4	3 1/4	Walnut
<input type="checkbox"/>	1	Lower base	7/8	6 1/4	6 1/4	Maple
<input type="checkbox"/>	1	Upper base	5/8	4 1/4	4 1/4	Maple
<input type="checkbox"/>	1	Shade support	1/2	1 3/4 dia.		Dowel
<input type="checkbox"/>	1	8' Lamp cord and bulb from your local hardware store				
<input type="checkbox"/>	1	Hardware kit				
		With dimmer socket:	#05D15.11	\$16.00 (+\$5 shipping)		
		With keyed socket:	#05D15.12	\$6.00 (+\$5 shipping)		
		From Lee Valley Tools, 800-871-8158 or www.leevalley.com				

one of the 1/4" falloff pieces, then set everything aside. Before you can glue the shade together you need to make a hole in the base piece, and it's just as easy to drill all the base pieces at once.

The Drill Press is Your Friend

The base itself is simple. It's two blocks of wood with a chunk of dowel rod glued to the top. The only part demanding care is drilling the hole through the center of the three pieces to hold the lamp hardware. That's where a drill press comes in handy.

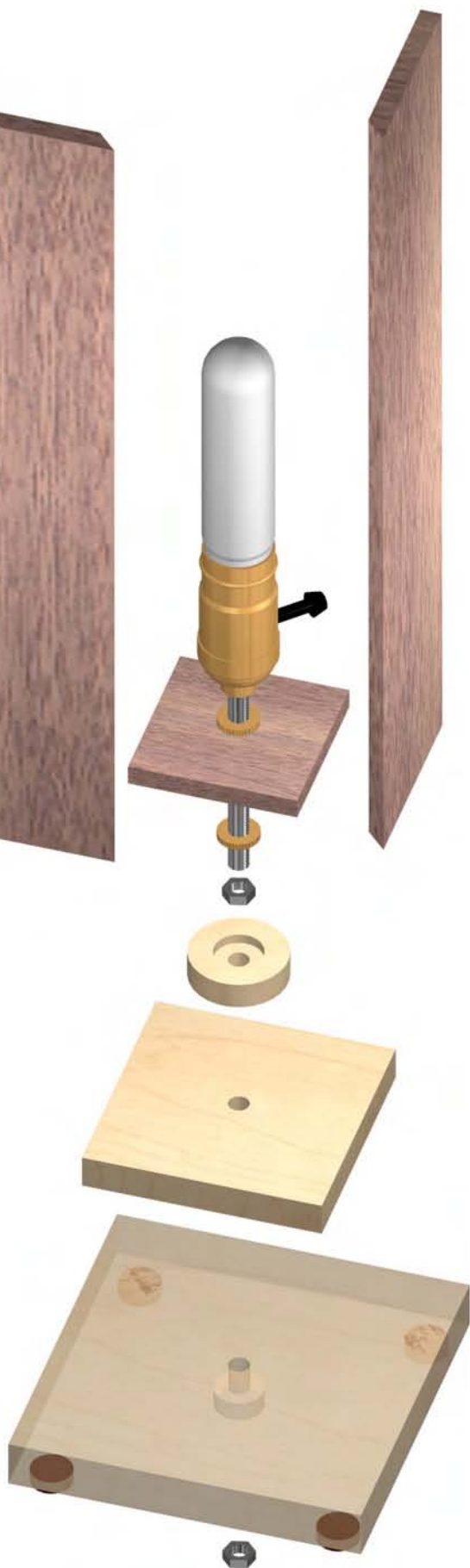
After cutting the blocks to size and trimming the 1/2" off the end of a 1 3/4"-diameter dowel rod, you need to mark the center of each piece, then drill recesses in both the lower base and shade support and through-holes in all three pieces. Use the photos below to complete this step.

Once all the pieces are drilled,

sand them to 150 grit, then assemble the base. I used the lamp hardware itself (the 3" x 1/8" ID threaded tube, two 1" washers and two 1/8" ID knurled nuts) to align the base pieces and clamp the base together. In addition, to hold the two square pieces properly aligned, I drilled and countersunk two holes in the bottom base, then screwed the two base pieces together.

Use just a little glue to hold the three pieces together, as the lamp hardware will do most of the holding. Plus, you don't want any extra glue squeeze-out to clean up. With the bases assembled, spray paint the bases with flat or semi-gloss black paint.

While the paint is drying, head back to the shade. With the shade base now drilled for the hardware, finish sand all the shade pieces before gluing. Don't plan on sanding the shade too much



Homemade Center Finder

Finding the center of a disc is harder than you might think. Sure they sell center-finding tools for \$5, but I wasn't in a hardware store! After a couple of minutes of thinking, I figured out how to use a try square and the head from my combination square to do the job (left). Make three pencil lines bisecting the disc to make sure you have an accurate center. Then, using the same bits and methods as on the square base blocks, drill a 3/16"-deep recess and a through hole in the 1 3/4" shade supports. Because of the round shape, the block will spin as you drill, so I used a falloff piece to apply extra pressure against the block to hold it tight against the fence and stop block.



Gluing Without Clamps

Whether you're using regular glue, cyanoacrylate or a new fast-drying polyurethane, the easiest way to glue the shade's miter is using masking tape. Align the two halves face-up on a flat surface and push the mitered edges together. Carefully apply a strip of masking tape along the joint, pressing to keep it tight to the wood. When you lift the two halves and fold them at the joint, the tape forces the miter together. Flip the shade over (miter gap up) and add glue to the joint (left). Fold the two halves together, using the shade base as a guide to keep the shade square (right) as the glue sets. Then apply glue to two edges of the shade base and glue it to the inside of the shade, holding it flush to the bottom edge of the shade. The wax paper makes this task easier without gluing the whole thing to the work table.



after it's assembled because even though it's a fairly sturdy shade you don't want to put too much pressure on it.

With the shade ready to assemble, follow the photos to make the process simple and clamp-free. After the shade is glued-up, sand all the edges to give a softer appearance. Then you're ready to add a clear finish and let the beautiful walnut pop.

Finishing Touches

During the past year or two I've become fond of using lacquer in

a spray can for small projects. It's not the least expensive way to put on a finish, but it dries quickly between coats, provides an even and durable finish and requires nothing more than a well-ventilated work area. Two cautions: This method is really only recommended for smaller projects as it becomes difficult to spray on an even finish over larger areas. Also, make sure you're spraying lacquer and not a urethane-based spray finish. Read the label carefully. Even though it may not call the product lac-

quer, if it recommends 30 minutes or so between coats, you've got the right stuff (and it usually takes less than 30 minutes to sand and recoat).

With your finish applied to both the shade and as a top coat on the base to protect the paint, you're ready to wire the lamp. I've provided information on two types of hardware kits. One offers a simple on/off turn switch on the socket, while the other offers a dimmer switch on the socket. While more expensive, I've found that I enjoy the ability to adjust the

intensity of the light emitted to fit my mood.

Neither kit includes the 40- or 60-watt display bulb and light cord, which can be purchased at most any hardware store.

I've got two of these lamps wired together on my fireplace mantel, and another on my desk. This project lends itself to making more than one at a time, so consider where your house can benefit from extra ambience, or think about special friends or relatives who deserve a nice gift. **PW**

THAT'S ONE 'SUPER' GLUE

One of the trickiest parts of this generally simple project was gluing the shade together. Because of the odd shape and very visible miter, I originally used a cyanoacrylate glue (Super Glue) to glue the miter and shade base in place. That was before the folks from Franklin International showed us the new HiPurformer glue. What is it? Polyurethane bonding strength and versatility with an initial set time of 30-75 seconds. Even better, because it's a "hot melt" glue it doesn't foam out like traditional poly, and if it gets on your hands, it dries, balls-up and rubs off. If you need quick, clamp-free adhesion with epoxy-like holding power (as I did in this case), this is a great option. I'm looking forward to trying it in other applications.

The glue comes in three blends (so far): two woodworking glues (with 30- and 60-second set times) and a third multipurpose blend designed for bonding almost everything else, including glass, ceramics, brick and metal. We were skeptical until we let the glue heat up and made some quick test pieces. We tried long grain-to-long grain, short grain-to-short grain and even butt joints. No clamps. We then waited about 10 minutes. We had to break the pieces over a workbench to get them apart. The short grain and butt joints failed sooner, but the strength provided would easily hold a picture (or door?) frame together. In many cases during our "test" it was the wood that failed, and not the glue. The system is a little expensive (\$99 to start for the gun, carrying case and three tubes of glue), so this isn't going to replace the bottle of glue on your workbench. Depending on your woodworking, HiPurformer may be the product you need. Contact Woodcraft (800-225-1153 or www.woodcraft.com).





Building Extension Tables

The hardware that allows a table to expand in size intimidates some woodworkers who have never installed it. Here's how to do it right the first time.



If you've served one too many turkey dinners with your aunts and uncles huddled around a card table, then it's time to build a dining table with extension leaves.

By using commercially available table slides and legs, it's a project that's not much more difficult than

building an end table. There are merely a few extra details that you need to watch out for as you go.

The table shown here will accommodate up to 10 people when extended to its full 100" length. It's basically a Queen Anne design that uses a cabriole leg with a pad

by Troy Sexton

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

Photos by Al Parrish.



Cut the knee brackets on the ends of the aprons using your band saw (top). Then clean up the cuts using a drum sander in your drill press (left).



A self-centering doweling jig (above) makes quick work of drilling the holes for the dowel pins. Just make sure your jig really hits the center of the work – some do not. A little glue is all it takes to secure the pin in its hole.

foot. But the plan and procedure that follows can be used for any style or size extension table. When you visit the web sites listed in the supplies box at the end of the article, you'll see how easy it is to customize your table to fit almost any furniture style by choosing different legs and altering the apron just a bit.

Begin with the Aprons

The aprons on the table are 4¼" wide with small knee brackets glued on the ends to act as a transition into the curve on the legs. (Many of the other styles of legs

available for sale will not need a transitional detail on the apron.)

When making the aprons, the first thing to do is to cut the tenons on the ends. The tenons measure ¾" thick, 3¼" wide and 1" long. I cut mine using a dado stack and a miter gauge on my table saw. To cut the face cheeks and shoulders, set the height of the dado stack to ⅜" and the fence at 1" from the left-most blade in your dado stack.

To cut the edge shoulders and cheeks on the tenons, raise the height of the dado stack to ½" and leave the fence at 1". Test the

fit of your tenons in a sample mortise cut using your hollow-chisel mortiser, plunge router or chisel.

With the tenons cut, glue ¾" x 2" x 4½" blocks on the edges at

the ends of the aprons. Try to match the grain and color of the blocks and aprons as best you can. When the glue is dry, use a band saw or jigsaw to cut the detail

EXTENSION TABLE

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL
		T	W	L	
1	Top	¾	44	76	Cherry
2	Leaves	¾	12	44	Cherry
4	Aprons for leaves	¾	4¼	12	Cherry
2	Short aprons	¾	4¼	24¼	Cherry
2	Long aprons	¾	4¼	54¼	Cherry
4	Legs*	1¾	1¾	29	Cherry
8	Knee brackets	¾	2	4½	Cherry

*Thickness and width refers to the block at the top of the leg

shown in the diagram below and sand the edges smooth.

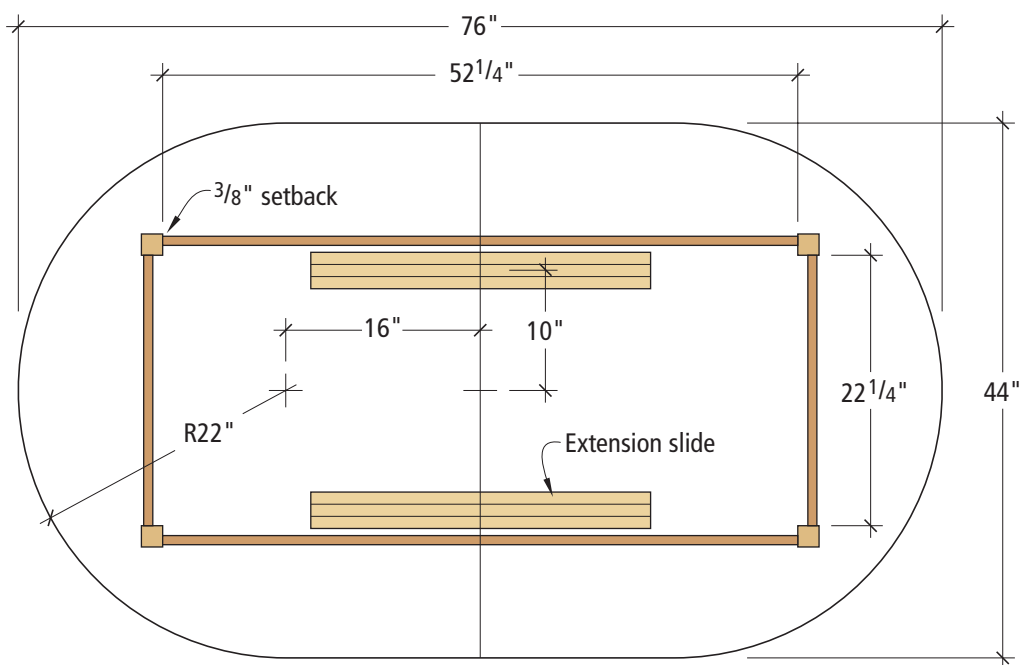
Now is the time prepare your aprons to attach them to the top. It might be tempting to use commercial Z-shaped clips (also called tabletop fasteners). While I've used this hardware for all sorts of tables, it has been my experience that it isn't well-suited for use with extension tables. Here's why: When you install the clips, you need to leave a little expansion room between the tongue of the clip and the bottom of the groove you cut in the long aprons. This space allows the table to expand and contract with the seasons. What I've found is that these clips can also allow the top to shift or skew, especially if the top gets knocked. If this happens, you won't be able to get the holes in the extension leaves to line up with your dowels and the table won't go together unless you loosen the Z-shaped clips and realign all the top pieces.

When I build tables, I prefer to instead use pocket screws every 6" that I ream out slightly using a drill bit to allow the top to move but not shift. Finish sand the aprons and move on to the legs.

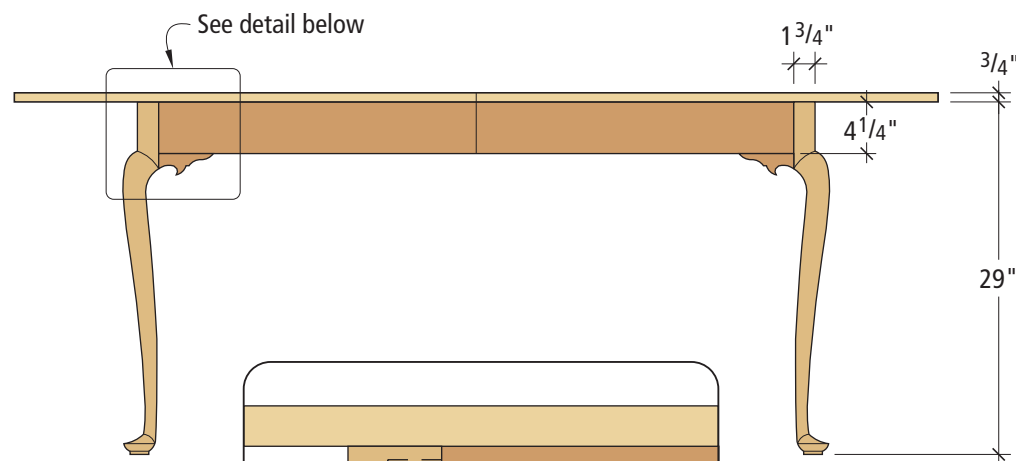
Mortising the Legs

Cutting and shaping cabriole legs is a skill unto itself that will test your band saw, rasping and sanding skills. As a result, even professionals will outsource their legs for a job such as this because the price is quite reasonable and the legs are presanded.

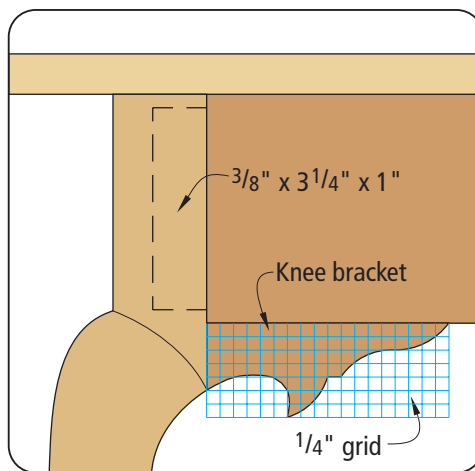
With some leg-making companies you can even pay a little more and they will mortise the legs for you. I have a mortiser, so I saved a few bucks and did it myself. The only tricky aspect of cutting the mortise in cabriole legs is clamping the leg so its curve fits against the fence of your mortising machine. I put the legs



Plan



Elevation



Apron details

up on small blocks of wood for my machine. (If you are making the cabriole legs yourself instead of buying them, cut the mortises before you shape the legs.)

The aprons are set back $\frac{3}{16}$ " from the legs, so your mortises should be located $\frac{3}{8}$ " from the outside edge of the leg.

Decisions, Decisions

With the mortises cut, it's time to make a decision. Should you glue the table base together and then cut it apart? Or should you crosscut the long aprons first and then glue up each end?

I find it easier to glue and clamp up the base, let it dry and then cut it apart using my chop saw and the help of a couple family members. (If you're building a table this big, you should have a few of them around.)

After the base is glued up, merely mark the midpoint of the aprons, put the table base on your chop saw and make the cut. Have

your helpers hold the ends, especially on the second cut when the whole thing comes apart. You're going to be surprised at how easy this is to do.

If that all seems too much, you can make the cut using a circular saw. Or you can cut the aprons before you glue up the mortise-and-tenon joint. If that's your decision, I recommend clamping the aprons you cut apart together using an intermediate board to keep everything square as you glue up the base.

Top and Leaves

Now surface all the lumber for the two top pieces and two leaves. Remember that the leaves will have their grain running perpendicular to the grain in the top. Glue up the panels you need for the top and leave them 2" oversized to make cutting the shape of the top easier. You also should leave the leaves a couple inches too long, too, so they can be cut

to fit at the same time as the top.

When the extension leaves are in use in this table, they are kept in the same plane as the top by using dowel pins.

You can buy special dowel pins for extension tables that have a bullet-shaped end. The tapered shape makes them easy to align and slide together. However, I find the pins simple to make using $\frac{3}{8}$ " dowel stock and sanding the edges to a bullet shape myself.

Begin by drilling the holes for the dowels in both edges of the leaves and the edges of the top pieces. The $\frac{3}{8}$ "-diameter holes should be 1" deep. Drill five holes in each edge: one in the center, two at 10" from the center and two at 20" from the center.

Glue the $1\frac{7}{8}$ "-long pins in place and sand their exposed edge to a bullet shape to make fitting the leaves together easier.

Now put the two top pieces and leaves all together upside down on your bench and lay out

the top. After toying with more complex shapes, I settled on a simple top that was 44" wide with half-round shapes on the ends that are a 22" radius. This shape is sometimes called a "racetrack oval" in furniture circles.

Cut out the shape of the top using your jigsaw. Now put the base in place on the underside of your top and get ready to attach it. As you can see by the photos and cutting list, I added apron pieces to the leaves that match the apron on the table base. These let you use the table fully extended without a tablecloth. Clamp these extra aprons and table base pieces in place on the top and screw everything down tightly.

Using a small punch, I marked a number on the underside of each leaf's edge and the same number at the edge it mates to. This allows the table to look exactly as I intended every time it's set up.

Extension Hardware

You can make your own table slides using a hardwood such as maple and some sliding dovetail joints. But why would you want to torture yourself this way? You can buy the extensions slides from a variety of sources (see the Supplies box at right). The set of slides for this table cost \$26.

Table slides are easy to install; there are just a couple tricks. The first thing you want to be careful of is to install the slides perfectly parallel to each other, with the center of each slide 10" from the center of the tabletop. Also, make sure you are installing the slides right-side up (this should be ob-

If you don't have a set of trammel points, here's a good trick. Take your straightedge ruler and drill a small hole at 0" and at the dimension of the radius you want (22" in this case). Drawing the half-round end is then a simple matter with a nail and a pencil.



vious, but you should check). The slides are bowed slightly to compensate for sagging.

To install the slides, you need to mark parallel lines that show where the inside edge and outside edge of each slide should go. Watch these lines as you position and screw down the slides.

Now extend the slides so they are 50" long and position them between your lines. Whatever you do, don't extend the slides all the way when you install them because then the leaves cannot be removed. Screw the slides down through the predrilled holes.

SUPPLIES

You can buy table legs from a variety of excellent sources, including:

Classic Designs by Matthew Burak, 800-843-7405 or www.tablelegs.com

The legs and table slides for this project came from Classic Designs by Matthew Burak, which features a wide range of table legs in a variety of woods. The legs are the Queen Anne Pad Foot Dining leg, 100-D, which cost \$42.50 each at the time of publication. These legs also are available in mahogany, maple, oak and tiger maple. Check the company's web site for prices.

Other styles of table legs available include: Federal, William & Mary and Hepplewhite.

The table slides also came from the same company. The 26" slides are item # 510-26 and cost \$26 for a pair.

Other sources for good legs are:

Adams Wood Products
423-587-2942
www.adamswoodproducts.com

Osborne Wood Products
800-746-3233
www.osbornewood.com

Finishing Touches

With the top attached and the table slides working, flip the table-top onto its legs and begin cleaning up the top's edge with a belt sander to remove the saw-blade marks from your jigsaw. When that looks good, rout a $\frac{5}{8}$ " roundover on the top edge using

your router. Finally, finish sand the top and edges up to 180 grit using a random-orbit sander.

I dyed the table using a red-dish water-based aniline dye that I mixed myself by blending several colors. A good place to find similar dyes is at Woodworker's Supply (800-645-9292 or

www.woodworker.com). Then I followed that up with a couple coats of clear water-based lacquer.

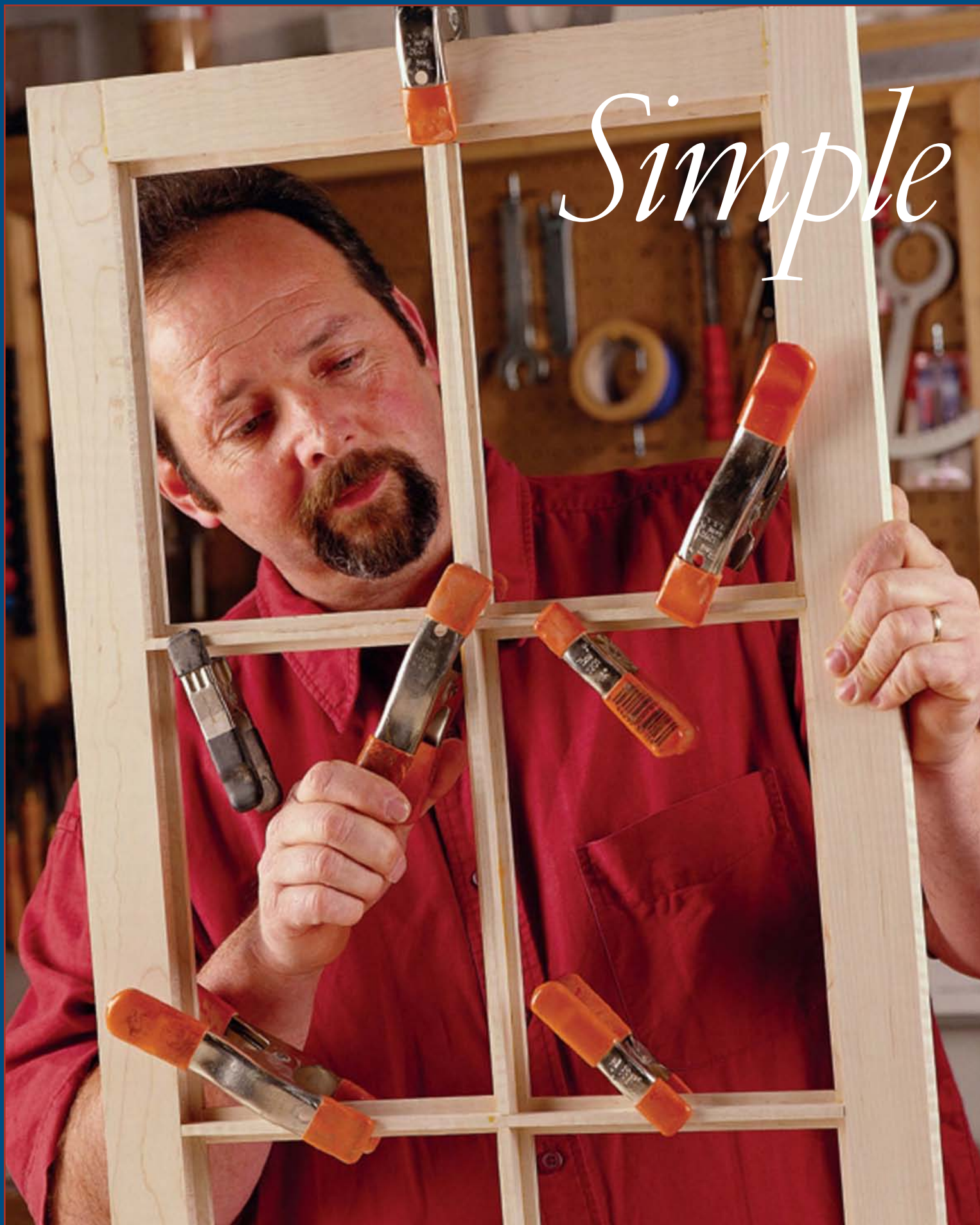
With this table complete, a lot of grown-ups in the Sexton family will now be able to graduate from the "kiddie" table when Thanksgiving rolls around again – maybe even me. **PW**



With the leaves in place between the top pieces, place the small aprons in place over the leaves. Clamp everything down, then screw the pieces in place.



Make sure your table slides are not fully extended when you screw them down. Otherwise, you'll be in for a rude shock: You won't be able to get your leaves out.



Divided-light Glass Doors

The easiest way ever to add mullions and muntins to any door.

Glass doors dramatically change the look of furniture. Not sure you can do glass doors? I have a trick for you!

A true glass door has what is known as divided-light panes, meaning each pane of glass is separated from the others by a wood frame. Some manufactured pieces of furniture use a large sheet of glass and overlay a framework to the front of the glass to look like a divided-light door, but it is just not the same to me. Traditionally, making a divided-light door requires special matched router-bit sets and a

difficult technique known as cope and stick. But even professionals find this technique a bit labor intensive.

For years I've been using a simple method to make divided-light doors using simple butt joints, glue and a box full of spring clamps.

This method works best with flat-mullion doors. The process can be used with profile-mullioned doors, but this heads you back into some cope-and-stick work, so we'll start with this simple door. This flat-mullioned style is appropriate for Shaker, Southern, Arts & Crafts and many 18th-century furniture designs.

The starting point is a door frame with a rabbet cut around the inside edges of the door frame. I use a couple of different methods to make the initial door frame. One is a more traditional joinery method called a rabbeted mortise-and-tenon joint, while the other is a more simple mortise-and-tenon door with a rabbet cut in the frame after assembly. Either works, so I'll let you decide if tradition should win out over speed and convenience.

by Glen Huey

Glen Huey builds custom furniture in his shop in Middletown, Ohio, for Malcolm L. Huey & Son and is the author of "Fine Furniture for a Lifetime."



Regardless of how you make your rabbeted door frame, this is your starting point for the tricky stuff to make a simple divided-light door. The frames above use the traditional rabbeted mortise-and-tenon joinery. It really does look a little nicer, and if you're already cheating on the muntins and mullions, maybe a little extra effort on the frame is not out of line.



The divider pieces for these doors are made from two different sizes of wood strips. The face material is $\frac{1}{4}$ " x $\frac{3}{4}$ ", while the backer pieces are $\frac{1}{4}$ " x $\frac{1}{2}$ ". I use a new sacrificial fence on my miter gauge for each new door project to keep tear-out on the backside of the pieces to a minimum. This also makes locating the cut easier by aligning the strips with the initial kerf in the fence.





To begin the muntin section of the doors, find the shelf locations on your project's case (generally the glass dividers align with the shelves) and mark these on the edges of the door. Cut the backer material to run from side to side. These pieces divide the glass area horizontally. The fit should be snug, but not so tight as to bow the frame. Glue the backer piece into the rabbet area and clamp until dry, usually about 30 minutes.



Now flip the door over. The first face pieces to install are the pieces that run the full length, in this case the center piece that divides the glass area vertically into two sections, left and right. The piece again needs to be snug, but not too tight. Glue each end (as well as each area) where the face crosses the backers (two locations in this case). You'll notice that I have the door elevated on some jars. The contents aren't important, but the elevation is very helpful.

SIMPLE MORTISE-AND-TENON DOORS

Both methods of door frame construction begin with the mortises. Make your centered $\frac{1}{4}$ "-wide mortise (for a $\frac{3}{4}$ "-thick door) $\frac{3}{4}$ " shorter than the width of the door frame, leaving a $\frac{3}{8}$ " shoulder on either edge to ensure that the rabbet doesn't expose the joinery (A). Then simply cut the matching tenon and assemble the door frame (B). When the glue is dry, use a rabbeting bit in your router to create a $\frac{5}{16}$ " x $\frac{1}{2}$ "-deep rabbet on the inside back edge (C). Finally, square out the corners of the rabbets with a sharp chisel (D).





Flip the door over again and begin to cut and install the three backer pieces that complete the "T" for the glass and run from muntin to muntin. These pieces back the face piece. Glue and clamp until dry.



Finally, flip the door face up one more time and cut and install the remainder of the face pieces. You can install all the pieces at one time, without allowing each piece to dry. You're limited only by the number of clamps you own, but don't work so fast that things get sloppy. **PW**

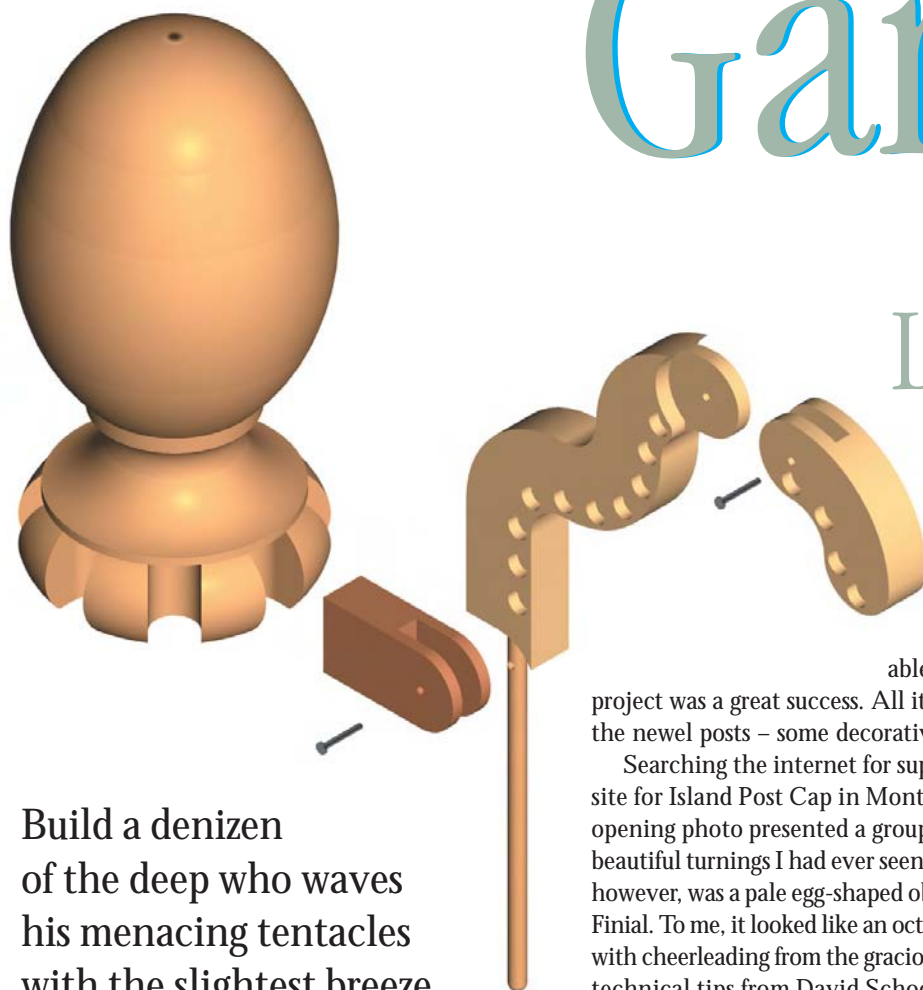
RABBETED MORTISE-AND-TENON DOORS

After cutting the mortises just as in the simple version, the first step in the more complex method is to create the $\frac{5}{16}$ " x $\frac{1}{2}$ " rabbet on the inside edge of all the door pieces. I simply make the cuts in two passes on the table saw (A). Next, define the shoulder of the face cheek on the tenon. Set the blade so it just clears into the rabbet (B). Now move the fence location $\frac{5}{16}$ " closer to the blade and make the second shoulder cut, creating an offset of the cuts (C). With the fence at the same location, create the edge shoulder (D). Finally, cut the cheeks, remembering that there are two different cheek lengths (E).





Octopus's Garden



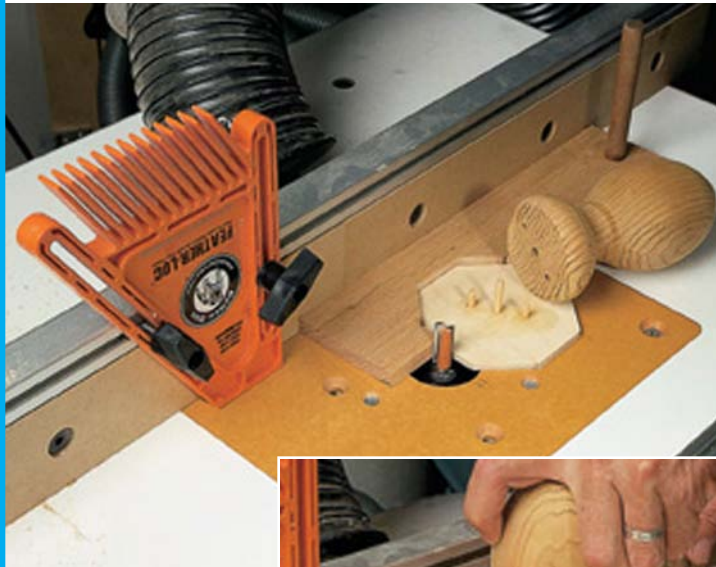
Build a denizen of the deep who waves his menacing tentacles with the slightest breeze. And yes, his head is a fence-post finial.

Last summer, I decided it was time to replace the dilapidated stairs that led to the front door of our house. Rather than just duplicating the same straight run of steep risers, I choose to go with a series of elevated platforms, dividing the ascent into three manageable climbs. Functionally, the project was a great success. All it needed was a little jazz at all the newel posts – some decorative finials.

Searching the internet for suppliers, I came across the web site for Island Post Cap in Montgomery, Ala. The company's opening photo presented a group portrait of some of the most beautiful turnings I had ever seen. The one that caught my eye, however, was a pale egg-shaped object listed as (what else?) Egg Finial. To me, it looked like an octopus's head. That photo, along with cheerleading from the gracious folks at Island Post Cap and technical tips from David Schoonmaker, managing editor of *American Scientist* magazine and co-author of "Whirligigs & Weathervanes" (Lark Books), led to the octopus whirligig.

by John W. Hutchinson

Between his duties as a practicing architect and illustrator for Popular Woodworking, John finds a few moments to indulge in some less-than-serious wood tinkering. Comments or questions? Contact John at jhutchi2@columbus.rr.com.



Here you can see how the head fits onto the sacrificial base plate when routing the eight slots (top). Be sure to use a stop block to limit the cut into the head piece (right).



Because I needed a readily available, lightweight and weather-resistant wood, I chose cedar. Fortunately, the egg finial is available in cedar. For the rest of the octopod's parts, you will find that even the lowest-grade cedar board will yield enough clear material for a fleet of these whirligigs.

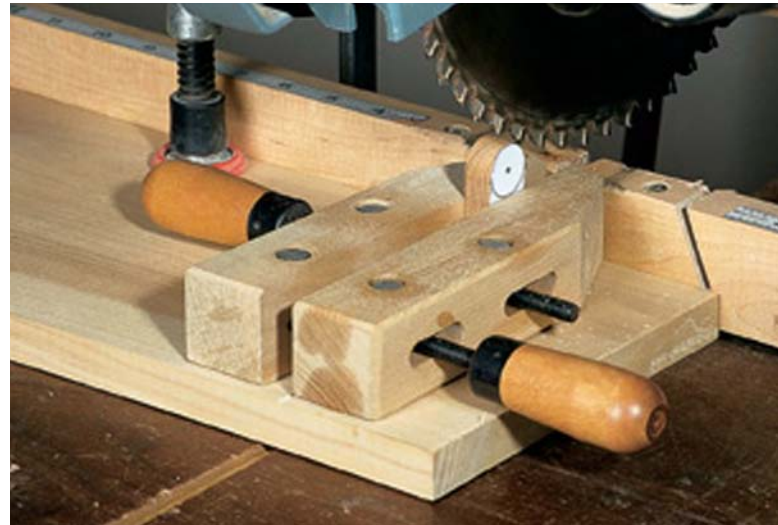
Routing the Head

Start the transformation of egg to octopus by attaching the finial to a sacrificial octagonal base plate. Use a short length of dowel in the original turning center and add a couple more dowels, slightly off center, to prevent the finial from rotating during the cuts. Chuck a $\frac{1}{2}$ " straight bit into your table-mounted router and cut eight (you'll be seeing that number a lot) shoulder slots in the base of the finial using the half-octagon jig. (See half-size patterns at right.)

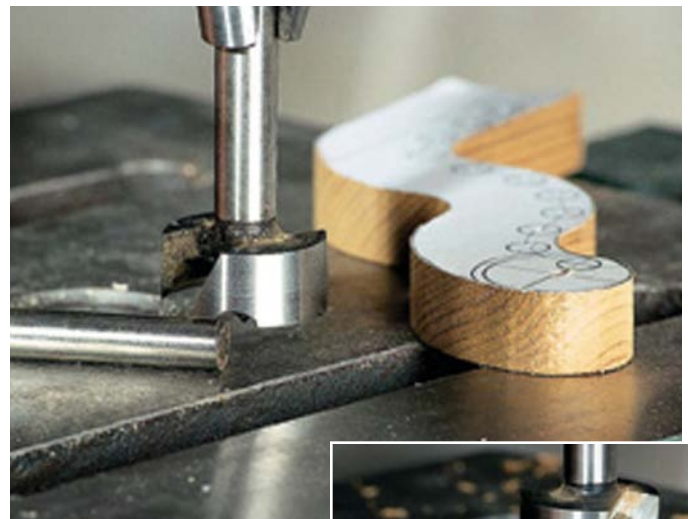
Tentacle Time

Plane your rough-sawn lumberyard cedar down to $\frac{1}{2}$ " thick. Cut out some straight-grained portions of the board for the tentacle components. Apply the full-size patterns for the shoulders, arms and hands with a light application of spray adhesive and then scroll saw for an hour while listening to Ringo Starr's "Octopus's Garden."

To safely cut the notches in the shoulders and hands, I came up with a simple jig for my radial arm saw that consists of a wooden handscrew clamp attached perpendicular to the long edge of a straight board. I aligned the notch's depth line on the pattern with the top edge of the clamp and adjusted the blade height until the tips of the teeth were just touching the top of the clamp. It was then a simple matter to nibble away the grooves.



Cutting the notches in the hands and shoulders requires making a simple jig to hold the work under a radial arm saw (above). If you don't have a radial arm saw, this could be rigged up easily on a table saw using a sled that runs in the miter slot. After cutting the slot, make sure your dowels move freely in the shoulder.



You can use a $2\frac{1}{64}$ " drill bit to set the depth of your Forstner bit when cutting the tenons. This will leave a $\frac{5}{32}$ "-thick tenon (above). Be sure to back up the underside of the tenon as you make the other cheek cut. The parts are small and the wood is lightweight (right).



To cut the tenons on the arm sections, return to the drill press, chuck in a 1" Forstner bit, and remove material from both sides. Since you're now dealing with some fairly delicate parts, it's important to support the half-cut

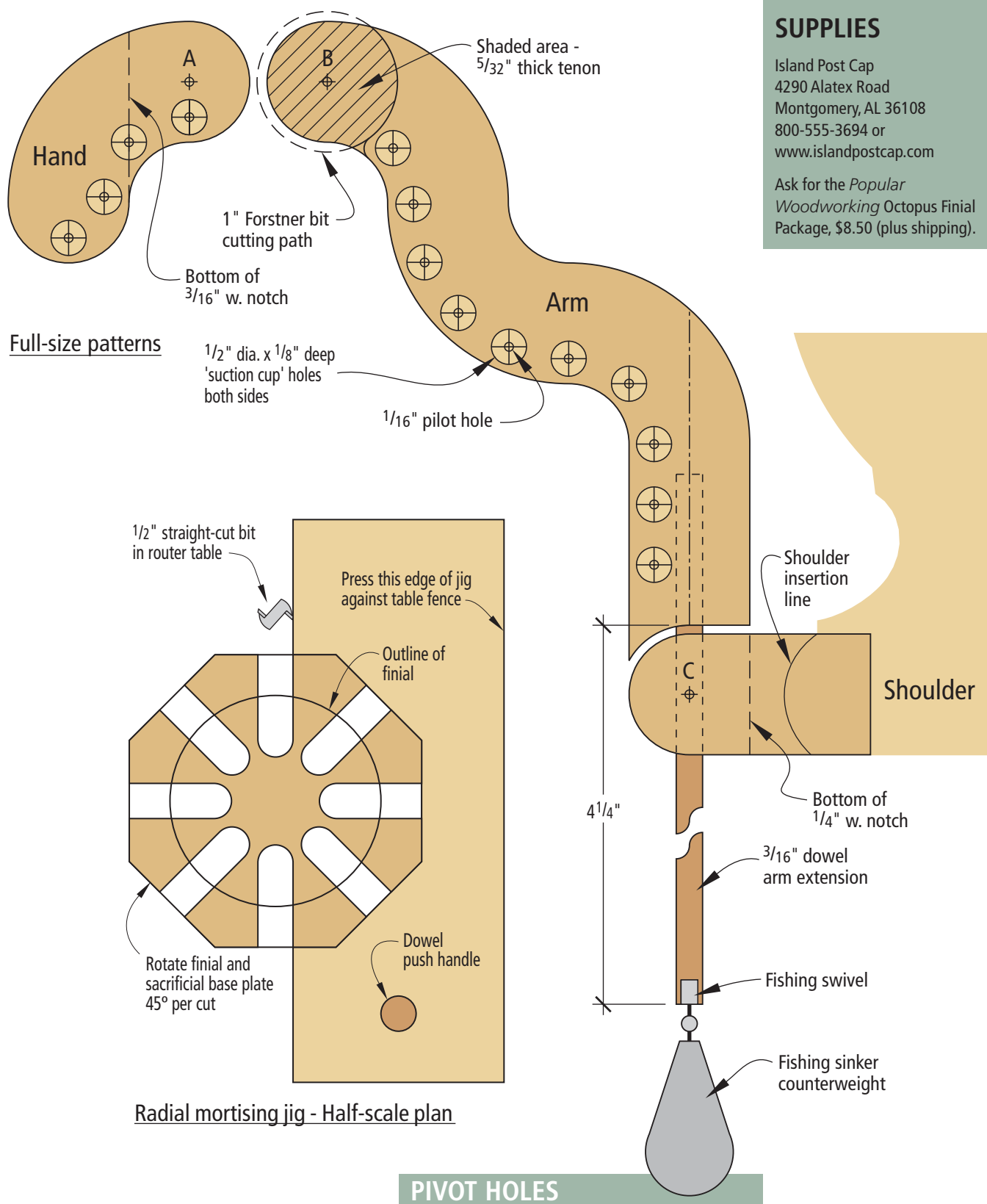
tenon from below when making the second bore. For this I used a small stack of plastic laminate samples from the hardware store.

With the mortise-and-tenon operations complete, turn to the drill press and bore the pivot-pin

SUPPLIES

Island Post Cap
4290 Alatex Road
Montgomery, AL 36108
800-555-3694 or
www.islandpostcap.com

Ask for the *Popular Woodworking* Octopus Finial Package, \$8.50 (plus shipping).



PIVOT HOLES

No.	Item
<input type="checkbox"/> A	1/16" capture hole
<input type="checkbox"/> B	3/32" pivot hole
<input type="checkbox"/> C	1/16" capture hole in shoulder and 3/32" pivot hole in arm extension

holes in the hand and arm (parts A and B) that will make the tentacles move. Finally, drill the $\frac{1}{4}$ " suction cup divots (28 per limb) in the arms and hands with a Forstner bit.

Although it might seem a bit obsessive-compulsive, I made a "negative" jig to hold the arms plumb while I drilled them for the $\frac{3}{16}$ " arm extension dowels. It worked great, and the jig became a nice addition to my "and-what-the-heck-is-that-for" collection. After gluing the extensions in place, carefully drill the pivot holes in the extension parts (part C) and shoulder parts.

Sea Chest Hides the Works

The sea chest, menacingly guarded by the octopus, is a simple bottomless box that conceals and protects the arm extensions, pivot point and rotor cam. Drill the ends of the lid slots with a $\frac{1}{4}$ " drill bit and remove the waste between them on the scroll saw.

The rotor, drive shaft and cam assembly would probably make a decent science fair project by itself. See the plans and description on the final page of the article for all the mechanical engineering details.

Problem: Inertia.

Solution? Fishing Gear!

If there is a secret ingredient in the octopus whirligig, it has to be the tentacle counterweights. At first I thought all eight arm extensions could simply lean against the cam and the slightest breeze would cause them to be pushed aside by the rotating cam. Wrong!

When Sir Isaac Newton said, "a body at rest tends to remain at rest," (his "First Law of Motion") he must have been working on some early version of the octopus whirligig.

It was only when I connect-



There are other ways to drill the holes for the arm extensions, but this simple jig holds the arms in place perfectly as you drill the $\frac{3}{16}$ " holes for the arm extensions.



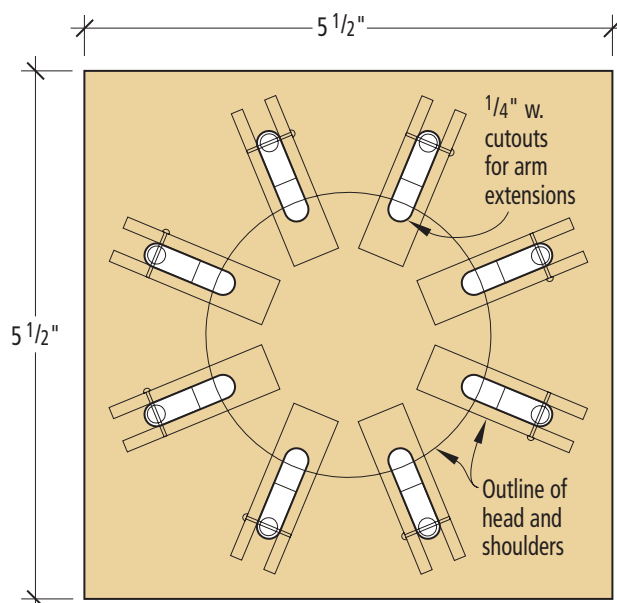
Drilling the suckers is just a matter of following the holes on the pattern (above).

to the ends of the extensions ($\frac{1}{4}$ ounces worked for me) that the whole thing came to life. The best way to visualize the arrangement is to think of the extensions as tubes on a wind chime. They want to dangle in space about halfway through their pivoting arcs. No more than two or three extensions should be contacting the cam while it is at rest. Because the greatest problem encountered by a whirligig is overcoming inertia (getting started) the counterweights help lighten the load.

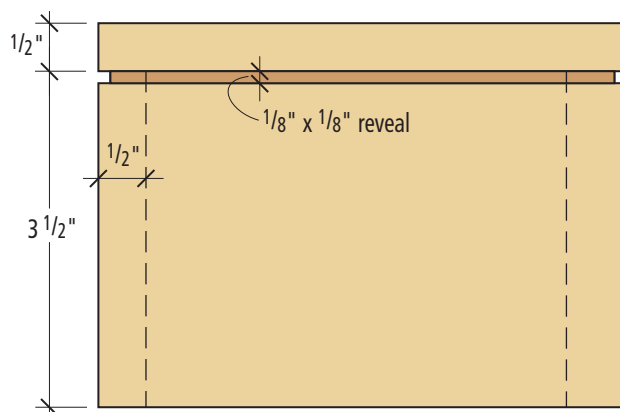
The Octo-perch

To levitate the octopus and sea chest above the vertical rotor, I came up with an assembly that looked (to me) like something out of a shipyard. It was designed to slip over the top rail of my deck. Because the design is totally arbitrary, I'd be interested to know if anyone can come up with a more elegant solution.

Although I'm now the proud owner of the only octopus whirligig on my block, the new staircase still lacks finials. I guess you could say I'm easily distracted. **PW**



Sea chest - Half-scale plan



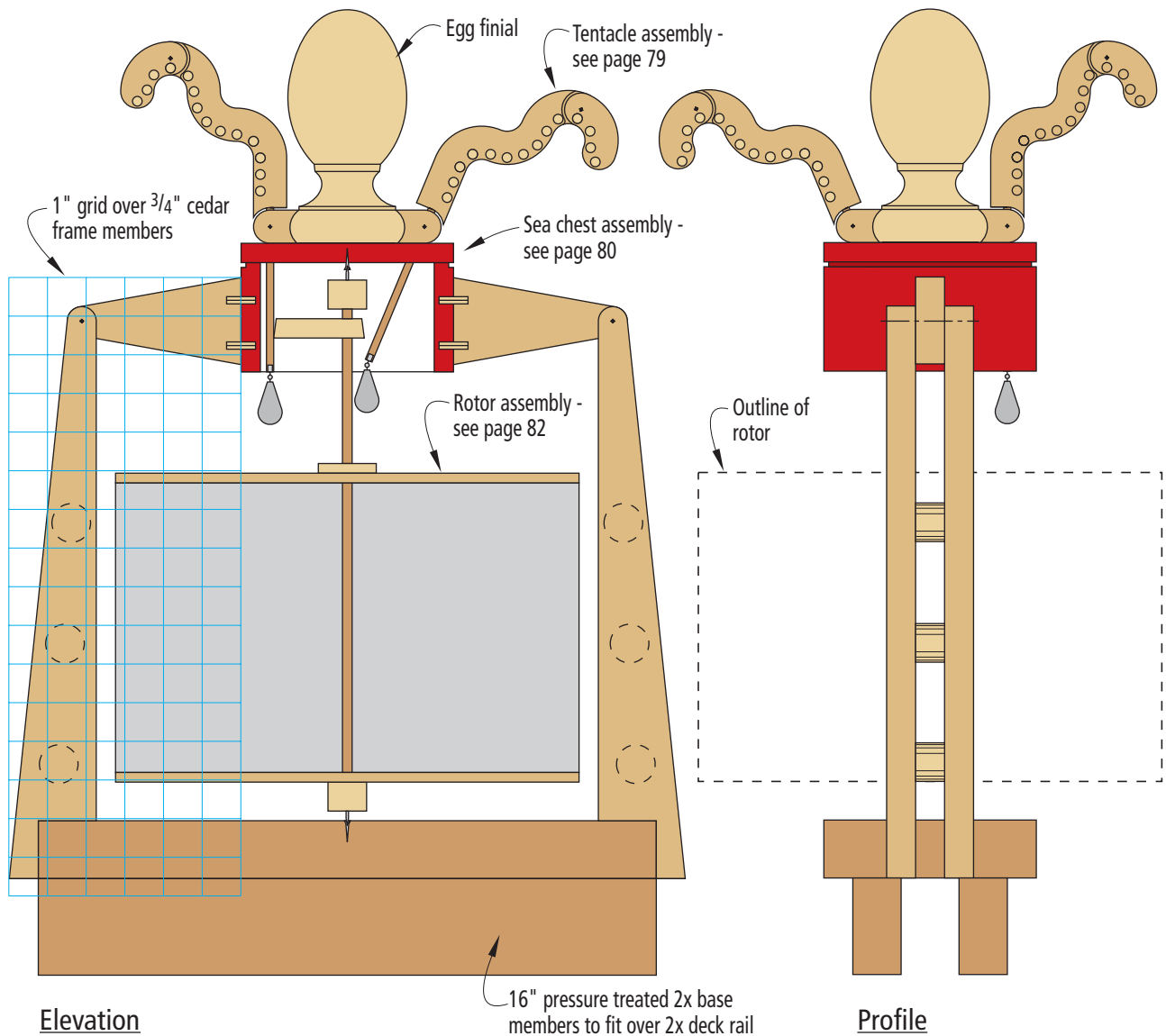
Sea chest - Half-scale elevation



Here's an assembly trick. Put the head upside down in a coffee mug to hold it in place as you add the tentacles.



This flywheel-driven "baby" octopus that I hatched in my shop eventually led to the fully tentacled mother.



ROTOR, CAM AND 'NEEDLE' BEARINGS

Most whirligigs employ some sort of multi-vaned propeller mounted to a horizontal drive shaft with a tail at the end to bring the whole assembly into the wind. Through the use of a crank-shaft or gear box, the axis of rotation is transformed from horizontal to vertical. This complex bit of mechanical engineering was simplified in the early 1920s by the Finnish designer Sigurd J. Savonius. The Savonius-type rotor that I used for the octopus whirligig has the advantages of always facing the wind and providing rotation directly about the vertical axis.

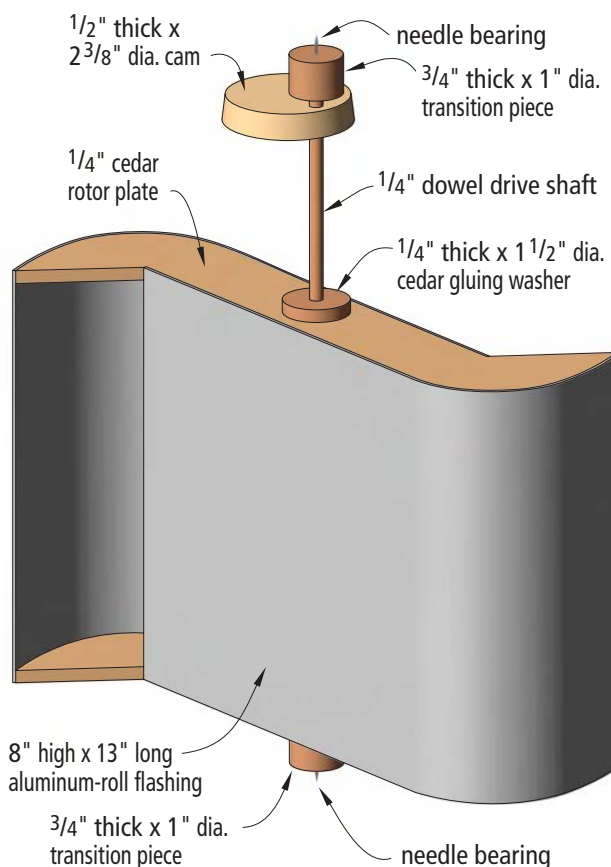
For the top and bottom of the rotor, I planed some cedar to $\frac{1}{4}$ " thick. The wind-catching sides are made using aluminum-roll flashing available at any hardware store. To join the elements of the rotor, I used epoxy and sheet-metal screws.

The cam is made from a smooth hardwood to reduce friction – in this case maple. The edge is beveled 5° so that only a sharp edge is contacting the pivoting arm extensions.

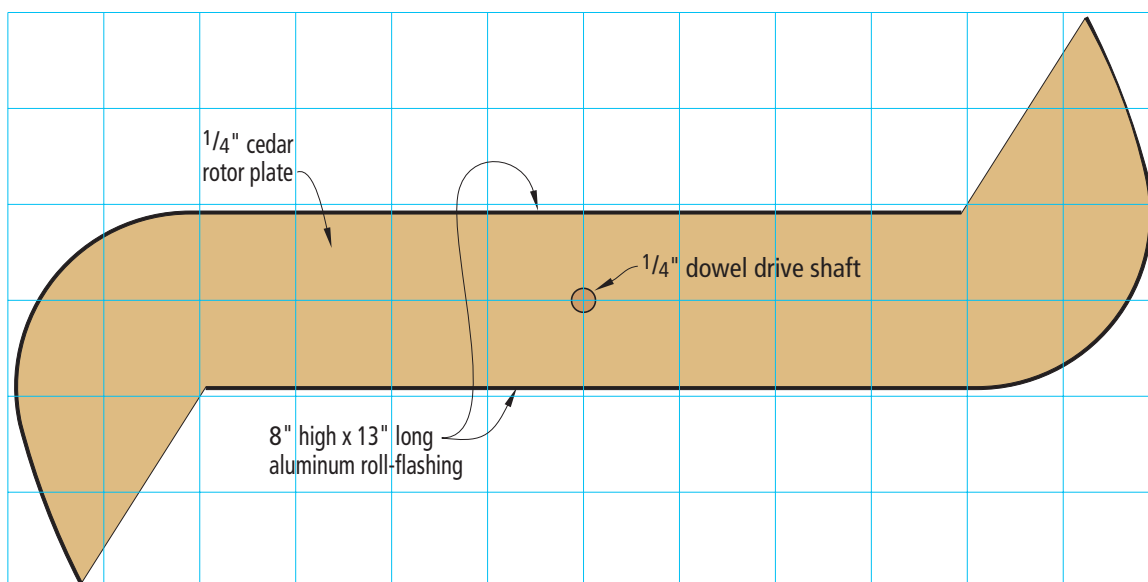
The "needle" bearings at the ends of the drive shaft are, in fact, clipped sewing-machine needles. Because it would have been extremely difficult to make plumb bores in the ends of the shaft for mounting the needles, I came up with an intermediate transition piece. With my adjustable hole cutter in my drill press, I made two $\frac{3}{4}$ "-thick x 1"-diameter disks. I bored a $\frac{1}{4}$ " stop hole on one face for the drive shaft and a $\frac{1}{16}$ " hole on the other for the needle.

Again using my hole cutter, I cut a $\frac{1}{2}$ "-diameter gluing washer from the $\frac{1}{4}$ " cedar stock. Mounted at the intersection of the rotor top plate and the $\frac{1}{4}$ " x 13" dowel drive shaft, it adds stability to the assembly by spreading the shear forces on the glue joint.

The rotor is then mounted in the whirligig with the needles resting in the cross-grooves of the smallest brass Phillips-head screws I could find.



Savonius rotor



Half-scale rotor



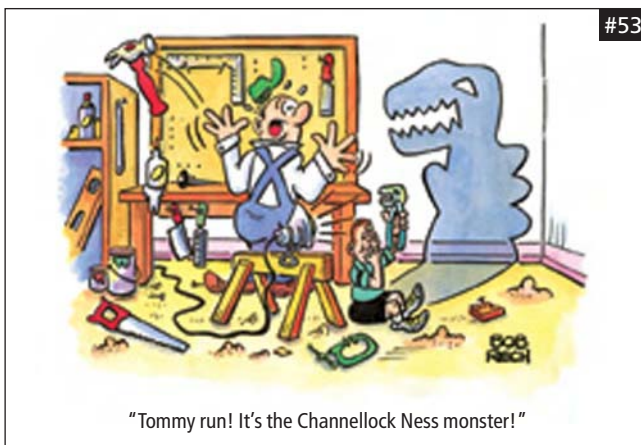
We Now Take E-mail Entries!

Submit your captions for this cartoon by e-mailing them to cartoon@fwpubs.com (be sure to put "Cartoon Caption #55" as the subject of your e-mail) with your name, address and phone number. Or send it to us on a postcard: *Popular Woodworking*, Cartoon Caption #55, 4700 E. Galbraith Road, Cincinnati, OH 45236 by **Oct. 5**. Winners will be chosen by the editorial staff.

The winner receives the Freud FJ85 Jigsaw with Electronic Cruise Control. This variable speed, 6-amp, orbital jigsaw has toolless blade change, and the cruise control keeps the blade speed constant under different loads to provide a finer, faster cut. The runners-up each win a one-year subscription to *Popular Woodworking*.



freud®



"Tommy run! It's the Channellock Ness monster!"

Randolph G. Bachrach, of Phoenix, Arizona, is the winner of our Cartoon Contest from the April issue and recipient of the Freud jigsaw. The following runners-up each receive a one-year subscription to *Popular Woodworking*:

"Quality time in Charlie's workshop came to a frightening halt when junior threw a monkeywrenchasaurus into the father-son bonding experience."

Angie Rommel, Wataga, Illinois

"Spotlight: \$10. Pliers: \$14. Scaring the pants off the old man: Priceless."

Rodger Green, Kearney, Nebraska

"Dad's overalls usually got soiled in the workshop, but never like this!"

Franz Geil, Northampton, Pennsylvania

Storing Finishing Materials

A few precautions will keep your finishes ready to use and your shop from burning down.

Storage is probably something you don't think much about until you start to accumulate a lot of finishes and tools, but storing your finishing materials properly will save you money and reduce clutter. And, in the case of flammable materials, proper storage could save your life.

There are three large categories of materials that need to be addressed when it comes to storage: flammable materials, products that can go bad if not stored correctly and finishing equipment that can be expensive to replace if stored improperly.

Flammable Materials

In terms of flammability, the finishing materials you use can be divided into two types: those that burn readily and can feed a fire that has already started in your workshop, and those that burn readily but can also start a fire all by themselves.

Almost all finishing products fit into the first category with the notable exception of water-based stains and finishes. If you have just a few small cans of flammable products sitting on a shelf, there's no particular reason for concern because they won't add significantly to a fire that's already burning so fiercely it engulfs them.

But once you start accumulating a lot of products, you should store them in a metal cabinet, ideally one that is designed for flammables. These are double-walled and commonly painted yellow. You want to keep a potential fire from getting to these products for as long as possible.

Oily rags fit into the second category and are probably the most dangerous item you can have in your shop because they can spontaneously combust. It is important to dis-



Photo by Al Parrish.

tinguish, though, that it is only oils that cure, such as linseed oil and to a lesser extent tung oil, that are a problem.

But because of misleading labeling on finishing materials, you probably should treat all products that thin with petroleum distillate (mineral spirits) as potential hazards. This even includes oil-based stains because manufacturers are now substituting

more oil for solvent to comply with regulations on volatile organic compounds.

Drying oils cure by absorbing oxygen, which creates heat as a byproduct. If the heat can't dissipate from a pile of rags, it builds up until the rags reach their combustion temperature and a fire breaks out. The obvious way to prevent fires, therefore, is to spread oily rags out so they are open to the air.

You can, of course, place oily rags in air-tight or water-filled containers, but you should keep in mind that this prevents spontaneous combustion only while the rags remain shielded from oxygen. When they're removed, they are still a fire hazard.

To allow the oil to cure so the rags are safe to throw in the garbage, hang them separately or spread them out on a table or the floor and let them harden. Unless I have a lot of rags, I usually just drape them over the edge of a trash can, making sure to avoid overlaps. Throwing rags with cured oil in the trash is no different, environmentally speaking, than throwing a piece of wood with a cured-oil finish in the trash.

Materials with a Shelf Life

All finishing materials will eventually go bad, but the time it takes varies considerably depending on the product.

The most obvious problem in most shops is water-based products that can freeze. Though they may survive a couple of mild freezes, it's unquestionably best if you store these products in a location that never freezes, even in your house if necessary.

Varnishes (including polyurethane varnishes) and oils exposed to oxygen go bad by developing a skin on the surface, or by turning into a gel, and then eventually hardening all the way through. Varnishes are much more susceptible to this than oils. (If varnish is still liquid under a skin, you can remove the skin and strain the varnish, and it should be fine to use.)

There are a number of methods to extend the shelf life of varnish, including:

- Close containers securely.
- Transfer varnish to smaller containers to minimize air spaces.
- Displace oxygen in a container with an inert gas (by using Bloxygen, for example).
- Turn the can upside down and let the skin form. Then when you open the can, the varnish will be at the top and fully liquid.
- Fill the can with marbles or clean rocks or rocks (silly in my opinion, but I needed to mention it because others suggest doing this).

Shellac begins losing its water resistance and ability to cure hard from the moment it's dissolved in alcohol. The deterioration rate of this finish is slow, so you can use shellac on furniture or cabinets with good results



Drying oils create heat as a byproduct. Wadded up oily rags can cause a disastrous fire. When drying out your rags, drape them over the edge of your garbage can or a bucket and don't overlap them.

for up to a year or so from when the finish was mixed, but you risk poor performance after that. Shelf life is extended if you store the shellac in a refrigerator or other cool place because this slows the deterioration.

Shellac in flake form also goes bad, especially the bleached or blonde varieties. You'll know that the shellac is bad if it doesn't dissolve properly. Again, the process is slowed if the shellac is stored in cool conditions and it is accelerated in hot conditions.

Lacquers and catalyzed finishes have a very long shelf life without any special care.

Dyes fade in bright light, so you should store these colorants in a dark cabinet if you keep them in glass jars.

Finishing Equipment

Finishing equipment includes brushes and spray guns. Here's how I recommend you clean and store your brushes:

If you intend to use the brush again in a day or so, you can wrap it in plastic wrap or hang it in its cleaning solvent: water for water-based products; mineral spirits (paint thinner) for varnish and oil; alcohol for shellac; and lacquer thinner for lacquer.

If you want to store the brush for several days or longer, use the following cleaning steps for each finishing material:

- For water-based products, wash the brush in soap and water.
- For varnish and oil, rinse several times in mineral spirits, then rinse in lacquer thinner or brush cleaner (a similar product) to



The final step in cleaning any stain or finish out of a brush is to wash it in soap and water until suds form easily. That's when you know your brush is clean.

remove the oiliness of the mineral spirits, then wash with soap and water.

- For shellac, wash in half-and-half household ammonia and water or rinse several times in denatured alcohol and then wash with soap and water.

- For brushing lacquer, first rinse the brush several times in lacquer thinner and then wash it with soap and water.

Shake the excess water out of the brush and return it to its holder or wrap it in paper to hold the bristles straight while they dry. Secure the paper with a rubber band or masking tape, and store the brush in a drawer or cabinet, or hang it on a wall.

To clean a spray gun, replace the finishing material in the cup with the cleaning solvent for the product, and spray the solvent through the gun. Do this right after you finish spraying so there's not time for the finish to harden in the gun. Including soap with your water will be more effective for water-based finishes, and lacquer thinner is the most effective solvent for all finishes.

Remove the air cap, fluid nozzle and fluid needle from the spray gun and soak them in the proper cleaning solvent or in lacquer thinner. If necessary, scrub them with a brush, such as a toothbrush. When everything is clean, replace the parts and hang or store the gun in a place where it won't get dirty. **PW**

Bob Flexner is the author of "Understanding Wood Finishing" and a contributing editor to Popular Woodworking.

A Lesson in Precision

After building a challenging project with a 'that's good enough' attitude, I learned how closely perfectionism and excellence intertwine.



When I saw a plan for a beautiful, solid-wood chess box, I knew I wanted to try to make one. It was a complicated project, requiring some skill and experience, but headstrong as any self-taught hobbyist, I dove right in to building it.

The chessboard is based on James Krenov's design of solid-wood squares, each dowel-joined to the others in a grid to compensate for wood movement of the different species. Two drawers below the top open to hold the playing pieces, and are flush to the corner blocks, nearly invisible when closed. I knew the project was going to be a challenge.

The biggest problem I had throughout the construction was a "faulty mindset." Too many times I was thinking, "It isn't exact, but surely that's good enough." This led to a compounding of errors that I was ready to shoot myself for later.

The start of my trouble was in thickening the lumber. If I had to have four matching drawer sides for two drawers, and one came off the planer $\frac{1}{16}$ " thinner than the others, I called it good and marked the narrow piece to compensate for joinery at the drawer front.

But when that happened at the backs of the two drawers, and they had to meet in the middle under the box top, a $\frac{1}{16}$ " shortfall in thickness meant the drawer back wouldn't reach the support for a double catch, and I had to fill in with a spacer.

If my dados in the corner blocks were a little deeper than $\frac{1}{2}$ ", I didn't worry. I knew a tongue would be glued in that space and it didn't matter. But it did matter, because the extra depth of the dado cut weakened the

outside of the corner block and it broke with simple handling before I got the sides glued together. It had to be redone.

When I thickened a board for the mitered top frame of the box, the entire length was just a bit thinner than called for, before mitering it in four frame pieces. They would all be the same, and I was running out of mahogany, so I decided to go with it anyway. But after cutting two stepped rabbets to receive the top, I didn't have enough edge left for under-carriage supports to cross the frame, and I had to cut them back to small blocks, out of the way of the drawer's travel.

This "comedy of errors" may sound familiar, and I know it's a recommended practice to produce a mock-up to work out such problems. If I do another one of these boxes, I'll know, and hopefully remember, the pitfalls to be avoided.

My biggest lesson though, after struggling through completion of the project, was in changing my faulty mindset. I had never needed to be a perfectionist, but in the end, this small carelessness had caused more problems than it was worth for what little time I saved during construction.

I once heard of an old man putting up a chicken coop with a novice woodworker for help. The young man lifted a beam and called down, "Is that the right length?"

The man hollered back, "Does it touch?" "Yeah."

"Nail it then."

I'm not building chicken coops. I'm try-

ing to follow directions someone has worked hard to make accurate on a fine wood project. I will now remind myself that it's just as easy to mark wood accurately to $2\frac{5}{16}$ " as it is to round off to $2\frac{1}{4}$ ". If I need sixteenths, it must be sixteenths, and measurements in the next increment will not be good enough.

A famous writing teacher named John Gardner said, "Circus knife-throwers know that it is indeed possible to be perfect, and one had better be. Perfection means hitting exactly what you are aiming at and not touching by a hair what you are not."

So, no more, "That's close enough" attitude. No more, "Does it touch?" Besides a responsibility to the material, there is a "caring" in this process, a slowing down to do what's right. I can't achieve excellence in anything I do without it.

I am going to school myself to inject more precision in my woodworking projects. Somewhere down the line, things will all fit together. Each step will lead flawlessly into the next, and the reward will be that soft, airy whisper of a drawer closing flush against a perfect surface. Maybe then I will feel I've finally "got it right." PW

Barb Siddiqui is a woodworking grandma in Wenatchee, Washington. She writes book reviews at WoodCentral.com and a "Starting Points" column at WomenInWoodworking.com. You can see her finished chess box at www.popwood.com/features/mag.html.