A Magazine Committed to Finding the Better Way to Build
Filled With Good Craftsmanship, the Best Techniques and No Ads

WOODWORKING MAGAZINE

Traditional Workbench Rediscovered

19th-Century Design Outworks Most Wimpy Modern Benches

Flush-Cut Saws: Meet The $22 Tool that Rips the Competition

Better & Simpler Hand-Tool Rack

Pumpkin Pine Finish: Chemistry Adds 100 Years in a Day

Bore Better: Become a Human Drill Press

woodworking-magazine.com ■ AUTUMN 2007

Contents

"The only really good place to buy lumber is at a store where the lumber has already been cut and attached together in the form of furniture, finished and put inside boxes."

— Dave Barry, columnist and author

HOLTZAPFFEL BENCH: PAGE 8

WALL-HUNG TOOL RACKS: PAGE 24

DISCOVER FLUSH-CUT SAW TECHNIQUES: PAGE 32

PUMPKIN PINE: PAGE 42

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Autumn 2007

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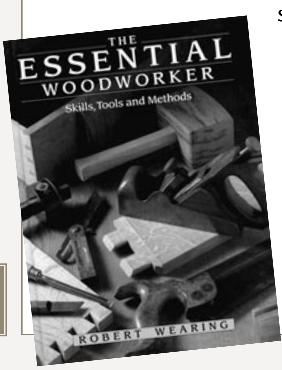
Highly Recommended

I'm often asked to recommend a book for people who want to learn hand tools. Here's my best recommendation: Robert Wearing's "The Essential Woodworker." It covers basic hand skills better than any other book. And it shows you how to put them to use to build a basic cabinet, table and drawer. You can find it used for $10 to $20.

— Christopher Schwarz



On the Level

Why I Waste Wood

No one told my eldest daughter that it would be difficult to make clothing by hand and by eye – without a pattern, a machine or even a lesson.

And perhaps because no one told Maddy that it would be hard, it wasn't. During the last three years she has made more than a hundred garments for her stuffed animals, from jogging suits to sequined disco pants to chain mail. She works entirely by instinct. Never measuring. Just cutting, stitching and improving.

Now, every parent will tell you that their child is remarkable, but I don't think that's the case here. I don't think Maddy is a stitching savant. I think that she simply is acting on an impulse and without fear of failure.

It would be easy (read: lazy) for me to now end this column with that same advice about woodworking: Don't be afraid; just get to it. But I know that the fear of failure can be crippling.

For example, last week I taught Maddy how to pump gasoline. Learning that common task was so stressful that by the end of the lesson, her hands were trembling a bit as she yanked the receipt from the pump. At first I was bemused by her trepidation. But then I realized the difference between pumping gas and pushing a sewing needle. It was the raw material.

"Don't fear slow, only fear stop."

— Chinese saying

Maddy has a lifetime supply of cloth in our basement, thanks to the women in my life who buy it for her. And when she needs more sequined fabric to make a disco jacket and floppy hat to match the pants, it will cost her a dollar or two for a supply that will last many years.

Now consider gasoline: It's precious, poisonous and explosive. So here's my real point: I think that wood is a lot more like cloth than it is like gasoline.

This statement might be hard for some of us to swallow at first. It was for me. I'm a conservationist at heart, and saving the trees always seemed like a good idea when I was growing up.

But home woodworkers aren't really the source of the problem when you talk about deforestation, which I know is a critical problem in some places on the globe. Several years ago I toured the hardwood forests of Pennsylvania with a group of journalists and watched loggers cut down enough cherry trees in an hour to last me more than 100 lifetimes of building furniture.

It was that trip that changed my view of the raw material we work with. Before that moment, I would squeeze every single part of a project out of the fewest number of rough boards, even if that meant compromising the design or aesthetics. I would allow myself to use a board with a less-than-ideal grain pattern in a face frame or door stile or stretcher. This, I argued to myself, was being a good steward of the forest.

Now I see things differently. I get only one chance to make each project. And the fate of that project – kicked to the curb or cherished by my grandchildren – depends on the choices I make today with regard to its design, grain, joints and finish.

I don't throw away tons of wood, but I'm not afraid to plow through lots of it to find the right board. I'm not afraid to make a lot of test cuts to get a tight joint. And I'm not afraid to make a lot of sample boards to get the right finish. My leftover pieces end up as interior parts for a future project, as kindling or as compost at the dump. So here's my confession: I now throw away more wood than I ever did before.

But here's how I rationalize that choice: The more wood I go through, the better my end result is. And wood is a renewable resource. We can get it almost anywhere, even rescuing it from the city dump if we so desire. Furthermore, wood is inexpensive when compared to the hours of labor invested in any piece of fine workmanship.

All this makes me bristle when I see companies hawking virgin plastic products under the guise of "saving a tree." Where do they think plastic comes from? It comes from petroleum.

So consider this: We can (and should) always plant more trees (or make more sequined cloth). Compressing dinosaur poop for a million years, however, is another matter. WM

Christopher Schwarz
Editor

Letters

ILLUSTRATIONS BY HAYES SHANESY

A Forecast for Successful Fuming

My nephew and I are constructing some quartersawn white oak frames to hold some Motawi tiles that my wife purchased.

We need some advice on fuming. (Yes, I know it's dangerous.)

My wife's family is in the seed and fertilizer business, and have about 7,500 gallons of NH3 on hand, which my brother-in-law tells me is 30 percent ammonia in layman's terms. I think it should work for fuming.

Our question is: Do we need to wait for warm weather (we live in Iowa) to fume?

We will wear respirators and eye protection when we place a small amount in a pie pan in the small plastic enclosure box that we are making for the frames. We will try a sample piece first.

We have read quite a bit about the fuming process, and we are fortunate to have the contacts to get a quart of the ammonia to use when we get the frames finished. We just need to know if the weather should be warm.

Greg Humphrey
Fort Madison, Iowa

Greg,
It sounds like you're going to be doing this outside (which is a good idea) and if that's the case, you'll have better results in warmer weather. The fuming process depends on the liquid ammonia evaporating, and as with water, the evaporation will go more quickly with a warmer temperature. If you're building a tent, a very small heater would also be effective.

The agricultural ammonia should work just fine. I get mine from a blueprint-supply company, and it's about 26 percent, so what you have will be slightly stronger, and should take a bit less time. Test some pieces and be careful.

Robert W. Lang, senior editor

Can a Leg Vise be Adjusted Without Losing Pressure?

The Roubo workbench you made (Autumn 2005) has inspired me to build my own. I plan to incorporate a leg vise, and I have a few questions.

I know that the farther away the parallel guide is from the vise screw, the more powerful its grip can be. However, I would like to place it higher up on the leg vise, so that when I do have to change the pin or put a block down there I will just have to bend over slightly rather than squat down. I plan on putting the vise screw 9" from the top of the bench like you did. So, how much higher do you think I could place the parallel guide and still maintain good, solid clamping pressure to hold pieces for carving and chiseling?

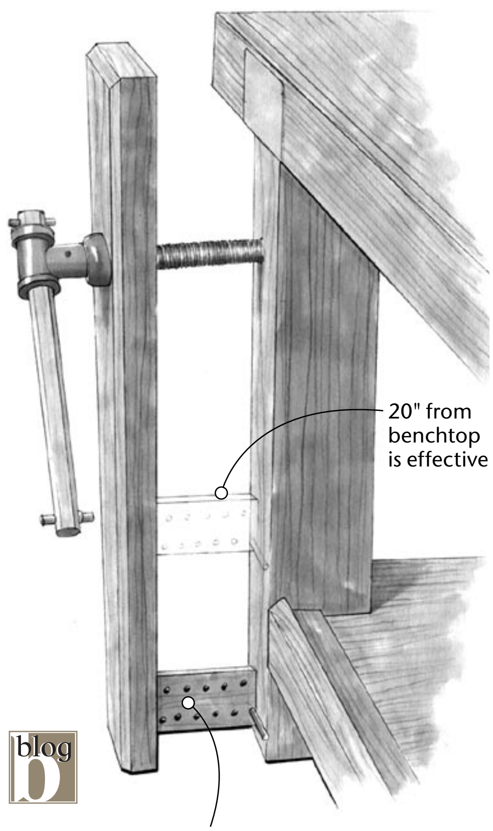
I was planning on placing the parallel guide 20" from the benchtop instead of placing it at the floor. Would this result in a significant decrease in clamping force?

Jason Wood
Ramsey, Minnesota

Jason,
You are going to be fine with your parallel guide at 20" from the benchtop. I went out to the shop and checked the pressure by using a small block of wood as a fulcrum at 20". I couldn't even tell the difference from what I normally get from the vise with the guide at the floor.

The real reason the parallel guide is at the floor is to make it easier to cut the open mortise in the leg for the parallel guide. Leg vises have power to spare.

Christopher Schwarz, editor



Truck Restoration Finish Advice

I am restoring a 1957 GMC truck. The step-side bed has wood strips in it. There is a choice of kits with either pine or oak for new replacement wood. I am thinking of using the oak. However, I have two questions:

1) Is oak the better choice for an outdoor application such as this?

2) What type of finish would be good?

There are so many products out there, and I have seen some that have been exposed to the extreme heat and sun we get here near Las Vegas. They blister and peel in less than a year. In the truck bed there really is no way to reapply the finish once it is in place on the truck bed due to the steel supports and runners used to hold the wood in place.

Jack Sivertson
Henderson, Nevada

Jack,
I would definitely use oak and preferably white oak (which is actually more brownish in color). White oak is not only harder than red oak, but it's a wood that's actually good for outdoor use.

As to finish, buy the most expensive marine varnish you can find – the kind used on old Chris-Craft boats. It's expensive because it's a "long oil" and has ample ultraviolet (UV) light-resistance additive. The extra oil, making it a "long oil," keeps the finish more flexible, which helps with the expansion/contraction problem you'll get with high heat. The UV additives are like "sunglasses" for the wood. UV light degrades wood fiber and when this happens, the wood to which the finish is literally stuck degrades so the finish has nothing more to adhere to. That's when the blistering occurs.

Also, be aware that no varnish will be permanent in the sun. You're going to have to re-apply the finish in the future. When the truck's all done but the wood finishing, you could just send it my way and I'll take care of that for you. It might take a couple years though!

Steve Shanesy, publisher

Can Mortise Chisel Handles Take a Good Beating?

Your piece on mortising chisels (Spring 2007) was, for me at least, dead on-target. I had been considering the Ray Iles chisels, but was hesitating for two reasons. First, I have three sets of mortise chisels already (both Sorby's London Pattern and heavy-duty monsters from Two Cherries). Second, I was considering the Lie-Nielsen ones.

The one issue not addressed in your article is the longevity of the handles. So many authors have noted how common it is to find "pigsticker" pattern chisels with cracked handles. I have seen quite a few of these with makeshift repairs generally consisting of wire neatly and tightly wrapped around a cracked handle. For this reason, I was considering the Lie-Nielsens with their socket handles. However, after your glowing review, how could anyone resist purchasing the Iles' products?

Mind you, I'm still considering the Lie-Nielsens, but they're going to have to wait for next year's capital budget.

Also, the brace in the photo on page 19 of the Spring 2007 issue is quite substantial looking; I couldn't put my finger on the model or manufacturer. Would you mind sharing who the manufacturer was?

Larry Ewing
Chicago, Illinois

Larry,
The Ray Iles chisels take a heck of a beating. I have one of the first sets made, have used them quite a bit and am impressed. I don't think a home woodworker would ever have to worry about the longevity of the handles.

And the brace? It's the best brace ever made. Ever. It's a North Bros. Yankee brace. You can find them on eBay. Also, tool dealer Sanford Moss sometimes has some to sell: sydnassloot.com/tools.htm.

I can't say enough good things about the North Bros. It's the Cadillac.

Christopher Schwarz, editor

Benchtops and Bench Dogs

I would like to build my workbench so it is stout enough for handplaning activity and occasional mortise chopping. I can get a laminated maple top that is about $1\frac{3}{4}$" thick for about \$150, which seems the route to go. I have a small shop, so 24" x 60" will do. I am concerned if $1\frac{3}{4}$" is thick enough, as I do not relish the task of laminating my own top to achieve more thickness. Will this be sufficient to prevent flexing?

I also like the concept of using the Veritas bench dogs and Wonder Dogs so as to eliminate the hassle of making a tail vise. The jaw of the Wonder Dog appears to be about $\frac{1}{2}$" thick, so planing at that thickness or less will be problematic, right?

I am left handed so I assume I should put the face vise on the right end of the bench when facing it, correct?

Please also note that the nice Southern yellow pine you use is not available in my neck of the woods (Minnesota) but I suspect almost anything from the local big box stores can be used for the under frame of the bench.

Peter Borth
Maple Grove, Minnesota

Peter,
On workbenches: You should be fine with the commercial top. Maple is quite stiff, and you're only talking about a short span. When you mortise, simply work over the legs to avoid flexing the top. And you can use any wood for the base, even white pine.

The Veritas Wonder Dogs are actually $\frac{5}{8}$" thick, which is their only real disadvantage. You can work around the problem with thin wooden shims if you need to.

And you are exactly right about reversing the face vise/end vise positions for a lefty.

Christopher Schwarz, editor

Wood-selection Woes

In one woodworking course that I took, the instructor said he no longer uses kiln-dried wood for his projects; instead he uses air-dried lumber. In another course, the instructor said that he only buys so-called "rough and ready" lumber for his projects. And, recently I read that one should not use S2S lumber. But, another of my woodworking instructors sees no particular issue with S2S stuff, as long as you buy it thick enough to "re-mill."

So, what's a fellow to do?

Dave Raeside
Norman, Oklahoma

Dave,
The question is a great one, but I'm afraid my answer won't be definitive. I think it is, for the most part, a white wine versus red wine question.

There is great advantage to using air-dried lumber in some cases. Some species, such as walnut and redwood, are often steamed during processing to migrate some of the color from the heartwood into the sapwood. The result is that the boards have less color overall. I think steamed walnut looks rather flat when you compare it to the stuff that hasn't been steamed.

However, air-dried wood is less likely to be stable and acclimated to its environment because of the unpredictable nature of the drying process. As a result, you need to be more careful when using air-dried wood and checking its moisture content to ensure you don't have any surprises ahead when you mill your material.

"Basically, I no longer work for anything but the sensation I have while working."
— John Gay (1685 - 1732)
English poet and dramatist

You also need to be more careful with air-dried wood when it comes to mold and fungus. Kiln-drying kills these organisms; air-drying does not. Also, when it comes to softwoods, kiln-drying will crystallize the wood's resins, making the boards less sappy and nasty on your tools.

As I see it, the rest is up for debate. The kiln-drying people say their wood will have fewer drying defects. The air-dried people say they can get the same yield when drying is done with care. The air-dried people say their wood is superior in that the kiln-dried stuff has a "dead" feeling. I've never experienced this, however.

I work with both. Instead of judging the wood by the process that dried it, I judge the wood on its grain, figure, defects and moisture content. If the boards meets all, or at least most of, my criteria, I'll buy it and use it.

On the subject of rough lumber versus S2S or S4S, this is a question that is more about your tooling and your time.

You'll save money if you buy rough lumber, but you'll need heavy-duty machinery to process it and allow more time in your schedule for processing. You'll also face more surprises with rough lumber (both good and bad) because beautiful figure and ugly figure can be obscured when the board is in a rough form.

If you buy surfaced stock, you'll be better able to judge the figure of what you are buying and it will take less time when you are processing it, but it will cost more and you do need to be more concerned about warping, twisting and bowing. Surfaced stock that has been poorly processed or stored will be more warped. So buying over-thick stock is a typical fall-back position.

So this debate comes down to judging the stock in front of you. If you are looking at rough stock, you need to develop an eye for picking out good figure in rough material. If you buy surfaced stock, you need to be acutely aware of twisting and warping. And, you have to consider the time factor and extra cost.

Christopher Schwarz, editor

In Search of the Perfect Tenon

I have been making a carcase using mortise-and-tenon joinery. I cut the tenons on my table saw using the dado blade and left a little extra to trim off for a good, snug fit. Then, I made the mortises using my drill press and squared up the mortise using chisel and mallet.

The problem I found with using a shoulder plane on the tenons to size each for its respective mortise, was that I frequently ended with the tenon tapering toward its end. I even clamped a good straight piece of oak on the piece I was working to keep me referenced square. I used the plane at waist height and used my body to try to get a nice fluid motion back and forth.

Any other hints for me? Also, my mortises were not perfect but I figure I will get better each time I do them. Should I switch to mortising chisels instead of bevel-edge chisels here?

Michael Schnurr
Ames, Iowa

Michael,
This is an interesting problem with many valid solutions. Here are a few that spring to mind.

1. When you hold your shoulder plane, focus the downward pressure directly over the bevel of the cutter to keep the tool in the cut and consistently cutting. I place my fingers right over the blade when grasping the tool.

2. Count the strokes you are making near the shoulder and near the end of the tenon. Be careful about overlapping the cuts as you get comfortable with using the shoulder plane. It is a finesse tool. Speed will come later.

3. Alternately, disregard all the advice above and embrace a tenon that has a slight taper. Some woodworkers swear that a slightly tapered tenon can be a good thing. They worry that a piston-fit tenon will scrape all your glue away from the mortise walls. A taper will help spread the adhesive evenly and a tenon has plenty of strength, even when tapered. I personally don't try to achieve a slight taper in my tenons, but if the end tapers a bit, I don't fret.

4. Try a different tool approach. You can use a router plane and a scrap of wood that is the same thickness as your tenoned piece to produce dead-perfect tenons. If you have a router plane, this is worth trying. If you don't have a router plane, I would keep practicing with the shoulder plane.

As to your chisel question, I used bevel-edge chisels for cleaning mortise corners for many years. That works fine. You don't have to have mortise chisels to cut mortises. They just make the job easier when hogging out material from scratch without drilling out material first.

Christopher Schwarz, editor

Details on the Shop Boxes

I am thinking of building the knock-down workstation in *ShopNotes* Vol. 15 Issue 87. The workstation includes a sort of I-beam in its design. However, I was recently looking at your blog on popularwoodworking.com and noticed the "I" beams you constructed for your shop. What

are the dimensions for those I-beams, and what would you consider the ideal length?

I already have some heavy-duty sawhorses and I think your I-beams and those sawhorses will do everything I need – and then some.

Richard D. Welsh
Washington, D.C.

Richard,
The I-beams, along with the boxes they sit on, were featured in the Autumn 2005 edition of Woodworking Magazine.

The three plywood pieces are $\frac{3}{4}$" thick x $4\frac{3}{4}$" wide. The top and bottom piece have a $\frac{1}{4}$" dado for the vertical center piece, making the overall height $5\frac{3}{4}$". The set I have now were ripped from a full sheet of plywood, so they are 96" long. Depending on the work you do, a 4'-, 5'-, or 6'-length might be more manageable. I can't take the credit for these – they are a common item in cabinet shops in Cleveland, but I don't think I've seen them elsewhere.

Robert W. Lang, senior editor

Drawbore v. Pegs: Which Offers More Holding Power?

I tend to get *Woodworking Magazine* and read the articles as I find a need for the skill. This week, I am making frame-and-panel doors with hand-cut mortises, so I studied "Mortising by Hand" in the Spring 2007 issue. I hope I can end up with a $\frac{7}{8}$"-thick frame, and want a $\frac{5}{16}$"-wide mortise.

While reading the same issue, I came upon Glen Huey's article on pegged joints. I had planned to use drawbore joints as you described in the Autumn 2005 issue. I think I would get more holding power. Can you make a comparison?

Don Boys
Hope, Michigan

Don,
You raise an interesting question. I don't think that either method (simple pegging or drawboring) strengthens the joint in all cases. In fact, any peg has the potential to weaken it if the joint is subjected to sudden stress. That's because the peg can rip up the mortise and make the piece impossible to repair.

However, the peg can provide other benefits. A simple non-drawbored peg can keep an assembly together if the glue fails in the joint. If the assembly isn't subjected to sudden shocks, the joint will only become loose instead of falling apart. This can be an advantage in some cases.

A drawbored peg offers you other advantages. If the wood is a bit wet, it will keep the assembly tight as it dries. If your cheek fit is loose, it will tighten up the joint. If you cannot get a clamp across the assembly, it will pull up everything tight.

So – bottom line – I would leave the joint unpegged completely if you have a nice tight fit, are using modern glue and the assembly is unlikely to see much stress.

Christopher Schwarz, editor

Does Table Stand Test of Time?

I was thinking about building the trestle table from the Autumn 2006 issue. I was curious, now that some time has passed, have you been happy with it? Has it been stable? Do you like the size? Are there any improvements you would make if you were building another one?

Rob Parsons
Peachtree City, Georgia

Rob,
We've been very pleased with the table. It has remained sturdy and the design specs (based on classic formulas) make it comfortable for sitting. The only change I would make is that I wouldn't use through-chamfers on the post. I'd stop them. That would look more traditional.

The table also looks good without chamfers (as in the one I built for my home). WM

Christopher Schwarz, editor

HOW TO CONTACT US

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Shortcuts

ILLUSTRATIONS BY HAYES SHANESY

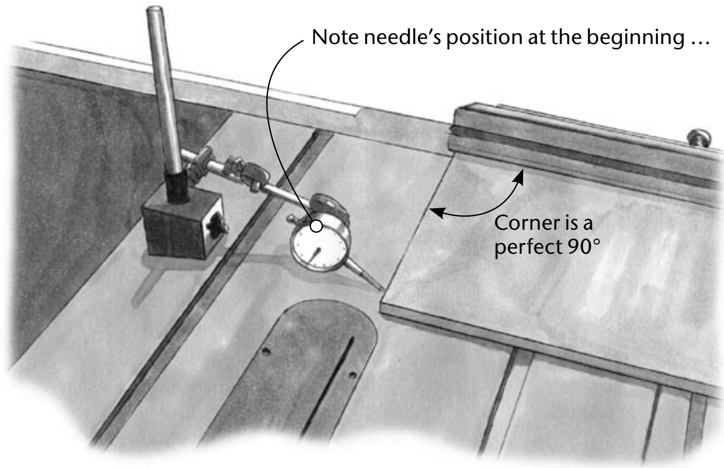
Set a Miter Gauge or Sliding Table Perfectly Square

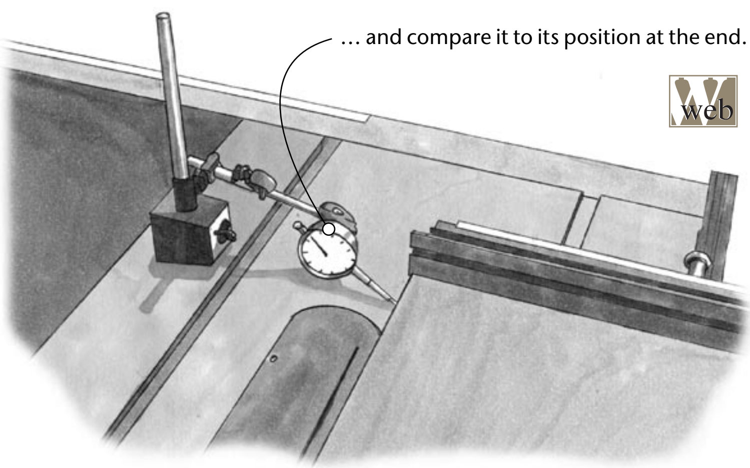
Setting a table saw's miter gauge or sliding table to make a perfectly square crosscut can be an endless cycle of cutting, testing and tweaking. I've found a quick and easy way to square my crosscutting devices using an inexpensive dial indicator with a magnetic base and a known square surface.

Here's how. Place your known square surface in position against your miter gauge or the fence of your sliding table. I use a machinist's square with a thick blade. You also could use a piece of MDF, UHMW (ultra-high molecular weight) plastic found in jigs, or even plywood. The key is to have a piece of work that has a square corner, smooth edges and is at least $\frac{1}{4}$" thick.

Now stick your dial indicator to your table saw's top and place the plunger against one corner of your square. Zero out the needle of the dial indicator. Now push your miter gauge or sliding table forward, as if you were making a cut, and watch the needle on the dial indicator. If it moves off zero between the beginning and end of the cut, then your gauge or sliding table needs adjustment. Simply adjust your gauge or table until the needle stays on zero as you move the square past the dial indicator. (Actually, being a couple thousandths off won't hurt anything, but I like to shoot for perfection.) Then go to work. No test cuts are necessary to confirm the setting.

Kelly Mehler
Berea, Kentucky





Sticks and Nails Slash the Time You Must Wait for a Finish to Dry

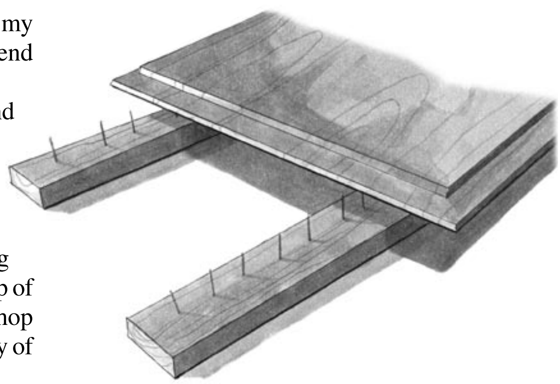
Whenever I finish a piece of furniture, I use my "finishing sticks" to cut in half the time I spend finishing a project. Here's how they work:

Make your finishing sticks from narrow and long offcuts. With a brad nailer, drive an array of $1\frac{1}{4}$"-long brads through the sticks. Use the same brad size, no matter what the thickness of your offcuts is.

Now lay these sticks out in your finishing area. When I spray lacquer I put a stick on top of each of my sawhorses. When I finish in the shop with a rag-on or brush-on finish I put an array of them on my bench.

When finishing furniture, almost every component has a show side and a non-show side. So begin finishing the non-show side with your work on the sticks. With the finish still wet, flip the work over onto the sticks and finish the piece's edges and the show side.

In almost all cases, the nail tips create only small indentations in the finish. These can easily be rubbed out so you can't see them. Or you can just leave them because they are barely noticeable and they will be on the underside of the shelf or the inside of a door.



This trick, simple as it is, cuts out a significant amount of time from your finishing process.

Christopher Schwarz, editor

Two Quick Table Saw Tricks

■ The purpose of a zero-clearance insert on the table saw is usually seen as preventing tear-out on the bottom of the work and keeping thin pieces from falling through the blade slot. But it has another function that can increase accuracy and speed your setups. The kerf makes it incredibly easy to set the fence, a stop on the miter gauge, or a piece of wood to be cut at the exact location of where the blade will be when cutting. Just line up a pencil line on your work to the kerf in the insert instead of with a tooth on the blade.

■ The hollow, square tube that serves as the front rail of most rip fence systems is a great place to keep the arbor wrench, push stick or other small item in easy reach, yet out of the way. Some saws have a plastic cap on the end of the tube. Throw the cap in the trash and keep the wrench in the now-accessible space.

Robert W. Lang, senior editor

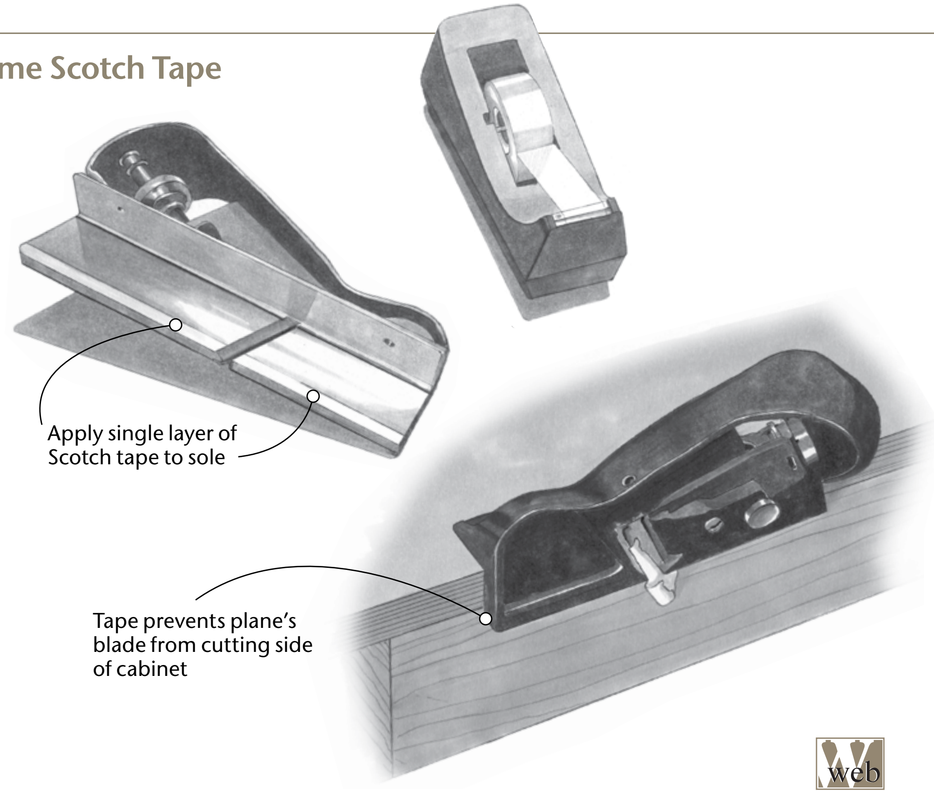
Trim Face Frames Flush With the Help of Some Scotch Tape

When building cabinets, I like to attach the face frame to the cabinet with a little bit of an overhang, then trim the face frame flush with the outside of the carcase. A bearing-guided flush-trim router bit works well for this, but if there are indentations on the carcase they will be transferred to the face frame, or sometimes I don't want to take the time to install the router bit just for one quick operation. Also, while the router is my favorite portable power tool, I do admit that it is a bit noisy.

I figured out a quick and easy way to use an edge-trimming plane as a flush-trimming plane, similar to a flush-trim router bit. The problem is that I run the risk of making some cuts into the carcase if I take off too much material. The solution I found was to put a piece of Scotch tape on the lowest edge of the plane in the positions shown in the drawing. The thickness of the tape is about the amount that the plane iron protrudes through the sole of the plane. (I didn't actually measure this.) The tape ends up being the equivalent of the bearing on the flush-trim router bit.

With the tape in place, I trim the face frame flush until the plane stops cutting. Then, the work is done.

Steven McDaniel
Humboldt, Tennessee



Plane Irons are Good for More Than Just Planing

The plane iron in your block plane or bench plane is useful for many workshop tasks once you remove it from the plane's body.

I use a sharp block-plane iron to slice off runs and sags left behind when I apply too much finish to a workpiece. Be sure to let the finish dry before attempting this. Place the plane iron flat on the work and move it forward into the sag. The cutting edge will slice the sag off the surface of your work. Then you can re-sand the piece and apply the next coat. This trick is both faster and more effective than sanding out a run or a sag.

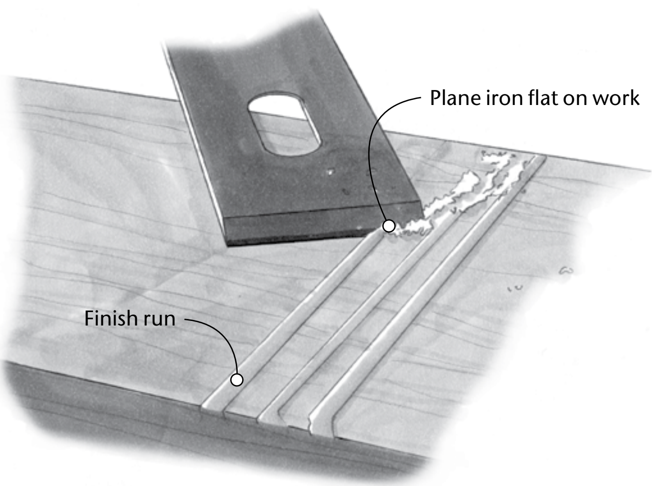
I also use my plane irons as scrapers. The iron from a smoothing plane or jointer plane works quite well as a scraper to remove localized tear-out. These irons typically have a slight curve to their cutting edge so the corners won't dig into your work when you scrape with them. To do this, hold the iron upright like a scraper and use the unbeveled side of the iron as the cutting edge. Because there's no hook – unlike what you find on a traditional card scraper – the scraper will take only light cuts. This can be a good thing.

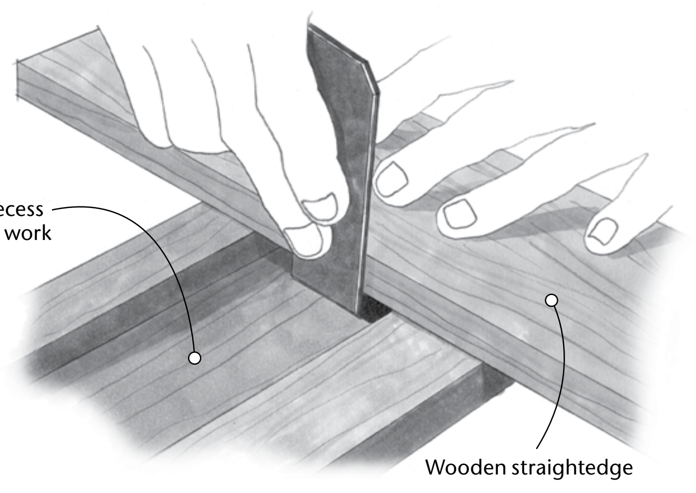
I also use my plane irons like a wide paring chisel. Sometimes I need to remove a thin sliver of waste in a corner and need an accurate and clean cut; I'll use a wide plane iron instead of a chisel. This is ideal when surgically removing junk from a rabbet or tenon shoulder. The wide iron can remove the waste in one clean cut – a typical bench chisel will require several overlapping cuts, and you might not overlap them all perfectly.

Longer plane irons are also excellent marking and cutting knives. When I need to mark an accurate line across a piece of work with a recess, I'll lay a wooden straightedge across the work and run the unbeveled face of the iron against the straightedge and use a corner of the iron to mark the work. This gets me into places my other marking knife won't go because its handle gets in the way or the blade isn't long enough.

I'll also use a plane iron in a similar fashion to slice thin veneer strips. I'll lay the straightedge on my cut line on the veneer. Then I run the iron against the straightedge like a knife. The mass of the iron is an asset with this cut – you don't need to press down as hard as you would with a typical shop knife.

Christopher Schwarz, editor





Change the Height of Your Benchtop in a Snap

A low workbench is great for handplaning and assembly, but it can be murder on older backs or when trying to do close-quarters work, such as inlay. You could build two workbenches at different heights, or you could make your bench convertible with this trick we picked up years ago from an English woodworking book.

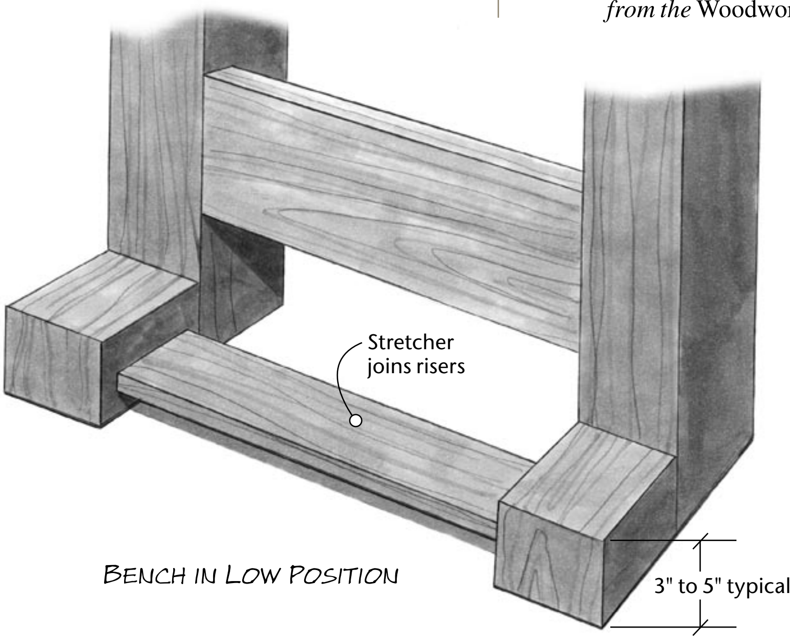
This trick comes from English author Robert Wearing, who describes it as a solution used in the manual-training schools for dealing with children both young and old.

First decide how low you want your workbench to be for planing and build it to that height – our 6' $3\frac{5}{8}$" editor finds that 32" to 34" high is right for him.

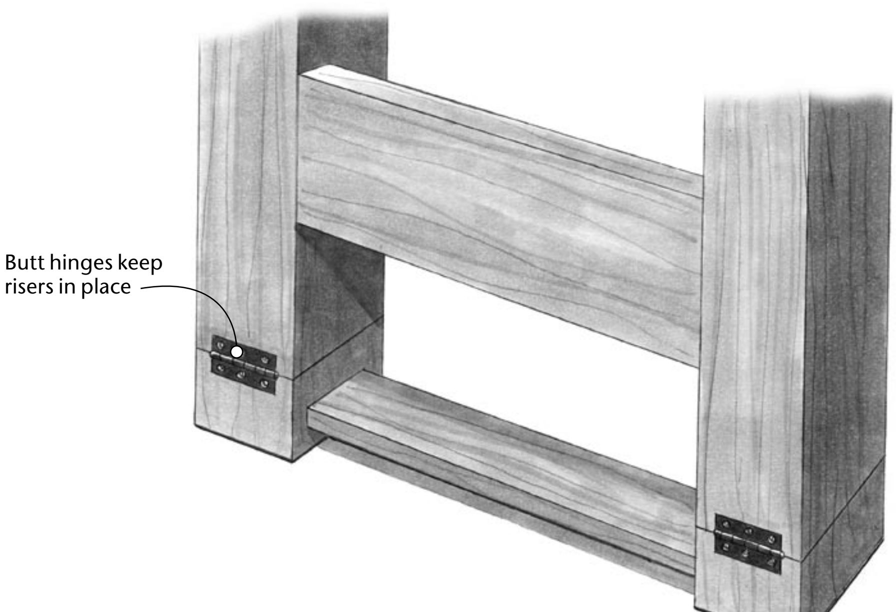
Then build simple risers that are the same width as your workbench and are as high as the height you want to add to your bench. Want to add 5"? Make the risers 5" high. Put the risers in place under your bench and attach the risers to your legs using a cabinet hinge – one hinge on each leg.

When you want to lower your workbench, simply lift up the top a little and fold each riser out from under the legs and set the bench's feet on the floor. When you want to raise the workbench, lift up the top and fold the riser in under the legs.

from the Woodworking Magazine *staff*



Bench in Low Position



Bench in High Position

How to Make Any Size Dowel Using Your Table Saw

When working with dowels, it seems we never have the exact diameter we need for the task at hand. Or perhaps we need a truly odd-size dowel for an odd job.

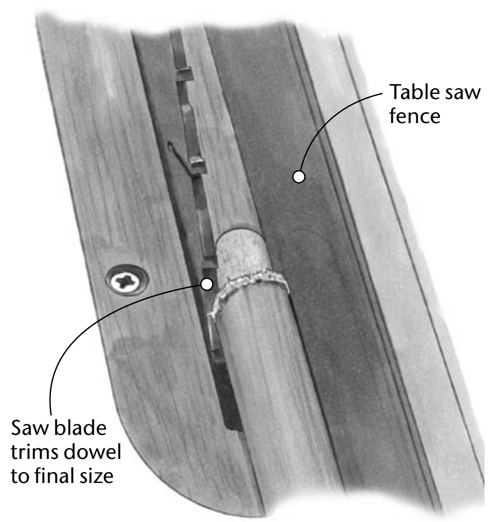
Here's the fastest and easiest way to remedy that problem – and you don't need a lathe.

Get a dowel that is slightly larger than the diameter you require and is at least 24" long. Set the fence on your table saw to remove half of the waste. Here's an example: Say you have a $\frac{5}{8}$" dowel and need a $\frac{1}{2}$" dowel – you are going to waste away $\frac{1}{8}$". Half of that is $\frac{1}{16}$", so set your fence to $\frac{9}{16}$". Raise your blade up high if you want a clean cut (don't forget the guard) or you can keep the blade fairly low if the final appearance of the dowel isn't important.

Turn on the saw and feed the dowel into the space between the fence and blade. With your hands safely away from the blade, rotate the dowel and feed it forward. I like to rotate it clockwise, but both directions work. The sides of the teeth of the sawblade trim the dowel to your finished diameter.

When you have fed enough dowel into the blade for the job you need, turn off the saw, let the blade stop then remove the workpiece. WM

Roger Amrol
Columbia, South Carolina



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The Holtzapffel Workbench

blog

This 19th-century design is a bit German, a bit French and entirely ingenious. Plus, we came up with a way around the typical sagging tail vise.

The Industrial Revolution did as much harm as it did good to the world of woodworking and workbenches. The Industrial Revolution created machines that could make metal handplanes and handsaws in tremendous numbers, but it also created the woodworking machinery that made those hand tools obsolete.

The Industrial Revolution created the manual training movement (shop class) when good-minded people thought that children should learn to do something with their hands (what with the entire world becoming automatic and mechanical). And the Industrial Revolution created both the market for and the ability to manufacture workbenches to encourage the spread of the manual-training movement.

And this, in my opinion, changed the course of workbench design in the 19th and 20th centuries. The old-style craftsman-made benches were displaced by the modern manufactured form that is dominant still today.

But in 1875, when the world was balanced on a precipice with its rural past behind it and the modern age spread before it, this bench was published in an English book: “Holtzapffel’s Construction, Action and Application of Cutting Tools Volume II,” by Charles Holtzapffel.

PHOTO BY AL PARRISH

This 19th-century workbench can be built with bolts to be knocked down, or it can be built as a permanent addition to your shop, as shown here.

web

It's a tremendous book even today and is crammed with details on working wood and metal with both hand and power tools.

The author was the head of Holtzapffel & Co. of London, a tool-making enterprise that is best known for its line of elaborate lathes but also manufactured everything from scissors to gardening equipment to exquisite miter planes.

I have doubts that Charles Holtzapffel actually designed or even advocated this particular bench. He died in 1849, and the edition of my book came out in 1875. I really should scare up an earlier edition of the book and see what sort of bench might be lurking there. But that could be an expensive whim. Original copies of the 1875 books can cost $1,500 a set. Earlier editions are even harder to find.

Why Build the Holztapffel?

The Holtzapffel workbench is the third archaic workbench that I've built and put to use in a modern shop. Each of the three benches had a deep connection to the culture that developed it. The bench from A.J. Roubo's 18th-century books is as French as bernaise, strong coffee and berets (see the Autumn 2005 issue). The bench from Peter Nicholson's 19th-century "Mechanical Exercises" (visit our blog to see photos) is entirely British. The only other place this English bench shows up with any regularity is in the Colonies.

The Holtzapffel is a cultural mongrel. The Holtzapffels were Germans who settled in England. And the bench has features of both cultures that, in my opinion, create a bench that is outstanding for cabinetmaking.

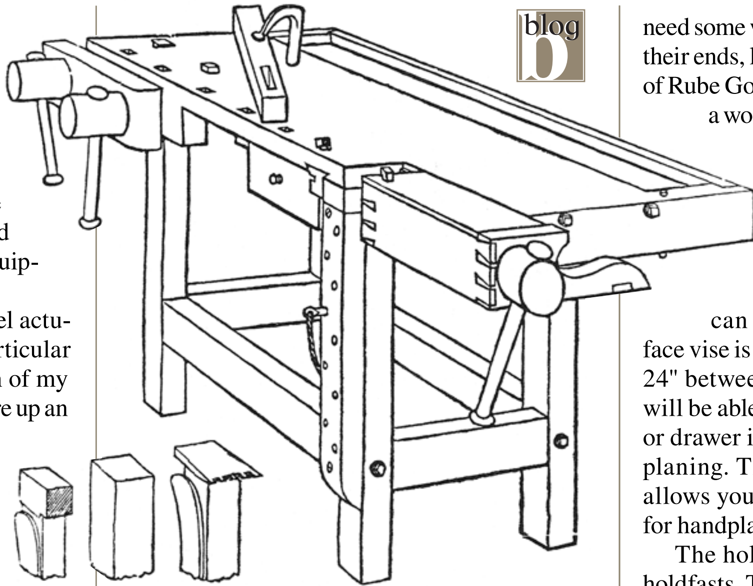
From the Germanic tradition, the Holtzapffel has a traditional tail vise on the right side that most English cabinetmakers and joiners would sniff at as unnecessary. The skeleton of the bench – its base and top – are equal drams German and French. The massive legs are Gallic. The tool tray and knockdown bolts are German.

The workholding is also a melting pot of Stilton, Camembert and Butterkase. The bench shows holdfasts (trés French), a variety of planing stops (English and French), a twin-screw vise (quite British), and a leg pieced with holes for supporting long stock (fairly standard pan-European fare).

Usually when you start mixing and matching bits and pieces like this, you end up with something along the lines of catfish pizza. But all the parts of the Holtzapffel work together like, well, I'll spare you any more food metaphors.

About the Bench's Framework

The original bench has a French undercarriage that is joined using bolts in some places. The legs and stretchers of the benches are – for the most



The Holtzapffel has old-world features, such as its tree-trunk legs. And it has elaborate workholding, such as its sexy-looking tail vise. Unlike some other benches of this era, the Holtzapffel blends several traditions to create an effective bench.

part – pushed out so they are flush with the front edge of the benchtop. This arrangement allows you to use the legs and stretchers as clamping surfaces, which is handy when working long boards and large frame assemblies.

I've built five or so benches using a bolt system and find it great for benches that will have to travel on occasion. For homebody benches, drawbored mortise-and-tenon joints are just as good. If you go with the bolt system, you can shorten the tenon on the stretchers to 1" long if you like. Leave it unglued, obviously.

If you go with the bolt system, you'll also want to modify the way the top of the bench attaches to the base. I went with the permanent old-school French method: drawbored mortise-and-tenon joints. If you want to knock down your bench, I suggest you add a second rail to the top of your end assemblies then use lag bolts (in slotted holes) to secure the top to the base.

My base is built using hard maple, though any heavy wood that is inexpensive and plentiful will do just as well. Yellow pine, Douglas fir and white oak are excellent choices.

About the Bench's Workholding

The top is made using some figured ash that was exquisitely dry, a bargain and easy to work with. Those three traits – and ash's weight and stiffness – made it an ideal choice for this benchtop. I implore you, however, to use what you have on hand. There is little magic in choosing a wood for a workbench; just go for stiff, heavy and cheap.

Far more important than the species of the wood is the selection of vises. All workbenches need some way to hold boards so you can work on their ends, long edges and faces with a minimum of Rube Goldberging. This bench is designed for a woodworker who builds typical furniture using both hand and power tools. It excels at working on panels with planes or sanders. And it is the best bench I have ever used for hand dovetailing.

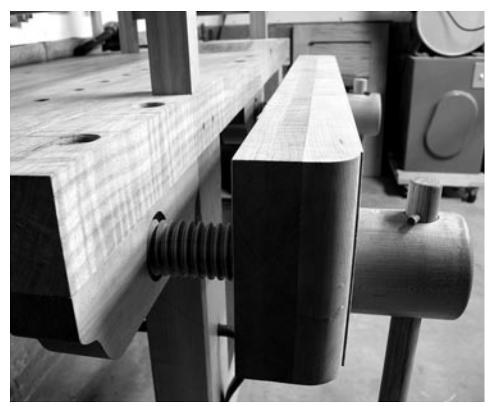
Here are the details so you can decide if this setup is for you. The face vise is a massive twin-screw vise that offers 24" between the screws. This ensures that you will be able to clamp almost any case side, door or drawer in its jaws for dovetailing, sawing or planing. The wide spacing of the screws also allows you to clamp a 72"-long board on edge for handplaning with ease.

The holes in the leg under the vise are for holdfasts. These support your work from below and even allow you to clamp the work to the leg if the need arises. You can use two metal screws to make this vise, or you can use the commercial Veritas Twin-Screw vise for this bench. (I used wooden screws that I had been saving for some time.) Each strategy has pluses and minuses.

The wooden screws are more fragile than iron, though they are durable enough for normal workshop tasks. I like how they don't mark your work with grease, which is a common problem with metal screws. The wooden screws operate independently – this allows you to easily clamp tapered and odd-shaped pieces, but it forces you to pay more attention to advancing and retracting the screws in tandem and with two hands.

Using two independent metal screws is also a fine choice (see the Supplies box for a source for metal screws). You'll be able to clamp tapers, plus the mechanism is easy to install and inexpensive. But you can mark your work with oil.

The Veritas Twin-Screw Vise also is a good choice. It takes longer to install, but that is offset



This wooden twin-screw vise has a tenacious grip. I can secure any board of any size and put my entire weight on the board without it slipping. That's good enough for me.

The Veritas Twin-Screw Vise takes about a day to install and adjust. But it offers many years of trouble-free service. I can't really say anything bad about it as a face vise.

by the fact that you can operate the jaws with one hand (the screws are connected by a chain drive). And it's more expensive than the other options.

If you never plan on dovetailing anything, you can replace the twin screw with another face vise, such as a quick-release iron vise. If you are an occasional dovetailer, I'd choose a leg vise for this position.

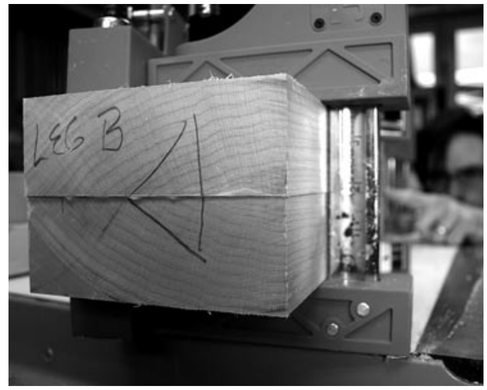
The end vise on this bench is a clever piece of work – it's my only real contribution to this venerable design. You see, I think the traditional L-shaped tail vise can be more trouble than it's worth. They are fussy to install. They tend to droop. And you cannot work on the vise itself. But the tail vise remains the dominant vise for the end because it offers great support for clamping panels and narrow boards on edge.

I wanted something easy to install, fast to use and as good as a tail vise. The arrangement I devised almost meets all three of these tough requirements. It's a quick-release metal vise with a big wooden chop (sometimes called a jaw). It takes a couple hours to install and will never droop. The quick-release function is quite handy in this position because it allows you to quickly switch setups for boards of different lengths – there's much less spinning of the handle than with a traditional tail vise.

The chop offers a lot of support for your work below, though I admit it's not as unerring as a tail vise. But what makes up for that is that I've spaced the dog holes in the benchtop less than 4" apart, so there's always less than 4" of open space below your work between the chop and the benchtop. And your work isn't going to sag or bow over that short a span.

There are also a few well-placed holes for holdfasts in the top to round out the workholding for the Holtzapffel workbench.

Another virtue of this bench is its utter simplicity. I built this bench in 37 hours of shop time, from surfacing the rough lumber to applying a second coat of finish. Other benches that have the same number of advanced functions are far more complex and have dovetailed skirts and tail vises for you to fuss with. This bench gets you straight on to the good part: building furniture.



Once you choose the boards for the legs, mark the mates with a cabinetmaker's triangle across the joint. These triangles help prevent mistakes and guide your assembly operations. Face-glue the leg pieces together, then joint and plane the assembly.

Begin with the Legs (or the Top)

If this is your first workbench, that can change the order of the operations involved. If you don't have any form of workbench in your shop, then

Strategies for Squeezing the Maximum Thickness From Your Stock

In woodworking, it is usually the first steps you take in any operation that set the stage for success or failure. And wood preparation is no exception to this rule. How you treat your stock at the beginning of a project will determine if you have plenty of stock that is thick and wide enough. Or if you will limp along through a project with boards that are just a bit on the thin side.

One of the worst mistakes a beginner will make is to take an 8'-long board, joint one face and then plane the other. Then rip and crosscut the board into smaller pieces. This is a wasteful path to creating stock that is too thin.

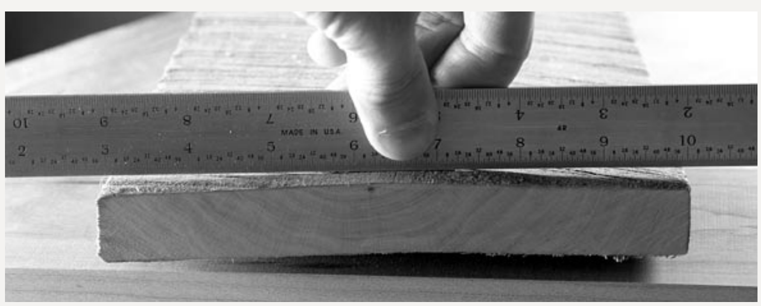
Here are the strategies that we use to ensure we squeeze the maximum amount of thickness from our stock.

1. First lay out all the available stock for a project and try to mark out all the parts you need on the rough stock with a grease pencil or chalk. Give yourself some extra parts for joinery setups, messing up a few rails and stiles and even some extra stock for unexpected problems. Allow yourself an extra 1" in length and an extra 1/2" in width for each piece.

2. Mark out some rough cuts on these boards and try to group the cuts so that your boards are of middling lengths. About 24" long should be a good minimum for grouping short parts. Parts that are longer than that (36", 48" etc.) can be marked out for cutting by themselves. By grouping parts into these lengths you will defeat any bowing over the length of the boards by sharing the bow among several boards. Crosscut your boards in their rough state on a miter saw or with a handsaw.

3. With great care, rip out your parts. If your stock is true, you can joint one edge and rip your parts on the table saw. If the board has any corkscrewing to it, the band saw is a much safer machine for this. Ripping your stock in the rough defeats any cupping along the width of the boards by sharing the cup among several boards.

4. With your parts roughed out, proceed to joint one face and then one edge. Then plane the opposite face down and rip the board to its final width. — *CS*


By ripping a cupped board into narrower pieces in the rough, you can get thicker stock. Simply face-jointing this entire board would result in a board that is thinner than I need.

Cut the shoulders first. The shoulder is the critical cut so perform it first. The rest of the tenon involves just wasting away the excess stuff on the face cheeks.

Keep consistent downward pressure. A sled or a sliding table on your saw makes this operation safe and accurate. However, even with those nice features, the work will tend to rise up a bit as you are in the cut. Keep firm pressure down to ensure a consistent tenon.

Check your work. Dial calipers can be a crutch, and I tend to use them more than necessary. However, they do point out where the errors are in my tenons so this tool earns its keep.

Then the edge cheeks. Having a stop on your sliding table or table-saw sled is key to cutting tenons. Here I am cutting the 1/2" shoulders and edge cheeks on the tenons.

you should glue up the top first, put that on sawhorses and build the bench's base on that. If you have a workbench (or a Workmate, or a solid-core door on sawhorses), you can begin by building the base and then adding the top.

For this bench, I began by building the legs from 8/4 rough maple. Each leg consists of two layers of maple, face-glued together. First I face-jointed one face of each board and then glued the two jointed faces together with the rest of the wood still in the rough. Because I handplane almost every surface, I did my best to keep the grain running the same direction on both halves of each leg.

Then, when the glue was dry, I jointed, planed and ripped the assemblies to their finished size. This strategy reduces the time slaving over the planer and jointer by processing things twice.

If you plan to join your top and base with a mortise-and-tenon joint, then you need to cut a 1"-thick x 2" long tenon on the top of each leg. If you are going to join the top with lag bolts, simply cut each leg to 31" long and move on to the stretchers.

I went with the tenon option, a joint I prefer to cut using a dado stack on a table saw. The only other way I'd cut this joint is by hand. I don't own a shaper, most routers don't have enough juice and using a tenon jig on the table saw involves a dangerous balancing act to cut the stretchers and legs with them sticking up in the air.

First cut the shoulders of the joint. Then waste the face cheeks. Lower the arbor of your saw so the blades project 1/2" above the table and then cut the edge cheeks. Note that these edge cheeks are optional. You can cut the edge cheeks as shown in the photographs, or you can omit them, as shown in the illustrations at the end of the article. It's your choice.

Make Stretchers and Decisions

The tenons on the stretchers are thinner than the ones on the legs, but they are made in the same fashion at the table saw. The tenons on all the

With your tenons milled, you can clean up any stray tool marks on your legs to prepare them for joinery. Here I'm using a finely set bevel-up jack plane. Usually I'd finish up with a smoothing plane, but the gnarliness of the work demanded a high planing angle (about 62°).

stretchers are ⅝" thick, 4" wide and 3" long.

These tenons are wider than traditional tenons. The rule on width is the tenon should be two-thirds the width of the work, which would put the tenon at 3⅜" wide. I bumped it up to 4" wide because these tenons aren't located anywhere near the fragile ends of the legs, where the tenon could blow out the ends when driven into the mortise. Plus, with a 4"-wide tenon, there is less material to remove when making the tenon and less end grain to pare to fit the joint.

With your tenons cut you should arrange the parts as they will be assembled and lay out your mortises in the legs.

Group your legs as they will be assembled to mark your joinery. Here I've bundled my legs so the front legs are facing up and the back legs are on the benchtop. This helps prevent layout errors.

Show the tenon to your leg and mark things out by using the tenon like a big ruler. Have you noticed how many of these photos are taken with the overhead lights off? That's not just to be moody (I'm moody enough as it is). The window light alone makes my marks easier to see. Fewer light sources equals better visibility.

Marking and Making Mortises

Use your finished tenons on the stretchers to mark out the locations of the mortises on the legs. Mark on the legs where the stretchers will go then place the shoulder of the stretcher's tenon directly on your work. Use your tenon like a ruler and trace its shape on the leg. The less you measure things out, the less likely it is that you'll make a mistake.

If you're a making a version of this bench that can be disassembled, don't forget to mark out the mortises for the additional stretchers that run at the top of the side assemblies. And be sure that you have at least a ¾" shoulder on the tenons of these stretchers, or you will likely blow out the end grain at the top of the leg at the worst possible moment.

Cutting the ⅝"-wide mortises takes some doing. While there are ⅝" hollow-chisel mortising bits available, they are not common and they are expensive. They also are not needed for this operation. If you are careful, you can cut accurate ⅝"-wide mortises using a ½" hollow mortising chisel by overlapping your strokes.

If you don't do this with care, you can snap a mortising bit (I've done this a few times when I had a little too much vim, vigor or venom in the blood that day). After laying out your mortises, go ahead and bore out the mortises with a ½" chisel, which will leave you ⅛" of extra waste that has to be removed.

Reset the fence of the mortising machine and bore out the remaining sliver of waste. Take this cut slowly. If you pound through this cut you can deflect the chisel into the path of least resistance – the open mortise. If you deflect the chisel, then your mortise will get skinnier in its deepest depths. Or the chisel will bend. Or break.

Once you bore all your mortises, you can test-fit your joints and tune them up. Clamp up your side assemblies and fix any gapping at the joints' shoulders. Then do the same thing as you fit the long stretchers to the legs.

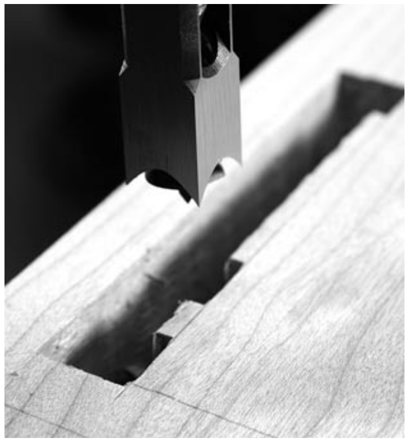
I use a couple strategies for fitting tenons. If there are problems, I'll undercut the shoulder near the tenon proper, leaving the outside of the shoulder. A chisel is the best tool for this job. Then I'll fit the outside of the shoulder with a shoulder plane until the gap closes tight.

This strategy prevents you from making the fit worse. By undercutting the shoulder first with a chisel, you leave just a small ribbon of wood to remove with the shoulder plane. This reduces the chance that you'll muck up the shoulder with the plane – it's easy to make the joint worse with a shoulder plane.

Assemble the Base

Though the original bench was bolted together, I decided to alter the bench joinery with some

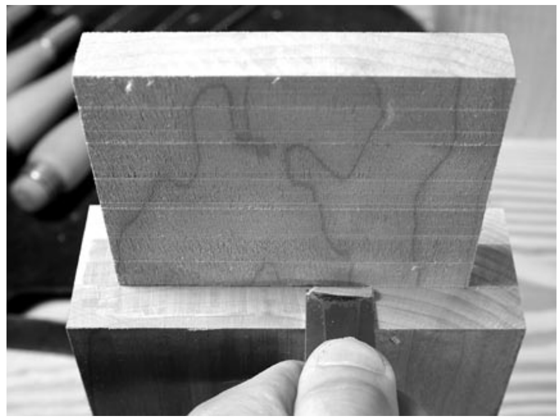
Make your 5⁄8"-wide mortises with your 1⁄2" chisel. Begin by boring a 1⁄2"-wide mortise for the stretchers on all the legs. This is a deep mortise, so be sure to let your tooling cool a bit and lubricate it with canning wax or a fancy high-priced lube.



Reset the fence on your mortiser to remove the 1⁄8" strip of waste. First mortise the ends (the most critical parts) then fill in by removing the waste between your first cuts.

I tune up all my tenons, and not because I'm some sort of anal-retentive craftsman. No matter how careful I am at cutting my tenons and mortises, the joints will be a tad too tight if I've done everything to the print. Remove a few shavings to make the tenon fit well and to correct the location of the shoulder. You can shift the stretcher in and out of its assembly by removing material from the inside or outside of the tenon's cheek. That is real power.

Assemble the ends and clamp them up. Take a close look at each joint and note where the shoulder touches the leg and where it doesn't. The places where the shoulder touches is where you want to remove material. Mark those areas while the legs are clamped up, then use the marks as a road map to fixing the problems in the shoulders.



Not every joint needs to be massaged, but many big joints do. The first measure is to undercut the shoulder. Begin with the chisel about 1⁄8" from the outside of the shoulder. Push the tool in and remove a wedge-shaped piece of end grain that's about 1⁄16" thick at its most girthsome.

The shoulder plane will true up a lumpy shoulder and knock down a shoulder that is too high compared to the other shoulders. It's easy to overdo things and reduce the shoulder too far. I take three passes then check my work during a typical tenon fix.

older technology: drawboring. I've written a lot about this traditional technique (see the Autumn 2005 issue), which involves driving a peg through a hole in the mortise and a hole in the tenon that are offset. The offset of the holes "draws" the "bores" together when you insert the peg.

I used 3⁄8"-diameter white oak peg stock and a 3⁄32" offset. This maple is tough and thick, so a brutish peg and serious offset are appropriate. I glued and clamped up each joint and drove two pegs through each joint. I removed the clamps immediately after driving the pegs.

Once the glue cures, trim your pegs flush (see Glen D. Huey's review of flush-cutting saws on page 28 for advice on this matter). Then plane all your joints flush, rout some stopped chamfers if you please and turn your attention to the top.

Build a Laminated Top

Workbench tops are a matter of some trepidation for beginning woodworkers. They tend to overdo things in the gluing one stick to another stick department. In general, I'm a fan of overdoing things, but I have limits.

Drawboring the joints reduces your dependence on expensive long clamps. A clamp or two plus your peg are enough to hold the joint as the glue cures.

You don't need to bolt your top together with massive all-thread rod. You won't hurt anything by doing this, but you will eat up precious shop time for little benefit. The glue by itself is plenty strong.

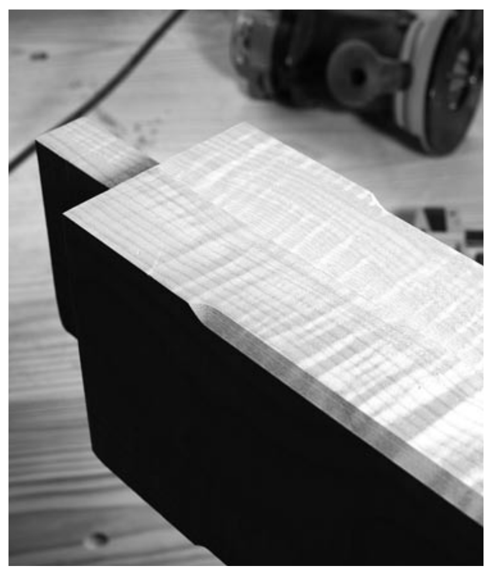
You don't need to use biscuits to align the boards in the lamination. Workbench tops are thick and are flattened regularly. So a few boards that are out as much as 1⁄32" aren't going to change things much when it comes to the final and effective thickness of your top.

Here's how I've glued up many workbench tops with wild success. Glue up three or four layers – however many you think you can manage at once. After the glue is dry, joint and plane the assembly flat. Make a few more assemblies, and joint and plane them as well. Then start joining the assemblies together and try to get these joints as accurate as possible.

Once your top is glued up to its finished width (24" in this case), you should trim the ends to size. Good luck trying this on a table saw with a stock miter gauge. I prefer a handsaw or circular saw. And when I feel the need for extra precision, I'll make the cut using a circular saw and an edge guide.

Mortise the Top

Joining the top and base with a mortise-and-tenon joint seems intimidating, but it's quite simple. Here's the basic drill: Turn the top upside down



I have always liked stopped chamfers. They protect the fragile sharp edges from splintering and look darn good as well. You can do them by hand with a drawknife and chisel, but the technique that requires far less skill is to use a 45° chamfer bit in a handheld router. The short ramps where the chamfers stop are simply where I pulled the router away from the leg. Purists will balk that I didn't flatten the ramp with a chisel. But I'm not pure.

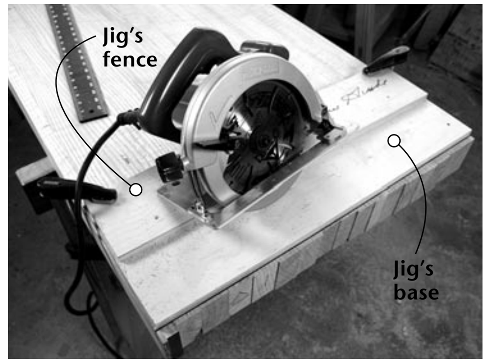
and hump the base into position on the top. Trace around the tenons and remove the base.

Bore out the mortises. Make the mortise at the rear of the bench 1/8" wider to allow the top to move (this is optional – old workbenches allowed the base to cast into an A-frame shape). Clean up the corners and join the base and top together with drawbored pegs.

So begin by getting the base in position on the underside of the top. After positioning it (take your time), trace around the 1"-thick tenons with a marking knife or marking awl. If you are aggressive with a knife, clamp the base to the top before you mark the locations of the mortises.

Chopping out the mortises can be tough work. These are wide, deep and long. I've done these entirely with a chisel and it's a lot of effort in hardwood. It's much more efficient to bore out the waste with a 1" Forstner bit and then clean up your work with a chisel. The tenons are 2" long, so make the mortises 2 1/8" deep. Don't go

Three assemblies together: For this top, I glued up three boards for each sub-assembly. Then I jointed and planed each of those and glued them to their new neighbors. Even experienced woodworkers have trouble managing nine boards all at once. So don't think you are wussing out with this approach.



This simple two-piece jig lends table saw accuracy to your circular saw. The jig is built so the base and fence fill the space on the left side of the saw's shoe. You just lay the jig on your cut line, clamp it down and saw right on the line. It's hard to miss or mess up.

Jointing a big edge: Here I've got the two assemblies for the top nearly ready and am jointing the edges. Even though these edges were planed flat, they were distorted by all the clamping pressure during assembly.

Use a square to guide your efforts to shift the base in position on its mate. Focus your efforts on getting the front of the legs flush to the front edge of the benchtop. Don't fuss over the back legs as much.

Do You Need a Sliding Deadman on Your Holtzapffel Bench?

Long-time readers (and critics) will note that there is no sliding deadman on this bench. No, I haven't gone soft. After some calculations, I think I can get away without a deadman. The huge twin-screw face vise will handle long boards and the holes in the right leg will allow me to clamp doors and assemblies to the legs and stretchers. At least, that's the theory.

Just in case, I added the architecture for a sliding deadman on the bench. So if I go running home with my tail between my legs, it will be a 20-minute fix, instead of something that is cobbled together and bolted on.

— *CS*

I cut two 45° bevels on the top of the front stretcher for my ghostly deadman.

A groove (or grave) for the deadman: After assembling the benchtop, rout a groove along the front edge of the underside of the bench for the deadman. Make it deep – 1" will do nicely – to give yourself flexibility when attaching the device to the bench.

The only cordless drill I'd recommend for this job is a brace and bit. (If you go that route choose a brace with a 12" or 14" sweep.) A cordless battery drill will balk at this task. Use a slow rpm and clear out the chips as best you can as you work.

too deep – you can blow through the top when mortising with the chisel.

For the mortises for the rear legs, I made this mortise $1\frac{1}{8}$" wide. I bored out the 1"-wide mortise and then knocked $\frac{1}{16}$" off each cheek of the mortise with a mortising chisel. The other option is to thin your tenon a bit, which is also a sound strategy with these sizable joints.

Then clean up the corners of the joint with a heavy-duty chisel such as a mortiser. Fitting these two assemblies together is no fun, so I recommend you take steps to avoid as much testing and tweaking as possible. Scrutinize your mortises before trying to assemble things. Undercut the shoulders of the tenons.

If you do have to take things apart a few times, spreader clamps are the best things to assist disassembly. Use the same gap-fighting strategy you used to assemble the base. Fit your joints, mark the problem areas on your tenons (these will be the high spots that touch the top) and work those until the gaps close.

Keep in mind that if your efforts don't seem to be producing predictable results, it could be the top that is out of whack instead of the tenon

When cleaning rounded corners, make the cut in a couple steps. Cut away half the waste. Then remove the rest to your layout lines. This makes it easier for you to steer the cut – otherwise the wood will be doing most of the steering.

shoulders. So doing some preliminary flattening on the underside of the top can work wonders. When you have to fix a problem with end grain on a workpiece, consider if the problem could be fixed by dealing with face grain on its mate.

When you're ready to assemble the bench, consider drawboring the top to the base. I've found that drawboring is particularly effective when dealing with joints such as this one. Bore the holes for the pegs in the mortises (I used $\frac{3}{8}$" pegs for this joint). Assemble the joint and mark the location of the hole in the mortise on the tenon

I use a brace and bit quite a lot when building a bench. With a little practice you will bore true with little effort. Until then, keeping a square handy to check your angle is a sound idea.

Early woodworking texts on drawboring say you should offset your holes by the thickness of a shilling. Old shillings are about a $\frac{1}{16}$" thick, maybe a little more. After you make five or six of these joints, you'll stop measuring, start eyeballing things and stop worrying about it.

By making repeated kerf cuts in the notch, you'll make the resulting notch cleaner. The chisel will follow your kerfs and be less likely to dig into the benchtop. So if you can slit straight, you'll be in good shape.

Popping out the waste is like working on the world's largest dovetail socket. Use your chisel to pop out the waste halfway through the top. Then flip the bench on its feet and finish the job. This makes for cleaner results.

using the tip of the auger bit (or brad-point bit).

Then drill a hole through the tenon that is 3⁄32" closer to the shoulder of the leg's tenon. Add glue, reassemble things and drive your pegs home. One quick tip on the pegs: I like to taper them with a pencil sharpener before driving them. The taper helps move the peg through the joint and prevents it from getting hung up or destroying things inside the joint.

Add the Vises

The end vise for this bench is a quick-release iron vise. And while I won't hold much work directly in its jaws, the occasion will come up. As a result, I decided to let the vise's rear jaw into the end of the benchtop. I first kerfed the entire notch with a dovetail saw (the saw's rip-tooth profile sped things up). Then I knocked out the waste with a mortise chisel and fit things with a paring chisel.

The Lee Valley quick-release vise needed a spacer between it and the benchtop to make the jaws flush with the top. My vise required a 5⁄8"-thick spacer. This size of spacer actually put the jaw a little below the top of my benchtop, but that's a good thing. This allowed me to flatten the top with a handplane without running the risk of colliding with the vise's jaws.

I nailed the spacer to the benchtop and then began drilling 5⁄8"-diameter holes for the 1⁄2"-diameter, 4"-long stove bolts that would hold the vise to the benchtop. Some people use lag bolts, but lags will sag someday. Bolting through the top is the better way to go.

Then bore the holes in the top for the dogs. I have flirted with square dogs on some benches. And they are more trouble than they are worth in my book. The round dogs are easier to make and can also be used for a traditional holdfast – which is reason enough to use them. Keep your dogs close – I bored 17 holes on 3 3⁄8" centers. This prevents you from having to move your vise much and reduces the amount of stock that will be unsupported by any setup.

I made a jig for boring the dog holes, but it is an unnecessary crutch if you have any experience with a brace. After drilling two holes with the jig, I threw it aside and drilled the remainder

With the vise in position, I drilled 5⁄8"-diameter holes though the spacer and top. As soon as the lead screw of the auger broke through the top of the benchtop, I stopped boring.

I used the hole left by the lead screw of the auger as a guide to bore the counterbore for the bolt heads on the top of the benchtop. Be sure that your counterbore is big enough to hold the washers you picked out at the hardware store.

This jig helps locate the dog holes. The additional hole in the jig allows you to position it right over your layout lines. The notches in the jig's face allow you to get a clamp right where you want it. After two holes, this jig was as good as firewood to me. Freehand drilling is much faster for me.

Sometimes it's hard to get a finger under the bench dog to push it up for action. A notch in the chop is a big help.

freehand. They came out great and the work went quickly. After drilling the holes in the top (see the illustrations for details) go ahead and drill the holes in the legs for holdfasts.

The other part of the end-vise setup is the big wooden chop screwed to the moving jaw of the quick-release vise. This chop ended up 2¾" thick, 4⅛" wide and 13½" long. I bored a ¾"-diameter hole through the chop for the bench dog (the metal dog on the vise isn't ideal). Then I cut a 1"-wide access notch in the bottom of the chop. This notch lets me push the dog up and down with great ease.

Then I routed the ends of the chop with a large beading bit for a traditional look and screwed the jaw to the iron vise, which has holes just for this purpose.

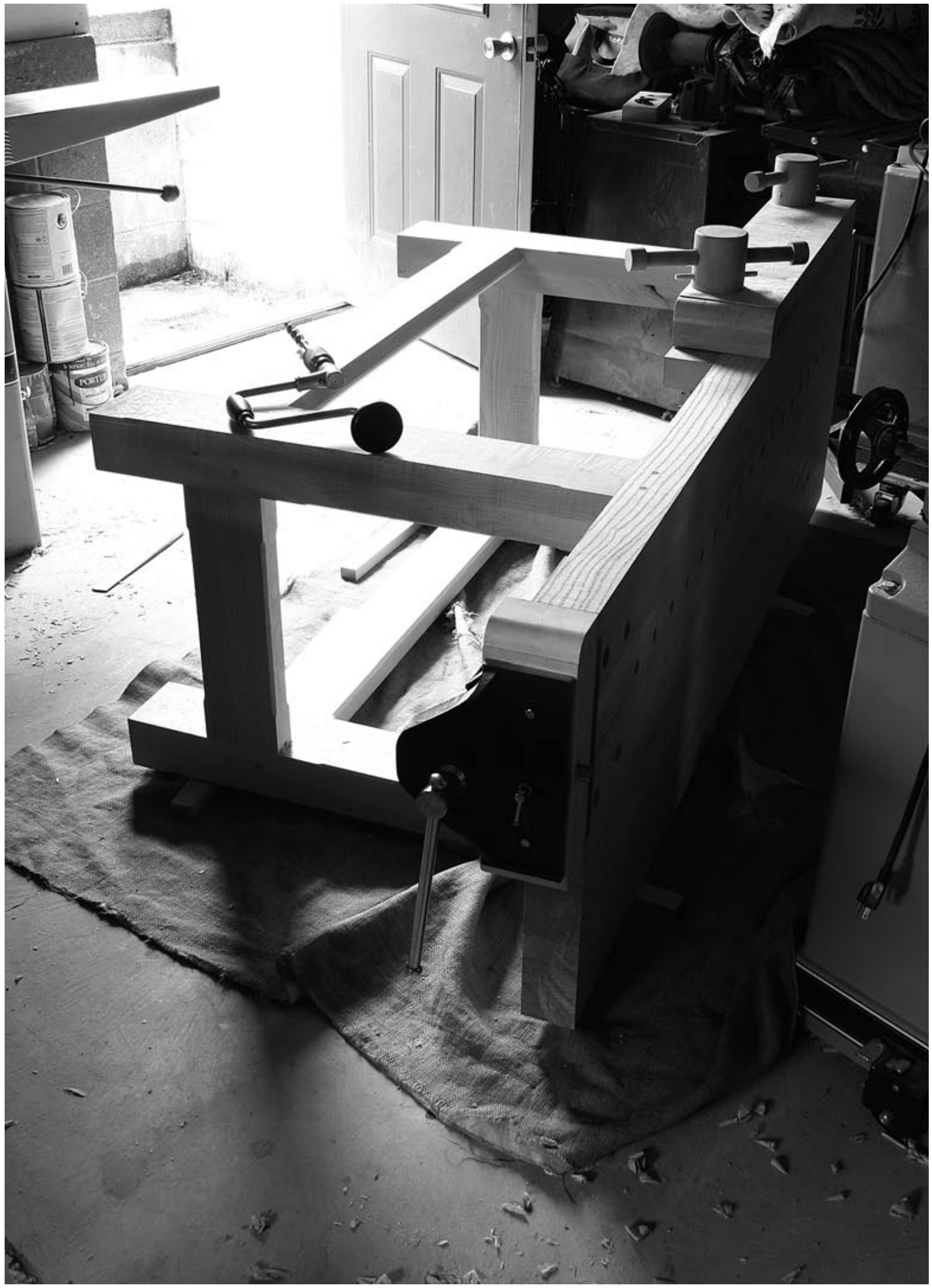
The Twin-screw Vise

There's not much to say about the twin-screw. It's an easy vise to install as long as you do the steps in the correct order. Here they are: Begin by building the chop. Create the 3"-thick chop by face-gluing up a few pieces of thick maple. Rout the ends to match the chop for the end vise then lay out the location of your holes for your vise screws.

Bore these holes and install the two screws in the chop.

You'll have two blocks that will house the threaded portion of the vise's screws. Run these onto the screws through your chop and tighten them up against the chop. Now place this whole assembly in position on your benchtop. Mark where the vise's blocks should go on the underside of the benchtop then bolt these blocks to the benchtop with through-bolts.

Depending on the screws you select, you might need to fit some support blocks between the screws and the underside of the benchtop. These supports will prevent the screws and chop from sagging. My wooden screws required ½"-thick support blocks that I simply nailed to the underside of the bench.



Installing the face vise is best done with the bench on its back. Gravity holds everything in place and you get access to both the benchtop and the underside of the top. It's also a good way to drill the holes in the legs for the holdfasts.

Flushing and Finishing

Now you can flatten the benchtop and flush up the chops with the benchtop so everything lines up. I use a jointer plane and diagonal strokes to true things up. If you were careful when gluing up your top this should be a 45-minute job on the outside.

Once the diagonal strokes flattened the benchtop, I switched to strokes that ran with the grain. How do I know when to switch my strokes? Winding sticks tell me that the top is flat and not in wind, and getting shavings from all points of the top tells me that the low spots on the benchtop are gone. That's when I switch.

The real evidence that the top is flat is that your work behaves predictably on your bench as you work it. If you have trouble planing things flat on the bench, one of the problems could be that your top is too far out of true.

When the benchtop is flat and the chops are planed flush to the top, I recommend you apply a layer of sueded leather to the moving jaw of the face vise. The leather is kind to your work and helps grip it fiercely. You can attach the leather with yellow glue. Put down the glued leather, roll out a layer of wax paper then close the vise until the glue is cured.

As to finishing a bench, less is better. (Some say that no finish is better.) For a workbench, I like a little protection from spills and stains. I like a finish that isn't slick or shiny. I like a finish that is simple to apply and renew. I like a finish that I can do in one day. Bottom line: I like an oil/varnish blend, usually sold as a "Danish oil."

These common finishes are boiled linseed oil with a little varnish resin in them and some paint thinner to make them easy to apply. Rag it on and rag off the excess. Apply another coat later that day and rag off the excess. When that layer is dry, you are ready to go to work.

I've already built several projects on this workbench during the last few months and I have been thrilled by the bench's workholding. The face vise is a monster when it comes to dovetailing. I am glad that I added the holes for holdfasts in the left leg. I tend to use these to support my work from below there because the vise takes two hands to open and close. That's a small price to pay for a vise that will hold a board up to 24" wide with little effort.

However, the quick-release vise in the end vise position has been the real surprise. Why I didn't do this earlier I'll never know. I'm both enthused and disheartened by this revelation. I'm thrilled because the vise works well beyond any expectations I had for it. And I'm disheartened because this surprise means there are probably other surprises ahead for me with this bench that I'm now blind to. WM

— Christopher Schwarz

e-mail

Wooden screws show up for sale from time to time on the Internet and at sales of old tools. When you see them, snatch them up. Or you can buy them from the supplier listed at right.

Supplies

web

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

- 1 ■ Quick-release Steel Bench Vise, large vise #10G04.13, $129
- 2 ■ 4⅜" Bench Dog #05G04.01, $11.95 ea.
- 1 ■ Twin-Screw Vise, up to 24" centers #05G12.22, $198
- 1 ■ Veritas Hold-Down #05G14.01, $59.50

Woodcraft
800-225-1153 or woodcraft.com

- 2 ■ Economy bench screw (a metal substitute for wooden screws) #144959, $29.99 ea.

Stephen Fee
sfee13@verizon.net

- 2 ■ Wooden screws, 2½" diameter, 24" length, $125 ea.

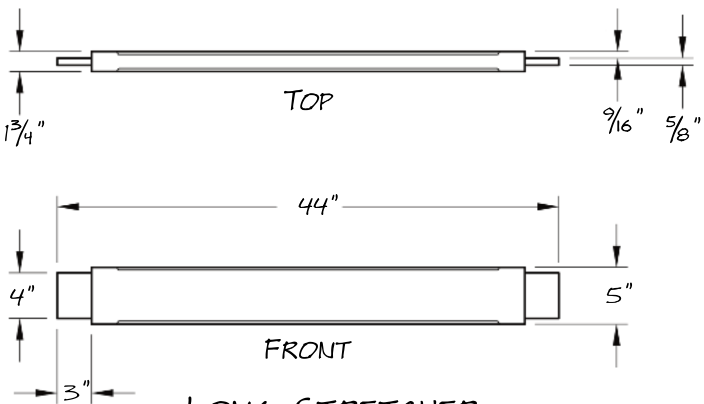
Tools for Working Wood
800-426-4613 or toolsforworkingwood.com

- 1 ■ Gramercy Holdfasts #MS-HOLDFAST.XX, $29.95 pair

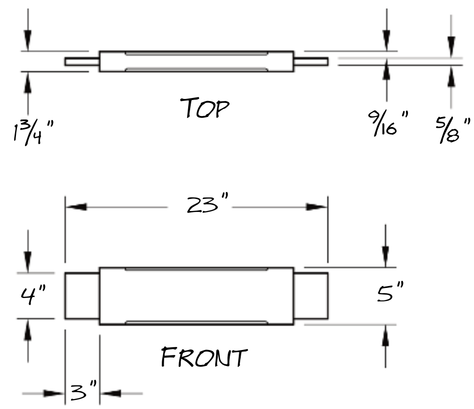
Prices correct at publication deadline.

Holtzapffel Workbench

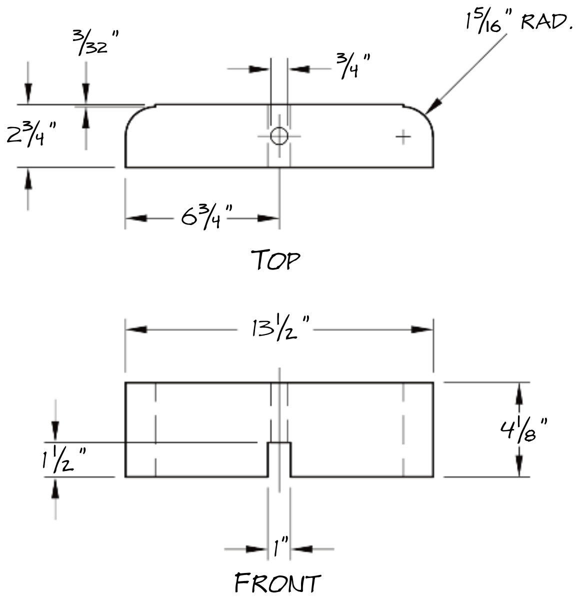
	NO.	PART	SIZES (INCHES) T	W	L	MATERIAL	NOTES
❑	1	Top	3	24	72	Hardwood	
❑	4	Legs	3½	5	33	Hardwood	1"-thick x 2"-long tenon on top
❑	2	Long stretchers	1¾	5	44	Hardwood	⅝" x 4" x 3" tenons
❑	2	Short stretchers	1¾	5	23	Hardwood	⅝" x 4" x 3" tenons
❑	1	Face vise chop	3	6½	34	Hardwood	Wide, plane to fit
❑	1	End vise chop	2¾	4⅛	13½	Hardwood	
❑	1	Spacer for end vise	⅝	6	10½	Hardwood	Sized for Lee Valley vise
❑	2	Supports for face vise screws	½	2	11	Hardwood	Prevents screws from sagging



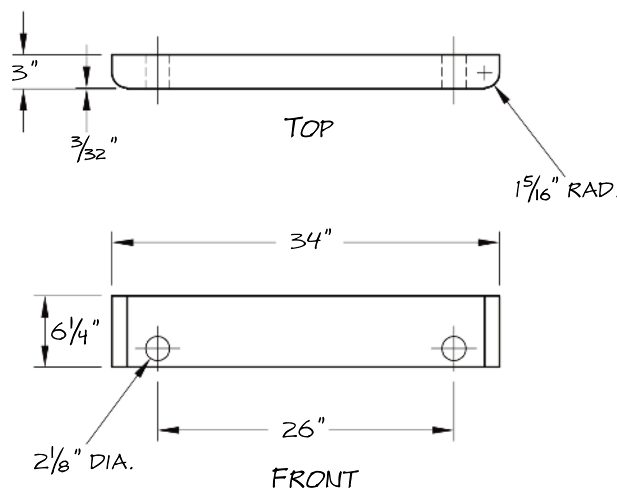
Long Stretcher
(Front and Back)



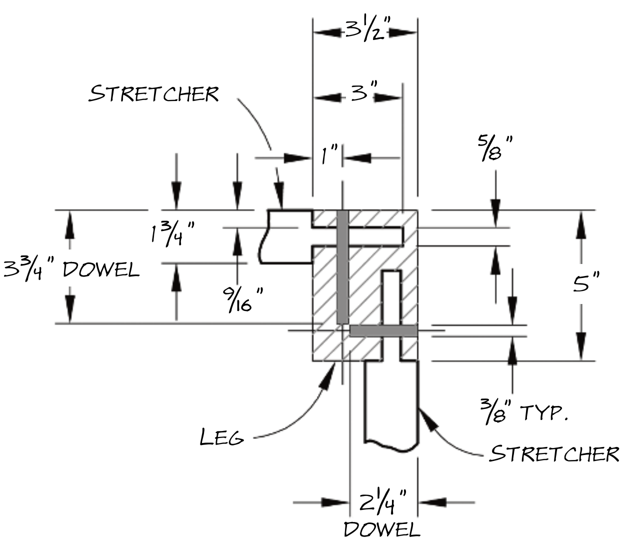
Short Stretcher
(Sides)



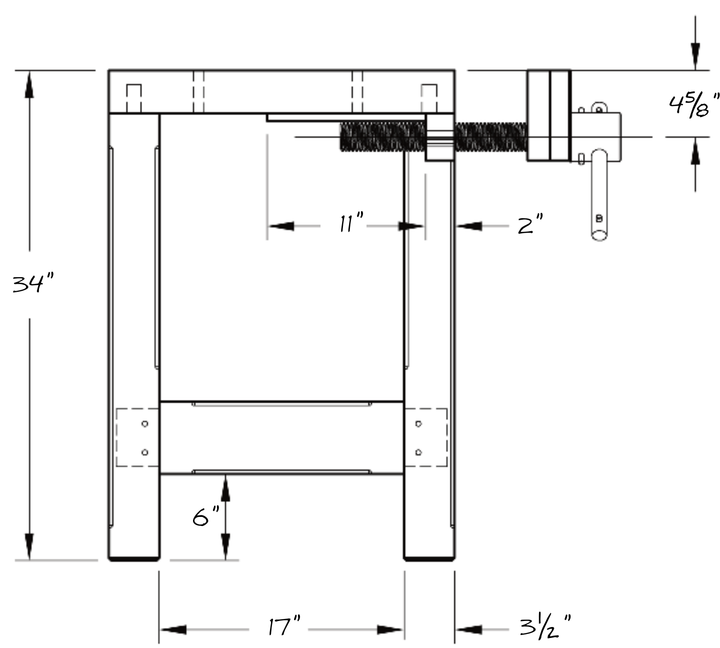
End Vise Chop



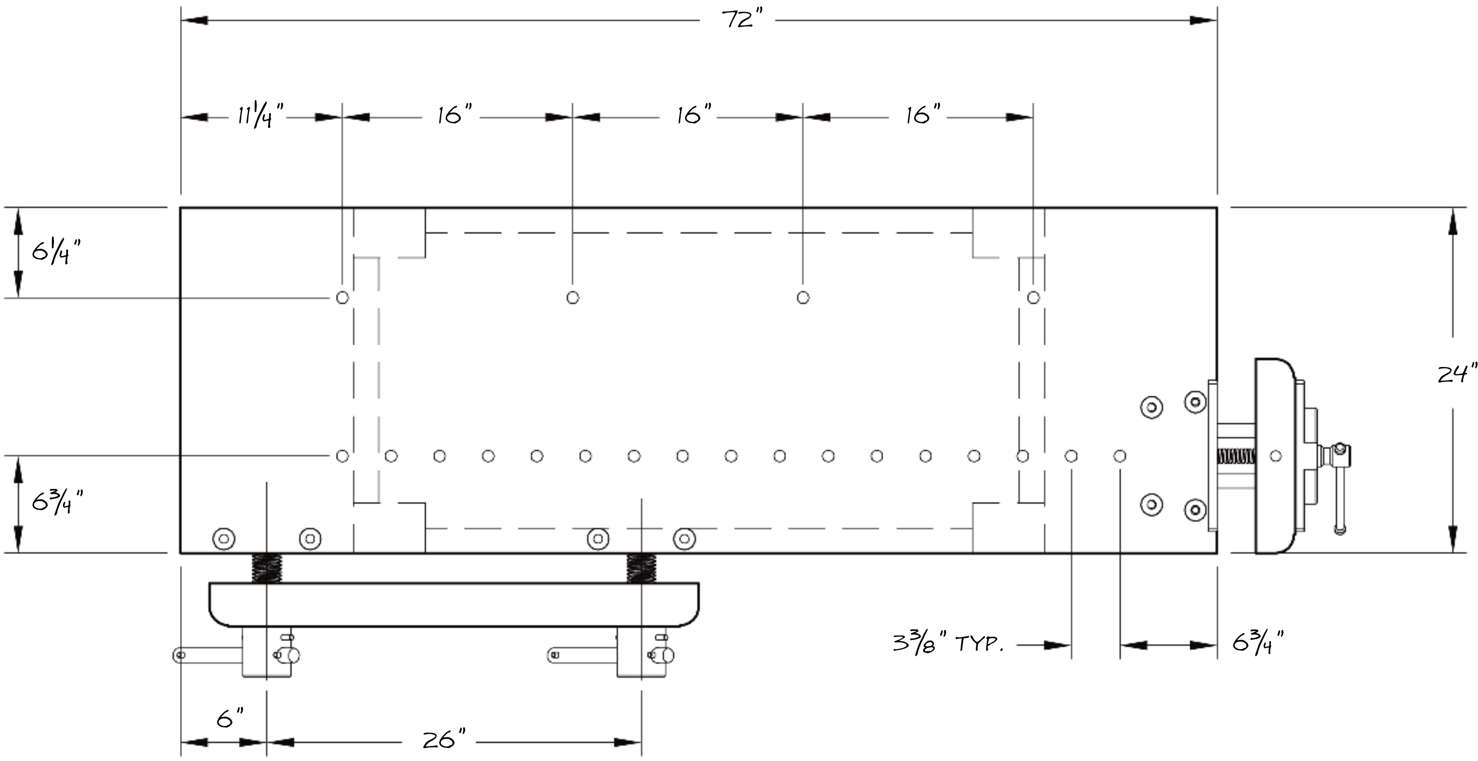
Face Vise Chop



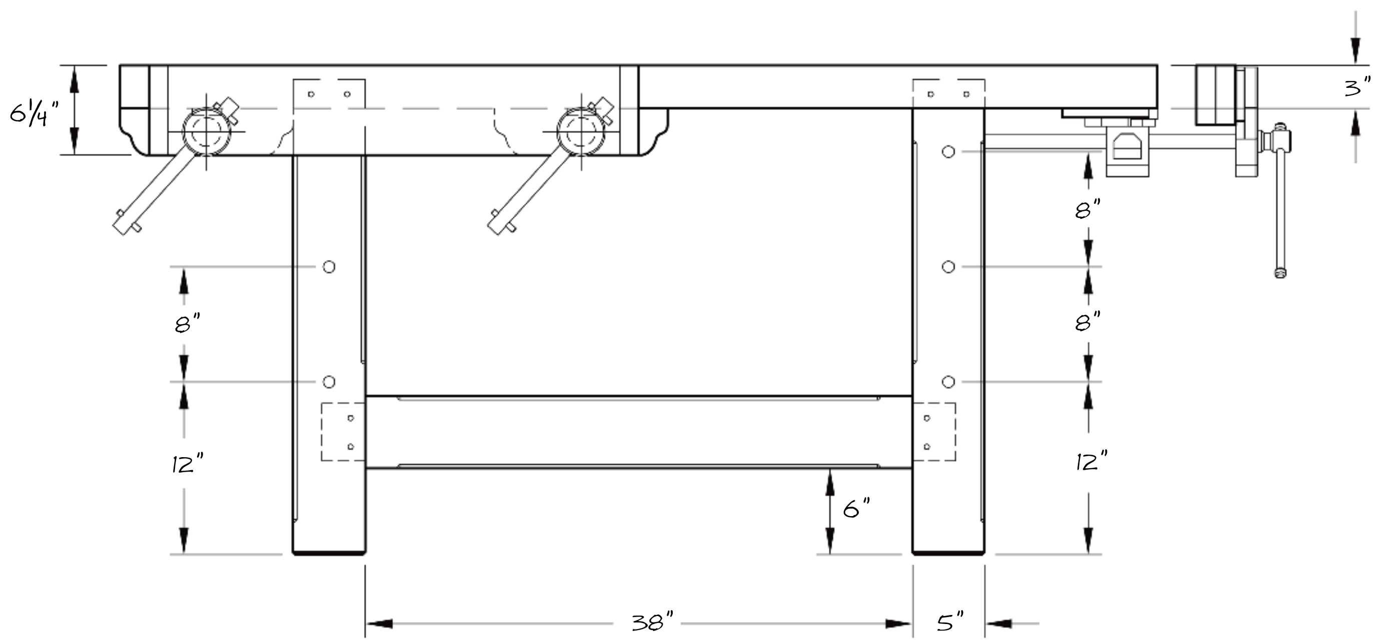
Typical cross-section
leg-to-stretcher joint



Left Side

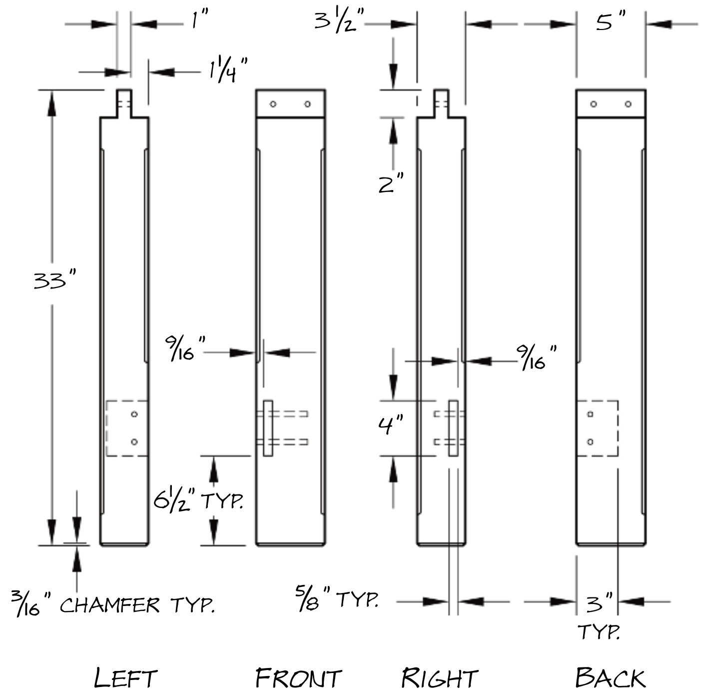


TOP VIEW

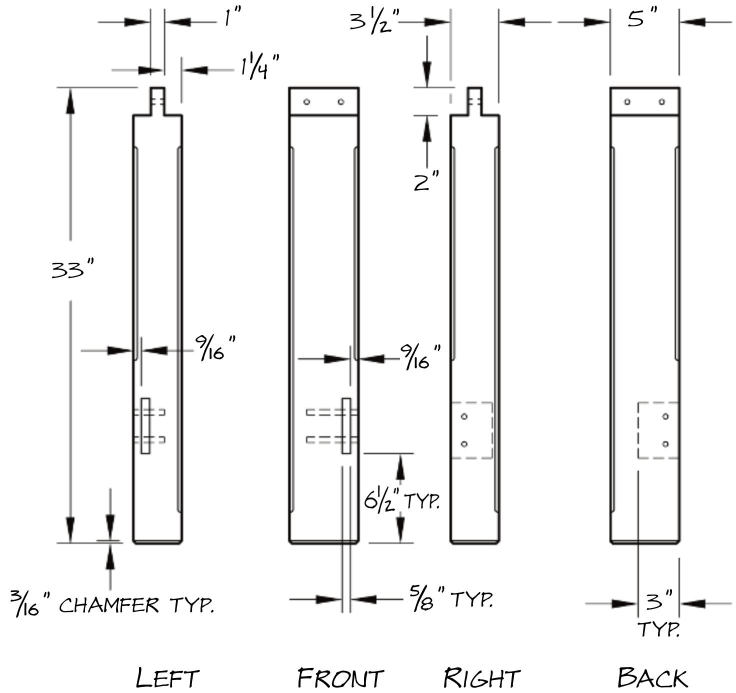


FRONT VIEW

ILLUSTRATIONS BY LOUIS BOIS

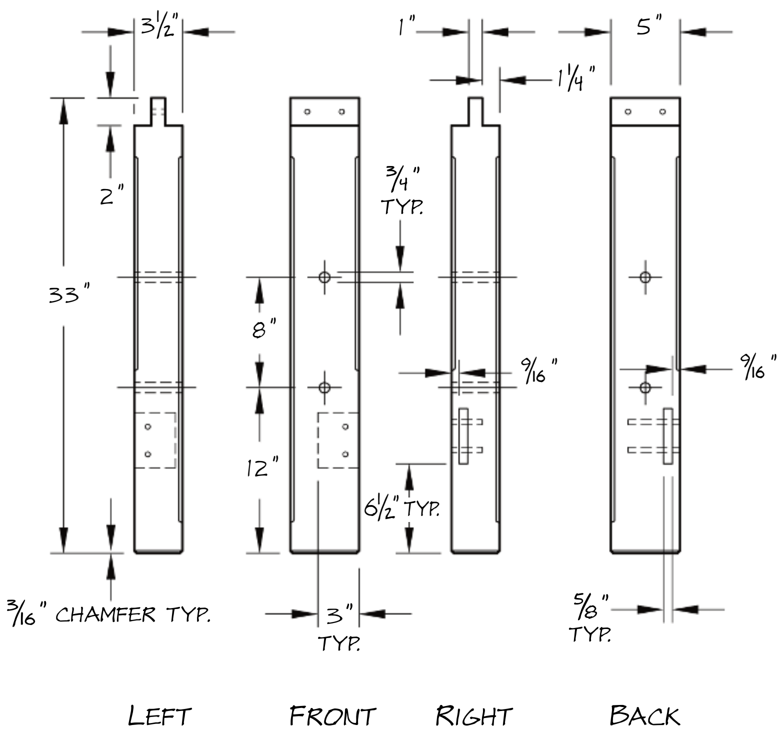


BACK LEFT LEG

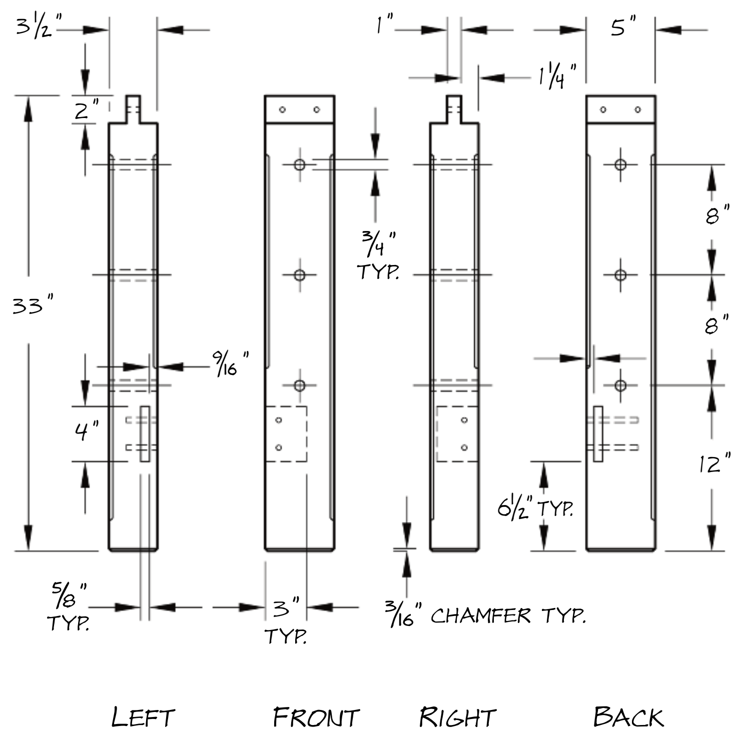


BACK RIGHT LEG

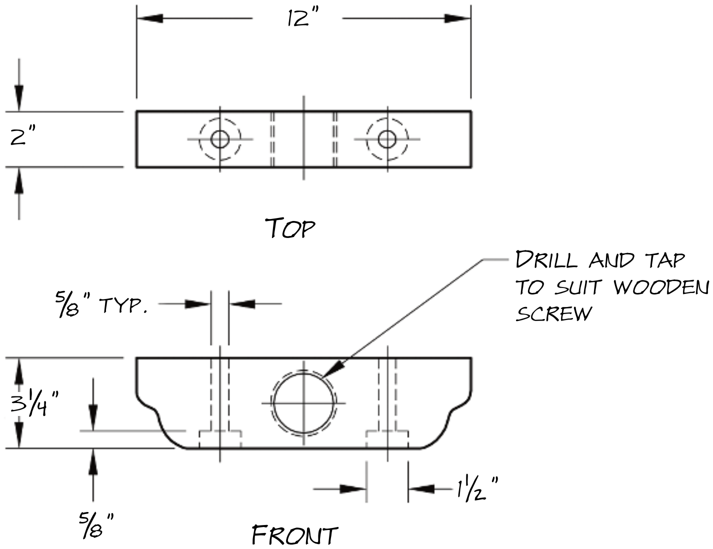
STOPPED CHAMFERS 3/16" X 3/16" AND 2¼" FROM ALL INTERSECTIONS



FRONT LEFT LEG

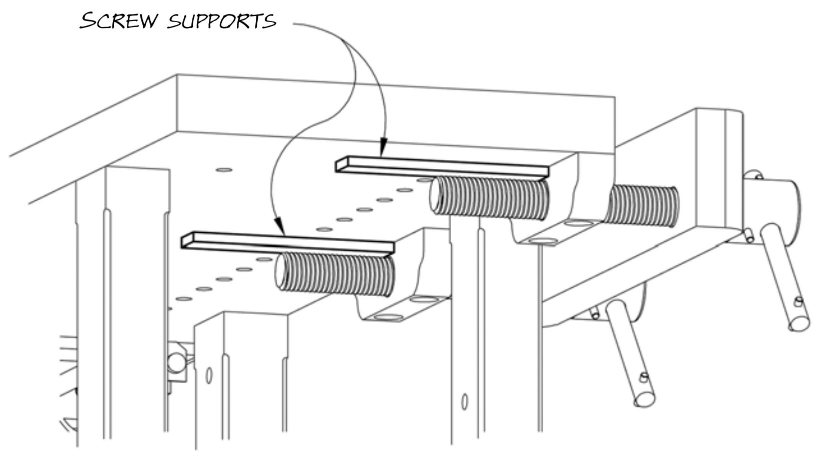


FRONT RIGHT LEG

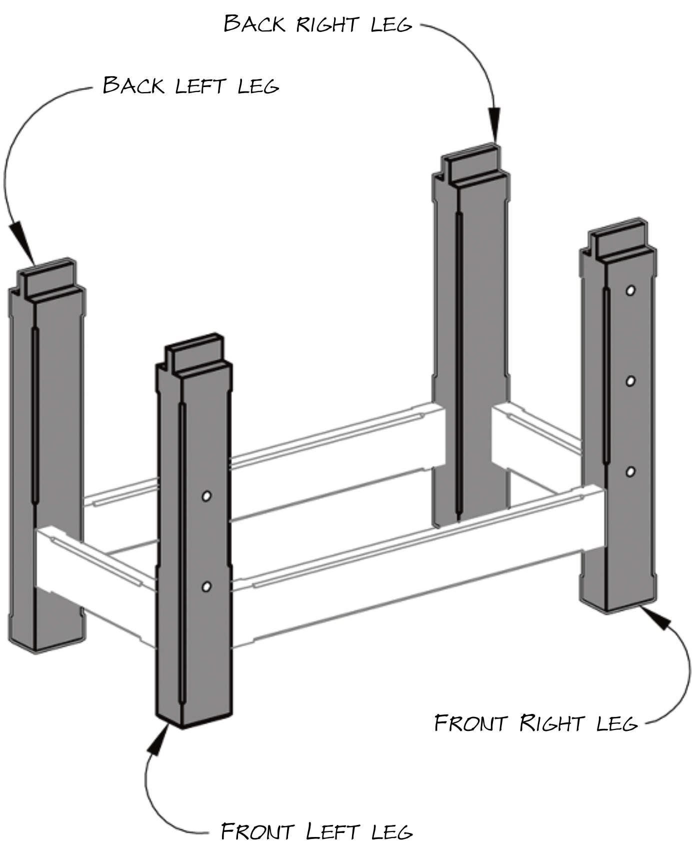


Threaded Nut
(2 req'd)

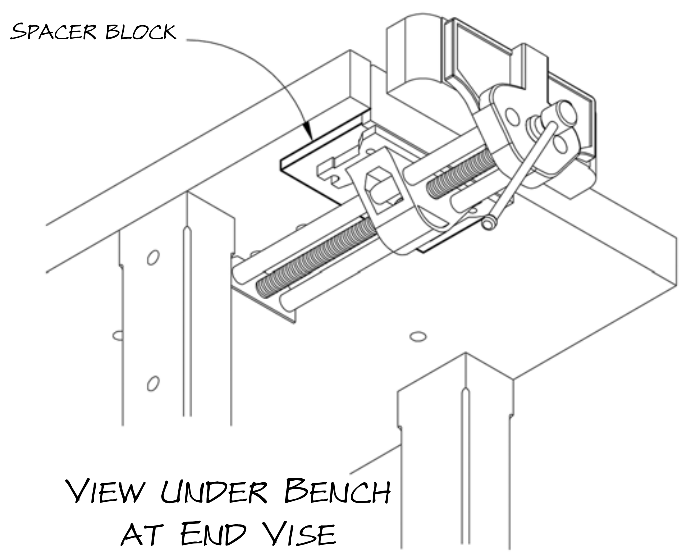
Threaded Nut End Profile



View Under Bench at Face Vise



Leg Arrangement



View Under Bench
at End Vise

Wall-hung Tool Racks

Tool storage out of the box: A flexible system takes root and grows on the walls of our shop.

I used to keep my hand tools in drawers in machinists' and mechanics' tool chests. My tools were organized and protected, but it wasn't very convenient. Edge tools rattled against one another as drawers opened and closed, and my layout tools were never at hand. During projects, tools stayed on the bench where they could be found, but soon were buried as my work, shavings, scraps and more tools piled up.

When I opened my first shop, I decided to make a wall-hung tool chest. Two wide doors opened off a cabinet. I designed the doors around the tools I used regularly, and in between the doors were shelves and a bank of dovetailed drawers. It changed the way I worked. The tools had a place to live and were right at hand. If I started to see too much empty space in the inside of the doors, I knew it was time to take a break and clean up.

While the wall-hung chest functioned well, I never quite completed it. I intended to put in a latch and lock mechanism to keep the doors closed, but after a few months, I realized that I rarely closed the doors. It was like a television cabinet in most homes – the doors are functional but if the TV is always on (or the tools always being used), the doors really aren't needed.

When I came to work at *Woodworking Magazine*, I planned to bring in my tool chest and hang it on the wall. My plan had to be aborted when I recognized that our shop's biggest blessing, an abundance of windows, didn't allow the 6' of wall space I needed. I was back to tools in drawers

PHOTO BY AL PARRISH

Waiting in line, ready to be used. A rack of tools directly above the bench keeps them out of harm's way and makes them easy to locate.

and odd boxes, and I pondered how to add a wall without losing any windows. I wanted the accessibility, safety and organization of the chest, but I was developing an impractical plan.

One day as I walked into the shop, I glanced to the left as I almost always do. Most of the time there will be some interesting project or part of a project or esoteric tool on Editor Christopher Schwarz's bench. What caught my eye that morning was his simple and elegant solution to the same problem I faced. He had installed a simple rack across the window directly above his bench and it held more tools than I would have thought possible.

Recognizable as leftover baseboard, two $\frac{3}{4}$"-thick boards, about $3\frac{1}{2}$" wide, were held $\frac{1}{2}$" apart by wood spacers in between. The back board was a few inches longer than the one in front, allowing it to be easily mounted to the wall, or in this case the wood casing on our window. By that afternoon, I was loading a similar rack across the window above the bench in my corner of the shop.

I was delighted at how well this simple solution solved a problem. My only reservation about hanging my tools was securing them so they wouldn't fall. When I made my tool chest, I made French-fit holders for individual tools. With the new rack, most would fit neatly within the slot between the two boards. They were handy, in sight and out of danger. A few didn't fit between the slots, so I drove a few screws and nails to hang them on the outer part of the rack.

Organization came in time. Instead of planning where each tool should go ahead of time, I started using the slotted rack as I worked, putting tools in a slot as I completed typical tasks. Before long, an organizational scheme emerged that works better than I would have planned. I also found that the slots were good for many tools, but not everything fit quite the way I wanted.

Above the bench at the other end of the shop, Shaker pegs began to appear on the outside of my shop mate's rack. First, a few near one end, then an entire row with hammers hanging from them. A day or two later, another row of pegs appeared above the first rack, holding more than a dozen saws. Not being a collector, I didn't need that

The simple start is two pieces of wood, $\frac{3}{4}$" thick x $3\frac{1}{2}$" wide, of a convenient length. The back piece is longer than the front by a few inches to allow fastening to the wall. The rack is wide enough to hold tools securely, and provides a place for Shaker pegs for hanging tools.

The two pieces are separated by $\frac{1}{2}$"-thick spacers, and tools drop into the space. This was a "sweet spot" for our tools and can be varied to accommodate your tools.

Screws and nails aren't as attractive as Shaker pegs, but function well – especially in tight spaces and for tool-specific hanging.

The flexibility of using the slots gives you freedom to change the overall arrangement as your tools, needs, habits or projects change over time.

much space – I only have four saws and five hammers, but my tool rack did need some improvements and additions.

My first addition was a simple shelf, about 4" wide that rests on band-sawn brackets. This provided a place for planes and a few other tools that I didn't want to hang, but needed at hand. The remaining problem to solve was the chisel chaos. They fit between the boards of the rack, but because they're top heavy with wide handles, they wouldn't hang straight. It bothered me to see them leaning against each other like a gang of out-of-work loafers. I wanted them standing straight – at attention and ready for action.

My solution was another shelf, held in notched brackets with a series of holes that fit the chisel handles. I experimented with some different-sized holes and various chisels and found that a 7⁄8" diameter worked for almost all of them. I also wanted a slot at the front of the hole so I wouldn't need to lift a chisel its entire length to get it in or out of the rack. A little more experimentation and a couple test-fittings later, and I had my final dimensions; the holes were drilled with the edge of the hole 1⁄8" back from the front edge of the 2"-wide board. A center-to-center distance of 1 1⁄8" provided room to reach each handle individually.

After marking off the series of equally spaced centerlines, I stepped off one-fourth the diameter from each side of the centerlines and sawed slots from the front edge of the shelf to each hole, leaving a 7⁄16"-wide slot connecting each hole to the edge. I used a rasp to chamfer the edges of the holes and slots, connected the shelf to the brackets, and mounted them in place. Wider chisels need a bit of a turn as they go in and out of the rack. Narrow ones slide right in. They all are held securely.

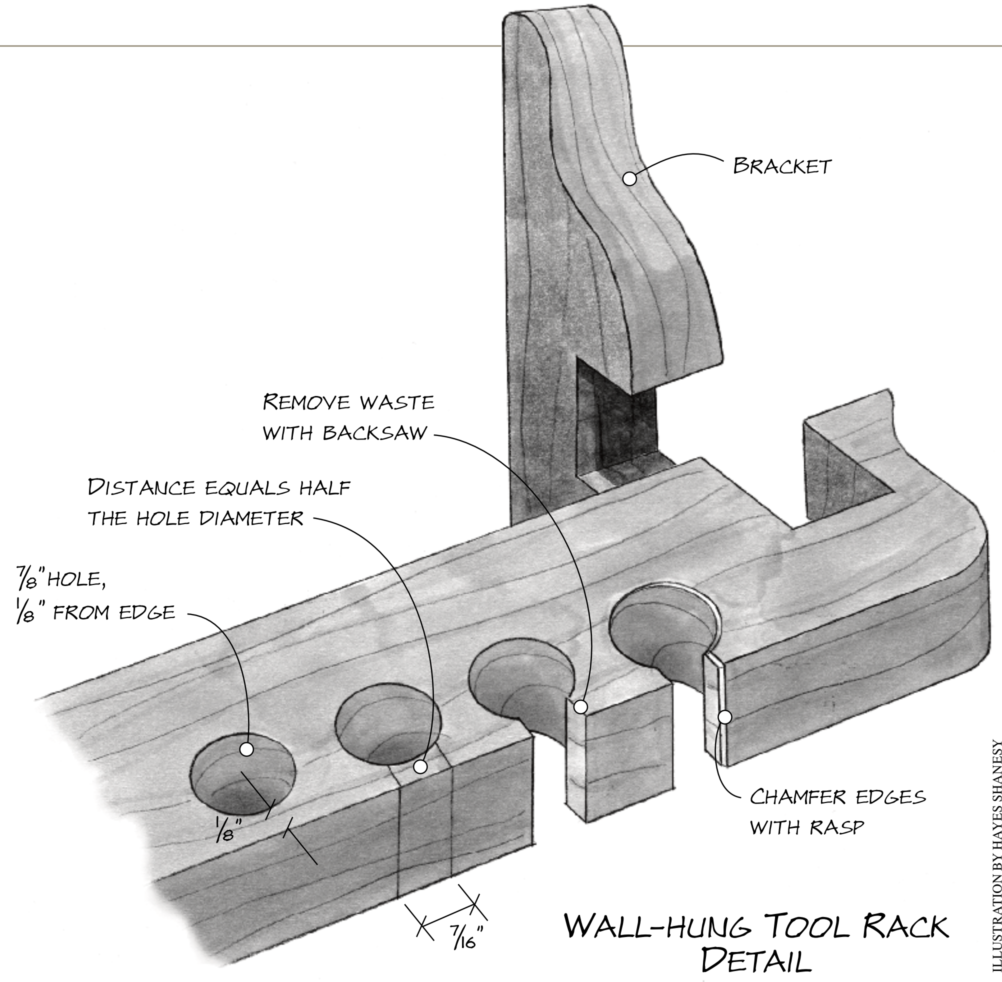
More concerned about function than decoration, I made my racks out of scrap hardwoods and didn't use a finish. A light sanding and a coat of shellac, lacquer, oil or wax would make them look nicer, but I rarely bother with doing that on something for the shop.

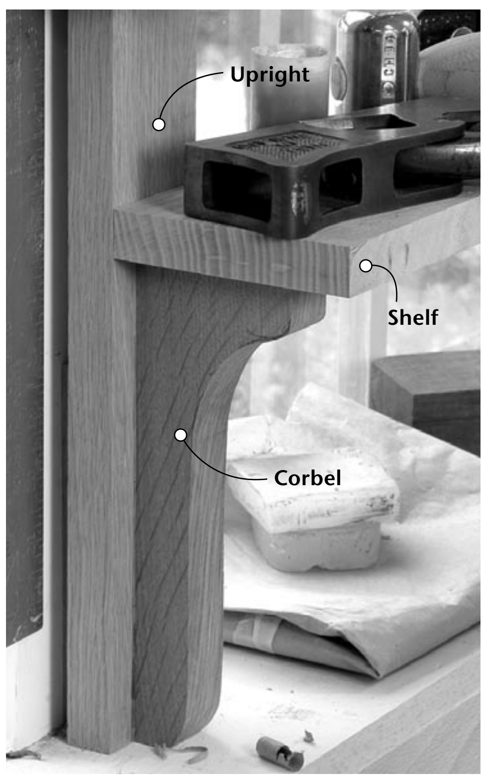
I considered doing some decorative carving on the brackets, but that reminded me that my carving chisels still live in canvas rolls in drawers in a nearby cabinet. I'm not a collector, but I will need a rack for 40 or 50 of them, and while I'm at it, I may as well start gathering the 30 or 40 more carving chisels that I really need. Maybe I can clear some space on the building column to the left of my bench for a row of them.

The great thing about these racks is that they are adaptable and made easily and quickly. As happened to me, once you start, you'll need another two or three as the list of necessary tools grows, and the way you work and the things you work on change. If you cross the line to "collector," you might need many more than that. WM

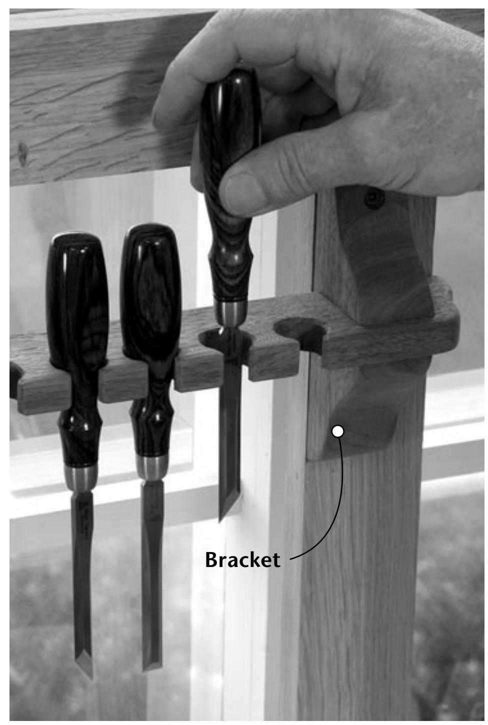
— Robert W. Lang

email





This rack has uprights at both ends and in the middle. These provide a place for brackets and corbels that can support shelves.



A 7⁄8"-diameter hole, 1⁄8" in from the edge of a 2"-wide shelf holds a variety of handle sizes. The sawn slot connecting the hole and edge allows you to hold a chisel with a blade that is wider than the handle diameter.

Glossary

"Rule of thumb: Always finish the job with the same number of fingers you started with."

— anonymous

Woodworking's lexicon can be overwhelming at times. The terms below are from this issue. Check out woodworking-magazine.com for an expanded and searchable glossary.

4/4 stock (n)
Wood sold in the rough is referred to in terms of thickness, in quarter-inch increments. Thus 4/4 rough stock is 1" thick, 5/4 is $1\frac{1}{4}$" thick, 6/4 is $1\frac{1}{2}$" thick and so on. Surfaced wood is not referred to in these terms.

S2S and S4S lumber (n)
The first "S" stands for "surfaced," the second "S" for "sides." So S2S is surfaced on two sides; S4S is surfaced on all four sides.

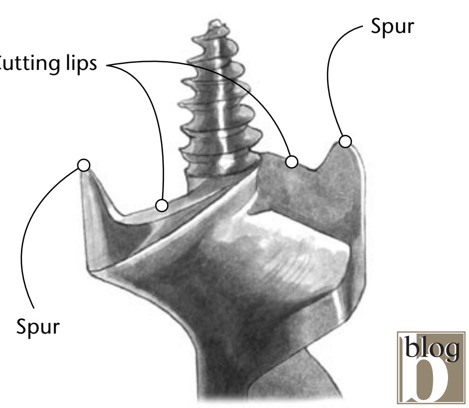
brace and bit (n)
A brace is a boring tool that holds bits. Pressure is applied to the head on top, and the tool is rotated with a U-shaped grip, which is part of a type of crankshaft. Many braces have a three-position ratchet on the chuck.

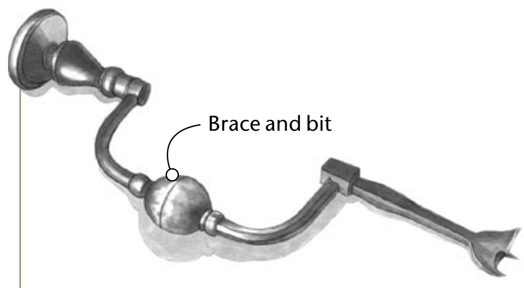
cabinetmaker's triangle (n)
A triangle drawn atop the pieces of a project that designates the front, back and sides of any assembly.

chop (n)
On a vise, the chop is a block of wood that acts as a jaw.

crochet (n)
The French word for "hook," this is essentially a planing stop for working on edges.

cutting lips (n)
The sharp beveled horizontal edges at the end of an auger or bit that levers waste out of the hole.

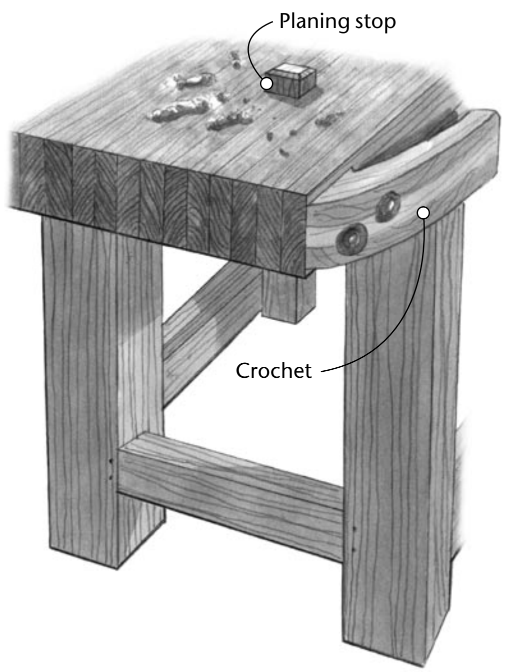




dado stack (n)
A nested set of table saw blades and chippers that cut a variable-width dado; the dado width depends on the number of chippers stacked together on the arbor for the cut.

dial indicator (n)
A precision measuring tool. A dial indicator has a plunger that moves in and out from the body of the indicator, which in turn moves the measuring needle on the dial face. Typical dial indicators usually have a 1" or 2" range, and are calibrated in increments of .001".

drawbore (n)
An early woodworking technique for reinforcing mortise-and-tenon joints with a wooden peg. Before assembly, a hole is bored through the mortise. Then an offset hole is drilled in the tenon. A wooden peg is driven into the holes, pulling the joint tight.



French fitting (n)
The use of the outline of a tool (or other item) to make a pattern. The pattern is then used to create a perfect tool-shaped nest for the tool to fit into. Very fussy, but offers excellent protection.

planing stop (n)
A piece of wood or metal (we recommend wood) that can be moved up and down in your benchtop, for workpieces to push against as they are planed.

sliding deadman (n)
Sometimes called a board jack, this panel slides horizontally across the front of a workbench and is pierced with holes to offer support of long boards or assemblies.

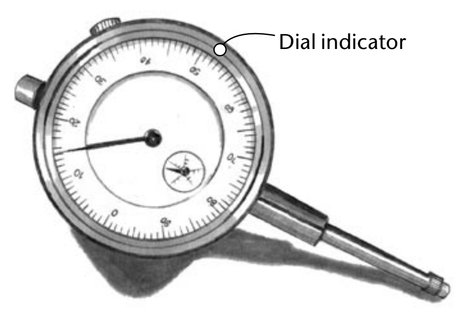
spurs (n)
The sharp beveled vertical edges at the end of an auger or bit that score the diameter of the bore.

tail vise (n)
A vise fixed at the end of a bench, usually bored with multiple dog holes. These holes work with dog holes in the workbench top so that it can adjust to grip workpieces of varying sizes.

twin-screw vise (n)
A vise with a long chop (usually 16" at least) that is secured to the bench with two adjustable screws, allowing a wide unobstructed area between the screws for clamping.

wash coat (n)
A thin sealing of protective film of any finishing product.

winding sticks (n)
Two perfectly true lengths of wood or metal used to divine whether a surface is flat. The sticks are placed at opposing ends of the surface and sighted across. Surface irregularities prevent the sticks from lining up in your field of vision. WM



ILLUSTRATIONS BY HAYES SHANESY

Choosing a Flush-Cut Saw

Wide or narrow? Thick or thin? Aggressive or fine? All these qualities influenced our choice for top saw.

PHOTO BY AL PARRISH

Flush-cut saws are available in many shapes, sizes and designs. The blades of these saws are flexible. While the sawing technique shown above isn't standard, it comes in handy in tight situations.

Until now, my flush-cut saw has had an air hose attached to the back of it with a 5" abrasive disc as the teeth. I'd cut pegs with my dovetail saw – one that had just passed its usefulness for cutting dovetails – then grind the surface with my Dynabrade random-orbit sander. In other words, I sanded any pegs flush to the surface before finishing. While I now know that a flush-cut saw is capable of trimming more than just pegs, there was once a time when that's all I thought a flush cut saw was for.

A long time back, I owned this type of saw, used it once or maybe twice and pitched it in the garbage can. That's because my cut was anything but flush. In fact, it was so not flush, that there was a distinct gash that required I sand even more than normal. Instead of smoothing the peg to the surface, I had to level the surface to the peg. After a couple harrowing experiences like this, you can see why the saw ended up in the dust bin.

Now I've been enlightened to the idea of using the saw to trim wedged tenons – my power sander used to have that covered too, when the need arose. And, I've heard mention that you can trim the height of inlaid dovetail keys.

As you may have guessed, I had a great deal to learn about the flush-cut saw. I needed to first learn how they work and how the brands differ, then I needed to learn how to use them correctly. (See the related article on flush-cut saw techniques on page 32.)

So I ordered a number of saws from different suppliers and delved into them to see what differentiates an ordinary flush-cut saw from a great one. The saws I received were priced from a high of $94 to a low of $15. Admit it; right now you suspect that the expensive saw is the best and contrarily, the least expensive is not. I began with the same convictions. The question is: Did I end up feeling that same way?

And in This Corner …

I began with a few ideas as to what to test in these saws, and after I got some saws in-house, I developed a few more things at which to look. I studied the teeth per inch (TPI), the length of the blade and the thickness of the blade. In addition, I checked the width of the blade. Surprisingly, this characteristic came to be of some importance. Finally, I looked at the aesthetics and ergonomics of the handle as well as the actual cut.

I tested saws from most major suppliers. Included were two saws from Lee Valley (the kugihiki and the Japanese flush-cut saws), two saws from japanesetools.com (the Kaneharu and the Maruyoshi; call Harrelson Stanley at 877-692-3624 for specific order information) and the Bridge City Tool Works JS-4. In addition, I examined the flush-cut saw from Robert Larson (available at Amazon.com) and the Nakaya kugihiki from thebestthings.com.

I also brought in three other saws that simply aren't worth discussing. Two, the Lynx and Pax, had round wooden handles with very narrow blades. Neither made the final testing because my cuts with these two resulted in a divot on the surface – as with the one I tossed in the trash years ago. Also, flush-cut saw teeth should be able to cut with either side of the blade flat on the work surface. This is where the Veritas flush-cut saw dropped the ball. These three aren't the saws to be buying in my opinion.

Saws That Bite

Studying the teeth on a typical handsaw leads you to look at the TPI as well as the set of the teeth (the amount the teeth are bent out). But, flush-cut saws are inherently different from most handsaws. There's no reason to check the set of the teeth; there should be no set because these saws are designed to lie flat on the surface and cut without marring that surface.

That left only the TPI for my study. The TPI on these saws ranged from a low of 17 to a high of 32. Which is better? This is an area of debate. Harrelson Stanley, of japanesetools.com, says the more teeth per inch, the finer the cut, so you'll notice a smoother cut through hardwood. The results should be a finer cut than something designed to whack off a heavier amount, but the cut takes longer to complete. Stanley is a hand-tool enthusiast. He's looking to get the finest cut so the next step is just a quick stroke with his plane (if necessary at all). If you work exclusively with hand tools, then you might want to test drive one of the saws with a higher TPI.

However, I like the quicker cut. I'm looking to remove the peg end and get into the finishing of the project. I'm a power-tool guy and my projects are going to involve sanding. That's what I do.

I also believe that the longer you have the saw against the surface while making those multiple strokes, the better chance you have to twist your wrist and introduce the teeth to the surface. That potential nick means additional sanding (or planing). That's d thing.

A quick glance at the chart on page 31 shows the TPI for all saws. The kugihiki from Lee Valley is my choice. With 17 TPI, I found the cut to be quick – decreasing the length of time the saw was on my project – and nearly as smooth as the finer TPI saws.

All About the Blade

As I set up the testing for these flush-cut saws, I figured that the length of the blade would come into question. I likened this to the length of the handle of a hammer. When most of us start working with a hammer, we grab the handle just below the head and gingerly tap the nail into the wood. As we gain experience, we move our hands down the handle and start to swing the head properly as we make contact with the nail.

I've seen woodworkers act in this manner with regular saws as well – short, choppy strokes until they feel comfortable, then long, strong strokes as their confidence builds. They cut using the entire length of the blade. But flush-cut saws are different for me and most others I've seen use them. Because of the very nature of what we're cutting, the stroke is short. We are generally cutting a small area on a small width, and that requires short, deliberate strokes. As a result, blade length isn't much of an issue and the lengths of the tested saws are not much different – ranging from the shortest at $5\frac{3}{4}$" to the longest at $7\frac{1}{8}$".

The thickness of the flush-cut saw's blade is a factor in its use. The thinner the blade the more likely you are to "flex" the blade while cutting.

This is a blade "flexing." Because these saws cut on the pull stroke the flexing occurs during the forward thrusting. Flexing can cause the teeth to slash into the surface.

What turned out to be most interesting, and the consideration I felt really made a difference in the usability of the saws, was the thickness of the blades. I immediately noticed that some blades exhibit an almost whip-like feature whereas others seem very stiff. How to get accurate measurements of thickness was my charge.

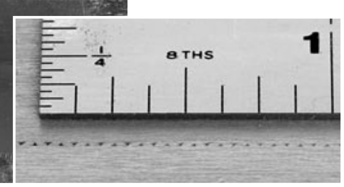
My fractional calipers were of no use. The variations in thickness were much finer than they could measure. So I grabbed the dial indicator that we use to set the blades for our machinery.

I tested using a table saw top (a known flat surface) as the platform. I set up the indicator with the magnetic base locked in and set the needle to zero. Next, I lifted the plunger and slid the saws in for a reading. The range was from .008" (very flimsy) to .021" (somewhat stout, comparatively).

What does this indicate as to the workability of the flush-cut saws? Let's start with the technique of using this type of saw. If you look at most catalogs, or even the picture at the beginning of this article, you'll see the saws flex to the point of risking permanent bend. I guess it's acceptable when you're in extremely tight quarters to work this way. But how often does that happen? The method that most use in cutting with these tools is to lay the blade flat on the work and place fingers on the blade to keep it flat (see "Flush-cut Techniques" on page 32 for more instruction).

So here's my take. As I used these saws I noticed that my fingers hold the saw flat and as I saw back and forth to make the cut, my drive hand (the one on the handle) tends to wander either upward or downward. As this happens, I begin to put force on the blade that causes the

Having no set in the teeth allows the blade to lay flat during use and cut without marring the surface of your project.



The number of teeth per inch (TPI) influences the saw's cut and varies from saw to saw. One way to find that number with really fine saws is to tap the blade into wood and count the holes in any given inch.

"Truth is immortal; error is mortal."

— Mary Baker Eddy (1821 - 1910)
author, founder of Christian Science Movement

thinner blades to bend slightly on the push stroke. On the pull stroke, the saws remained flat. This caused me to raise my fingers and lose that flat contact between the blade and the surface. Marring is more apt to occur during this sequence of events. The thicker blades didn't show signs of this happening.

Obviously, there's a direct correlation between bending and the thickness of the blade stock. I'll take a thicker blade – remember we're talking a difference of .013" – for my flush-cut saw. I found it easier to keep the thicker blade flat.

Wider is Better

You've heard it before I'll bet. I think it was a car commercial. Wider is better. While I'm not so sure about a wider body on a car, I do think this is fact when working with flush-cut saws. The wider the blade, the better able you are to keep the blade flat. Narrow blades allow you to twist the blade across the cut.

Two major things can happen when the blade doesn't stay flat to the surface. First, the cut wanders down into the surface. You know that causes problems from above. Do you want to level the surface to the peg? No. The second result of blades not staying flat is the cut of the dowel or peg is proud. Is that what we are aiming for with this entire exercise? No again.

Interestingly, the two widest blades in the test, the Bridge City Tool Works JS-4 and the Nakaya kugihiki from thebestthings.com, were also the thinnest blades in the test. I think that one characteristic offsets the other.

Also, none of the saws are impulse hardened to keep the teeth sharp. And, there's a golden sheen on two of the saw blades. This is a simply a result of factory processing and adds no benefit.

Test Drive for Looks, Comfort and Cut

There can be no doubt that the Bridge City saw is the most handsome. It will take any award for looks, hands down. The handle is wrapped in a burgundy thread-like material that is secured with showy brass bands. That material is actually line used for shark fishing.

The next tier for looks includes the Maruyoshi from japanesetools.com and the Nakaya kugihiki from thebestthings.com with the handles wrapped with raffia. Following closely is the bubinga handle on the kugihiki saw from Lee Valley. The balance of the saws have fairly nondescript handles.

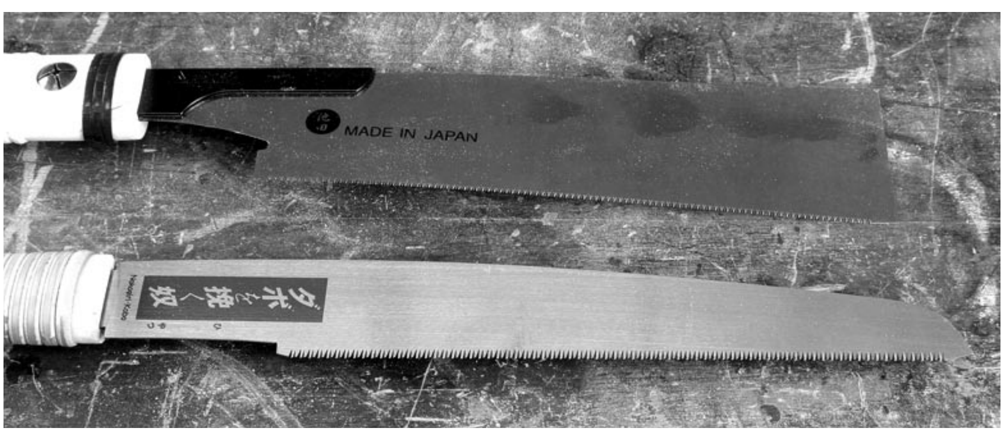
If a tool is uncomfortable to hold, I doubt you'll reach for it when you need that job done – unless it's the only tool that can do that job. Given all the saws and the many different handles, I had to find one that was comfortable to use – even though I don't plan to use a flush-cut saw as often as I do my dovetail saw.

Of all the saws, only two did not have a typical Japanese-handle design. The Lee Valley kugihiki saw and the Robert Larson saw both have an oval handle with a flared end. I found these handles very comfortable and they felt secure in my hand during use.

The All-important Cut

No matter how the saws stack up in the looks department, the telltale of purchase-worthiness is the cut. It might be a great-looking saw, but if the cut is not right, you don't need it in your toolbox or hanging on your wall.

In order to make cuts that I could look at closely, I planed a walnut board by hand, installed 5⁄16" dowels and made a cut with each saw. I was looking for two things. The first was if the teeth left any indication that they were there (that gnarly gash). The second was the resulting cut. Was the dowel flush with the surface? Did the saw tend to float up or move down as it cut? This would tell the story.



Wide blades give more support while cutting, reducing the chances of twisting your wrist and driving the saw teeth into the surface.

The Lee Valley kugihiki is the winner. This saw brings everything from an aggressive cut to a shapely and comfortable handle to the table. Not the most expensive – just the best saw for your money.

None of the saw cuts slashed into the walnut, however a few did leave ever-so-slight lines: the Nakaya kugihiki, the Kaneharu and the Maruyoshi. Not a problem really, just a calling card. With the other four saws I saw no lines in the grain.

The peg cuts of the Kaneharu, Maruyoshi and the Lee Valley kugihiki saws left a smooth top on the dowel and the finish was flush with the walnut. The Nakaya kugihiki, the Robert Larson and the Bridge City JS-4 saws rolled uphill as the cut progressed, leaving a slight elevation at the back edge of the cut. The Lee Valley Japanese saw was humped in the center of the dowel.

Where I'll Place My Money

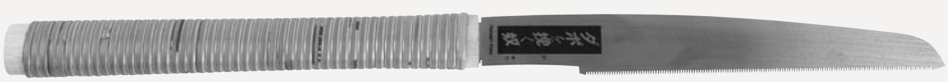
These are not saws that you quickly wear out, but what if you break a tooth on these saws? Are they trash? There are four saws for which a replacement blade is available: the Nakaya kugihiki, the Maruyoshi, the Lee Valley kugihiki and the Bridge City JS-4. If they are used appropriately, I wouldn't expect that you'd go through three saws of this type during your woodworking days.

So, how do they stack up? Make a list of the important features of a flush-cut saw and you'll find what I think is the best saw for your hard-earned money. Choose thicker blade stock with a more aggressive cut, a wide enough blade to allow two-finger hold down and to help eliminate any potential for twisting, and a nice-looking tool that fits and is comfortable in the hand. Finally, it must have the right cut. That's a cut that is flush with the surface without leaving scratches, stays flat across the entire peg width and leaves the finished surface of the cut smooth.

At the beginning of this story, I mentioned the costs of the saws and wondered if I would choose the most expensive one. I didn't. For my money, I'll select the Lee Valley kugihiki with the bubinga handle. It fits all the requirements for a great flush-cut saw at the reasonable price of $22. This flush-cut saw fits nicely into any tool arsenal. WM

— Glen D. Huey

Flush-Cut Saws

BRAND	PRICE	TPI	BLADE THICKNESS	BLADE LENGTH	OVERALL LENGTH	AVAILABLE FROM	
Highly Recommended							
Lee Valley kugihiki (60T06.20)* 	$22	17	.021"	6 1/4"	13 1/2"	leevalley.com or 800-871-8158	The comfort of the handle, the thickness of the blade as well as the aggressive TPI make this the pick saw. The cut was nearly as smooth as higher TPI saws.
Recommended							
Bridge City JS-4 (#1101-170)* 	$59	32	.008"	6 5/8"	16 1/4"	bridgecitytools.com or 800-253-3332	By far the most elegant saw in the group. This saw has a thin and wide blade. Cutting is very fine given the TPI. Overall a good choice.
Kaneharu 	$94	26	.012"	7 1/8"	17 1/8"	japanesetools.com or 877-692-3624	A very nice saw. The blade thickness lessened the chance of flexing while the cut of the peg was dead flat. Light scratch lines appeared on the surface after the cut.
Lee Valley Japanese (60T1901) 	$27	22	.011"	6 1/4"	16 1/4"	leevalley.com or 800-871-8158	The thin and narrow blade makes this saw susceptible to reacting to wrist movements. Those movements have a negative effect on the cut.
Maruyoshi* 	$56	23	.014"	7"	18 1/4"	japanesetools.com or 877-692-3624	With the excellent fit and finish, this saw's only downfall is the narrow blade. The cut is smooth but fine scratches showed up on the surface.
Nakaya kugihiki (K-180G)* 	$35	32	.008"	7"	16 1/2"	thebestthings.com or 800-884-1373	The flimsiness of the blade is offset by its wide profile, which gives it more area to hold flat to the surface. More strokes are needed due to the high TPI.
Robert Larson 	$15	19	.021"	5 3/4"	12"	amazon.com	The least expensive saw in the group. The stout blade makes using this saw easy and the fit of the handle makes it comfortable. Worthy of being in the test.

* replaceable blades

Discover Flush-cut Saw Techniques

Trim the fat from flush-cut saw techniques. With proper practice your finished cuts will be extra-smooth.

"Is it the saw or operator error?" That question arises in discussions about problems using flush-cut saws. Learning proper technique puts half that question to bed.

When I began building furniture I bought a flush-cut saw. Knowing that I was going to build Shaker-style furniture and that square pegs were used in nearly every project, I was certain the saw would be one of the most-used hand tools in my shop. With saw in hand, and willing to spend some time testing the cut, I loaded a few pegs into a chunk of wood and started at it.

Having no formal woodworking education – I'd last received lessons in junior high shop class – I made the flush cuts. I wasn't sure how to correctly handle the saw or even if I had my hands in the right position. Was there a proper method to using these saws? Pictures of the saws in woodworking catalogs show the blade of the saw bent just short of a 90° angle. I always wondered if this was the correct sawing position.

I positioned the saw flat to the surface while I sawed back and forth, allowing the saw blade to slide over the surface of the wood. Some cuts were acceptable, some weren't. Eventually I found more cuts weren't acceptable. The blade dug into the wood and my overall sanding time escalated as I found myself leveling the surface to remove the gash left in the wood. The saw was causing too much repair work. And so I pitched it into the garbage. Was I doing something wrong? Was my technique bad?

I then adopted a new technique of cutting close to the face of my project with a regular backsaw, then sanding the pegs flush with a random-orbit sander. Sometimes I'd place a piece of laminate or a business card over the peg and trim as close as possible then sand everything flush. I worked this way for years.

Recently I brought a number of flush-cut saws into the *Woodworking Magazine* shop to test and to select the best saw (See "Choosing a Flush-cut Saw," page 28). At the same time I thought I would get some first-hand experience using this type of saw. I'd refine my technique. So, I loaded some pegs into a block of wood in order to perform a couple dozen cuts and complete the tests.

Seeing the momentous number of advertisements and pictures of these saws being used with that huge bend, I again wondered if I was approaching this cut in the correct manner. Not wanting to miss an opportunity to learn, I bent the saw to that extreme angle and began to cut. It wasn't a good thing. At that angle, the saw cut worse than if I'd just taken a small hatchet and chopped at the peg. I couldn't keep the saw flat on the surface and the cut was ragged at best.

Practicing a few times with the same results, I began to think that I just wasn't going to be capable of using this technique to cut flush. So, I enlisted the help of editors Christopher Schwarz and Robert W. Lang to help uncover my problem. Was it me or were all those photos and advertisements wrong?

"Trust your gut instinct." "Your first thought is probably correct." Do these sayings sound familiar? They do to me. I contemplated these truisms as I watched Chris and Bob step to the bench one at a time. I didn't let them know what I was looking to find, only that I needed them to cut the peg with a flush-cut saw.

Much to my relief, they both approached the peg with the saw flat on the work and didn't bend the blade as they worked. I now knew I had the basic technique correct. What I needed was to refine the procedure and make the saws work for me instead of against me by leaving that huge gash in the wood.

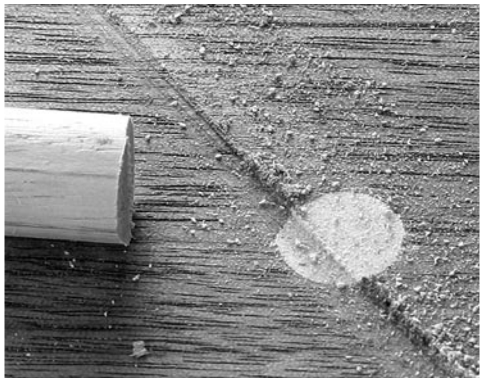
The Technique, Step by Step

I needed to start at the beginning, so I mulled over the process of using the flush-cut saw. First things first: Position the blade flat on the surface of the project. There shouldn't be any set in the teeth of a flush-cut saw so placing the saw to either side of the peg is acceptable. I'm right-handed, thus you might think it's correct to begin with the blade on the right-hand side of the peg. However, if you're right-handed it's best if you begin with the saw on the left side of the peg. This requires that you rotate your wrist 180º or change your grip on the handle.

As we determine the correct placement of the left hand, you'll see why this saw positioning is so important. Two fingers of the left hand should hold the blade flat to the surface. This keeps the blade flat, minimizing the chance of it lifting from the surface, which would result in a proud peg. And, it prevents the teeth from diving into your nearly finished surface and causing those nasty gash lines, which would be worse.

Your fingers act as a hold-down for the saw as you stroke the saw back and forth, allowing the blade to slide between your fingers and the surface. Make sure that you hold your wrist so the blade remains flat. If you twist forward you place additional stress at the front of the blade increasing the chances of digging into the surface. If you twist back you'll place that stress at the rear of the blade and your cut won't be flat and smooth across the peg. Using a saw with a wide blade provides you a better chance to remain flat to the surface. A wide blade helps obtain a better cut.

And here is the importance of setting your hands properly: As you finish the cut through the peg the saw blade isn't traveling toward your hand. If you've cut with your hands positioned differently – moving the blade toward your stationary hand – when you finished the cut I'll bet you jabbed the blade into your hand. I've seen this happen on more than one occasion in the classes I've taught. I'll let you in on a secret: I've done this a time or two to myself (third time's the charm.) If you haven't made this mistake, consider yourself lucky, as well as warned.



Bad technique or a bad saw? Either way this is not good. The only recourse from here is to level the surface to the gash left by the saw.

This cut started on the right. Rolling the wrist caused the blade to ride upward as the cut progressed, which resulted in a higher left side. Additional work is needed to flush the peg. Holding the wrist level results in a smooth cut.

Location Dictates the Direction

What happens when you need to make a cut with the blade positioned on the right-hand side of the peg because there isn't enough room on the left side of the peg for you to place the blade flat on the project?

If you're a left-handed woodworker the procedure is as described, only mirrored. If you're a right-handed woodworker, the process requires a repositioning of the stationary (or left) hand.

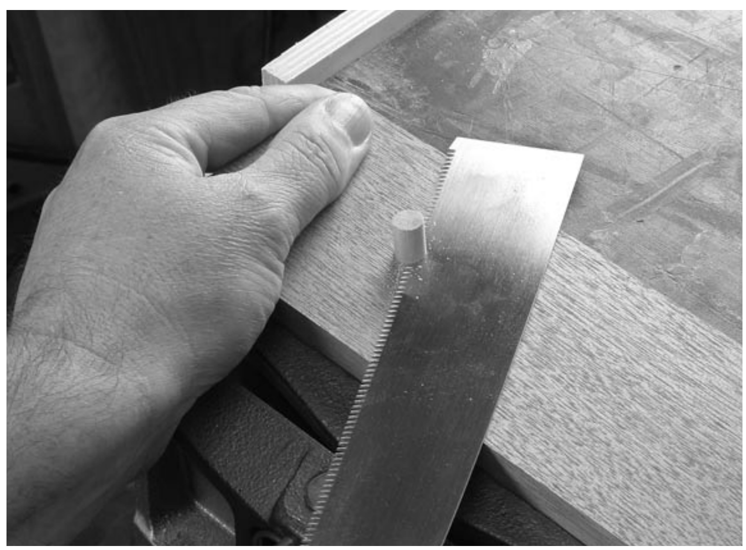
Now, in order to keep your stationary hand out of the line of fire as you complete the cut, it's necessary to reach across the peg to place your fingers on the blade. (See the top-left photo on page 34.) This position may feel awkward but rest assured, you will not cut your hand as the saw slices through the peg.

Making the Flush Cut

With hand positioning covered, how do you cut? I've seen people try to make this cut using surprising techniques. One such technique was to slice through the cut by starting at the back end of the blade and zipping completely past the front end of the blade – all in one swift motion. This action was repeated numerous times until the cut was complete – each time introducing the blade to the peg and the surface of the project.

Basic handsawing techniques suggest that you start the cut with a few short strokes in the

This is ideal hand placement. My fingers keep the blade flat on the surface and once the cut is finished the hand is clear of danger.



This cut is wrong in so many ways. The blade is not held flat, it's not supported through the cut and the blade has direct access to the stationary hand. This is an accident waiting to happen.

When having to cut toward your stationary hand make sure to raise the wrist and other appendages out of harm's way. Maintain two fingers on the blade for support and guidance.

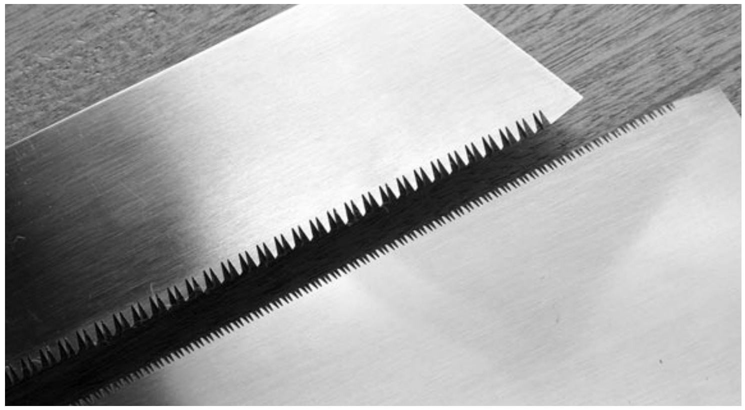
direction that is opposite of the tool's cutting motion. On Western saws this would indicate a cut on the pull stroke. On the Japanese design, which includes most flush-cut saws, the cut would begin with a push stroke. Once the cut is begun and the saw is nestled into the kerf and running smooth you should use full and complete strokes of the blade.

Using the entire blade does two things. First, it allows for better waste removal. When the gullets between the teeth fill up with dust, the saw stops cutting. Using full strokes helps empty the gullets. Second, using full strokes allows all the teeth to cut, which keeps the blade sharper longer. If you only use a small sampling of the teeth, those teeth wear faster.

One area of particular interest when using handsaws, especially thin-bladed saws such as the flush-cut saw, is the amount of pressure you exert as you saw. In working with any saw, the more force you use, the more apt you are to veer from the line. This happens (in part) because the blade bends or warps under the force.

Continuous sawing as the blade bends causes the kerf to drift. This is not acceptable when using the flush-cut saw. If your blade moves off the flat surface you'll end up with a cut into the project or a cut that is nowhere near flush. In extreme instances it's possible to actually kink the blade of flush-cut saws.

Allow the blade to cut with minimal pressure. If the length of time it takes to make the cut seems long, it's probably because the saw isn't sharpened correctly or the teeth per inch (TPI) count is high. The higher the TPI, the finer the



The number of teeth per inch (TPI) influences the time required to make the cut. More teeth keeps the saw at its job longer and that increases the chances for mistakes.

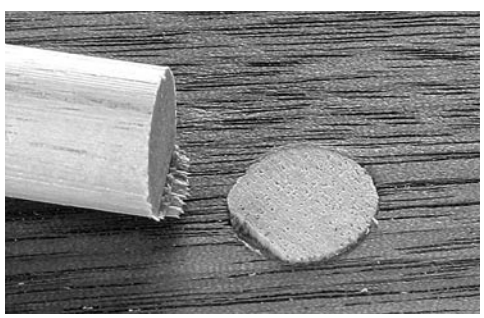
cut – and the slower the cut is made. Lower TPI saws are more aggressive.

About the Cut

Should you perform the cut from only one direction, or do you start the cut on one side of a peg and then move to the second or opposing side to complete the operation?

The simplest method is to start the cut and saw through the entire peg. That's fine if all you're looking to do is hack away waste material. Much of the time this is exactly what you're after. But, problems surface if you catch the second-to-last stroke wrong. As you return to make the last stroke, it's possible to break the remaining material before it's cut by the teeth. Because the break is at the outer edge of the peg, it's conceivable that the fibers of the wood will tear down the peg side versus simply breaking off. That can leave a jagged finish to the peg that will require additional work or a nasty visible area that has to be addressed. This is same reason why tree loggers make a relief cut on the back side of the trunk as they fell trees.

Creating a cut on one side prior to completing the cut from the opposing side reduces this possibility. If something does happen, say the peg breaks as the two cut areas intersect, the peg will not rip down the outer edge, but break somewhere in the interior of the peg. If material is left protruding from the surface, it's much easier to pare the center of the peg with a chisel without damaging the project surrounding the peg.



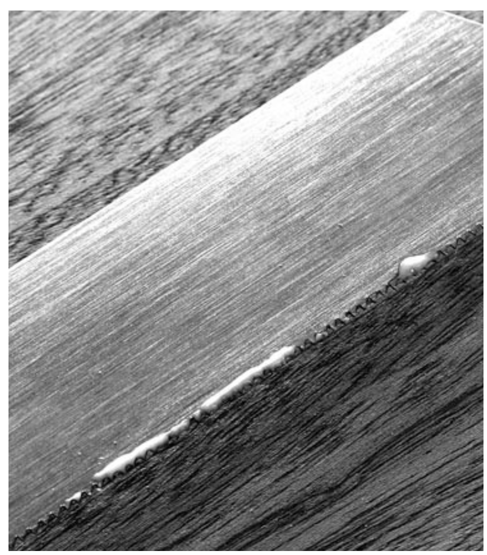
Starting the cut on one side and finishing on the opposing side reduces any chances of ripping the grain down the side of the peg. A faux pas such as this shows in a finished project.

A Final Note

In most woodworking if you're trimming pegs, chances are you've installed them using some type of glue. Glue is the enemy of flush-cut saws (and saws in general). The teeth are small and the glue easily becomes lodged in them. Within a short time the saw becomes useless or untrustworthy as it cuts. Either scenario is something to avoid. Make sure to clean any glue remnants as soon as they're discovered.

Develop correct cutting methods and a flush-cut saw will reap huge rewards in your woodworking. These saws are delicate with fine teeth, but will last a lifetime if cared for properly. WM

— *Glen D. Huey*

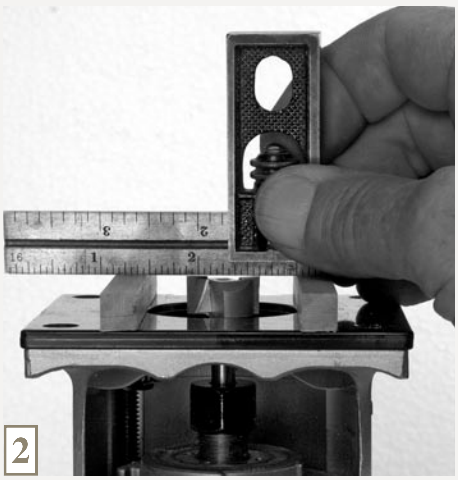


The main use for flush-cut saws in my woodworking is to trim pegs. Those often have been glued into position. The glue fills the teeth, rendering the saw useless. So you must clean the teeth well on a regular basis.

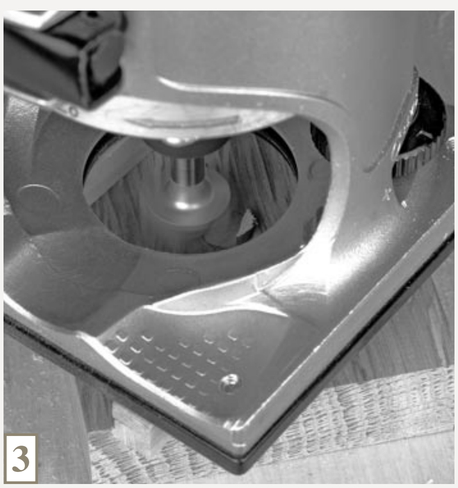
Flush-trimming Router Base: Pare Your Pegs With Power

There is always more than one way to perform any task in woodworking. For flush-trimming pegs, here's a motorized method for tackling this task.

Adhere two small strips of wood to the router base plate with double-stick tape. Space them as far apart as possible, but less than the width of the surface they will be resting on.



Set the bottom of the mortising bit even with the bottom surface of the wood runners.



After making test cuts to set the depth of the cutter correctly, trim the pegs by slowly moving the spinning cutter across the protruding peg.

A trim router equipped with a mortising bit would be ideal for flush-trimming pegs, were it possible to set the bottom of the bit even with the bottom of the router base, while at the same time push the base over a protruding peg. This simple, 10-minute modification to the trimmer base does just that.

Two 3/8" x 3/8" pieces of smooth hardwood are attached to the base plate with double-stick tape. The exact location will depend on the width of the piece; narrow stiles and rails require the pieces be placed close together. It's a balancing act; they should be as far apart as possible while leaving both on the surface.

The best router bit to use is sold as a mortising or dadoing bit. The key is that the bit is designed to leave a flat-bottomed cut and has a carbide cutter on its end.

Set the bit height with a straightedge spanning the two wood runners. Start with the cutter a hair below the straightedge and make a test cut. Lower the cutter and repeat the test cut until it will trim a peg flush without marring the surrounding wood. If dead flush makes you nervous, the peg can be left a wee bit proud, then sanded or scraped flush.

This method works best when the router is doing the least work possible, so don't leave much of the peg exposed, 1/8" to 1/4" works well. The only real risk in this method is allowing one of the runners to fall off an edge, tilting the base. Move the cutter in slowly over the peg, and remove it in small nibbles by rotating the tool.

— Robert W. Lang

email

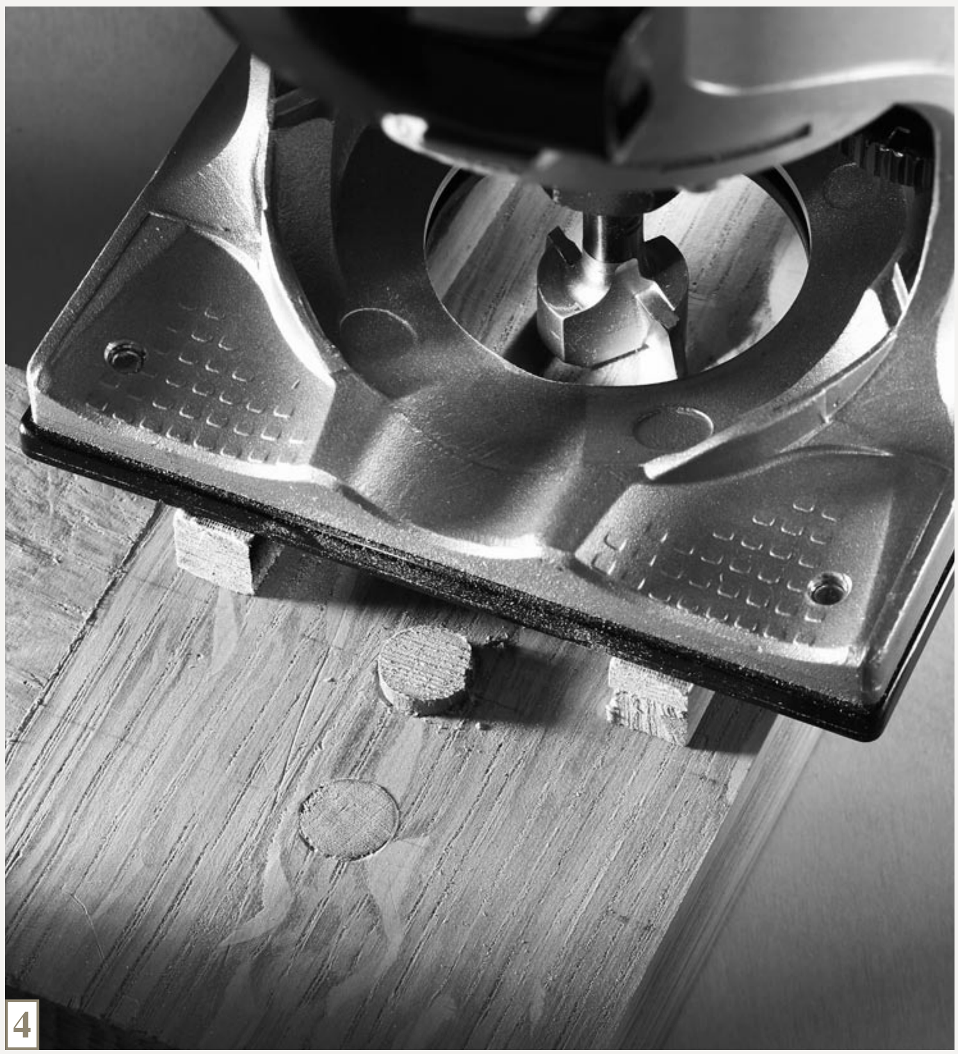


PHOTO BY AL PARRISH

Keeping the wooden runners in contact with the surface is essential. If one runner falls off an edge, the base will tilt and the router bit will dig into the wood surrounding the peg. A bit of paraffin on the bottom of the runners will allow them to glide across the surface.

Become a Better Borer

Drilling clean, accurately placed holes is essential to good woodworking. Learn to become a human drill press with our simple exercises.


PHOTO BY AL PARRISH

The trick to boring accurate holes isn't years of practice (though that always helps). Instead, you need to understand the goal of your hole, and the role each of your hands must play in the boring saga.

Modern woodworkers tend to look at making holes as merely one small step toward crafting a joint. We bore out waste to make a mortise to hold a tenon, or we drill a pilot hole for a screw. But for centuries, it was the holes themselves that were the height of high-technology joinery.

In many pieces of early Egyptian and American Indian furniture, the only joints were holes that were then lashed together with leather strips. I've seen beds, coffins and household goods such as buckets built using this system.

This skill didn't disappear with the Pharaohs. The skill – sometimes called marlinship – survived through the Victorian era. Even the Wright brothers' early airplanes were lashed together using some of these principles.

Today we lean on the drill press when we need an accurate hole, and we use an electric drill when accuracy is second to speed. And when we need a hole at an odd angle or in an odd place, we end up building complex jigs and guides that can consume hours of valuable shop time.

I worked this way for years until I took a chairmaking class. The only boring tools in the chairmaker's shop were the brace and bit. The entire time I was taking the class, I made mental notes about how I could develop a drill-press jig to make the difficult compound bores involved in building Windsor chairs. But by the end of the week, I'd abandoned my plans for jigs.

"I try not to anthropomorphize my tools. They hate that …."

— Tom Bruce
Akbar 'n' Jeff's Tool Hut
(www.workingtools.biz)

That's because somewhere after about 30 or so holes, I found I could bore as straight as a drill press with a brace and bit. What was the trick? Well, the practice helped – it always does – but more important was understanding the proper body position for boring and thinking through the goal at hand.

Excited, I took my new-found love of boring back home, and during the airplane ride I contemplated throwing away my cordless drill. The batteries weren't holding a charge, anyway.

That turned out to be a cockamamie idea as well. Cordless drills are a gift from the gods when speed can trump accuracy. Plus, I found that my new-found brace skills spilled over to using the cordless drill as well. In other words, I was an all-around better borer.

You can be one, as well, with just a bit of practice. The first step is to understand the tools and what they're used for. Let's begin with the brace itself.

Brace Yourself

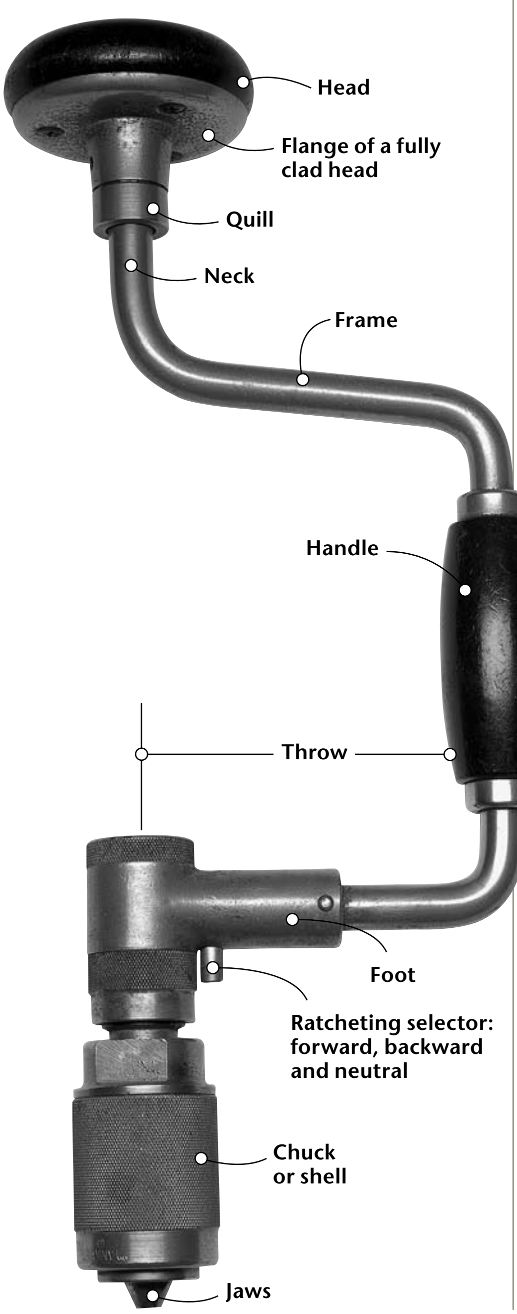
Before braces were invented, holes were bored with a bow drill, according to old paintings and drawings. What's a bow drill? Picture a drill bit held in place at the end of a long wooden handle. Then the string of a bow – much like a bow for arrows – is wrapped around the wooden handle. Each stroke of the bow rotates the bit. It's a fairly inefficient and low-torque way to make holes.

On the other hand, the brace – even in its most primitive form – is a marvel of mechanical advantage, courtesy of the 15th century. The bit is held in a chuck. One hand grasps the top of the tool. The other hand cranks a U-shaped handle. With this simple tool you can develop torque that only large-horsepower motors can achieve.

I stumbled on this revelation while drilling $^3/_4$" holes in 3"-thick yellow pine with an auger bit. The task drained a cordless drill's battery after one or two holes. So I switched to a corded drill. After two holes, that drill caught fire. But the brace with the same sharp auger breezed through the wood, and I barely broke a sweat.

Here's an anatomy lesson of a brace, and a discussion of its most important features.

■ The Head or Nave: The round knob at the top of the brace is properly called the head, though you will see other names for it, such as "pad." It is made of metal, wood or a composite material and should spin freely around. When you pick up a vintage brace, one of the first things you should check is how well the head fits. A wobbly head is an indicator that the tool is worn or poorly made. The wobble will make it difficult to bore straight.



■ The Frame: The U-shaped section of the brace is called the frame, though sometimes it's called the crank. The part where the frame joins the head is called the neck. The part where the frame joins the chuck is called the foot. The place you grasp the frame is called the handle. What's important about the frame is how much the handle is offset from the head and chuck of the tool. Braces commonly have an offset from 3" to 7" – this offset is called the throw. Tools with more throw can generate more leverage with less effort, but they require more space to work. If you take the amount of throw and double it, you've calculated the sweep of the tool. The sweep is essentially the diameter of the circle created by turning the handle one revolution. The sweep is the number that tool merchants use to describe the tool's size. The most common sweeps are 8" and 10". The 6" size is good for small bits in tight spaces; the 14" sweep is good for holes that are larger than 1" diameter in tough woods.

■ The Chuck: The part that holds the bit is the chuck, and it is the biggest variable in a brace. There are probably hundreds of different designs. Most of them work fine for holding the tapered, rectangular tang designed for braces. But some chucks also will hold standard round twist and brad-point bits, which is handy. The most important thing to look for is that the jaws of the chuck close tightly and don't flop around inside the chuck, sometimes called the shell. Floppy jaws are usually a sign that the spring inside the chuck is broken or dislocated. I'd pass on a brace with a broken chuck.

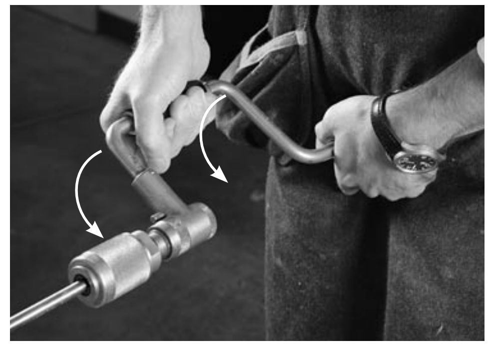
Many chucks have a ratcheting feature, which is a lot like the three-position switch on a socket set. You can set the brace to turn the bit only on the forward stroke, only on the reverse stroke or during both forward and reverse. While some woodworkers think the ratchet is as unnecessary as socks on a squirrel, I disagree. The ratchet allows you to bore easily in tight spots where you can only move the handle through part of its arc, such as in a corner. Also, the ratchet allows you to easily rotate the handle in one part of its arc that is comfortable or requires less effort. One example: When working with the brace horizontal, it's easier to push the handle to the floor (gravity is your helper), and the ratchet allows you to work in that narrow band.

The ratchet does add some weight to the tool, which some people dislike. But I don't mind the weight. Most boring at the bench is done with the brace vertical, so the weight isn't an issue.

The ratchet should move smoothly and click (just like a socket set) when engaged. In vintage braces, the ratchet mechanism can get gummed up. On some tools it's easy to clean and lubricate these. On others (particularly the fine brace made by North Brothers of Philadelphia) re-assembling the ratchet requires an engineering degree and an extra hand.

Basic Brace Use

Braces aren't difficult to use. To load a bit in the chuck, here's the basic drill: With the chuck pointing up to the ceiling, grasp the chuck with one hand and hold the tool's handle with the

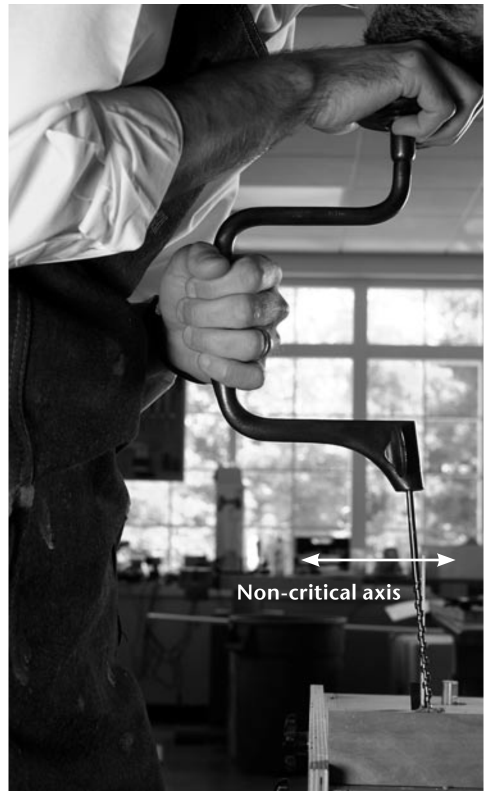


When boring large-diameter holes you can fatigue one set of muscles on the arm that is holding the handle. Instead, engage the ratchet and work only in the narrow area where gravity is working with you.

Cranking the jaws closed by using the handle is faster than simply spinning the shell with one hand. Plus, you can get the jaws tighter on the bit with less effort by adopting this technique.

Keep your body as close to the axis of the brace as possible and focus your downward pressure on the head of the tool. Note that the hand on the handle is employing a loose grip.

With many holes there is a critical axis that requires attention. If I stray left or right here, this door stile is as good as firewood.



Here's the non-critical axis. If I stray forward or back then it's no big deal. That can be corrected with the next hole.

other hand. Set the ratchet (if there is one) to the middle position so it is disengaged. This is like the neutral position on some ratchets in a socket set. Now crank the handle clockwise to open the jaws. Insert a bit between the jaws and close the jaws until they just barely hold the bit. Wiggle the bit until its rectangular shank finds its nesting place in the jaws. Now crank the handle until the jaws close tight.

To make a hole, place the tip of the bit in position. If you are boring with the tool vertical, then do your best to get your body over the tool as much as possible. I'll frequently perch my chin on the head of the brace. This increases accuracy.

If you are working horizontally, brace the head of the tool against your stomach or chest (whichever is more convenient).

Now you want to begin boring. I like to assign separate jobs to each of my hands. My dominant hand typically goes onto the head and grasps tight. That hand has only one job: Steer straight down. My off-hand goes on the handle – lightly now – and has only one job: Travel in a circle.

Mastering this basic stroke and approach to the work is the first step to getting an accurate result with a brace. The other tricks have to do with all forms of boring, whether they are powered by electrons or empanadas.

"The more a guitar is played, the better it will sound; it needs to get used to being an instrument and not a chair, so it's difficult when some musicians expect a guitar to play itself. That's why I think most good luthiers would make great shrinks: It's usually not the guitar."

— Frankie Montuoro
guitar technician for the band Wilco in "The Wilco Book" (DAR)

Learn Plumb; Learn Level

While growing up, we first learned good posture by balancing textbooks on our heads and then walking around the classroom. To learn to bore accurately, there are a couple good crutches to lean on until you get the feel for the tool. These rules apply no matter what sort of boring tool you have in your hands.

Most boring is done at 90° to the work, so you can teach yourself to bore true by sighting your work against a try square positioned on your work or your bench. You also can sight your bit against any layout lines scribed on your work, such as when you've marked out a mortise on a stile. What's critical is to figure out which axis is more important to observe, and to then position your body (and try square) to take advantage of that knowledge.

Here's a classic example: Let's say you are boring out the waste in a mortise in a door stile. The stile is sitting on your bench and you are standing at the end of the board. The critical axis for this job is left and right. If you lean left or right as you bore, the mortise will not be straight – or you might even bore through the face of your stile. The non-critical axis is forward and back. If you lean too far forward or too far back, it's no big deal. The next hole (or your chisel) can correct that error. In some cases the error doesn't even need to be corrected.

So remember this when you bore: It is easier to sense whether you are listing left or right than it is to tell if you are leaning forward or back. That should tell you where to stand and where to place your square as you are training yourself to work at 90°.

But what about when you must bore at an odd angle? That is, anything to do with a chair or a stool? You might not be able to train yourself to hit 17.5° off of 90° in your sleep, but you can train

In critical boring operations, you can use a block of wood that's cut to your desired angle and press the flutes against the block.

Extend your index finger when drilling, hammering, sawing or planing. Your finger will help bring the rest of your body in line.

yourself to stay consistent once the cut has begun. Just remember that one hand steers and the other hand cranks, and you'll get the hang of it.

When boring odd angles, you can use a sliding T-bevel as a guide, which is a help. But you also can use a friend to act as a spotter. Whenever I get ready to bore something on the odd side, I'll take one of three approaches.

If it's an angle that has to be dead-on, I'll position a T-bevel along the critical axis and have a friend or co-worker spot me as I begin the hole. (Once the cut has commenced, you're committed and it's probably better not to have people watching.) If I'm alone in the shop, I'll begin the hole with the lead screw of the auger only and try to get the bit lined up against the blade of the T-bevel before I commit to burying the bit's cutting spurs into the work.

The third option involves the miter saw. Set the saw to make a cut that matches the angle you're seeking. Cut a piece of 2x4 scrap at that angle. Then clamp or screw that scrap so the flutes of the bit ride the angle as you bore. This final approach isn't as fussy as building a complex boring jig, but it does increase your accuracy dramatically. And remember, if you measure the angle from the underside of the stool or chair you can screw your guide block directly to the work because any holes from that process will be hidden.

The above guidelines aren't just for braces. They work with cordless and corded drills as well. When dealing with drills that have a pistol-grip (corded or cordless), there is an additional trick to learn. When you grip the handle of the drill, point your index finger out so it's in line with the chuck of the tool – don't use your index finger as the trigger finger. That's the job of your middle finger.

This little trick works with any tool that requires guidance (especially handsaws and jigsaws). Sticking your index finger out to point the way is a cue to your body to straighten out and head the direction of the pointer finger. This might sound like bunk. I swear it is not.

Most early tools were designed for a three-finger grip and encouraged the user to extend the index finger. Modern woodworkers who pick up these old tools usually assume that the reason the handle hurts their hand is that it was designed for people back in the day when they had smaller hands. That's just not the case. Study the old books that depict hand-tool use and you'll see immediately that extending the index finger is common. And, in fact, people weren't that much smaller in the 18th century. Not to belabor the point, but if you're interested in this myth, The Plimoth Plantation in Plymouth, Mass., has an engaging article on this topic on its web site: plimoth.org/discover/myth/.

Watch the Spurs

Once you have the confidence to leave the try square behind as you bore (and your head has been cleared of images of our forefathers being tiny people), then try this other trick to check your work as you begin boring. When using an auger bit, the first part of the bit to bite the wood is the lead screw. It's a simple cone and can't help you

When you are boring a critical hole, begin the cut cautiously so you can see if the spurs are entering the wood at the same time, which is a good sign. With this wayward bore, there's still time to correct the angle.

Supplies web

Tools for Working Wood
800-426-4613 or
toolsforworkingwood.com

- Nicholson 7" Auger Bit File # ST-AUG, $9.80

Brass City Records and Tools
203-574-7805 or
brasscityrecords.com

- Walt Quadrato is an excellent source of vintage braces and auger bits at fair prices.

Sydnas Sloot
sushandel@msn.com or
sydnassloot.com

- Sanford Moss's excellent web site is a wealth of information on braces. Sanford also sells a fair number of braces and other vintage boring accessories.

with anything except making sure your bit starts at the right point. Whether or not you are plumb isn't the job of the auger's lead screw. Instead you need to pay attention to the spurs – the football-shaped cutters that rim the bit and score the outside diameter of the hole. These spurs travel the entire circumference of your hole, and you can use that to your advantage.

As the lead screw begins to bury itself into the work, watch the hole and advance slowly. Watch to see if both spurs hit the wood's surface simultaneously. If the bit is angled off 90°, one spur will contact the work before the other spur – assuming your spurs are filed to the same height.

If one spur plows across the wood before the other, then stop boring, release the brace and step back to see where things are going awry. It should be fairly obvious to your naked eye. If not, get out a square to see where you are leaning. With just the lead screw engaged, it's fairly easy to make a slight adjustment and get on track. But once both spurs and the flutes of the bit are engaged, you're fairly committed to cutting that angle.

But not always. Chairmakers commonly use spoon bits to allow themselves some wiggle room before committing to a particular angle. A spoon bit looks like someone split a metal pipe along its length and ground one end to a rounded spoon shape. The rounded end allows the woodworker a fair amount of time to change angles as the cut begins. I'm personally not fond of spoon bits for a few reasons. One, they're somewhat rare. They cut slower than an auger. And the inexperienced borer is just as likely to wander off of a correct angle as wander onto the correct one.

Engage the Autopilot

There are other tricks to drilling holes with precision that don't involve a drill press. Whenever I have a hole to bore that must be located precisely or involves combining bores of different diameters, such as when drilling for a bolt and its washer, then I almost always rely on a narrow pilot hole to guide all of my bits.

A pilot hole is a good idea for a couple reasons. One, a small-diameter hole is easier to drill in a precise manner than a large-diameter hole. With small bits you can focus almost all of your effort and attention on boring true without worrying about swinging your arm wide and throwing off your angle.

Once you get a pilot hole drilled, you can use that to guide all of your other larger bits. The lead screw or brad point of your bit will always want to follow the pilot hole because it's the path of least resistance through the wood.

How big should a pilot hole be? You need to use some judgment here. Use the smallest-diameter bit possible for the thickness of the work you are drilling. Thicker woods will require bits that are bigger and longer. For 3⁄4"-thick work, I'll usually choose a 3⁄32" bit and work up from there.

Once you get your pilot hole drilled, you should drill the largest-diameter holes first – usually these are the counterbored recesses for the washers, the nut or the head of a bolt or screw. For these counterbores, always pick a bit that has some sort of well-defined point, such as a Forstner, brad-point, auger or center bit. Garden-variety twist bits (designed for metalworking) don't follow a pilot as well. Their blunt tips can be difficult to start without first using a centerpunch on your work to dimple the wood.

Place the point of the bit in your pilot hole and drill your counterbores on the entry and exit points of your pilot.

With the counterbores complete, you can then drill the hole that connects them. Again, choose a bit with a well-defined point. Place the tip in the pilot hole in the middle of the counterbore and bore the through-hole. If it's a particularly deep hole, you can work from both entry and exit holes to increase the chance that your holes will line up just right in the end.

How you stop the cut is almost as important as how you begin it. When you bore through a piece of work, you can blow out the far side of the workpiece as the bit exits the work. You can prevent this blow-out by backing up the exit hole with a piece of scrap. But sometimes that's not practical, such as when boring into the middle of a board. So here's another approach.

Drive the bit into the work until the lead screw just begins to poke out the far end of the work (mark your bit with tape so you'll know when you are close to the final depth). Remember this: Stop boring as soon as you can feel the bit on the exit side. You want the exit hole to be really small. A small hole will make the next hole you make easier to bore accurately.

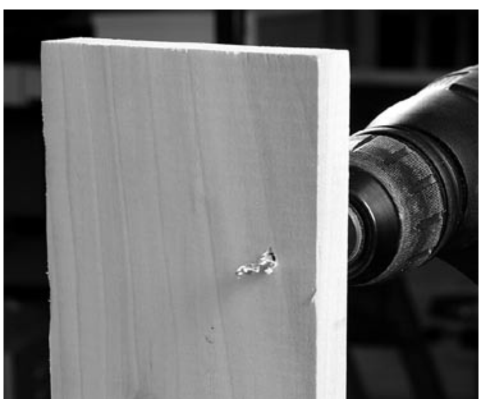
Remove the bit from your first hole then move over to the hole's exit side. Place the lead screw of the bit into the small hole on the exit side and advance the bit. It will cut a clean exit hole that's lined up with your first hole.

Clear a Path

Don't, however, confuse pilot holes with clearance holes. Their names give away their jobs in the shop. A pilot hole is designed to lead the way for something else that will then cut into the walls of the pilot hole – perhaps it's another bit, a wood screw or a cut nail.

A clearance hole, on the other hand, is supposed to clear a wide path for something to follow behind, such as a bolt or a piece of hardware. The difference is important. A clearance hole should be wide enough so the hardware doesn't cut significantly into the walls of the hole. Whereas a pilot hole should be small enough that the hardware can bite into the walls of the hole but big enough to prevent the hardware from jamming and breaking.

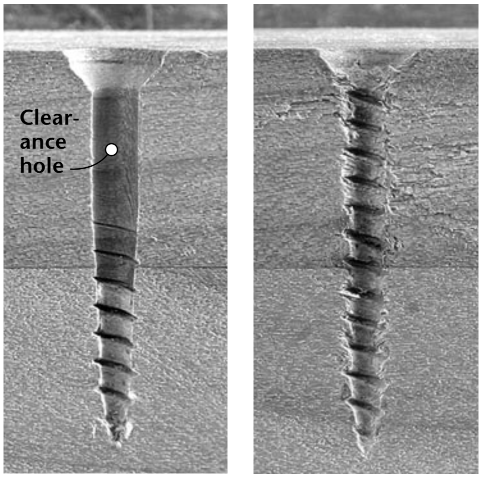
The most common (but misunderstood) application of pilot holes and clearance holes is when using a screw to fasten two pieces of wood. Let's say you are going to screw a top piece to a bottom piece. The best form of this joint is where you first drill a pilot hole through the top piece and



When you need a hole that's dead-on or stepped in size, consider making a pilot hole first to guide your future drilling efforts.

The pilot hole helps guide all subsequent boring operations. For the counterbore, place the lead screw in the pilot hole.

When the lead screw poked through the exit side of this hole I stopped turning the handle, removed the auger and began the cut on the exit side. This eliminates the grain from blowing out as the bit clears your work.



In this cutaway, you can see how the pilot, clearance hole and countersink all work together to ensure that the screw will pull the work up tight (left). And you can see an example of what bridging looks like with the screw removed.

into the bottom piece. The pilot hole should be the same diameter as the shank of the screw (the metal part minus the threads). This is sometimes called the "minor dimension" of a screw.

Then drill a larger-diameter clearance hole in the top piece only. The clearance hole should be slightly larger than the entire diameter of the screw (this is sometimes called the "major dimension" of the screw). Drill a countersink for the head of the screw if necessary then drive your screw. This arrangement of holes will allow the screw to do its job: The threads will bite into the walls of the pilot hole and pull the head of the screw down – pulling the top piece onto the bottom piece. If you don't drill a clearance hole in the top piece, the screw's threads could bite into the top piece and prevent the joint from closing. This is called bridging.

With these basic skills in hand you will be prepared to move into one of the great unexplored realms of woodworking: boring holes. Open any old tool catalog or book from the 19th century and you will be stunned by the wide variety of bits that were available to the woodworker.

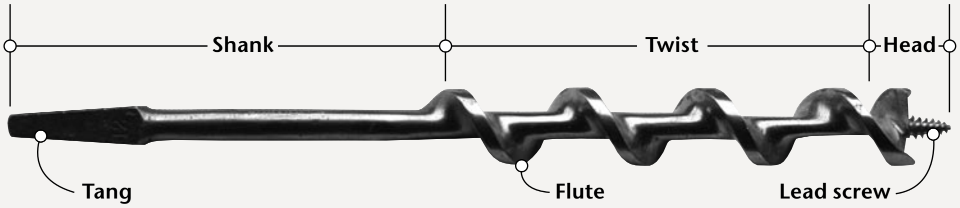
And though all the different types of bits might be bewildering, they all work on the same principle. Take heart in that when Joseph Moxon penned the first English text on woodworking in 1678, he barely made mention of the brace, which he called a "piercer."

"Its Office is so well known, that I need say little to it," Moxon wrote. "Only, you must take care to keep the bitt straight to the hole you pierce, lest you deform the hole, or break the Bitt."

That's all you get in the first-ever English book on the craft. According to Moxon, the whole world of hole knowledge is widespread and shallow. But I actually think it goes a bit deeper. WM

— Christopher Schwarz

The Care and Feeding of Auger Bits



Auger bits are wondrous, efficient bits of tooling. When sharpened, they eat through wood with little effort. Sharpening them is simple. The first rule is to sharpen them as little as possible. Mimic all the angles present on the tooling and take as few strokes with an auger bit file as possible. Here are the important parts of the auger bit and how to care for them.

■ The Lead Screw: If this is clogged, the bit will not advance into the work. You don't have to sharpen the lead screw, but you do have to keep it clean. If it's gunky, I'll soak it in some mineral spirits and then clean the threads of the screw with some dental floss. If the threads get worn or broken I pitch the bit and reluctantly spend another 25 cents on a replacement at the flea market.

■ The Flutes or the Twist: These carry the shavings out of the hole. If they are rusty, the bit is more likely to clog. You can polish up the flutes with fine sandpaper if things aren't too bad. Or you can spend another quarter. Keep the flutes as shiny as possible. Wipe down the flutes with a little WD-40 or light machine oil when you are done with the bit for the day.

■ The Spurs: These football-shaped cutters score the diameter of your hole. You file them on the inside only. Filing the outside will shrink the diameter of the circle that they score and the auger will jam. Game over. Take a few strokes with an auger bit file and mimic the gentle radius of the spur.

■ The Cutting Lips: These two wedge-like parts of the bit act like levers. They wedge themselves under the waste that's defined by the spurs and force it up the flutes. File their bevels, which face up toward the flutes of the auger. Five or six strokes will do. *— CS*

To file the cutting lip, brace the bit against a piece of scrap and rub the file against the lip. A few strokes should produce a fresh edge.

To file the spurs, clamp the auger upright and gently file the radius of the spur. Never file the outside diameter of the bit. Work the inside only.

Carving out a Pumpkin Pine Finish

We experimented to find the perfect recipe for this most-requested finish for pine – and it's as easy as pie.

PHOTO BY AL PARRISH

The most sought-after pine finish is a one-day, three-step process. Finding a sample to copy (such as this antique firkin) is a good strategy. See the Contents page of this issue for a color photograph.

Pumpkin pine is a developed patina that glows a warm orangy color similar to – you guessed it – a pumpkin.

Ask woodworkers what finish they want to replicate when using white pine as their primary wood in a project, and you're likely to hear two words: pumpkin pine.

A real pumpkin pine finish has many years of age. Begin with heartwood from Eastern white pine then allow a century of wax, grime and exposure to daylight, and you'll start to see a patina that displays a golden-orange hue.

Old Growth v. New Growth

Back in the day, Eastern white pine or yellow pine was sought after by woodworkers. It was easy to work, available in very wide boards, had tight growth rings and developed a rich warm patina over time. Who wouldn't want to use this type of lumber to build furniture – especially with the abundance of white pine in New England and yellow pine in the South.

Today, we don't often have the opportunity to work with old-growth material. It is salvaged occasionally from sunken logs and old buildings that sacrifice their beams to be resawn into lumber. But for the most part, we use new-growth lumber for woodworking.

Preparing to Finish

Most pine bought today is dimensioned lumber from retail stores. This S4S lumber is sent through sharp knives on jointers and planers at a high feed rate. As a result, milling marks are evident. These marks won't be completely erased unless you start the sanding process with #120-grit sandpaper. With pine, it's best to sand to #220 grit, which will help reduce its tendency to blotch. Because pine is a softwood, the progression of each sanding step is quick. It's also necessary to step through each grit because it becomes evident if grits are skipped when stain is applied. Scratches stand out after applying color.

Three Steps to Pumpkin

With the enlisted aid of my local Rockler salesperson – where the products with which to experiment are close at hand – I began mixing ingredients and ideas to arrive at the pumpkin pine finish.

One of the biggest roadblocks in using pine is how the finish blotches because of variations in grain density. To combat blotching, you could add a wash coat of shellac (shellac thinned with alcohol). If the wash coat is too heavy, new problems are created; the stain won't penetrate the surface. If the wash coat is too thin, the end result after staining would still be blotchy.

Finding a reliable way to control the blotching caused by the stain is the task. For that, we used a water-base clear stain.

The Pumpkin Pine Formula

The pumpkin pine finishing process begins with a coat of natural stain (no pigment present), then a second layer of pigmented stain that adds color, then two coats of shellac as a topcoat. It's easy to complete the process in one day.

The formula begins with a coat of General Finishes wood stain in Natural (generalfinishes.com). Don't be surprised when you open the can. The stain starts as a paste-like goo but dries clear. This product has enough resin in it to partially seal the pine against color penetration, like a wood conditioner. And because it is water-based, it dries faster than oil-based conditioners. The sealing

web

action of this product allows some coloring near the surface of the wood, but it prevents the color from penetrating deeply and blotching.

Simply apply a coat onto the surface of the project with a clean cloth then immediately wipe away the excess stain as you rub the goo into the wood. Remove as much as possible when wiping clean, then allow the piece to dry. Drying takes from two to four hours under ideal conditions. And if conditions aren't ideal, small projects can be forced dry with a hair dryer or heat gun.

The next layer of stain is also a pasty goo, but with color added. We liked the look of General Finishes Shaker Maple water-based stain. Brush on a coat and rub the stain into the wood by twisting the brush bristles. The twisting action pushes the stain into any small scratches to create a uniform color layer.

Let the pigmented stain sit on the surface for about five minutes then wipe away any excess. Don't be tentative. This isn't like a glaze where you wipe selectively to create faux effects. And we're not trying to even out any mis-matched coloration. Wipe as much stain off as possible and allow the stain to dry for two to four hours.

The Shaker Maple stain adds two important colors. First, it develops the brown shade necessary to present the aged look. Second, it casts a reddish hue onto the piece.

Why do we need the reddish hue? Remember those school days when you studied the primary colors? Yellow and red make orange – or pumpkin, in our case.

The amber shellac delivers the yellow.

Shellac: Is it the Right Stuff?

Shellac isn't the most durable topcoat, and you should always consider how your project will be used before choosing a topcoat. If you're finishing a tabletop or an area that will experience a lot of wear, a tougher finish is probably called for. Add a more durable topcoat after the pumpkin finish is achieved – but test it first to make sure that it doesn't affect the pumpkin pine color.

Before applying the first coat of shellac, use a maroon non-woven abrasive pad to knock down any fibers that raised after applying the first coat of water-based stain.

Zinsser's amber shellac, ready to use right out of the can, is the topcoat. (I said it was easy.) Check the date of manufacture while at the store. Outdated shellac – it's definitely good for a year after the date printed on the can – shouldn't be used because it won't dry.

You can brush the shellac onto the piece or apply it with a cotton rag. With either option watch for runs or sags in the finish. A run or sag is actually another layer that increases the color build. Because shellac adds color with each layer, any imperfections such as those will show.

Lightly sand the surface with #400-grit sandpaper once the shellac is dry; don't sand through the earlier finish.

The next coat of shellac delivered the exact look for our pumpkin pine finish and the surface was thick enough to level to a smooth finish.

You might need a third layer to build the shellac and ensure a smooth finish. If this is so, use a clear shellac because it adds to the thickness without affecting the color. Apply a third coat directly over the previous coats and remember to sand lightly in between.

Once both the color and the thickness of the finish are reached, sand the piece again with #400-grit sandpaper and apply a good coat of paste wax.

Three readily available products with a one-day stretch in the shop, and you'll have a finish that comes as close to aged pumpkin pine as anything I've tried or seen. WM

— Glen D. Huey

Apply the "Natural" stain with a cotton cloth. Pad it into the pine and wipe away any excess. The stain dries clear.

Apply the pigmented stain making sure that it's worked into the surface. On small pieces, swirling as you apply the stain works best.

The pumpkin pine color becomes apparent after the second coat of shellac is added. Scuff the surface between shellac coats. If you need an additional coat to build the surface, use a clear or super blonde shellac. Notice the even tone of the stain. This is a result of the first layer of unpigmented stain.

ILLUSTRATION BY BRUCE BOLINGER

Caught in the Act

Knowing when and how to break the rules can keep you from getting locked up.

I am caught breaking the rules on a regular basis. When you do woodworking and publish the results for a few hundred thousand woodworkers, it comes with the territory. When readers respond to something I've written or said, the questions begin one of two ways: "I thought you were never supposed to …" or "I thought you were always supposed to … ." And so I admit that, yes, I broke the rule, but here are the reasons the rule doesn't apply in this particular case.

The rules are the rules, usually based on decades or even centuries of experience. But even with a sound basis for most of them, the words "always" and "never" never always apply.

There is a comfort in rules, especially when trying something new. The expectation is that the rule will make up for a lack of experience, and the logic of the rule will prevail and keep us out of trouble. The dilemma in woodworking is that the rules are narrow while the material and situations they apply to are wide and ever-changing. Traveling a city street is not the same as hiking a mountain trail; rules for one may not apply to the other, even though the principle behind the rule, going from point A to point B, is the same.

New woodworkers are inundated with rules: "Feed the wood into the jointer cupped side down"; "Feed the wood into the jointer bowed length down"; "Feed the wood into the jointer so the cutter doesn't lift and tear out the grain."

Some of my best thinking is done while performing mundane woodworking tasks, and all of this came to mind, as you might guess, while I spent an afternoon milling a lot of lumber at the jointer. In nearly every piece I was trying to straighten, following one rule required breaking another. I didn't want to spend the day dissecting the structure of each piece to make the right decision, so I was left with something other than following the rules.

It's not that the thinking behind the rules is flawed; they became the rules because they are correct. The problem is that each piece of wood we work with is an individual with a distinct set of inherited character traits, and something very close to a personality.

Building furniture with solid wood is like being a Cub Scout leader or a second-grade soccer coach. There is a potential in each piece, but to join them in a successful whole requires getting to know each piece's strengths and weaknesses and fitting them in a place where the strengths are seen and the weaknesses are (hopefully) hidden forever.

Woodworking is an art of relationships. How well does the worker know his material, his tools, his strengths and weaknesses, and his willingness to take a risk? The rules we hear and repeat are the foundation for developing these relationships, but in the end, the nature of the parts of the equation affect the rule more than the rule dominates the parts.

When we face a paradox of conflicting rules, and discover a resolution that works for us, we tap into the part of woodworking that moves it beyond a pastime and into a way of life.

An understanding of the rules is vital, but so is the knowledge of when they should be bent, broken or ignored. This comes from experience – from following rules to successful work and from following the rules to sometimes-flawed or failed work.

When you find yourself at the jointer, with a piece of wood with rising and falling grain that bows one way and cups another, you can stand there paralyzed trying to decide which rule trumps another. Or, you can make your best guess, give it a try and see what happens. If it works it works. If it doesn't work, try something else.

If you catch me breaking a rule, or ask me to explain the best or right way to do something, be prepared for an answer that begins with, "Well, it all depends … ." WM

— Robert W. Lang

e mail

Extras

"It is a curious and sad fact that although most machines are developed not to cheapen quality but to lessen cost, this is precisely what usually happens."
— Graham Blackburn, "Traditional Woodworking Handtools"

Questions About *Woodworking Magazine*?

What is *Woodworking Magazine*?
Woodworking Magazine teaches the fundamental knowledge necessary for good craftsmanship. Our goal is to make you an independent, mindful and competent woodworker by filling the inevitable knowledge gaps left by teaching the craft to yourself. To ensure our magazine is of the highest quality, we challenge woodworking's conventional wisdom to find the techniques, materials and tools that work best. Every operation and tool in *Woodworking Magazine* has been tested time and again by our staff of professional and enthusiastic woodworkers in our shop in Cincinnati.

Why is there no advertising?
To ensure that *Woodworking Magazine* is free of bias – or the perception of bias – we don't accept any outside advertising from the manufacturers or sellers of woodworking tools and equipment.

Who publishes this magazine? And who are the editors?
Woodworking Magazine is owned by F+W Publications Inc. F+W publishes a wide variety of magazines and books for the enthusiast on topics that include hunting, scrapbooking, gardening, writing and woodworking. The editors include a staff of professional journalists and woodworkers who also work on a sister publication, *Popular Woodworking*. Their names, phone numbers and e-mail addresses are listed on page 1, as well as online.

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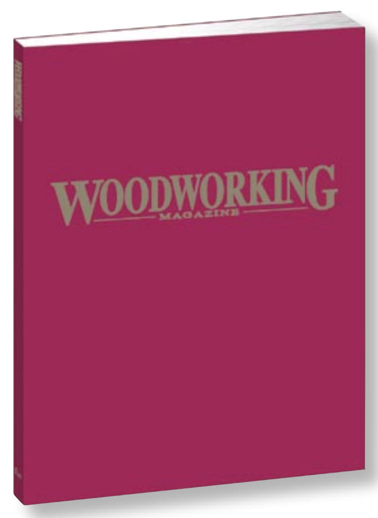
Coming Soon: *Woodworking Magazine* – the Book



Though we now offer digital versions of all eight issues of *Woodworking Magazine* … we have an affection for the printed word. So, at the request of readers, we've also collected the first seven issues of the magazine and bound them into a book.

This hardcover book features a sturdy, deep red cover with a foil-stamped title on the cover and spine, as well as heavyweight interior matte-finish pages and colored end papers. This book belongs in your permanent collection.

Woodworking Magazine – The Book will be available on our web site (woodworking-magazine.com/books) on or before Sept. 1, 2007, for $30. It's a perfect way to ensure your collection will last for years to come … not to mention it's a great holiday gift for a fellow woodworker. Order yours today – quantities are limited!

IMPORTANT SAFETY NOTE

Safety is your responsibility. Manufacturers place safety devices on their equipment for a reason. In many photos you see in *Woodworking Magazine,* 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!

Discover In-depth Information at *Woodworking Magazine*'s Weblog

Our magazine's weblog (some people call it a "blog") allows you to explore in further depth the projects, tools and techniques in the printed version of the magazine.

Updated weekly, our weblog discusses what we're working on for future issues, answers questions from readers about projects we've published, and discusses the techniques we're testing right now. To visit our weblog, go to woodworking-magazine.com/blog.

CONTACT US

We welcome letters from readers with comments about this magazine, or about woodworking in general. We try to respond to all correspondence.

To send us a letter:

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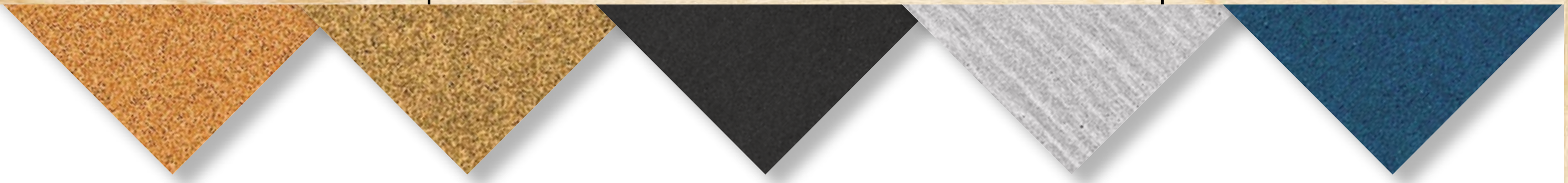
WOODWORKING MAGAZINE

SANDPAPER

AUTUMN 2007



GARNET

- NATURAL ABRASIVE
- NOT FRIABLE
- CUTS SLOWLY, WEARS QUICKLY
- PRODUCES A SMOOTHER FINISH THAN ALUMINUM OXIDE OF THE SAME GRIT

ALUMINUM OXIDE

- HIGHLY FRIABLE – ABRASIVE CREATES NEW, SHARP EDGES AS IT WEARS
- LASTS LONGER THAN GARNET PAPERS

SILICON CARBIDE

- WET/DRY PAPER
- USEFUL FOR WET SANDING WITH LUBRICANTS
- FRIABLE ON METAL, BUT NOT ON WOOD
- WEARS QUICKLY

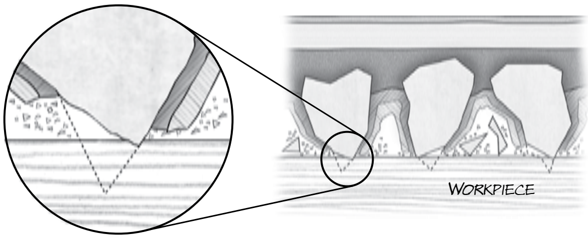
LUBRICATED

- TREATED WITH LUBRICANT TO GLIDE OVER FILM FINISHES
- USEFUL FOR SANDING BETWEEN COATS OF FINISH

CERAMIC

- HARDEST OF ALL CURRENTLY AVAILABLE ABRASIVES
- IN WOODWORKING, GENERALLY USED ONLY FOR HOGGING OFF MATERIAL
- MOST COMMONLY FOUND ON SANDING BELTS

HOW FRIABLE ABRASIVES WORK



AS MINERAL PARTICLES ARE WORKED DURING SANDING, THEY FRACTURE.

FRACTURED TOPS BREAK OFF, REVEALING NEW, SHARP FACETS THAT CUT MORE AGGRESSIVELY.

BACKING MATERIALS FOR SANDPAPER

- **PAPER**
  INEXPENSIVE. EASY TO WORK WITH. TEARS EASILY. MOISTURE CAUSES CURLING AND DECOMPOSITION. GRADED A (EXTREMELY FLEXIBLE), C (MODERATELY FLEXIBLE), D (MODERATELY STIFF), E (VERY STIFF) AND F (EXTREMELY STIFF).
- **WET/DRY PAPER**
  COATED WITH LATEX. STRONGER THAN REGULAR PAPER. OFTEN OF SILICON CARBIDE. USED FOR WET-SANDING APPLICATIONS. GRADED A AND C.
- **FIBER-REINFORCED PAPER**
  HEAVYWEIGHT PAPER WITH CLOTH FIBERS. USED ON HEAVY-DUTY ABRASIVES SUCH AS COARSE GRITS FOR MACHINE SANDING.
- **CLOTH**
  OFFERS STRENGTH AND DURABILITY. OFTEN USED ON SANDING BELTS. GRADED J (THIN, VERY FLEXIBLE), X (MODERATELY FLEXIBLE) AND Y (THICK, FAIRLY STIFF).
- **FILM**
  EXPENSIVE. EXTREMELY FLAT AND EVEN, SO IT YIELDS A CONSISTENT SCRATCH PATTERN. GOOD FOR FINAL SANDING AND FOR LEVELING FINISHES.

ADHESIVES USED IN SANDPAPER

- **HIDE GLUE** – INEXPENSIVE, FLEXIBLE. ALLOWS FOR GRIT DEFLECTION UNDER PRESSURE, SO HIDE GLUE PAPERS RESULT IN A FINER SCRATCH PATTERN THAN RESIN-BOND OF SAME GRIT.
- **RESIN** – GREATER RESISTANCE TO HEAT AND IS MORE DURABLE THAN HIDE GLUE, BUT LESS FLEXIBLE AND CAN LEAVE HARSHER SCRATCHES THAN HIDE-GLUE PAPERS OF SAME GRIT.

DIFFERENT GRIT SCALES

IN THE UNITED STATES, THERE ARE TWO COMMON GRIT-GRADING SCALES: COATED ABRASIVES MANUFACTURERS' INSTITUTE (CAMI) AND FEDERATION OF EUROPEAN PRODUCERS (FEPA). CAMI PAPERS OFTEN ARE MARKED WITH JUST THE GRIT NUMBER; FEPA PAPERS OFTEN PRECEDE THAT NUMBER WITH A "P."

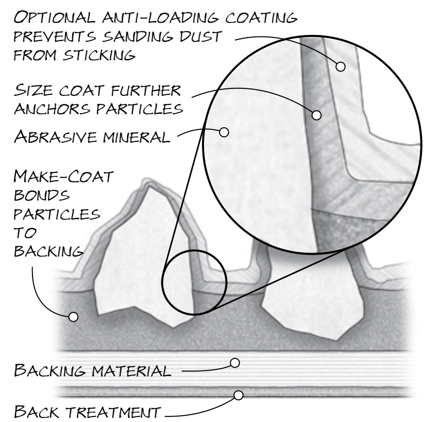
FEPA PAPERS HAVE A LARGER NUMBER OF PARTICLES THAT ARE CLOSE TO THE STATED GRIT, RESULTING IN A MORE CONSISTENT SCRATCH PATTERN. UP TO #220 GRIT, THE DIFFERENCE BETWEEN THE TWO SCALES IS SLIGHT; ABOVE #220, THE GRADING DIVERGES.

SO HOW DO YOU KNOW WHICH SCALE IS BEING USED? EUROPEAN MANUFACTURERS (MIRKA, KLINGSPOR) USE THE FEPA SYSTEM, BUT ONLY MIRKA ADDS THE P. NORTON'S 3X PAPERS USE FEPA GRADING, BUT THE P IS PRINTED ONLY ON THE PACKAGING. 3M HAS BOTH FEPA AND CAMI PAPERS, BUT DISTINGUISHES BETWEEN THEM BY ADDING A P ON FEPA PRODUCTS.

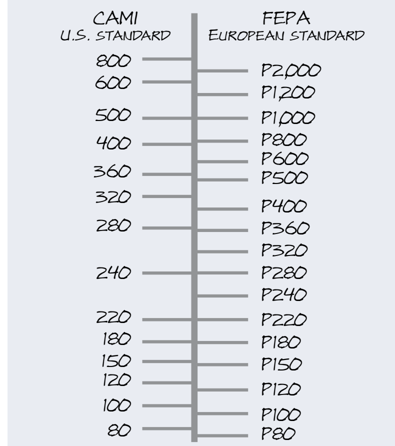
RECOMMENDED GRITS

- #100 – REMOVES MACHINING MARKS
- #150 – REFINES SCRATCHES ENOUGH FOR A CLEAR FILM FINISH
- #180 – FINEST GRIT TO USE WHEN FINISHING WITH DYES (OTHERWISE THEY MAY NOT PENETRATE CORRECTLY)
- #220 AND HIGHER – FOR OIL FINISHES ONLY

ANATOMY OF SANDPAPER



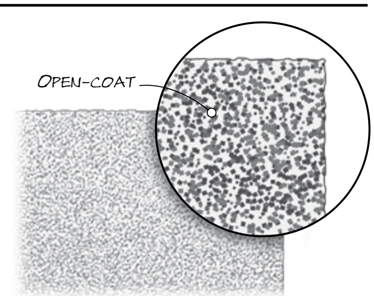
APPROXIMATE EQUIVALENCIES OF THE TWO COMMON SANDPAPER SCALES



CLOSED-COAT V. OPEN-COAT

- SURFACE COMPLETELY COVERED WITH ABRASIVE. MUST BE CLEANED OFTEN, AND RUN MORE SLOWLY ON POWER SANDERS TO REDUCE LOADING AND BURNING.

- SURFACE COVERED ONLY 50-70 PERCENT WITH ABRASIVE.
- SPACES PROVIDE CLEARANCE FOR DUST SO PAPER WON'T CLOG AS QUICKLY. THE BEST CHOICE FOR MOST WOODWORKING.



ILLUSTRATIONS BY MATT BANTLY

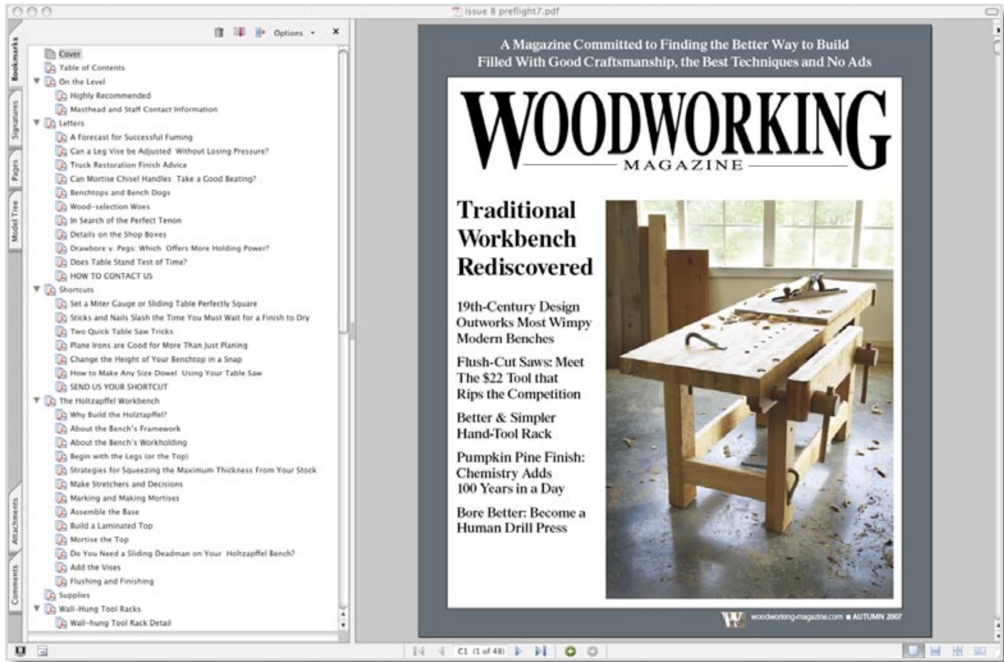
How to Use This Enhanced PDF

In this enhanced PDF version of *Woodworking Magazine*, Autumn 2007, you'll find lots of little extras. A simple click of the mouse, and you can e-mail the authors, or be connected to a manufacturer's web site, or read more about a topic on our blog. Plus, we've included bookmarks to help you easily navigate the issue, so you can quickly find exactly the information you need.

Wherever you see the "web" icon, you can click to be connected to additional resources on the woodworking-magazine.com site, or to external sites including commercial sites where you can get a closer look at the items we recommend.

The "blog" icon clicks through to Editor Christopher Schwarz's *Woodworking Magazine* blog, where you'll find entries he's written about a relevant subject, as well as reader responses to the posts (and of course, you're welcome to post a response, too.)

We've hot-linked the e-mail addresses of all the authors, and a few suppliers who prefer to be contacted by e-mail. A simple click, and a blank e-mail message will pop up, with the address already in place. All you have to do is write your question or comment, then hit "send."



Working With Bookmarks

As you've no doubt already noticed, when you opened this PDF, a list of "Bookmarks" appeared next to the magazine's cover. This is a list of all the articles in the issue, and unless you close it, it remains open as you move through the issue. Simply by clicking on the topic or a sub-topic you want, you'll be taken there, without having to navigate back to the Table of Contents on Page 2 (but, the Table of Contents is still hotlinked to everything in the issue).

Using "Find"

Under the "Edit" menu, you'll see the "find" function. If, for example, you're looking for all the articles in this issue written by Senior Editor Robert W. Lang, simply go to the find function, then type in "Lang." Everything he's written for the issue will come up in list form, and you can click through to the article you wish to read.

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If you have any questions about this PDF, about *Woodworking Magazine*, or any general questions about woodworking, please contact us:

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