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17 Tips for Working—Metal?!

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#164, FEB/MAR 2013



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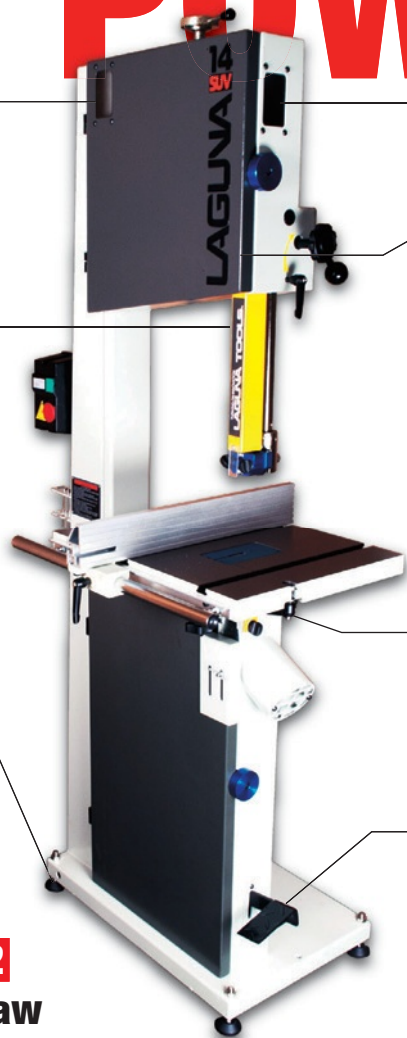
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14 SUV Bandsaw

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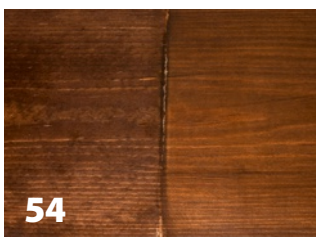
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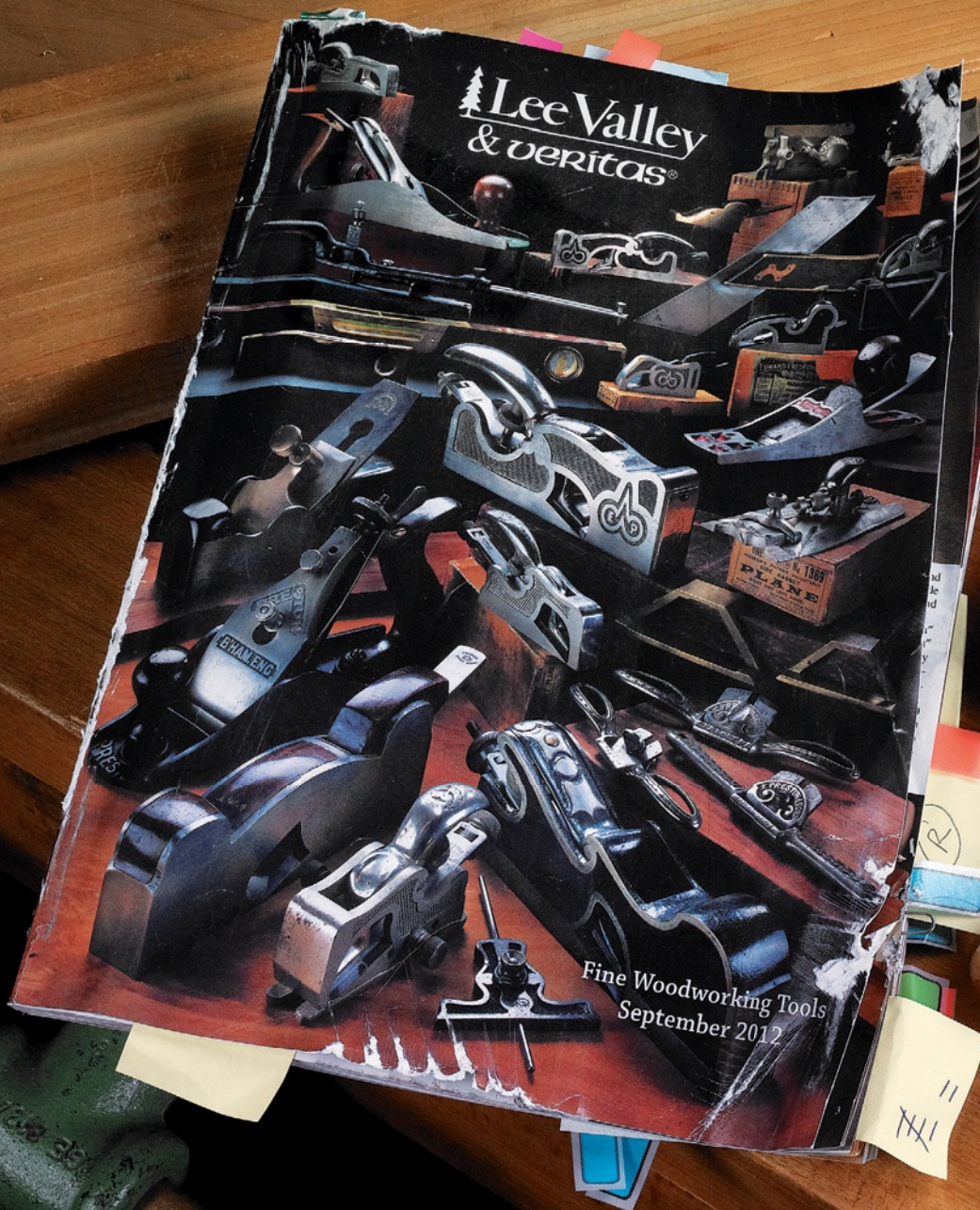
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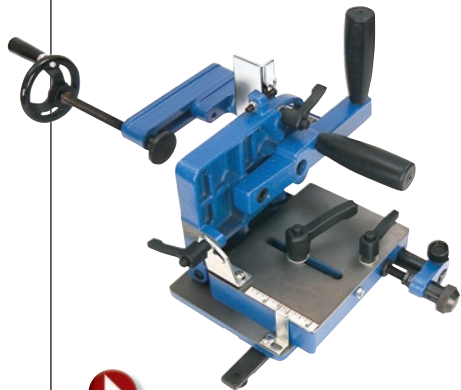
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Fitting Doors

Watch Chad Stanton build his "Learning Cabinet" (p. 42) at AmericanWoodworker.com/WebExtras



Stain Without Blotching

See how stain controllers (p. 54) work on birch. AmericanWoodworker.com/WebExtras

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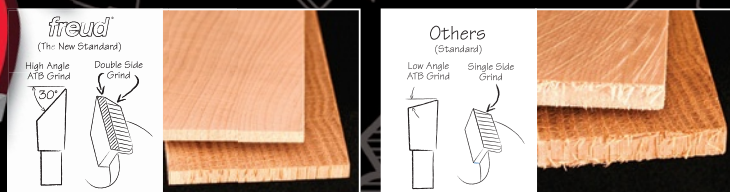
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Plywood Cutting Guide

Terrific Tip!

CROSSCUTTING A FULL SHEET of plywood on a table-saw is pretty difficult, particularly when you don't have any help. I use a circular saw and this shop-made edge guide, instead. The cuts aren't finish quality, of course, but at least I end up with smaller pieces that I can easily cut to final size on the tablesaw.

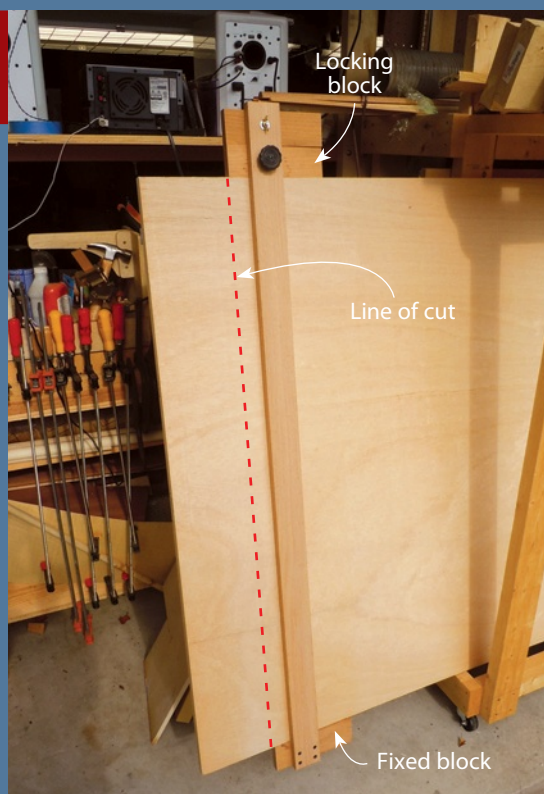
My guide is easy to use and there are no loose parts. You just line up either end of its arms with a pencil line on the wood and you're ready to go. One turn of a knob locks the guide in place.

I often cut a sheet on edge when it's still sitting in its storage rack, so I don't have to lift it. When the offcut is quite large, I pull the sheet all the way out and lay it flat on a 4x8 piece of 2" foam insulation. The foam supports the whole sheet and can be reused many times—mine has dozens of saw kerfs running across it.

The guide's locking mechanism is composed of two pieces with opposing, beveled sides (see the detail photo at right). The outer piece is fixed to the guide's arm; the inner piece is loose, but attached to a knob. Tightening the knob draws the two pieces together, and because they're beveled, forces the inner block to wedge against the plywood, holding the guide in place.

I determined the lengths of these pieces by measuring my circular saw. The long side of each one corresponds to the large offset to the left of the blade; the short sides correspond to the small offset to the right of the blade. The precise lengths of the offsets are important, since the ends of these pieces show you exactly where the saw will cut. This way, depending on the situation, you can cut on either side of the guide. There's a fixed block at the lower end of the guide with the same offsets.

The guide is made from four pieces of hardwood;



the fixed block and wedge parts are all 3/4" x 3" x 7" (the length of these pieces may have to be adjusted for your saw). The straightedge is 3/4" x 3" x 56".

Mark Thiel

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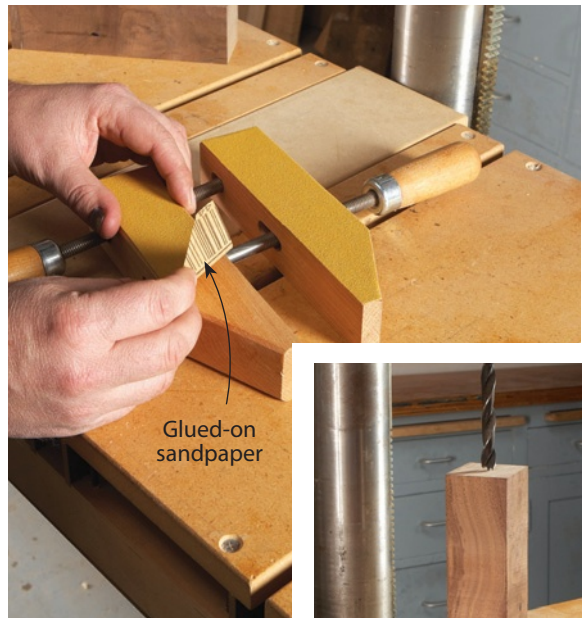
Flexible Sanding Tool

A COMPLEX MOLDING can sure be difficult to sand. Softening its crisp edges is a crime, so I use a thin, flexible stick with sandpaper adhered to it for getting into the flat areas.

Not just any stick will do—it must have just the right amount of spring. An auto-body putty spreader, cut into narrower pieces, is perfect. Putty spreaders taper in thickness from end to end. The part you hold is thick and somewhat stiff; the part that holds the sandpaper is thinner and more flexible.

Look for a putty spreader at an auto-parts store. It will cost only a few bucks.

Richard Tendick



Grippy Clamp

SOME OBJECTS aren't easy to hold for drilling.

When I run into a situation like this, I use a wooden-jawed handscrew that has sandpaper glued to one side of it, so it doesn't move around. You can use either adhesive-backed sandpaper or spray an adhesive on regular sandpaper.

Yoav Liberman



Jointer-Fence Straightedge

CAN YOU ASSUME that a board is straight, just because you've jointed its full length? Nope. If it was convex to begin with, it can still be as bowed as ever.

Before I joint any board, I check to see how straight it is—or isn't. Rather than pull out a long straightedge, I just place the board against the jointer's fence and look for gaps.

If I spot a gap at either end, the board is convex. I then know that I should bear down on the middle of the board as I joint. Pressing down on either end can rock the board, and it will end up the way it started—convex.

One pass usually isn't enough, of course. I'll joint the board a few more times until I hear the knives cut the full length of the board. But even then, I check the board against the fence one more time.

Tom Caspar

Hardware Store “T-Bolts”

SPECIALTY HARDWARE can be really annoying. Take the T-bolt—it’s essential for attaching anything to a T-track, but where can you buy one at a moment’s notice? Hardware stores don’t carry T-bolts, but I’ve found that they always have a good substitute in stock: closet bolts.

Closet bolts are used to fasten a toilet to the floor. (The prissy name must come from describing a bathroom as a “water closet.” I call them toilet bolts.) Closet bolts are slightly cheaper than T-bolts, but don’t expect to save a bundle. You may have to file their heads a bit narrower to fit in the track, but this is no big deal.

Why not just use hex-head bolts, you may ask? Fine and good—if your T-track accepts them. Many types don’t. But even if yours does, I recommend using closet bolts. Their heads are rounded and thinner in cross-section, so it’s easy to insert them into the end of the T-track. They’ll slide better, too. Closet bolts come in either 1/4" or 5/16" diameters, and lengths from 2-1/4" to 3".

Jon Nowlin



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Workshop Tips

continued



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Tablesaw Storage

PERFBOARD isn't just for walls—it's perfect for organizing stuff wherever you need to store it. I've bolted a piece of perfbord to the end of my tablesaw's extension table to hold all the accessories I turn to each day in the shop. Choosing from a wide variety of hooks makes it possible to hang just about anything.

John Cusimano



Clamp the Clamp

WHEN YOUR HANDS aren't strong enough or large enough to put the last squeeze on a big clamp, try clamping the clamp.

My ingenious wife, who has very small hands, invented this solution. She works in my shop, too, and she can't get adequate pressure with some of our clamps—the grips are simply too large.

Sometimes our small grandchildren “help out” in the shop and find that they can't get their hands around a big clamp. My wife shows them this trick, and they love it!

Alejandro Balbis

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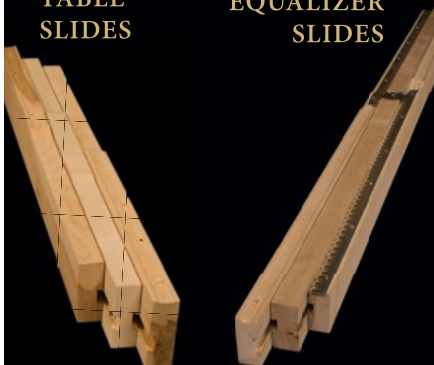
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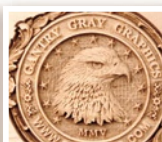
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Pipe Clamp Vise

A TAIL VISE is an essential part of a first-class workbench. It's used to hold work on top of the bench, between dogs. Most types of tail vises are quite complicated to build, but the folks at Lee Valley have figured out a way to make a simple one from an ordinary pipe clamp.

I remember trying to do this years ago, but my design never worked. First, the stock handle on my pipe clamp was too long, so it stuck up above the top of the bench. Second, the clamp was very awkward to adjust in and out. And third, my mounting block was, well, inadequate.

Lee Valley has solved all of these problems. The handle on their clamp has a low profile, there's a quick release mechanism that's very easy to operate, and the mounting block is quite robust. You'll have to supply the pipe, a wooden jaw and a bench dog.

I'm not so keen about using this device as a substitute for a metal-jawed face vise, however. Lacking guide bars, the pipe clamp vise racks too much, both up and down and side to side. It will rotate, too. This may sound bad, but it's not a deal-breaker for a tail vise. Up and down racking and rotation aren't a prob-



lem as long as you don't use the vise for support; side to side racking isn't an issue because a round bench dog can rotate to compensate for this movement.

As you'd expect from Lee Valley, this is a well-made tool. It's a good value if you're trying to quickly get set up on a small budget.

SOURCE

Lee Valley & Veritas, leevalley.com, 800-871-8158, Pipe Vise Head and Base, #15G01.03, \$59; Extra Base, #15G01.01, \$35.

No-Plug Ear Plugs

HEARING PROTECTION takes a back seat to convenience in my shop all too often, but these new earplugs from Crescendo might make me change this bad habit.

As things are, I put on earmuffs when I'm going to make a lot of noise and take them off when I'm done. Wearing the muffs makes me feel like I'm under water, so I rarely leave them on all the time. (I've tried regular, disposable earplugs, and they're no better.) Here's my problem: When I only need to make a cut or two, and my ear muffs are inconveniently located on the other side of the shop, I go without any hearing protection.

Sound familiar? If so, you may want to try Crescendo Reds. Unlike other plugs, they have filters that allow air to pass through. You get 25dB noise reduction without that underwater feeling, so you can comfortably wear them the whole time you're in the shop.

These plugs don't have a connecting cord, like regular plugs, and at first I thought that was odd. But then I realized that if I were to leave the Reds in my ears all the time, I wouldn't need to hang them around my neck. Crescendo provides you with an aluminum storage case to keep them clean, because at \$38 a pair, these aren't disposable. Cre-



scento recommends that you frequently clean the plugs in accordance with their instructions.

You get two sizes of plugs when you buy a set. Choose which one best fits your ear, pop in the filters and bring on the noise. These plugs are a little pricey, but cost far less than hearing aids.

SOURCE

Crescendo, crescendo-hearingprotection.com, 305-463-9304, Crescendo DI Red 25dB, \$38.

Heavy Duty Spindle Sander

CURVED PARTS add a higher degree of difficulty to any project, including the task of making them smooth. While you could use hand tools or a sanding drum mounted in a drill press to fair a curve, it's hard to beat the speed, convenience and performance of an oscillating spindle sander. Delta's new Heavy Duty Benchtop Spindle Sander delivers plenty of power in a mid-size package.

The spindle of an oscillating sander goes up and down while it's going round and round, and that produces a surface that is free of the parallel scratch marks you get with a drill press sanding drum. The rate of this oscillation varies a lot from machine to machine. At 29 spm (strokes per minute), this new sander is a bit on the slow side (Delta's floor model runs at 71 spm), but to be honest, I was perfectly happy with the results.

This sander is powered by a 1/2 hp, 115V motor that pulls 7.5 amps. You'd have to lean on the spindle pretty hard to slow it down. The table tilts to 45° and sits 18" high. Although this is called a "benchtop" sander, placing



COURTESY OF MANUFACTURER

the machine on most benches puts the table at an uncomfortably high level. Weighing in at 66 lbs., this sander is a bit too heavy—for me, anyway—to lug around the shop. Considering the machine's height and weight, I'll be building a mobile stand for it with storage for extra sanding sleeves and the wrenches needed for mounting the spindles.

The machine comes with 1/4", 1/2", 5/8", 1-1/2" and 2" spindles. A 3" spindle is sold as an accessory. I'm not going to hesitate to get one, because a 3"

spindle is much better than a 2" spindle at removing lumps from large-diameter curves.

Taking the machine's oscillation into account, all of the spindles will sand a surface up to 3-1/2" wide.

This machine includes a 2-1/4" dust port with a 4" adaptor, a 100 grit sanding sleeve for each spindle, 4 table inserts and a 5 year warranty.

SOURCE

Delta, deltamachinery.com, 800-368-1487, Heavy Duty Oscillating Bench Spindle Sander, #31-483, \$720; 3" Heavy Duty Drum & Sleeve Kit, #31-489, \$58.

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continued



Sander, Unchained

LOOK TWICE at this picture. Yes, that's a battery on the sander's back—it's a cordless tool. Losing a sander's cord could be a big benefit on a jobsite, but is it so important in a workshop, where there are plenty of outlets? Well, ask yourself this—do you still use a corded drill?

The analogy isn't perfect, but we all know how annoying a cord can be while sanding a large project. You can trip on it, snag it on a corner or find that it's exactly 1" too short. You won't have any of these problems with the Makita LXT 18v 5" random orbit sander.

You may wonder whether adding a battery also increases the sander's weight. It doesn't—the LXT weighs a bit less than 4 lbs., about the same as most corded sanders. The battery doesn't throw off the sander's balance, either. I found this machine to be reasonably comfortable to hold and easy to control.

You may also wonder how long the charge lasts. The answer depends on the speed you select. At 7,000 opm (orbits per minute), the slowest of the three available speeds, you can sand up to 40 minutes. At 11,000 opm, the fastest setting, you'll get up to 20 minutes. That's plenty of time for me, before I need a break. The LXT comes with two 3.0 Ah batteries and a 30-minute charger, so factoring in coffee breaks, you could sand all day.

There's just one thing about a cordless sander that bothers me, and that's dust control. Granted, the LXT's onboard filter catches a lot of dust, but not nearly as much as a vacuum can collect when it's hooked up directly to a sander's dustport. When sanding indoors, I'd prefer to hook up any sander to my tool-actuated vac. And that means trailing around a hose, so losing a cord wouldn't be an advantage. But when sanding out on the driveway, where a vac isn't needed because dust is carried off by the breeze, a cordless sander would be sweet!

SOURCE

Makita USA, makitatools.com, 877-267-2499, Cordless Random Orbit Sander, #LXOB01, \$289; Tool only (less batteries and charger), #LXOB01Z \$99.

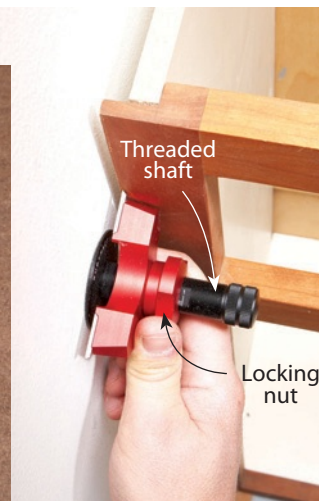
Precision Scribing Tool

ARE WALLS ever as straight as the furniture you build? Nope—they're often wavy or crooked or out of square. When you build a cabinet that must fit tight against a wall, you use a scribing tool to transfer the wall's shape to the cabinet, then trim the cabinet to fit. You can make a simple scribing tool from an ordinary washer, but I've just tried one that any lover of sophisticated tools would appreciate. It's called—I kid you not—a Thingamejig.

I guess the Australians who make the Thingamejig must have a good sense of humor, but they're quite serious about their scriber. It's precision engineered, with an anodized aluminum body and three carbide blades. Each blade is triangular and can be rotated, giving you 9 edges to wear out before you have to change blades.

To set the Thingamejig, you turn the tool's threaded shaft to raise the blades to a height equivalent to the largest gap between the cabinet and the wall. You can directly make this adjustment by holding the tool up to the gap or you can measure the gap and refer to a laser-cut rule on the tool's shaft. Tightening a locking nut secures the setting.

To scribe, you slide the tool's foot along the wall and press one of the blades against the cabinet, marking a crisp, accurate line. (You can add a protective plastic pad to the foot to avoid scratching the wall.) Because the blades are carbide, you can also scribe objects with hard surfaces, such as cabinets veneered with plastic laminate, painted items,



stone and soft metals.

I love the Thingamejig's large foot. It's 2" across, providing a stable, wobble-free base that helps you scribe a smooth line. There are situations where the foot's size would be a drawback, though. An extreme example would be when scribing a brick wall; the foot would simply span small irregularities, like mortar joints.

The scribing tool comes with an extra set of three blades and an extra protective pad.

SOURCE

Thingamejig Precision Tools, thingamejigtools.com, Scribing Tool, #SC-I (imperial scale) #SC-M (metric scale), \$80.



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DO YOU AVOID changing blades on your tablesaw? Do you feel like your tablesaw doesn't have enough power? Is your current blade coated with burned residue? If you answer "Yes" to all these questions, then it's time to take a good look at a high-quality thin-kerf blade like this one, the Super-General T.K. from Infinity.

Blades that perform well at both ripping and crosscutting were once called "combination" blades. Many manufacturers now make "general purpose" blades, which have a slightly different tooth pattern but can also be left in the saw for both cutting operations. Infinity's Super-General is, as the name implies, one of those blades.

As for increasing horsepower, well, a new blade can't actually do that, but it can reduce the load on your saw's motor. With its narrower teeth, a thin-kerf blade removes up to 25% less material than a typical 1/8" kerf blade. Cutting a board with a thin-kerf blade requires less power, so the saw is less likely to bog down. You won't have to push as hard, either.

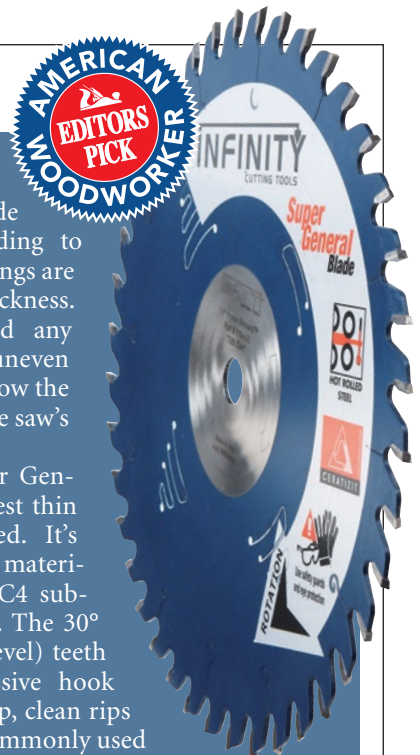
The Super-General's plate has a hi-tech, aluminum infused coating that reduces friction and is easy to clean. According to Infinity, this particular coating also aids in quickly diffusing heat, which helps the teeth stay sharp longer. You'll notice, however, that there's no coating on

the blade's hub. This helps keep the blade running true, according to Infinity, because coatings are rarely uniform in thickness. Infinity has removed any possibility that an uneven coating could affect how the plate mates against the saw's arbor washers.

The Infinity Super General is one of the nicest thin kerf blades I've used. It's made with first-rate materials, including thick, C4 sub-micron carbide teeth. The 30° ATB (alternate top bevel) teeth also have an aggressive hook angle and deliver crisp, clean rips and crosscuts in all commonly used materials.

SOURCE

Infinity Cutting Tools, infinitytools.com, 877-872-2487, 10" Super General T.K. 40T Saw Blade, #010-045, \$99.



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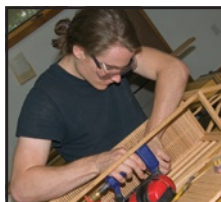
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Mark Sfirri

**An off-beat,
off-center
wood turner.**

by Spike Carlsen

MARK SFIRRI ISN'T JUST A WOOD TURNER—he's a turning teacher, turning researcher, turning author, turning lecturer, and turning exhibit curator and judge. What's odd about this well-rounded turner is that he doesn't turn in the round. Multi-axis turning is his specialty—and few do it better.

A circular path

Mark, who is 60 years old, became enamored by art at an early age. "I doodled WAY more than the average kid," he explains. He had the good fortune of attending a high school with a special arts program run by a rigorous teacher, where he learned about shape, color, and the basics of art and design.

After graduating high school, Mark was accepted at the Rhode Island School of Design. "My parents were okay with me going there as long as I majored in architecture so I could get a job," Mark recalls. But the

program was conceptual, while he wanted a hands-on program. "So I wandered through the different art studios at the school. The glass, printmaking and jewelry programs didn't excite me, but I loved the wood, tools and machinery in the wood shop." He also discovered a teacher named Tage Frid, who taught him, among other things, the importance of planning and drawing out his ideas so he could communicate them.

When Mark graduated, Frid asked him to run the school's woodshop. (Mark also worked in Frid's Rhode Island shop.) In 1978, after receiving his master's degree from RISD, Mark moved to Rochester, N.Y., to work for an office furniture manufacturer. By the time he left three years later, he had become director of design and engineering.

A position opened up at the fine woodworking program at Bucks County Community College. Mark was hired because he possessed one qualification no one else

had—industry experience. While teaching, he continued developing his own woodworking and furniture business. “In the ’80s, it seemed like anything went—kind of like the Wild West. There were lots of collectors and opportunities, and price wasn’t a huge factor.”

The financial landscape changed in the ’90s when recession hit, so Mark began to build very conservative furniture—a style he labeled “Recessionary Expressionism.” “I couldn’t sell any of it,” he explains, “so I decided I might as well make stuff that was appealing to me.” And what was appealing to Mark was multi-axis turning.

Where math meets art

Mark has an affinity for math and art, and multi-axis turning allows him to combine these two loves. He also savors the engineering, the challenge posed by the difficult turning work and what he calls the “dash of illusion” that’s involved.

With conventional turning—where one centers an “X” on each end of the blank and uses these marks for positioning the lathe’s live and dead spindle centers—the turned piece has no option but to be round. Multi-axis turning involves mounting a blank in an offset position, turning all or part of it, then repositioning the blank and turning some more. Depending on the setup, the finished piece may be football-shaped in cross-section, symmetrical or seemingly free form. While multi-axis turning can appear to be free flowing and sculptural, careful calculations and planning are essential to achieve specific results.

The setup might involve marking 1" away from the center on one end, making a second mark on the other end that can be in the same plane as the first or not, and turning based on these offset centers. Other variations, such as repositioning the blank on a second set of offset centers after turning a portion of it on the initial offset centers, result in more complex shapes.

For simple offset turnings such as a candlestick (see **Photo**, top right) Mark creates a game plan by drawing the cylindrical shape on kraft paper and cutting it out. Then he cuts the cut-out shape into multiple pieces and arranges them at the desired angles. From this pattern, Mark can determine the center points—and off-center points—that are needed to create the actual object.

For more complex pieces he often turns “three-dimensional sketches” on the lathe to work out the details. Mark sometimes builds half the project and leans it against a mirror. Then he steps back and squints to envision what the completed piece might look like. His studio has a wall full of samples. Mark describes some as “happy accidents,” but most are the result of careful planning. Mark also keeps detailed sketchbooks and notes that allow him to recreate a piece—or at least the technique—later on.

Since multi-axis and offset turning involves mounting wood on the lathe in unbalanced positions, Mark



Left:
Tippy Candlestick
(2000)

Ash
12-1/4" x 4-1/2" x 3-1/2"

Right:
Offset Candlestick
(1994)

Maple
11-1/2" x 3-1/2" x 3-1/2"

Ribbon Silhouettes
(1999)

Oak, poplar, paint
20-1/2" x 12" x 6"



Homeland Security (2002)
Maple; 4" x 18" x 5"

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prepares and works with caution. When he first started turning, a workpiece "got away," took a divot out of the floor and then flew 20' across the room to shatter a cabinet. "If that cabinet had been a person, the piece would have killed him," Mark observes. As a result, Mark places a premium on safety. He checks the blank and tool rest four or five times before starting the lathe and carefully adjusts the speed based on the blank's size, shape and state of balance. Using cup centers is a must, he says. "Spur centers are dangerous, because they grip the wood. If a tool catches, either the tool or the workpiece has to give. Cup centers are much safer, because they have round, continuous rims that hold the wood, so if a tool catches, the center keeps spinning, but the workpiece simply stops."

Mark's advice to anyone who wants to try multi-axis turning is to start small and simple. "Experiment," he says, "and plan to learn on something you can throw away!"

Inspired designs

While some of Mark's pieces are meticulously planned, others are simply inspired. After turning a baseball bat for his son, for example, Mark began thinking about its elegant form and perfect engineering—about how every part, from the knob on the end through the slender handle to the meat of the barrel, was built for pure function. "I began thinking about what a perfect blank canvas this would be for multi-axis turning," he says. *Rejects From the Bat Factory* (see **Photo**, opposite page, top left) has become one of Mark's signature works. His rejected bats are tied in knots, double handled, curved, cut in half and comically indented.

Mark's brightly painted, cartoon-like food cans and containers combine the best of Andy Warhol and Pop-eye (see **Photo**, opposite page, top right). His inspiration for them came during a teaching jaunt to France, where he became intrigued with container shapes and how to animate them while trying to decipher the labels. You gotta love a guy who creates a can of *Fromage Wiz*. Humor is a serious part of Mark's work. "But, it's not like I'm laughing the whole time I'm making things," he says. "Creating the illusion is a very measured process." Still, there's no denying that Mark loves to push the limits with wood. "In glass blowing and ceramics you're working with droopy, fluid material and your goal is to make the final piece symmetrical. But in woodturning, once your piece is on the lathe, symmetry is a given. So lots of my work is aimed toward making wood look more elastic than it actually is."

"For a few years I was worried that I'd run out of ideas. But I realized that if you leave yourself open to creativity—and nurture it—the ideas just keep coming," Mark explains. He draws inspiration from pop



PHOTO BY JOHN CARLANO

Fromage Wiz II
(2003)
Poplar, paint
9-1/2" x 5" x 4"

Rejects from the Bat Factory
(2002)
Ash, poplar, paint
38" x 24" x 16"



PHOTO BY JOHN CARLANO



PHOTO BY JOHN CARLANO

Madonna and Child
(2003)
Walnut
20-1/2" x 4" x 4"
16-1/2" x 4" x 4"

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A Great American Woodworker

continued

culture and artists ranging from Picasso to Wanda Gag to Alphonse Mattia. He's a devoted fan and authority on Wharton Esherick. "Esherick is the grandfather of the studio arts movement, one of the first people to think about personal expression through furniture," he explains. "Even today, people who have never even seen Esherick's work are influenced by artists that were influenced by him."

Survival and road kill

As both a turner and a woodworker, Mark is somewhat of an anomaly. "Someone recently mentioned it was unusual to have feet in both camps. But the truth is when I'm with furniture makers they say, 'Oh, you're a turner—you're one of *those* guys,' and when I'm with turners they say 'Oh, you're a furniture maker'—like I'm not part of either club." But Mark's versatility has served him well. His tables, chairs and casework combine creative elements from turning and furniture making, and include both careful planning and spontaneity.

When choosing wood, Mark keeps the end product firmly in mind. Most turners like to showcase beautifully burlled or curly-grained pieces of wood. (Mark jokingly refers to such woods as "road kill.") But since many of Mark's works are sculptural, he prefers woods with less drama and more straight grain, such as ash and mahogany. "I don't want to get into the battle of wood grain vs. design," he explains. For painted pieces, he prefers smooth, tight-grained woods. But he's not opposed to showcasing a gorgeous hunk of tiger maple, cherry or walnut when the project calls for it.

Mark credits the financial stability of his teaching gig at Bucks Community College (31 years and counting) for allowing him to stay with wood turning for the long haul. He loves every aspect of the craft. "Doing peripheral things such as research, curating and judging gives me a more well rounded view of the art world," he explains. On the day of our interview, Mark is heading to Philadelphia for the grand opening of an exhibit at The Center for Art in Wood called "YOUR PERSONAL HANG-UPS." It contains work by a wide variety of woodworkers—some of whom take the title literally, while others interpret it very (very) conceptually. Mark's entry, a coat rack titled *Lunar Pad Foot* (see **Photo**, opposite page, top left), shows inspiration from each viewpoint, just like its creator.

Spike Carlsen is the author of *Woodworking FAQ*, *A Splintered History of Wood* and *Ridiculously Simple Furniture Projects*. For more information visit spikecarlsen.com or facebook.com/spikecarlsenbooks.



Lunar Pad Foot
(2012)
Cherry
68-1/2" x 22" x 19"



Hall Table
(2011)
Bubinga, mahogany, paint
36" x 41" x 15-1/2"

Branch Rolling Pin
(2006)
Mahogany
3" x 4" x 22"



PHOTO BY JOHN CARLANO

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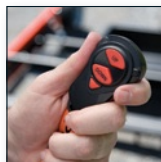
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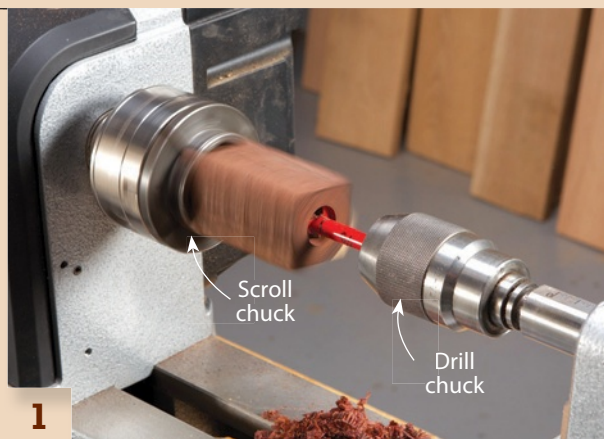
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With this shaving brush and razor set, you can repeat this refreshing scenario every morning. Your brush and razor will get wet on a regular basis, so choose water-resistant wood for the handles, such as cocobolo (shown here), which is naturally oily. Other dense hardwoods will also work well if you apply a durable water-resistant finish.



1

Drill a shallow hole for the brush head in the handle blank after mounting it in a scroll chuck and installing a drill chuck in the tailstock. Then use a roughing gouge to round the blank.



2

Widen the hole as necessary to fit the base of the brush head. The bases aren't consistently sized, so each hole has to be custom-fit.



3

Use a detail/spindle gouge to establish transition points that define the handle's beads and concave neck.



4

Define the end of the handle by cutting in about 1/8" with a parting tool. Widen the cut sufficiently to provide enough clearance to finish shaping the bottom bead.

Shaving brush

This project starts with a brush head (also called a "hair knot"). The wide variety of available brush heads—made from such materials as badger hair, boar bristles and nylon—is one indication of the artful shave's renaissance. I use 24mm silver-tip badger brush heads, which are thick, with extra stuffing for softness and fullness (other grades and sizes are available; see Sources, page 27). These heads absorb water and work with either shaving soap or cream to whip up a rich, warm lather and deliver it to your skin, lifting and softening your beard. Ahh!

Each brush head is unique, so it has to be custom-fit to the handle. Mount the handle blank in a four-

jaw scroll chuck and install a drill chuck in the tailstock (see Sources). Then drill a 7/8" dia. x 1/2" deep hole in one end (**Photo 1**). Turn the blank to a cylinder. Then true the hole and widen it to fit the base of the brush head (**Photo 2**).

Shape the handle so it's narrow enough at the neck to fit the stand (see Sources) and comfortable to hold—a rounded shape at the base feels good, for example. The handle shown here has beads at both ends and a cup-shaped middle. Install a cone center in the tailstock to support the drilled-out blank. Then use a detail/spindle gouge to establish transition points and start shaping the beads and cup (**Photo 3**). Switch to the parting tool to establish the

handle's bottom end (**Photo 4**). Cut in only about 1/8"—any further will weaken the blank. Use the roughing gouge to shape the narrowest part of the cup (**Photo 5**). Then return to the detail/spindle gouge to finish shaping the handle.

Sand and finish the handle while it's still on the lathe. Start with 180 grit sandpaper and work up to 400 grit. For oily woods, such as this cocobolo, a buffed wax finish is sufficient. For non-oily woods, make a finish that's tough, durable, water-resistant and easy to apply with a soft cloth, by thinning Behlen Rockhard Table Top Varnish by 50% with mineral spirits (see Sources). Three light coats, sanded between with 600 grit paper, provide adequate protection. It's best to wait



5

Use the roughing gouge to shape the handle's narrow neck. Switch to the detail/spindle gouge to refine the shapes and complete the turning.



6

Cut the handle from the waste block after sanding it and applying the finish. Sand and finish the end after the handle is cut off.



7

Glue the brush head into the handle using five-minute epoxy.



8

Glue a brass tube in a hole drilled through the razor handle blank. To spread the glue evenly, apply it to the tube and then spin the tube as you slide it into the hole.

six to eight hours between coats.

Part off the finished handle (**Photo 6**). Then sand the parted end by hand and apply the finish. Use five-minute epoxy to glue the brush head into the handle (**Photo 7**). To keep water from soaking into the end grain at the top of the handle, use a toothpick to apply a small bead of glue around the base of the brush head.

Razor

The razor handle kit shown here (see Sources) is designed to hold Gillette Mach 3 blades. Other kits are available for different types of blades—including old-fashioned safety razor blades!

To make a handle for the razor, cut a 1" square blank the same length as the brass tube that comes in the kit

(3" long, in this case). Mark the center of the blank at both ends. Then mount it on the lathe between centers and cut a short tenon on one end. Remove the blank and install the scroll chuck and the drill chuck on the lathe. Remount the blank in the scroll chuck, using the tenon on its end. Then drill a centered 9/32" hole all the way through it.

Remove the blank to glue in the 8mm brass tube (**Photo 8**). Either CA glue or five-minute epoxy will work. Use a 7mm barrel trimmer to square off the ends of the blank flush with the brass tube (**Photo 9** and Sources). Mount the blank on a 7mm pen mandrel with sizing bushings installed at both ends (see Sources). Shape the handle with the roughing gouge (**Photo 10**). A shape that swells at one

or both ends makes the handle easier to grip. Turn both ends down to the bushings. Then finish sand the handle and apply wax or the wipe-on finish described above.

Before assembling the razor, screw the razor holder all the way into the coupler and install a set of blades. Place this assembly on a flat surface and position the handle behind it with its grain oriented for the most pleasing appearance—with the annual rings at top dead center, for example. Gently press the coupler into the handle until it stays put; then remove the blades and the holder and install the coupler and lower cap (**Photo 11**). All that remains is to clip the blade onto the razor holder (**Photo 12**).



9

Flush the ends of the blank with the brass tube using a 7mm barrel trimmer.



10

Shape the handle after mounting the blank on a pen mandrel between specialized sizing bushings. Turn both ends down to the bushings. Then sand and apply the finish.



11

Press the coupler and lower cap into the ends of the handle.



12

Clip a blade onto the razor holder, which screws into the coupler.

Brush care

- The brush may shed some at first. This is normal.
- The brush head is sterilized. Don't boil it in an effort to clean it.
- Don't use excessive pressure when you lather up; doing so will break brush hairs and cause shedding.
- Rinse the brush well after use and shake it to remove soap and excess water.
- Let the brush air-dry on the stand with its bristles facing down, so water doesn't seep into the handle.
- Don't put a wet shaving brush in a shaving bag or other enclosed space.

SOURCES

The Golden Nib, thegoldennib.com, 480-575-0729, Silvertip Badger Hair Knot, 24mm x 58mm, \$19.95; Gillette Mach 3 Turbo Blades, 4-pack, \$6.99.

Oneway Manufacturing, oneway.ca, 800-565-7288, Talon Chuck, #2985, \$232.

Packard Woodworks, Inc., packardwoodworks.com, 800-683-8876, 1/2" Drill Chuck #2 MT, #111012, \$36.95; 7mm Barrel Trimmer, #154993, \$16.95.

Penn State Industries, pennstateind.com, 800-377-7297, Pen Mandrel System, 7mm, #2MT, #PKM-FSM, \$29.95; Mach 3 Razor Handle Kit, #PKRAHAN, \$8.95; Bushing

Set for Mach 3 Razor Handle Kit, #PKRAHANBU, \$4.95; Brush and Razor Stand, #PKRASTA, \$8.95.

Rockler Woodworking and Hardware, www.rockler.com, 800-279-4441, Behlen Rockhard Table Top Varnish, 1 qt., #44539, \$24.19.



Mary Lacer

has been turning wood for more than 30 years. She has taught in a number of turning programs across the country.

The Learning Cabinet

AS THE OLD SAYING GOES, sometimes you have to learn to walk before you can run. That's certainly been true in my career as a cabinetmaker: I've tried to learn the basics on small projects, where I could afford to make mistakes, before tackling the really ambitious work that I've had my heart set on for years.

This utility cabinet is one of those small projects. I built one like it years ago, when my wife needed storage space for linens and I needed an opportunity to hone my skills building face frames and making and fitting doors. Today, we need even more storage space, so I thought I'd build another one and share the whole process with you.

Build the case

Although you could make this whole cabinet out of solid wood, I built the case from veneer-core plywood to save time and money. You'll need one sheet of 3/4" material plus a small piece of 1/4" material for the back. Start by cutting the sides (A1) and subtop and bottom (A2) to their finished sizes. Be sure that their edges are straight and that the pieces are square.

Cut shallow dadoes across the sides to receive the bottom (**Photo 1**; Fig. D, page 44). I use pocket screws to assemble plywood cabinets, so a dado isn't strictly necessary here. But I like the way that the dado registers and aligns the bottom during glue-up, so making it is worth the extra time. If your plywood is slightly less than 3/4" thick, set up a dado set that's 11/16" wide and add shims until it cuts a dado that fits your plywood.

Next, cut rabbets on the ends of the sides to receive the subtop. Leave the dado set at the same

Teach yourself how to precisely fit doors while building a useful utility cabinet.

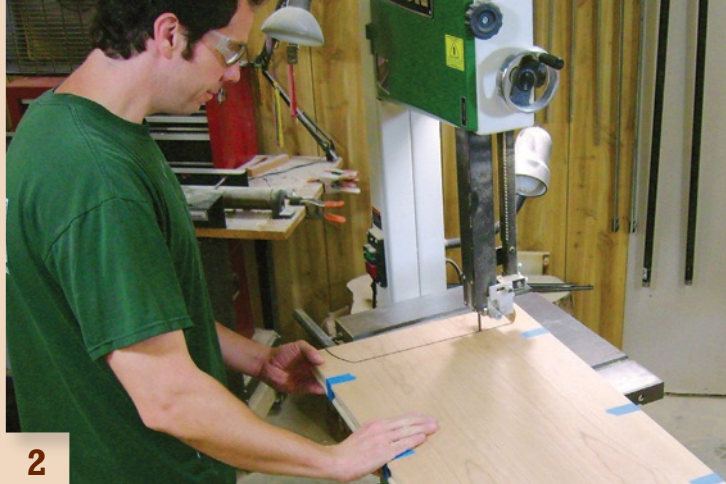
by Chad Stanton





1

Dado and rabbet the sides of the cabinet to receive the bottom and the subtop. Although you'll be fastening the cabinet with pocket screws, dados make the parts much easier to align.



2

Cut out the legs of the side pieces. Tape them together so you can cut both pieces at the same time.



3

Glue the bottom and subtop to the sides. Fasten them with pocket screws, so you don't have to use any clamps.



4

Make a face frame that exactly fits the cabinet. Temporarily clamp up the face frame and place it on the cabinet. Make sure its edges are flush with the cabinet's sides.

height and clamp a sacrificial board to your fence—the blade will go right up next to it. Reset the fence and adjust the dado set's height to cut rabbets for the back. While the sides are still loose pieces, drill holes for the shelf pins (Fig. A).

Tape the side pieces together, inside to inside. Using a compass, lay out the legs on the top piece (Fig. D). (Note that the back legs are wider than the front legs; the front legs will become wider when you add the face frame.) Cut out the legs on the bandsaw (Photo 2). Smooth the rough edges of the cut with a half-round file and coarse sandpaper.

Drill pocket holes in the subtop and bottom pieces. The exact spacing of the holes isn't important. My pocket-hole jig was set up for drilling pairs of holes in face frames, so I drilled these holes in pairs, too. Temporarily assemble the cabinet. (Note that you must use 1" long pocket screws, which are shorter than normal. That's because the dados and rabbets you cut into the sides effectively reduced the sides' thickness to 5/8".)

Place the case face down. Cut the back (A3) to fit and put it in place. Make sure the case is square, then pre-drill holes for screws through the back.

Glue and screw the subtop and bottom pieces to the sides (Photo 3). Install the back right away, with screws, before the glue sets. This will ensure that the cabinet is square.

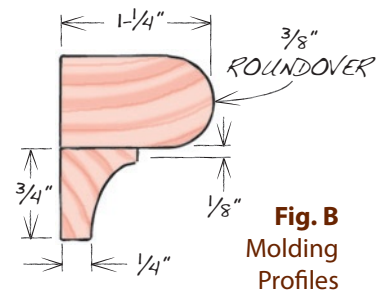
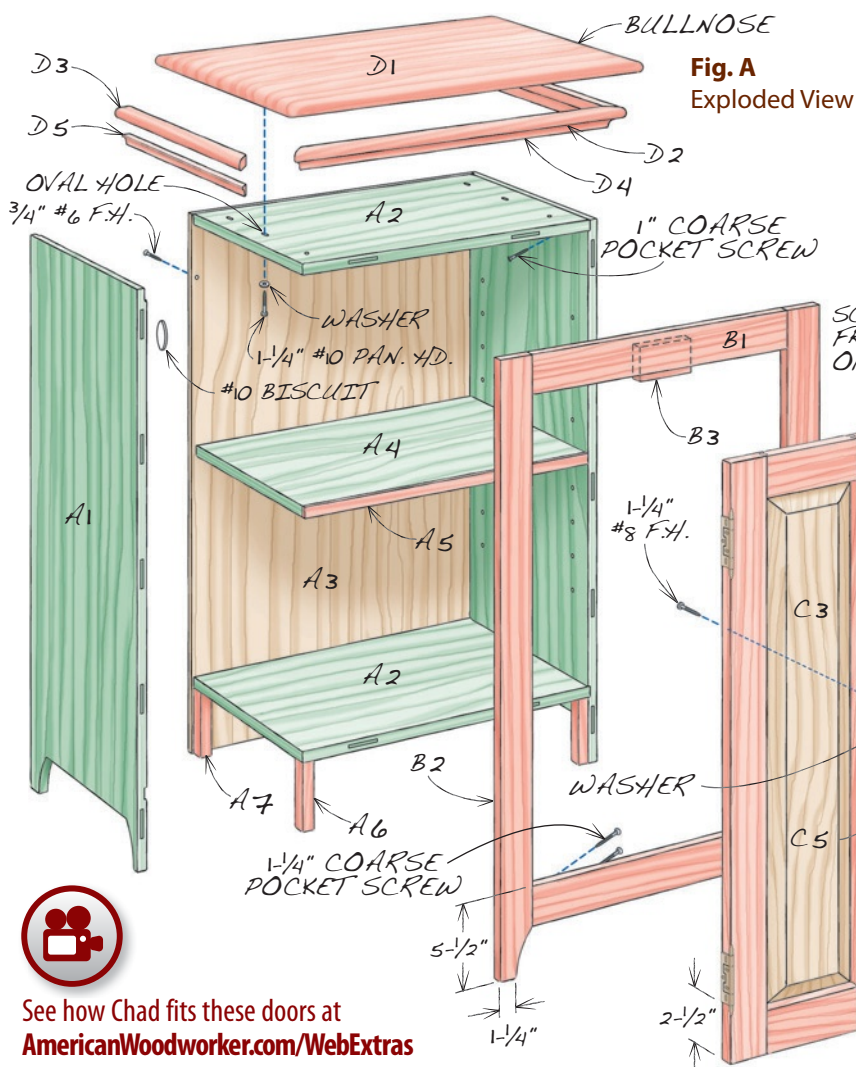
Make the face frame

During my years as a professional cabinetmaker, I've seen half a dozen different ways to build and attach a face frame. Some guys build it oversize, so it hangs over the cabinet's edge all around. They'll glue it to the cabinet, then trim it flush with a router. I do things differently: I make the face frame the same size as the cabinet, with no overhang.

Mill the rails and stiles for the face frame (B1 and B2) to final thickness and width, but leave them about 1" extra-long. Trim the stiles so they're the same length as the cabinet's sides, then trim the rails to their final length. Double-check the lengths of the rails by clamping the face frame together; it should be flush with the cabinet on both sides (Photo 4). Position the face frame so it's flush with the bottom of the cabinet, then reposition its lower rail, if necessary, so it's flush with the cabinet's bottom. Mark the rail's location on the stiles.

Bandsaw legs on the bottom ends of the stiles. These legs should be the same width as the rear legs on the cabinet's sides. Drill pocket holes in the rails, then glue and screw the face frame together (Photo 5). Make sure it is square by measuring its diagonals or by using a framing square.

Cut a number of biscuit slots on the cabinet and corresponding slots on the face frame.



See how Chad fits these doors at
AmericanWoodworker.com/WebExtras

Cutting List Overall Dimensions: 39-3/4" H X 28-1/2" W x 18-3/4" D

Section	Part	Name	Qty.	Material	Th x W x L
Case	A1	Side	2	Ply	3/4" x 16-1/4" x 39"
	A2	Subtop and bottom	2	Ply	3/4" x 16" x 23-3/4"
	A3	Back	1	Ply	1/4" x 24-1/2" x 39"
	A4	Shelf	1	Ply	3/4" x 15-3/4" x 23-3/8"
	A5	Shelf edging	1	Solid	1/8" x 3/4" x 23-3/8"
	A6	Corner block, front	2	Solid	3/4" x 1-1/4" x 4-3/4"
	A7	Corner block, back	2	Solid	3/4" x 2-1/4" x 4-3/4"
Face frame	B1	Rail	2	Solid	3/4" x 2-1/2" x 20"
	B2	Stile	2	Solid	3/4" x 2-1/2" x 39"
	B3	Door stop	1	Solid	3/4" x 2-1/4" x 4"
Door	C1	Rail	4	Solid	3/4" x 2-1/2" x 6-1/4" (a)
	C2	Stile	4	Solid	3/4" x 2-1/4" x 31-1/8" (b)
	C3	Panel	2	Solid	3/4" x 6" x 26-5/8"
	C4	Handle, fixed side	1	Solid	3/4" x 2-1/4" x 2" (c)
	C5	Handle, pivot side	1	Solid	11/16" x 2-1/4" x 2-7/8" (c)
Top	D1	Top	1	Solid	3/4" x 18-3/4" x 28-1/2"
	D2	Bullnose molding, front	1	Solid	3/4" x 1-1/4" x 27-1/2"
	D3	Bullnose molding, side	2	Solid	3/4" x 1-1/4" x 18-1/4"
	D4	Cove molding, front	1	Solid	5/8" x 3/4" x 26-1/2"
	D5	Cove molding, side	2	Solid	5/8" x 3/4" x 17-5/8"

Notes:

- Adjust the rails' length, if necessary, so the doors fit tight inside the face frame's opening.
- This length is oversize; it should be 1/16" more than the height of the opening in the face frame.
- Cut from one piece 3/4" x 2-1/4" x 4".

Fig. C Door Details

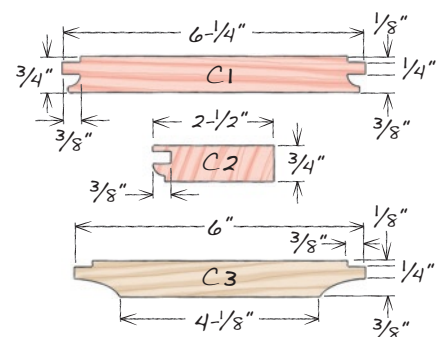
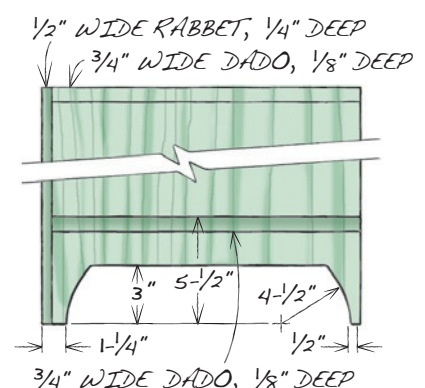


Fig. D Side Details





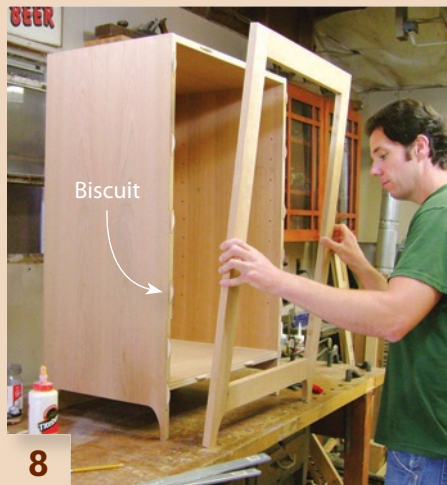
5 Once you're sure that the face frame fits, unclamp it and cut the bottom end of each stile to form a leg. Glue and screw the face frame together.



6 Make the doors and fit them inside the face frame. Use shims to establish the clearances. This process is much easier when the face frame is not attached to the cabinet, but sits flat on a bench.



7 Attach hinges to the doors and plane bevels on both inner stiles. These bevels allow the doors to close with a minimum amount of gap between them.



8 Glue and clamp the face frame to the cabinet. Align the pieces with biscuits.

Fit the doors

You've got a lot of options for making the doors, so I won't go into much detail. I use a standard set of cope and stick router bits to join the stiles and rails (C1 and C2) and a large cove bit to shape the panels (C3; Fig. C, see Source, page 47). After cutting the coves, I rabbet the back sides of the panels so the panels will fit into the grooves in the stiles and rails.

I usually make my doors oversize to begin with, then methodically trim them until there's about 1/32" clearance all around. Before fitting, they are 1/16" taller than the opening in the face frame. Their width is generous, too: Placed side by side, the doors should fit tight across the opening. (However, if you're off in width by up to 1/16", one way or the other, it really doesn't matter.) Note that the dimensions given in the cutting list are for these oversize dimensions—they are not the final sizes of the door's rails and stiles.

Fitting the doors is much easier to do with the face frame lying flat on my bench rather than attached to the cabinet. This way, I don't have to rig up something to support the doors; they lie right on the bench, too.

A set of plastic laminate shims—which are about 1/32" thick—are invaluable for trimming the doors. After gluing each door together, fine-tune its length. Lay one door

on the bench and place the face frame on top of it. Place two shims between the bottom of the door and the face frame's lower rail. Because the door is oversize, the top rail of the face frame should now sit on top of the door. Using another shim as a spacer, scribe a fine pencil line along the top of the door (**Photo 6**). Cut as close to this line as you can on the tablesaw, using a crosscut sled. If the line is slightly tapered, use a plane to finish the job. The door should now have a perfect 1/32" clearance top and bottom.

Theoretically, you could have just cut the doors to the right length on the tablesaw, but my experience has taught me that this can be risky. If the face frame is just a little bit out of square, scribing is the only way to correct the error.

Scribing isn't necessary for trimming the door's width, however. For this operation, use a jointer to remove an equal amount of material on both of the hinge-side stiles until you can fit shims where the hinges will go (the hinges require about 1/32" clearance, too). At this point, the doors and shims should fit tight inside the face frame, with little or no gap in the center.

Next, mount the hinges on the doors and hang the doors inside the face frame (Fig A). Trim the center stiles by hand, using a block plane (**Photo 7**). Both of these stiles must be beveled about 2° so the doors will close properly.

Making Flush-Fit Handles

I HAD A FUNNY URGE when designing this cabinet. Although its doors have a traditional look, why not give the handles an ultra-modern touch? When closed, they would be flush with each other, forming a single design element. When open, they'd become two pulls with different, graceful shapes.

If there's one thing a woodworker truly enjoys, it's that an abstract idea can soon become reality. I made a few prototypes to perfect the design, but, in the end, these handles proved to be quite easy to make. They would work well on many types of doors.

Start out with one block of wood (see Cutting List, page 44). Mark a centerline around the block, position it on the doors and trace around it (**Photo 1**). Round over the block's edges with a belt sander and mark "Left" and "Right" on the block's back side.

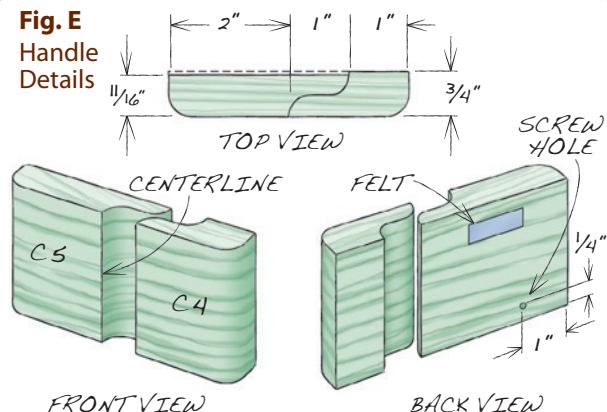
Draw an ogee curve on top of the block (Fig. E, below). Begin the curve, from front to back, on the block's centerline. Saw the curve on a scroll saw (**Photo 2**). (You could also use a bandsaw with a 1/8" blade.) File and sand the rough surfaces smooth.

Glue the right handle (C4) to the door within the lines you marked—its left end should align with the edge of the door.

Using a belt sander or block plane, reduce the thickness of the left handle (C5) by about 1/16". (This side must be thinner so it can pivot on a washer.)

Drill a hole through the door for mounting the handle. This hole should be 1/4" above the line marked on the door and 1" from the edge of the door. Place the handle on the door, butted up to the part that's glued to the door and positioned slightly above the hole. Mark the location of the hole on the handle, then drill the handle to receive the screw.

Glue a piece of felt to the left handle—this will prevent it from scratching the finish. Fasten the handle (**Photo 3**), placing a washer between the handle and the door. Test the handle's operation. If it's too tight, file or sand the ogee.



Position the handle on the cabinet and trace around it. At this point, the handle is a single block.

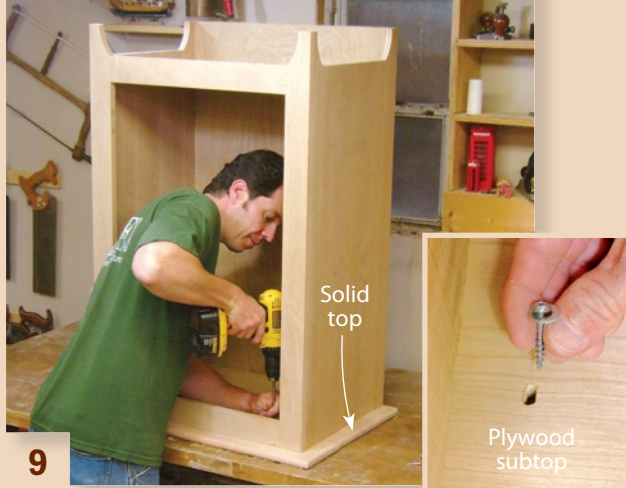


Cut the handle into two pieces on the scroll saw.



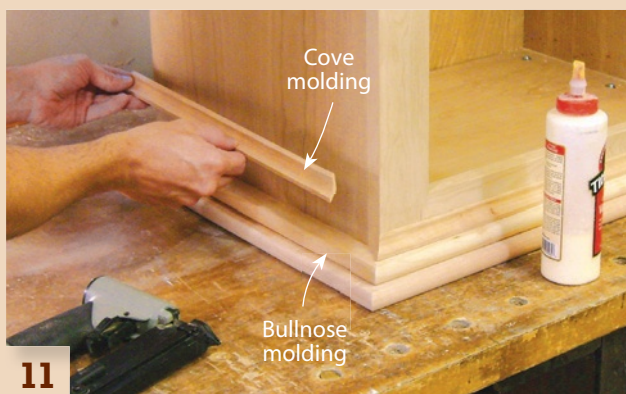
The left piece pivots on a screw. The right piece is fixed to the door.





9 **Make** a top from solid wood and fasten it to the cabinet. Drill elongated holes in the cabinet's plywood subtop so the solid-wood top can expand and contract without cracking.

10 **Shape** two coves on a board, then rip the board to make two moldings. Although this router bit is round, adjusting its height and depth a few times yields a nice elliptical shape.



11 **Glue** the moldings to the case, but not to the solid-wood top. These pieces run across the width of the top; gluing them to the top would restrain the top from moving and may cause it to crack.



Attach glides to the ends of the legs. Glides prevent the plywood sides from splintering when the cabinet gets pushed across the floor, which is bound to happen!

You don't need a protractor, however. Just scribe a line $1/32$ " below the inside edge of each stile and bevel the stile until you get to the line. Then plane the entire bevel until there's an even $1/32$ " gap between the doors when they're closed.

Remove the doors from the face frame and glue the face frame to the cabinet (**Photo 8**).

Make the top and moldings

Glue up the top (D1), sand it even and rout a bullnose rounding on its front and side edges (Fig. A). (I do this on the router table, using a standard roundover bit; see Source.) Using the same setup, make the bullnose moldings that go under the top (D2 and D3; Fig. B).

Drill holes in the subtop for fastening the top (Fig. A). Note that two of the holes on each side must be oval, so the top is free to expand and contract. Fasten the top to the cabinet with screws and washers (**Photo 9**).

Make the cove moldings that also go under the top (D4 and D5, Fig. B). Rout the edges of a board that's about 4" to 5" wide (**Photo 10**), then rip the moldings from the board. You can create this molding's elliptical shape using a standard cove bit, which has a round profile, by making a series of overlapping passes (see Source). Just adjust the height and depth of the cut a few times, then remove any small waves between the

cuts by sanding.

Trim the front bullnose molding to length first and glue it to the case. Cut both side pieces next and glue them as well. Repeat the procedure for the cove moldings (**Photo 11**).

While the cabinet is upside down, make and install corner blocks (A6 and A7) to reinforce the legs. Shape the blocks to follow each leg's curve. These blocks also provide more material for supporting furniture glides (**Photo 12**). Pre-drill holes for the glides before tapping them in place.

Turn the cabinet on its feet and glue a block (B3) inside the face frame to stop the doors. Hang the doors on the cabinet and install the handles (see "Making Flush-Fit Handles," page 46).

Remove the handles, doors, top and back for finishing. Apply finish to both sides of the top to prevent it from warping. 🛠️

SOURCE

Freud Tools, freudtools.com, 800-334-4107, Adjustable rail and stile bits, round over profile, #99-760, \$125 at many dealers; rounding over bit, $3/8$ " radius, #34-124, \$26 at many dealers; round nose bit, $3/4$ " dia., #18-112, \$21 at many dealers.

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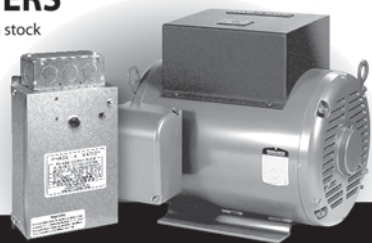
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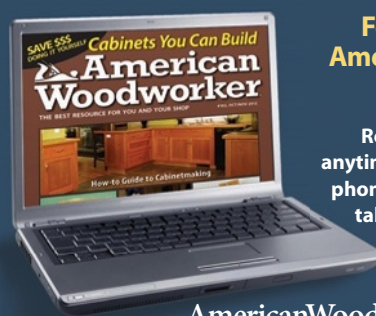


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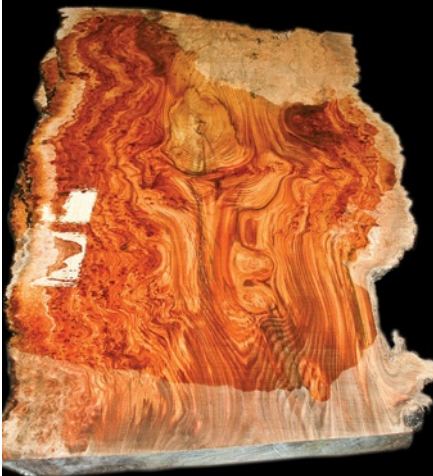


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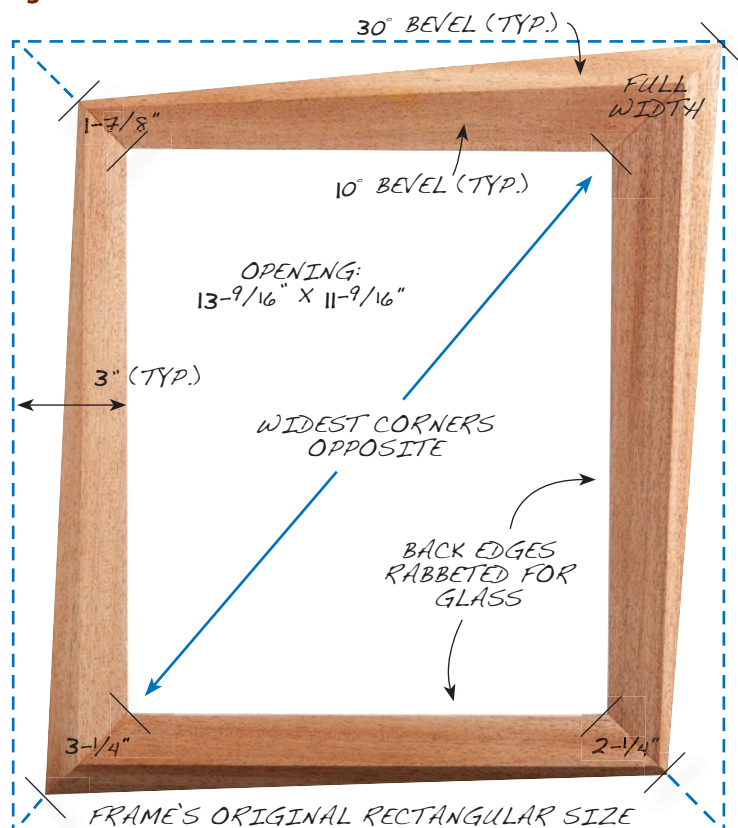


SNAZZY *frames*

by Jason Zentner

Angled cuts and a simple jig create kookie shapes.
Like ... crazy, man. They're cool.

Fig. A Dimensions



THESE FRAMES appear challenging to build at first, because each side has to be beveled, mitered, tapered, and beveled again—at a skewed angle. But once you understand the process, they're surprisingly easy to make and just as easy to modify. Skew only the top, or skew both sides toward the bottom. Alter the skews' pitch. Change the bevel angles. Change the width of the frame pieces or the shape of the opening. You can make these frames using only a tablesaw and bandsaw, but the job will go faster if you also have a miter saw, jointer and router table.



See how to cut the frames' wonky bevels at
AmericanWoodworker.com/WebExtras



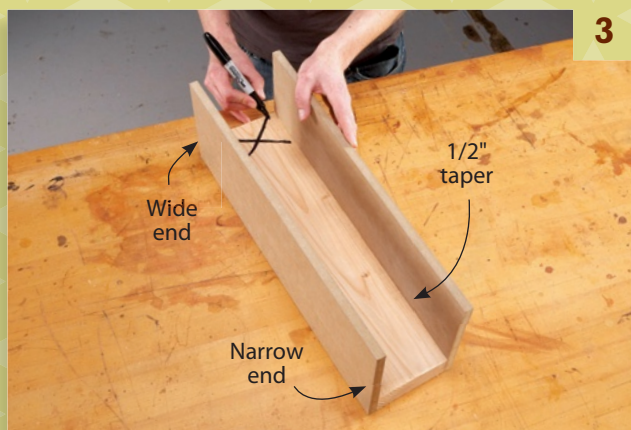
1

Map out the frame's tapered edges on a mitered frame with a wide inside bevel. Use a different point on each miter to create unique corners and tapers. The narrowest corner must be at least 1-5/8" wide.



2

Bandsaw the frame's tapered edges. Exaggerated tapers are most dramatic.



3

Make a two-sided jig from a 2x6 with one tapered edge to cut tapered bevels on the frame's tapered edges. Mark the wide end of the jig.



4

Mark the back of the frame to position it on the jig. Use a square to draw registration lines that intersect at the miter on the two wide corners, exactly 1" from their outside points.

Start square

Believe it or not, each of these frames starts out as a plain rectangular frame with 3" wide sides and a 2" wide bevel around the opening. You can buy such a frame (watch out for metal fasteners at the miters) and skip to the next section, or build your own frame. The frames shown here are sized for 12" x 14" images—or 8" x 10" images surrounded by 2" mats. To build one of these frames, you'll need two pieces of 3/4" x 3" x 40" stock. Each piece contains one long side and one short side.

Cut a 2" wide bevel on the face of both frame-stock pieces by tilting the blade to 10° and setting the tablesaw's fence to leave the edges 1/2" thick. Sand, plane or joint each bevel to remove the saw marks.

Route a 1/4" wide x 1/4" deep rabbet for the glass on the back inside edge of each piece. Next, cut the four sides to length by mitering the corners to create a 13-9/16" x 11-9/16" opening. Simply butt the miters when you glue the frame together—don't reinforce the joints with biscuits or mechanical fasteners. Note: The miters must meet precisely at the corners and all four sides must be flush, so the frame sits flat on its back.

Create dramatic tapers

To establish a different taper on each side of the frame, leave one mitered corner full width and mark different points to uniquely shorten the other three corners (Fig. A, page 51). Then connect the dots (Photo 1). Taper the frame's outside edges (Photo 2). Make sure each corner remains centered on the miter when you remove the saw marks.

Build a jig

Build a tapering jig to bevel the outside edges of the frame (Photo 3). Using one side of this jig allows you to increase the bevel during the cut; using the other side allows you to decrease it.

To make the jig, joint one face and one edge of a 20" long 2x6 so both surfaces are flat and the corner is square. Mark a 1/2" end-to-end taper on the non-jointed edge. Bandsaw the taper and joint the edge to remove the saw marks. Fasten 1/2" x 6" MDF fences to both edges, so you can clamp the frame to the jig. Mark the jig's wide end.

Cut wonky bevels

Draw registration lines on the frame's two widest corners, so you can position it on the jig (Photo 4). On this frame, the widest corners are opposite one another. Use a square to mark a line that crosses one of the wide miter joints exactly 1" away from its outside corner. Mark a second line from the adjacent side, so that the two lines intersect at the miter. Repeat the process to mark the frame's opposite corner.

Orient the frame on one of its long sides to cut the first tapered bevel (Photo 5). This places the registration lines at the front end of the frame. Align the wide end of the jig with the vertical registration line. Then clamp the frame to the jig. Tilt the blade to 30° and set the fence to leave the edge 3/16" thick. Then cut the bevel (Photo 6).

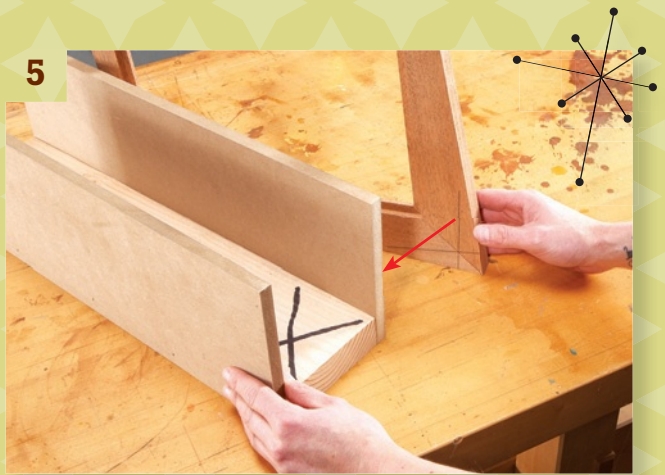
Bevel the adjacent side of the miter without changing the saw setup. Unclamp the frame and rotate it forward 90°, so the registration lines are at the back (Photo 7). Then spin the jig 180° so its wide end is also at the back. Align the wide end with the vertical registration line. Then clamp the frame to the jig and cut the bevel (Photo 8). Because the jig's wide end is registered from the same point on the frame for cutting both bevels, their tapers will rise from the opposite ends of the two sides to meet at the miter.

Move to the opposite wide corner of the frame and repeat the process to bevel the two remaining sides. Because the bevels taper at the same ratio during all four cuts, the bevels on the two narrow corners automatically meet at their miters.

Take a break to comb your D.A. and plan more snazzy frames. The key to making variations is to always register the frame on same end of the jig (wide or narrow) when you cut the tapered bevels on adjacent sides. 🐘

Jason Zentner likes fuzzy sweaters, long walks on the beach and discussing politics while lounging by a cozy fire. On weekends he sits in his rat rod pretending to be racing for pinks ... which is also the color of his bedroom.

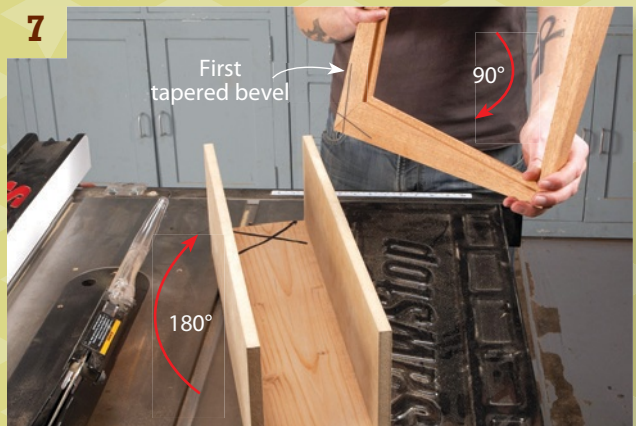
Align the fence on the wide end of the jig with the registration line on the long side of the first marked miter. Then clamp the frame to the jig.



Cut the first tapered bevel with the wide end of the jig at the front. This bevel decreases in width as it runs down the frame's long side—and simultaneously tapers both the side's beveled face and its outside edge.



Rotate the frame and spin the jig to cut the tapered bevel on the adjacent short side. Align the jig's wide end with the registration line—both are now at the back. Then clamp the frame to the jig.



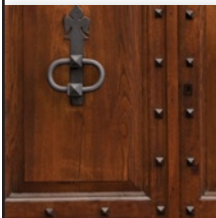
Cut the second tapered bevel. This bevel increases in width as it runs down the frame's side and rises to meet the previously-cut tapered bevel precisely at the miter.





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| ✓ Candle Cups | ✓ Felt | ✓ Nozzles | ✓ Turnings |
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Summer Table

by Redge Estell

Perfect for a summer porch, this table is easy to take apart for storage during the winter.



Three identical frames, shaped like an "F", have arms that lock together like a puzzle.



Taken apart, the table breaks down into three flat pieces.

Fig. A Exploded View

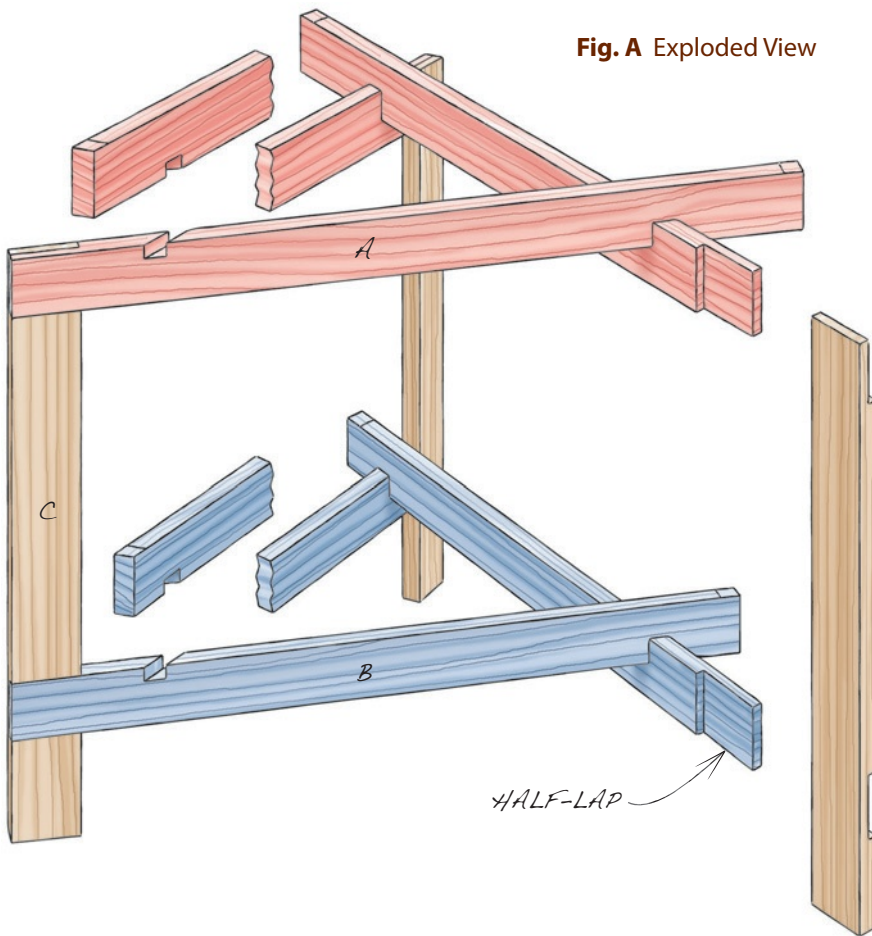


Fig. B Tablesaw Setup for 4° Cuts

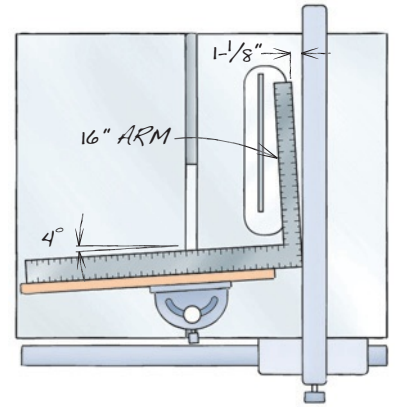


Fig. C End Cuts

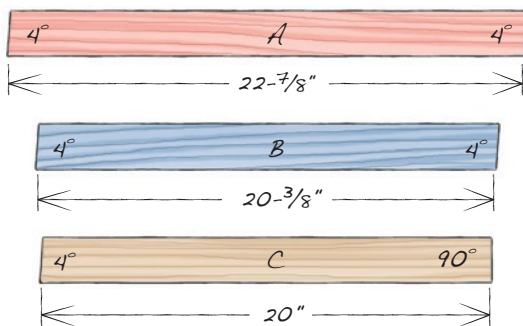
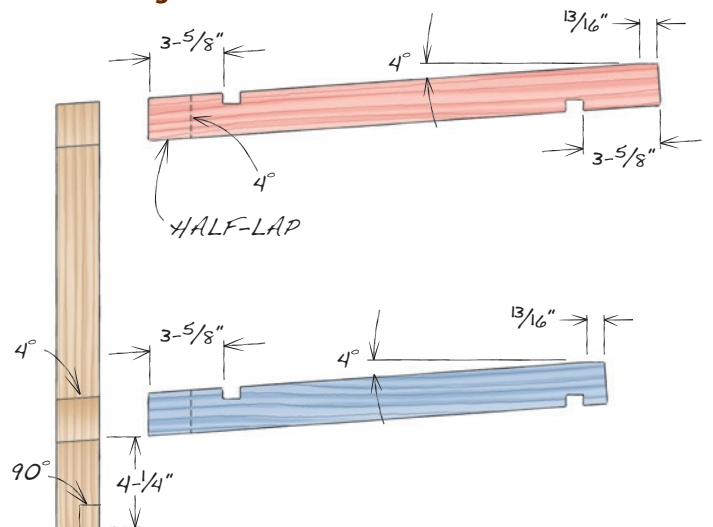


Fig. D Frame Details



Cutting List

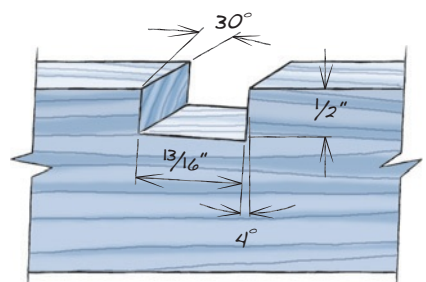
Overall Dimensions: 30" Dia. x 22" H

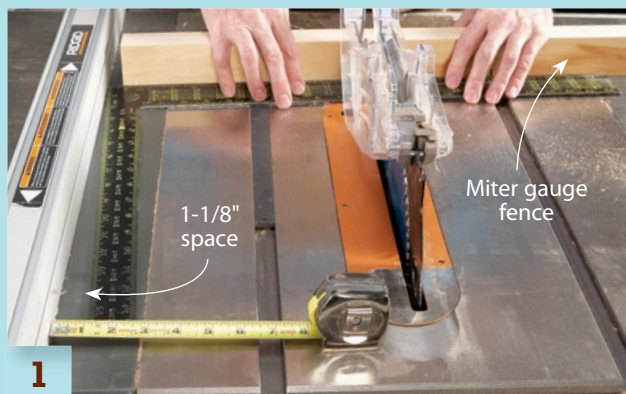
Part	Name	Qty.	Th x W x L
A	Top arm	3	3/4" x 2" x 24" (a)
B	Bottom arm	3	3/4" x 2" x 22" (a)
C	Leg	3	3/4" x 2" x 20"
D	Top	1	3/8" x 30" dia.
E	Shelf	1	3/8" x 20" dia.

Notes:

a) Rough length. See Fig. C for final length.

Fig. E
Notch Details

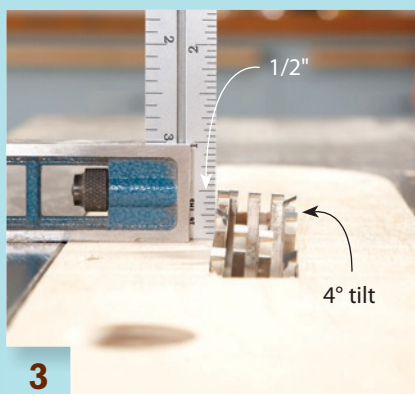




1 **Adjust** your miter gauge to 4°. Use a framing square and a ruler to hit this angle right on the money.



2 **Cut** the ends of the arms and legs at 4°. When trimming the pieces to final length, use a stop block that is also cut at 4°. This ensures that the pieces are oriented the correct way.



3 **Install** a dado set in your saw and tilt it to 4°. Raise it to make a cut 1/2" deep.



4 **Adjust** the miter gauge to 30°. This angle is easy to establish with a 30-60-90 drafting triangle.



5 **Mark** the forward-leaning ends of all the arms. Keep track of which way these marks go in the steps ahead.

REMEMBER LINCOLN LOGS? When I was a kid, my friends and I spent hours building cabins and forts with them. Lincoln Logs locked together just like the real deal—one on top of another—and were my first introduction to wood joinery. While playing with them, I must have learned something that stuck with me years later, when I became a cabinetmaker.

The parts of this table lock together, too—without any glue or fasteners—but in a most unusual way. The table is triangular, and all of the Lincoln Log-style notches are set at a compound angle. The table is composed of three identical frames shaped like an “E.” Each frame has only one leg and two arms, so they’re very easy to build. All the joints are made on the tablesaw.

One small warning: Follow the directions closely. All of the pieces look alike, so it’s easy to get mixed up and make a mistake. I’ve figured out a sys-

tem that should be foolproof (famous last words!), but even so, I recommend that you build a table with some cheap wood first just to get the hang of it.

Cut all the parts

Begin by milling the wood for the top arms (A), bottom arms (B) and legs (C). All of these pieces are 3/4" thick, so you could use boards from a lumberyard or home center that have already been planed down to this size. (Face-frame material is ideal.) Cut all of the pieces about 1" extra-long, then joint and rip them to the finished width (see Cutting List, page 38).

All of the arms slope at 4° (Fig. D), an angle that will come up a number of times while you’re building the table. For the next step, fasten a fence that’s about 30" long to your tablesaw’s miter gauge, then use a framing square and a ruler to set the miter gauge at 4° (Photo 1 and Fig. B). You’ll need to

reset the miter gauge to 30° later on, and then return it to 4°, so the square-and-ruler method has a lot going for it: It’s very easy to repeat.

Cut one end of the top arms, bottom arms and legs at 4°. (Use a fine-toothed crosscut blade to minimize sanding later on—these ends will show.) In addition, cut 4° ends on two 3/4" x 2" x 4" stop blocks and one 1-3/4" x 1-3/4" x 4" stop block. Use the large stop block to trim the top and bottom arms to final length (Photo 2 and Fig. C). Pay close attention to which way the angles go—the arms should look like a parallelogram when you’re done. Reset the miter gauge to 90° and trim the legs to final length.

Cut the notches

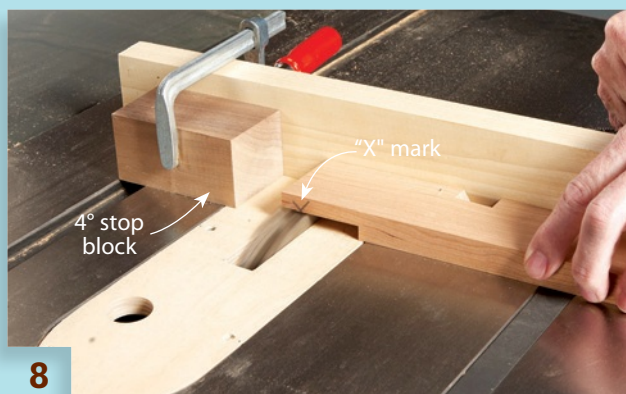
Next, you’ll cut the notches that enable the three parts of the table to lock together. For ease of assembly, these notches must be 1/16" wider than the



6 **Saw** two notches in the top arms. Trap the arm between two angled stop blocks. After cutting one notch, flip the arm around to cut the second notch.



7 **Cut** similar notches in the bottom arms. Leave the stop blocks in the same position. Cut the first notch with the arm butted up against the front block; cut the second notch with the arm butted up against the rear block, as shown here.



8 **Make** half-lap joints in the ends of both arms. Here, the dado blades are reset to 90°; the miter gauge is reset to 4°.



9 **Cut** mating half-lap joints in the legs. Use two stop blocks to determine the width of the lower joint.

thickness of the arms (3/4"). Assemble a 13/16" dado set on your saw's arbor. (If you don't have a 1/16" chipper, add shims that add up to 1/16".) Tilt the dado set to 4° and raise it to cut 1/2" deep (**Photo 3** and Fig. E). Adjust your miter gauge to 30° (**Photo 4**). Note that I'm using a left-tilt saw; if your saw tilts to the right, set your miter gauge in the opposite direction.

At this point, it's a good idea to mark your pieces so you won't cut a notch in the wrong place (**Photo 5**).

Draw a notch on one of the top arms (Fig. D). It doesn't matter which end of the arm you mark, because both of the notches on the top arm are the same distance from each end. Position the arm on the miter gauge, then clamp angled stop blocks at both ends of the arm, trapping it. Saw the notch. Flip the arm around so it fits between the stop blocks again and saw a second notch (**Photo 6**). There's only one way

the arm will fit between the blocks, so you can't make a mistake.

The procedure for the lower arm is a bit different. Leave the stop blocks where they are. Butt one end of the arm against the forward stop block

I've figured out a system that should be foolproof—just follow the "X"

and make a cut. Flip the piece around, butt the same end against the rear stop block and make the second cut (**Photo 7**). This method ensures that the distance between the notches is

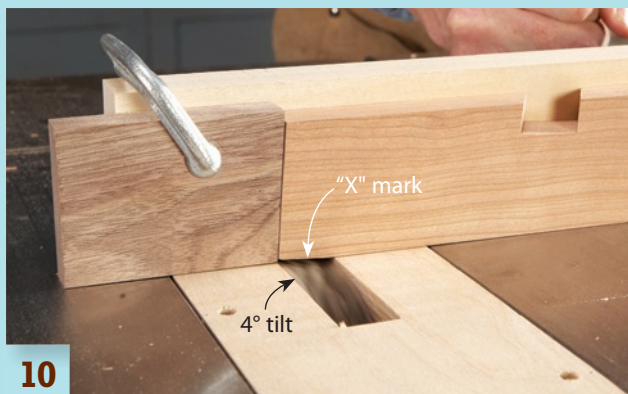
the same on both the top and bottom arms, even though the arms are different lengths.

Make half-lap joints

Return the dado set to 90°. Lower its height to 3/8". Use the square-and-ruler method to adjust the miter gauge back to 4°. Clamp the large angled stop block to the fence in order to make a dado that's exactly 2" wide—the width of the legs. Cut half-laps in the ends of all the arms (**Photo 8**).

Using a test piece, fine-tune the height of the dado set so that the half-lap joints come out perfectly flush. Without moving the stop block or re-adjusting the miter gauge, cut half-laps in the top ends of the legs. Once you're done with these cuts, remove the stop block.

Mark the location of the lower half-lap on one of the legs (Fig. D). Set up two stop blocks to make this cut. Place the large angled block against the top



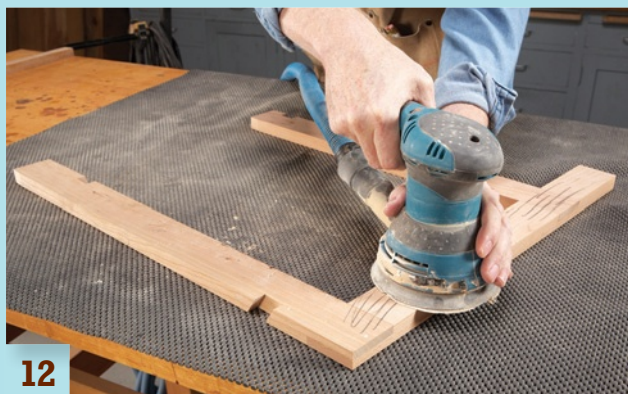
10

Saw a 4° bevel on the ends of the arms. This creates flat spots to support the glass top and shelf.



11

Glue the arms to the legs. Make sure the pieces are oriented the correct way—the arms of the “F” should incline up, not down.



12

Sand the joints even. Draw pencil lines across the joints and sand until all the marks are gone—this ensures that the arms and legs are flush.



13

Round over all edges with a trim router. That’s about it—the table is ready to assemble!

of the leg and a square block against the bottom of the leg (**Photo 9**). Adjust the blocks to make a cut that’s about 1/32" too narrow. Cut a half-lap in one of the legs, then adjust one of the stop blocks to widen the notch until it’s just right. Use the same setup to cut the remaining two legs.

You’re just about done on the table-saw. There’s only one more operation—sawing a 4° taper on the top ends of the arms, where they support the glass. The easiest way to do this is with your dado set (**Photo 10**). Tilt the dado set to 4° and adjust the miter gauge to 90°. Lower the dado set so it will cut a flat spot about 13/16" wide—the exact dimension isn’t important. Saw the ends of all the top and bottom arms.

Assembly

Glue the arms to the legs (**Photo 11**). When the glue dries, draw pencil lines across both sides of the half-lap joints.

Sand each assembly until all the pencil lines disappear (**Photo 12**). Plane or file the end grain of the half-lap joints flush with the surrounding wood.

Using a 1/8" roundover bit, soften all the edges of the legs and arms (**Photo 13**). Avoid routing into the notches; soften their edges by hand, using a file and sandpaper.

If your table will have to brave the elements, finish it with an exterior polyurethane. I bought glass tops for my table at a local Pier 1 store (see Source, at right); you can order them online from Pier 1 or have a local glass supplier make them up for you.

To assemble the table, first lock two of the frames together. At this point, there will be plenty of play in the joints, so the pieces can swing like a hinge. Insert the third piece, but keep it swung open as shown on page 37. Finally, lock the last pairs of notches together, one at a time. Snapping the

pieces together will require a small amount of force, but that’s good. The tension in the joints turns the assembly into a rigid unit. 

SOURCE

Pier 1 Imports, pier1.com, 800-245-4595, 3/8" glass tops, 30" dia., #2260461, \$50; 20" dia., #2260459, \$25.



Redge Estell

has been a woodworker since the early '70s in various cabinet shops, fixture shops and exhibit companies in New Mexico, Colorado and Minnesota. He now designs and builds furniture and art in his home studio in Corrales, New Mexico.

Stacking Tool Cabinet

Beautiful wood and stylish design turn an ordinary storage cabinet into one that says, "This was made by a true craftsman."

by Jim Stack

UNIQUE because of its handsome appearance and easy to build because it's constructed using basic woodworking techniques, this two-part cabinet provides a lift-top lid, drawers of all sizes and full-extension drawer slides. The two cabinets share the same features and joinery, so building them at the same time offers economy when milling the parts. But either cabinet would make a super storage unit all by itself. So build one or both, as your shop warrants.



Mill the leg blanks

Glue up blanks for the legs (A1, Fig. B, page 44; C1, Fig A; Cutting List, page 46). Use 8/4 stock, so the tapers won't cross the glue line on the base cabinet legs. When the glue has dried, mill the blanks to their final square dimensions and cut them to length.

The two outside faces of each leg will be tapered (Fig. E). Orient the grain patterns as you like, and then mark the inside corner (between the two sides that won't be tapered) on both ends of each leg. These marks tell you which sides of the leg to taper and where to cut the mortises. They also make it easy to distinguish between the tapered and non-tapered sides after the tapers have been cut.

Cut the mortises before you cut the tapers. Lay out the mortises on the front inside face of each front leg blank (Fig. E). Then use a mortiser or a drill press equipped for mortising to cut them.

Shape the legs

Draw the taper on one outside face of each leg. Bandsaw these tapers and then draw the second taper on each freshly cut face (**Photo 1**). Use the mortises and end marks made earlier to assure these tapers are correctly located. Cut the second tapers. Then smooth both tapers on each leg using a hand plane or a jointer. Save the wedge-shaped offcuts to use as cauls when gluing and assembling the cabinets.

Chamfer the legs' tapered outside corners (**Photo 2**). Then use a miter saw to cut the 45° miter at the top (**Photo 3**). This cut should connect each leg's opposite corners, but as the miter is purely decorative, it doesn't matter if the cut's a bit off. You can make minor adjustments by sanding.

Mill the rails and stiles

Cut the front rails (A2, C2) to final dimensions. Then cut 3/8" thick x 1-1/4" long tenons on both ends of the base cabinet's front rails (**Photo 4**). Stand the rails on edge to cut the tenons' top and bottom shoulders. Reposition the stop block to cut the 3/4" long tenons on the top cabinet's front rails.

Cut the rails and stiles (A3–A5; C3–C5) for the paneled back and side frames to final dimensions. Note that the rails are thicker than the stiles. Rout a centered 1/4" wide groove in one edge of each stile. Then cut tenons on both ends, sized to fit the groove (Fig. D). Go back to the router table and use the same setup as for the stiles to rout the grooves in the rails—these grooves will be offset (**Photo 5**). Make sure to position the rails' inside faces on the table, so the assembled joints will be flush on the back. Finish by beveling the rails' outside edges (**Photo 6**).

Assemble the frames

Glue up blanks for the back and side frame panels (A6, A7; C6, C7). Mill the blanks to final thickness and cut them to final width. Outfit your tablesaw with a crosscut sled to square the blanks and cut them to final length. Then use a panel-raising bit to shape the edges (**Photo 7**). The panels' tongues should slip smoothly into the grooves in the rails and stiles. Substituting 1/2" hardwood plywood for the panels is an option worth considering to save time and money. Simply rabbet the back of each plywood panel to create the tongues.

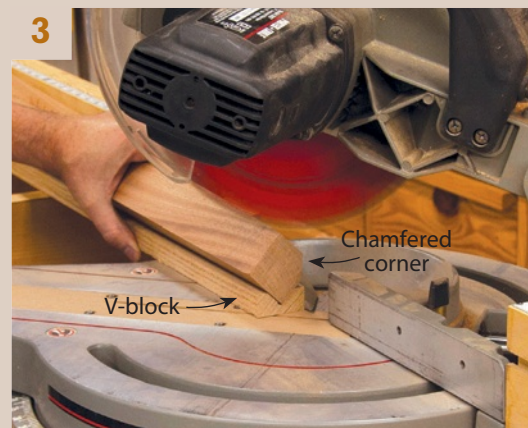
Taper the two outside faces of each leg on the bandsaw. Then remove the saw marks by jointing, hand-planing or sanding.



Chamfer the tapered outside corner of each leg.



Miter the top of each leg for a distinctive look. Support the leg in a shop-made V-block. Then position the leg's chamfered corner against the saw's fence so the cut bisects the opposite corners of the leg's square top.



Cut tenons on the front rails to fit the leg mortises, using a dado set and a miter gauge with a long fence and a stop. Each tenon cheek requires two passes.

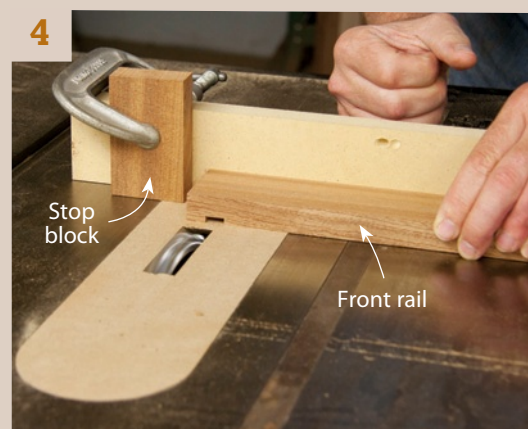


Fig. A Top Cabinet

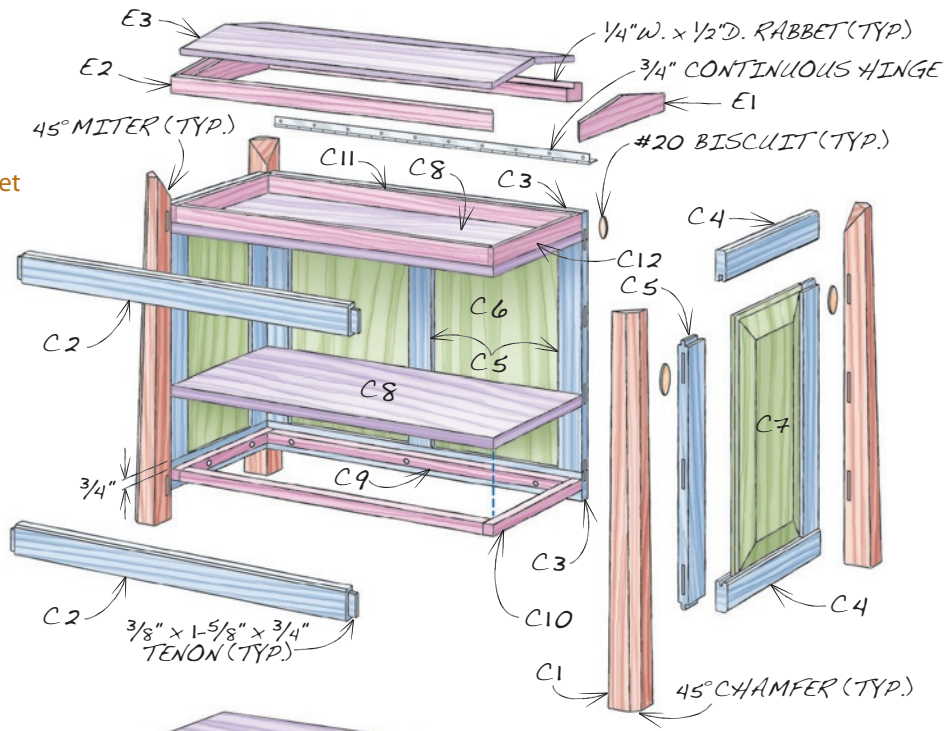
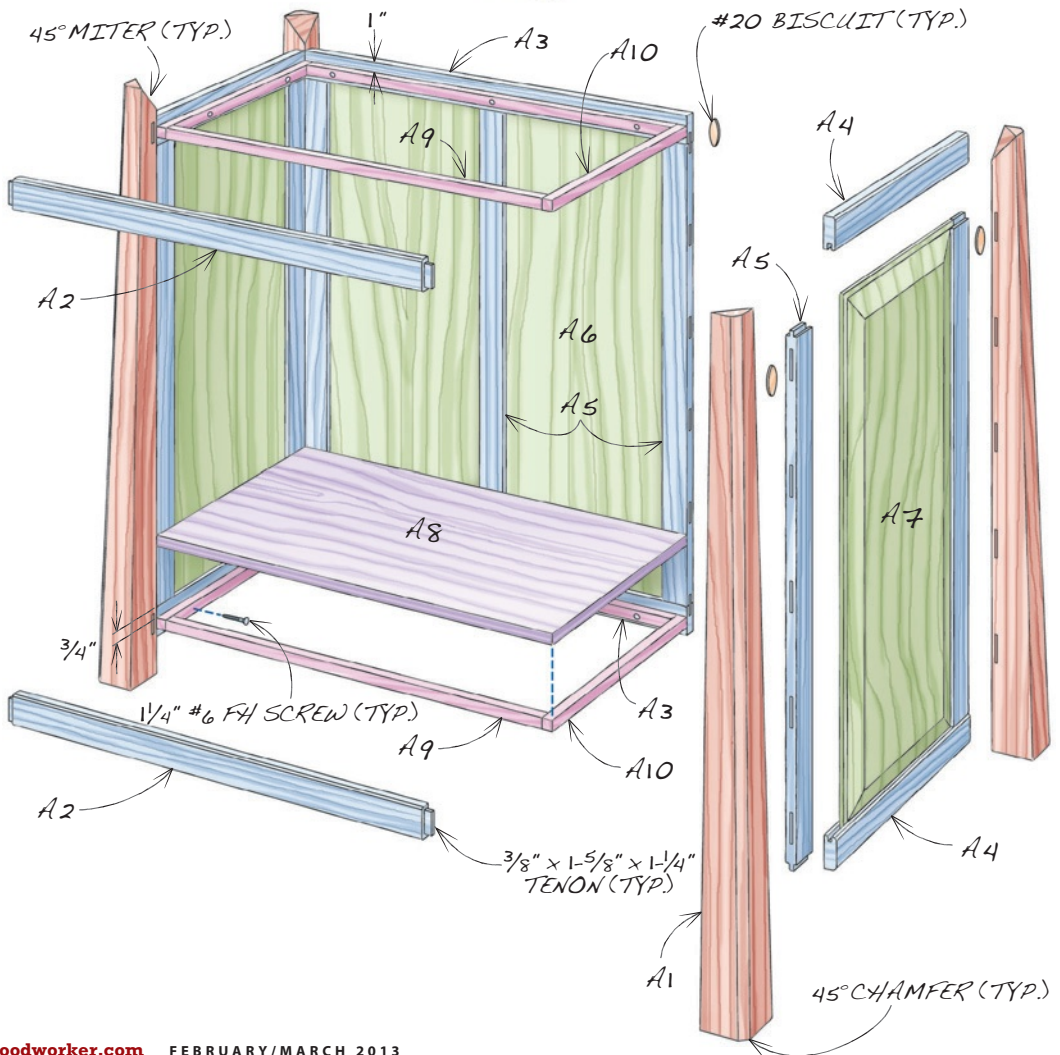


Fig. B Base Cabinet



Dry fit each frame-and-panel assembly to make sure the parts fit properly. Gather the necessary clamps and lay everything out so the gluing process proceeds smoothly. If you've made solid-wood panels, brush glue only on the stiles' tenons and the portions of the grooves that those tenons fit into. Then install the panel and assemble each frame. (Solid-wood panels must be free to expand and contract inside the frame, so they can't be glued in. Plywood panels, on the other hand, can be glued in.) Make sure the stiles and rails are flush and the assembled frame is square when you apply the clamps (**Photo 8**).

Glue the carcass

Draw registration lines to indicate the top of all the rails on all the legs. Then lay out the biscuit slots on each leg and paneled frame (**Photo 9**). Stagger the slot locations on adjacent frames. Then cut all the slots, using the same biscuit joiner setup (**Photo 10**). Dry assemble each side of the carcass with the top rails on the registration lines to make sure all the inside edges are flush and the joints fit properly.

Glue together the front legs and rails (**Photo 11**). This assembly creates the opening for the drawers and drawer fronts, so it must be absolutely square. Brush glue in the mortises and on the tenons and use the offcuts from tapering the legs as cauls. Next, glue together the back legs and the paneled back frame (**Photo 12**). This assembly must also be square.

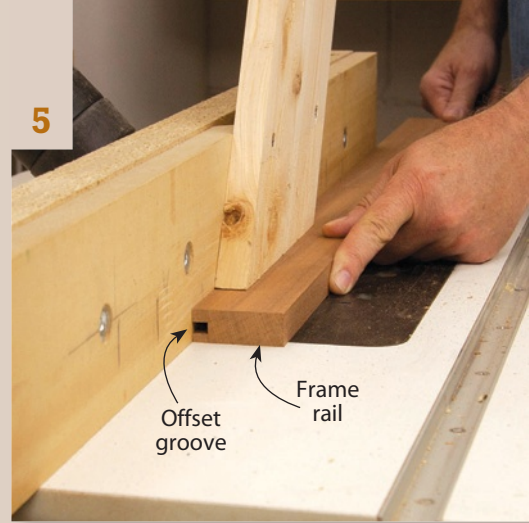
Glue the paneled side frames between the front and back leg assemblies (**Photo 13**). This is a complex glue-up, so dry-assemble the carcass and think through the process of applying glue to the biscuits, slots and along each joint before clamping the four assemblies together. You might decide to use glue with an extended open time. You might even phone a friend; an extra set of hands would be helpful at this point. At the very least, free up your hands by taping the cauls to the legs and using spacers to position the paneled side frames at the top registration lines. After everything is glued and clamped, make sure the carcass is square by measuring diagonally across the top on the outside or by checking inside with a framing square.

Install the shelves

Install the cleats for the base cabinet's bottom and top shelves (A8–A10) and for the top cabinet's bottom shelf (C8–C10). Position the cleats for each bottom shelf so that the shelf will sit flush with the tops of the bottom rails. Fasten the cleats with glue and screws. Then brush glue on the tops of the cleats and set each bottom shelf in place. Drive nails or add weight (sandbag, toolbox, engine block, etc.) to hold the shelf in position until the glue dries.

The base cabinet's top shelf sits 1/4" below the top of the top rails, to create a lip around the edge. Install the cleats and this shelf using the methods described above. Installing the top shelf in the top cabinet is a bit different. Start by gluing the filler strips (C11; C12) flush with the top rails. Then turn the cabinet upside down. Apply glue to the bottoms of the filler strips, set the shelf in place and add weight to hold it in position until the glue dries. Here's a tip: Apply the glue in the corners where the fillers meet the rails. This will keep glue from squeezing out onto the shelf's top face.

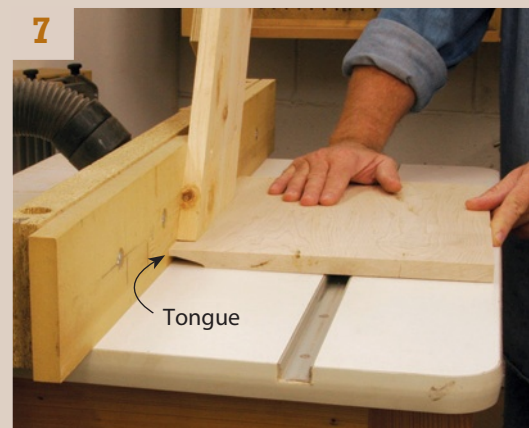
Cut tongue-and-groove joints in the back and side frame stiles and rails. The frames' rails are thicker than the stiles, so the grooves in the rails are offset to make the assembled joints flush on the back.



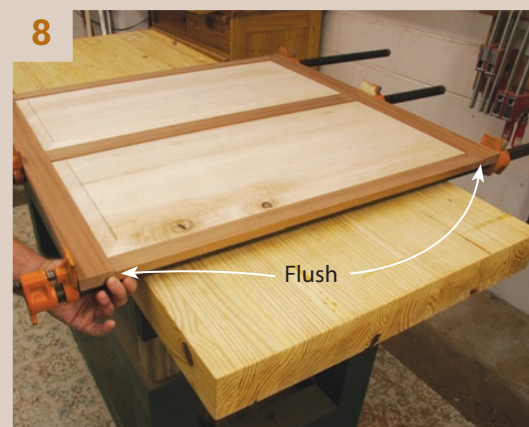
Bevel the outside edges of all the frame rails. The bevels ease the transition between the thick rails and thin stiles.



Shape each panel with a panel-raising bit. Complete the profile by incrementally raising the bit and making several passes. Make sure the tongues cut on the panel fit the grooves in the stiles and rails.



Check the outside edges to make sure the stiles and rails are flush when you glue each paneled frame. Measure the diagonals to verify that the frame is square.



Cutting List

Overall Dimensions: 59" H x 37" W x 24" D

Base Cabinet

Overall Dimensions: 38-3/4" H x 37" W x 24" D

Part	Name	Material	Qty.	Th x W x L
A1	Leg	Mahogany	4	3" x 3" x 38-3/4" (a)
A2	Front rail	Mahogany	2	3/4" x 2" x 33-1/2" (b)
A3	Back rail	Mahogany	2	3/4" x 2" x 31"
A4	Side rail	Mahogany	4	3/4" x 2" x 18"
A5	Stile	Mahogany	7	5/8" x 1-3/4" x 30-3/4" (c)
A6	Back panel	Maple	2	5/8" x 13-3/8" x 30-1/2" (d)
A7	Side panel	Maple	2	5/8" x 15" x 30-1/2" (d)
A8	Top/bottom shelf	Maple	2	3/4" x 18" x 31"
A9	Long cleat	Maple	4	3/4" x 3/4" x 29-1/2"
A10	Short cleat	Maple	4	3/4" x 3/4" x 18"
B1	Drawer box end 1	Maple	2	1/2" x 1" x 30"
B2	Drawer box end 2	Maple	4	1/2" x 2" x 30"
B3	Drawer box end 3	Maple	6	1/2" x 3" x 30"
B4	Drawer box end 4	Maple	2	1/2" x 5" x 30"
B5	Drawer box side 1	Maple	2	1/2" x 1" x 17-5/8" (e)
B6	Drawer box side 2	Maple	4	1/2" x 2" x 17-5/8" (e)
B7	Drawer box side 3	Maple	6	1/2" x 3" x 17-5/8" (e)
B8	Drawer box side 4	Maple	2	1/2" x 5" x 17-5/8" (e)
B9	Drawer box bottom	Maple plywood	7	1/2" x 18" x 30"
B10	Attached front 1	Mahogany	1	3/4" x 1-3/4" x 30-3/4" (f)
B11	Attached front 2	Mahogany	2	3/4" x 2-7/8" x 30-3/4" (f)
B12	Attached front 3	Mahogany	3	3/4" x 4-3/4" x 30-3/4" (f)
B13	Attached front 4	Mahogany	1	3/4" x 7-1/4" x 30-3/4" (f)
B14	Pull	Maple	7	3/4" x 3/4" x 30-3/4" (g)

Top Cabinet

Overall Dimensions: 22-3/4" H x 29-3/4" W x 15-3/4" D

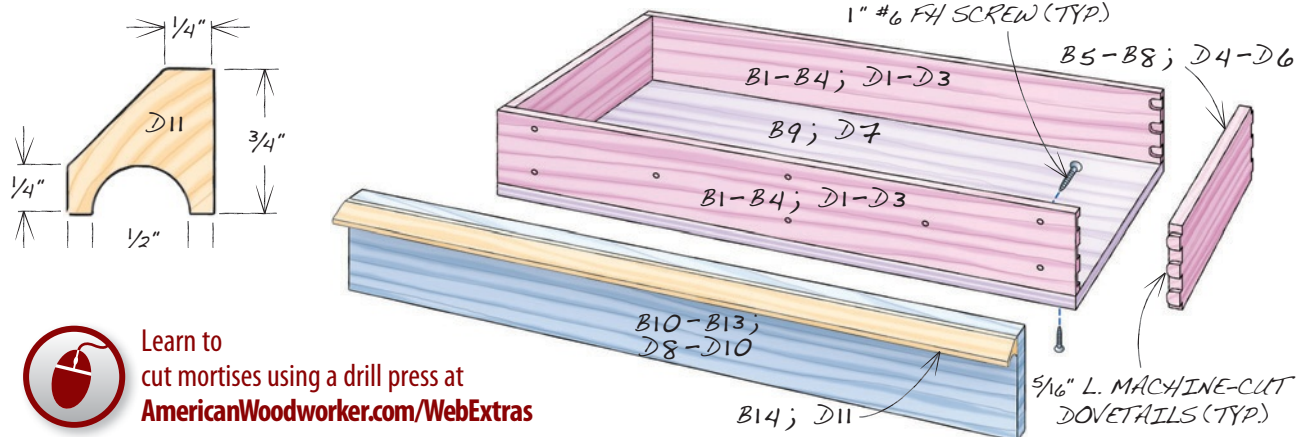
Part	Name	Material	Qty.	Th x W x L
C1	Leg	Mahogany	4	1-7/8" x 1-7/8" x 22-3/4" (h)
C2	Front rail	Mahogany	2	3/4" x 2" x 27-1/2" (j)
C3	Back rail	Mahogany	2	3/4" x 2" x 26"
C4	Side rail	Mahogany	4	3/4" x 2" x 12"
C5	Stile	Mahogany	7	5/8" x 1-1/2" x 15-1/4" [c]
C6	Back panel	Maple	2	5/8" x 11-1/4" x 15"
C7	Side panel	Maple	2	5/8" x 9-1/2" x 15"
C8	Top/bottom shelf	Maple	2	3/4" x 12" x 26"
C9	Long cleat	Maple	2	3/4" x 3/4" x 24-1/2"
C10	Short cleat	Maple	2	3/4" x 3/4" x 12"
C11	Long fill strip	Mahogany	2	1/2" x 1-1/4" x 25"
C12	Short fill strip	Mahogany	2	1/2" x 1-1/4" x 12"
D1	Drawer box end 5	Maple	4	1/2" x 1" x 25"
D2	Drawer box end 6	Maple	4	1/2" x 2" x 25"
D3	Drawer box end 7	Maple	2	1/2" x 3" x 25"
D4	Drawer box side 5	Maple	4	1/2" x 1" x 11-5/8" (e)
D5	Drawer box side 6	Maple	4	1/2" x 2" x 11-5/8" (e)
D6	Drawer box side 7	Maple	2	1/2" x 3" x 11-5/8" (e)
D7	Drawer box bottom	Maple plywood	5	1/2" x 12" x 25"
D8	Attached front 5	Mahogany	2	3/4" x 1-7/8" x 25-3/4" (f)
D9	Attached front 6	Mahogany	2	3/4" x 3" x 25-3/4" (f)
D10	Attached front 7	Mahogany	1	3/4" x 4" x 25-3/4" (f)
D11	Pull	Maple	5	3/4" x 3/4" x 25-3/4" (g)
E1	Lid end	Mahogany	2	3/4" x 2" x 11-3/4" (k)
E2	Lid rail	Mahogany	2	3/4" x 1-3/8" x 25-3/4" (l)
E3	Lid panel	Maple plywood	2	1/2" x 5-1/2" x 24-3/4" (m)

Notes:

- a) Both outside faces taper to 1-3/4" at the top; one inside face is mortised for the rail tenons.
- b) Length includes 1-1/4" long tenons on both ends.
- c) Length includes 3/8" long tenons on both ends.
- d) Raised center with 1/4" tongues on all edges.
- e) Length includes 5/16" long dovetails on each end.
- f) Cut oversize in width and length; trim to final dimensions when fitting to cabinet.

- g) Cut from 4" wide blank. Cut oversize in length and trim after gluing to drawer front.
- h) Both outside faces taper to 1" at the top; one inside face is mortised for the rail tenons.
- j) Length includes 3/4" long tenons on both ends.
- k) Width tapers to 1-1/4" at both ends.
- l) Top edge is beveled to match the slope of the lid's ends.
- m) Cut to fit with both edges beveled to match the slope of the lid's ends.

Fig. C Drawer Construction



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Installing heavy-duty casters is optional (Fig. G; Sources, page 49). Each caster supports 150 lbs. Turn the base cabinet upside down and drill holes in the bottom of each leg to house the caster and its socket. Adjust the holes' depths to increase or decrease the caster's exposure.

Build the drawers

The drawers consist of boxes with applied fronts (Fig. C). The boxes assemble with 5/16" long half-blind dovetails cut with a router and a standard dovetailing jig. Adjust the part sizes as necessary if you use different joinery. Mill and cut the box parts (B1–B9; D1–D7) to final dimensions. Then rout the dovetails. Glue together each box and immediately fasten the bottom with glue and 1" screws—the applied bottom automatically squares each box. The drawers operate on full extension slides (see Sources). Locate and install the drawer-box parts of the slides flush at the front of each box and 15/16" on center from the bottoms (Fig. F).

Inside the cabinet, use spacers to locate each slide at the proper height (**Photo 14**). Install the slides flush with the back edge of the front legs. Mount the drawer boxes on the slides in the cabinet, check their operation and make any necessary adjustments. Note: The assembled drawer slides will be flush with the drawer bottoms.

Mill the drawer fronts (B10–B13; D8–D10) to final thickness. Cut them a little longer than their final dimensions. Rip and joint all but the two top drawer fronts to final width. Leave these two fronts (B10; D8) about 1/4" extra-wide.

Mill 3/4" thick x 4" wide blanks for the drawer pulls (B14; D11; Fig. F). Cut these blanks at least 1" longer than the drawer fronts. Install a 1/2" core box bit in the router table and set the fence 3/8" away from the center of the bit. Then rout a cove on each side of the blank that's deep enough to provide a finger grip. Install a 45° chamfer bit and rout both edges of the blank. Complete these chamfers in two or three passes, by incrementally raising the bit. Use the tablesaw to cut the completed pulls from the blank.

Glue the pulls to the drawer fronts, flush at the top. Then cut the drawer fronts to final length, 1/4" less than the width of the openings in each cabinet.

Attach the drawer fronts

Use 1/8" spacers to fit the drawer fronts to the cabinet (**Photo 15**). Place a pair of spacers on the top of the bottom rail. Then set the bottom drawer front on the spacers. Continue stacking spacers and drawer fronts until only the top drawer front remains. Measure between the spacer and the top of the opening, subtract 1/8" and rip the top drawer front to this width. Install this drawer front, check the space at the top and make adjustments, if necessary. Then remove all the drawer fronts and drawer boxes.

Adhere strips of double-sided tape on the front of each drawer box and 1/8" thick x 29" long spacers on both sides of the cabinet opening. Install the bottom drawer box. Then, as before, place 1/8" spacers on the bottom rail. Set the bottom drawer front on top of these spacers and use the spacers stationed on both sides to center it. Then press the drawer front firmly against the drawer box, so it adheres to the tape. Apply clamps to securely hold the drawer front and

Mark biscuit slot locations after positioning each paneled frame on the appropriate leg. Use a registration line to align the top of the frame with the top of the rail.



Cut slots for biscuits in each paneled frame. Use the same setup to cut slots in the legs, so all the inside edges will be flush when the cabinet is assembled.



Glue together the front rails and legs, using tapered cauls to correctly direct the clamping pressure. Make sure both rails are flush with their registration lines and the opening between the rails is square.



Apply glue along each joint when you glue the paneled frame between the back legs. Use the same registration and clamping methods as for the front legs and rails.



STILE

RAIL

5/8"

3/8"

3/16"

1/4"

45° CHAMFER

3/4"

Technical drawing of a wooden post and bracket assembly. The main post is 36-1/2" high, 3" wide at the base, and 3" wide at the top. It has a 30" section with a 3/16" (TYP) wide mortise. A bracket is attached to the top of the post, with a 3/4" wide top edge and a 1-3/4" wide base. A detail view shows a 3/8" W x 1-5/8" L x 1-3/8" D MORTISE (TYP). Another detail view shows a 3/8" W x 1-5/8" L x 7/8" D MORTISE (TYP). The bracket is 20-1/2" high and 14-1/2" wide at the base. The post has a 2-1/2" wide base and a 2" wide top.

Fig. F Drawer slide location

Diagram illustrating the components of a casting mold assembly:

- 3/8" DIA. x 1-1/2"**: Dimensions of the top cavity in the mold.
- 1-1/4" DIA. x 1"**: Dimensions of the bottom cavity in the mold.
- SOCKET**: The component that fits into the mold cavities.
- CASTER**: The component that holds the socket and allows for pouring.



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then gently remove the drawer. Drill pilot holes through the drawer box and install screws to fasten the drawer front. Install this completed drawer in the cabinet and then install each ascending drawer front using the same method.

Construct the lid

The lid is 1/4" smaller in both length and width than the opening in the top cabinet. It rests on the cabinet's fill strips. Cut the lid's ends (E1) to final width, but leave the rails (E2) oversize. Miter the corners of all four pieces while cutting them to final length. Gang together the end pieces to band-saw their angled tops and remove the saw marks. Make sure the peaks remain centered. Then saw or rout a 1/4" wide x 1/2" deep rabbet in the top inside edge of each end piece.

Bevel the top edge of each rail to match the slope of the end pieces. To determine the bevel angle, draw a perpendicular line on one of the end pieces, from its bottom to its peak. Then set a sliding bevel square on the end's angled top edge, align its adjustable arm with the line and lock it. Use the square locked at this angle to tilt the saw blade. Cut the bevel on each rail and joint the edge to remove saw marks. Then rip both rails to final width, so their profiles match the end pieces. Install a dado set and use the same angled setting to cut the rabbets on the rails' inside edges.

Clamp together the lid's frame and measure between the rabbets to fit the panels (E3). Cut the panels to length. Then return the blade to the bevel angle and cut the top edge of each panel. Test fit the panels and mark their final widths. Then cut their bottom edges at the same bevel angle.

Glue the lid together in stages (**Photo 16**). First, assemble the miter joint between the two panels and tape it together on the outside, so the panels open like a book. Spread glue on the open joint and in the rabbets in each end piece. Close the taped joint as you place the panels in the ends' rabbets. Clamp these parts together. Then glue the rails to both the ends and the panels to complete the lid.

Install the lid, using a continuous hinge that's surface mounted on the lid's back rail and the cabinet's top back rail. When the lid is opened, the hinge will close.

Sand the cabinets and drawer fronts and finish them with several coats of shellac or lacquer. Then load the drawers and congratulate yourself: This may be the first time you've seen an uncluttered workbench in years! 🛠️

SOURCES

Rockler Woodworking and Hardware, rockler.com, 800-279-4441, Acme Ball Casters, #24695, \$32.99 per pack of four; Centerline Series Full-Extension Drawer Slide, 12", #24932, \$10.49 per pair (five pair req.); Centerline Series Full-Extension Drawer Slide, 18", #28293, \$13.69 per pair (seven pair req.).



Jim Stack worked for 20 years in commercial cabinetmaking and furniture making shops. He has written seven woodworking books and most recently was Senior Editor of Popular Woodworking books.

Glue the paneled side frames between the front and back leg assemblies. Work on a flat surface and stand the frames on risers to position them at the proper height.

13



Use spacers to install the drawer slides in the cabinet (see Fig. F). This method guarantees that every slide will be level and at the correct height. Some spacers are used more than once.

14



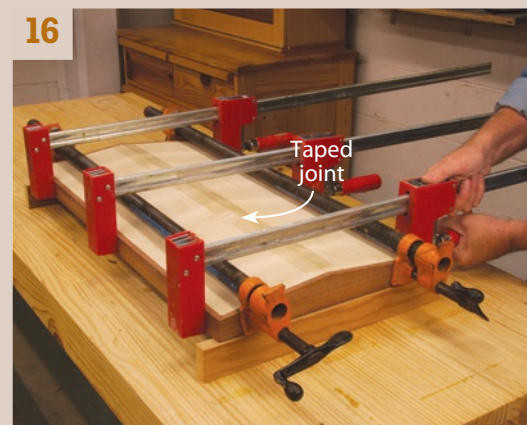
Create equal spacing between the drawer fronts by using spacers. Before cutting the top drawer front to final width, measure the opening to confirm its proper size.

15



Glue the lid together in stages. Tape and glue the mitered joint between the panels and then immediately glue the panels to the ends. Finish the job by gluing on the rails.

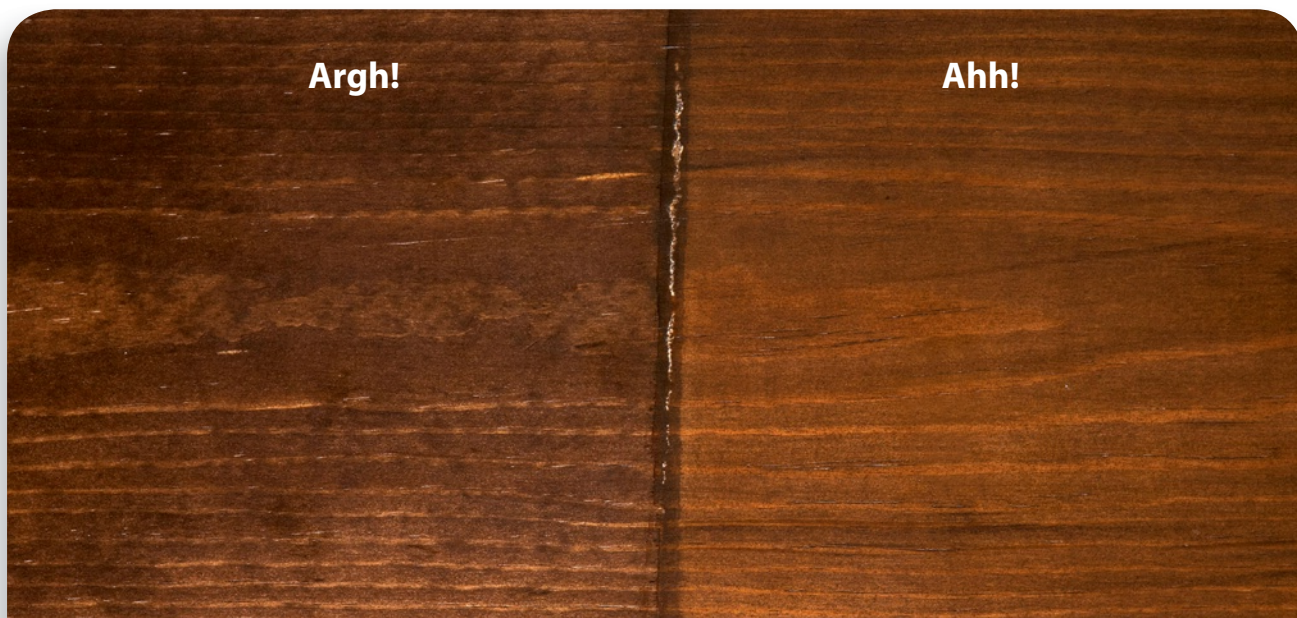
16



How to Control Blotching

Clear gel varnish works better than commercial wood conditioners.

by Kevin Southwick



DISCOVERING UGLY BLOTCHING after applying stain is one of the worst finishing problems a woodworker can encounter—especially because the unsightly patches of dark, deeply absorbed color seem to appear out of nowhere, without warning. This problem can be very difficult, if not impossible to correct. Treating the wood with strong bleach usually doesn't work. Sanding until you remove all the unwanted dark patches is the only solution, and that can mean removing a lot of wood.

The cause

Woods like pine, fir, birch, maple, poplar and cherry are among those known to be susceptible to blotching. The root of the problem is that these woods are

unevenly porous, so they don't soak up stain consistently across the surface of a board. This can be due to obvious changes in grain direction or early- and latewood differences in density, but there are also variations in absorbency that are hard to detect and predict. Wetting a board with paint thinner will sometimes reveal darker areas that are likely to blotch. Highly figured woods contain these grain variations in patterns that are beautiful when finished well, but can turn into a blotchy mess when stained improperly.

Like other characteristics of wood (such as seasonal movement), this challenging quality can be managed with a good plan. Whenever possible, skip staining altogether or at least avoid

blotch-prone woods when staining is necessary. Also, be aware that a light golden stain color will create less blotching than a color with dark tones. Stains that contain black or dark pigment, even in small amounts, usually produce the worst blotching (**Photo 1**). Gel stains help reduce blotching somewhat, because they're thick and don't soak in quite as deeply. However, they still soak more deeply into the open porous areas, which means they can still cause blotching. Water-soluble dyes reduce blotching somewhat, especially on hard wood such as hard maple, but they too can go dark in those thirsty porous areas.

The solution

When it's necessary to stain a wood that might get blotchy, the best plan is to use a clear stain controller (Fig. A). Terms such as stain controller, wood conditioner, pre-stain sealer, glue size and wash coat are closely related and



See how to control blotching on birch at AmericanWoodworker.com/WebExtras

often used interchangeably, as they all describe clear materials that are intended to soak into and partially plug up the wood's surface. The goal is to alter the surface to be more consistently absorbent (although less absorbent overall) and still open enough to soak up some stain color. Because the wood's more porous areas will naturally absorb more stain controller than the less porous areas, the two become more alike in their absorbency.

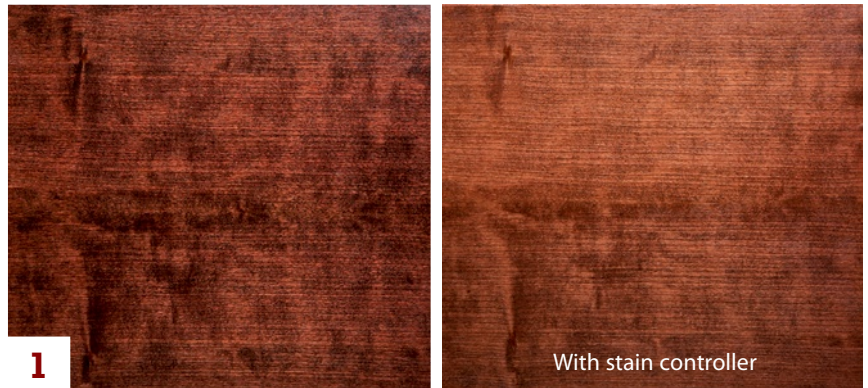
Finding the right balance of reducing the blotches while still leaving the wood porous enough to accept stain is challenging and brings up the question: Just how much do you want to seal up the wood? If 0% sealed is bare and blotchy, and 100% sealed keeps stain from soaking in at all, what percentage of sealing will reduce blotching to an acceptable level and still get the right darkness of color? By my best estimate, the answer is usually somewhere around 20% to 40% (**Photo 2**). As is always true, testing any finishing process carefully is the best way to ensure predictability.

A problem

Many finish manufacturers sell products made to prevent blotching, but they usually just don't work very well when used according to directions. All of these magical potions are nothing more than clear liquids made of a small amount of varnish resin and a lot of solvent—they're just thinned-out varnish. The directions tell you to apply the liquid, give it time to soak in, wipe off the excess, then wait some period of time (from 15 minutes to two hours) before applying stain. These odd directions seem to be intended to allow enough time for most of the thinner to evaporate, but not enough time for the small amount of remaining varnish resin to harden. This plan consistently results in a wood surface that is barely sealed against blotching (approximately 10% to 15%, by my best estimate).

A better solution

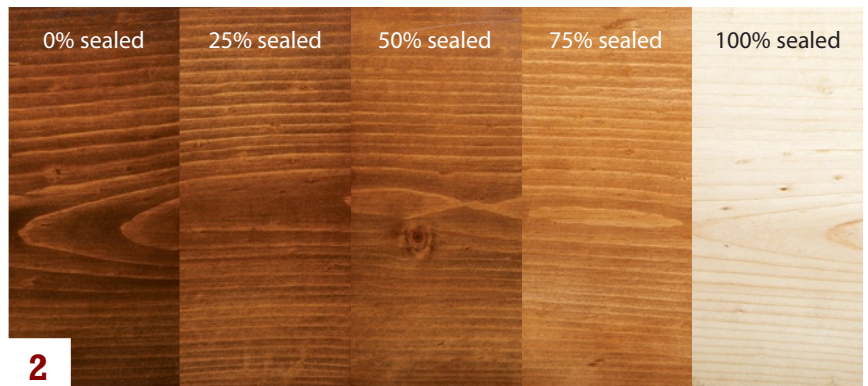
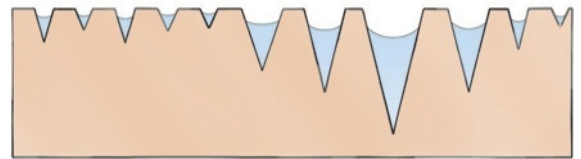
Make your own stain controller. Any clear finish will work, but wipe-on, rub-off materials are the easiest to use because they allow enough working time to ensure consistent wood surface saturation and removal. Shellac, lacquer,



Stains that contain black pigment can cause blotching even when a stain controller is used to avoid it. Black pigment, used by some manufacturers as an inexpensive way to intensify color, can even be found in light-color stains.

Fig. A: How Stain Controller Works

This abstract representation shows how an unevenly porous wood absorbs a clear stain controller to reduce its drastic variations. The stain can no longer rush into the deep, thirsty pores, so it soaks in more evenly, although less deeply, overall.



Sealing the wood to reduce blotching also reduces the stain's ability to add color. Using only the human eye as a meter, these estimates show a good balance at around 20% to 40% sealed.

Clear gel varnish is easy to use as a stain controller for oil-based stains and requires no wait. Simply wipe it on, rub off the excess and immediately apply the stain.





4 **Make** a universally compatible stain controller by thinning one part gel varnish with four parts mineral spirits. Apply the thinned controller generously, thoroughly rub off the excess and let the surface dry overnight before staining.

and water-based products can also be used as stain controllers, but they dry so rapidly, they're more challenging to work with, whether wiping, brushing or spraying. Corners and complex shapes are especially difficult to seal consistently with such fast-drying materials.

My favorite stain controller is clear gel varnish. It's the most reliable and easiest to use of all the options. As you can imagine, its unique thick consistency makes it more effective at filling empty space in a porous surface and controlling blotching than thin liquid conditioners. Another advantage is that depending on the application method, clear gel varnish can be a universally compatible stain controller that works well with any stain, including water-based stains and dyes.

Application method No. 1: Wet on wet—for use with liquid or gel oil-based stains (**Photo 3**). By my estimate, this method seals the surface about 30% to 40%. After careful sanding and surface prep, apply clear gel varnish generously straight from the can with a rag or brush. Work it in thoroughly then rub off all excess within about five minutes. Immediately apply oil-based stain—for maximum blotch control, use oil-based gel stain.

Application method No. 2: Overnight dry—for use with any type of stain or dye (**Photo 4**). By my estimate, this method seals the surface about 20% to 30%. Mix one part gel varnish with four parts mineral spirits. After careful sanding and surface prep, apply the thinned clear gel with a rag or brush. Work it in thoroughly and rub off the excess within five to 10 minutes, using absorbent cloth or paper towels. To make sure that all the excess is removed, wipe with clean towels until the last towels remain completely dry. Allow the surface to dry overnight.

The next day, apply oil-based stain as usual. This method allows slightly more stain penetration than the wet-on-wet method (**Photo 5**). For use with water-based stains and water or alcohol dyes, first prepare the partially sealed surface by dampening it with clear water. Let the surface dry and sand very lightly with 400 grit or finer. Then apply dye (**Photo 6**).

The ratio of spirits to varnish can be varied to allow for a higher or lower percentage of sealing control. I usually use the 4:1 ratio because it seems



5

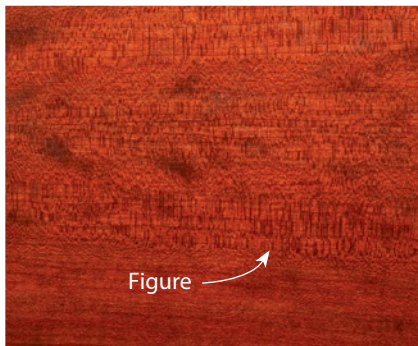


No. 2

Results of the two methods for applying stain controller described in Photos 3 and 4 and in the text are similarly effective but slightly different. The second method doesn't seal the wood quite as effectively, so the stain soaks in a little more.



6



Figure

Water-based dye can cause blotching, just like any other coloring material. Thinned clear gel stain controller that has dried overnight minimizes unsightly blotching that obscures delicate figure.



7

Match the color on the end of a stained workpiece with its surface by applying clear gel to the end grain only and then immediately applying any oil-based stain. This process also reveals the end grain's eye-catching figure.

to provide a good balance. By my estimate, clear gel straight from the can that's allowed to dry overnight will produce approximately a 60% to 75% seal. Likewise, a 1:1 reduction will produce a 50% to 60% seal and a 2:1 reduction around 40% to 50%.

Unlike the shop-made stain controller featured here, allowing those commercially available controllers to dry overnight doesn't work very well. The results are unpredictable and often do not look good.

Additional benefits

This stain controller can also be used to help get the best appearance on wood that isn't blotchy. For example, to keep the end grain on a tabletop from turning dark, apply straight clear gel varnish to the end grain only, immediately before using an oil-based stain (**Photo 7**). The exposed end grain above and below the center portion of a raised panel can be similarly treated to keep it from turning dark. Turning or carving wood also exposes end grain that can create distracting discoloration when stain is applied without a stain controller.

Applying stain controller mitigates blotching around knots (**Photo 8**) and makes woods with tiny surface pores—such as cherry, maple and birch—look more natural when they're stained (**Photo 9**).

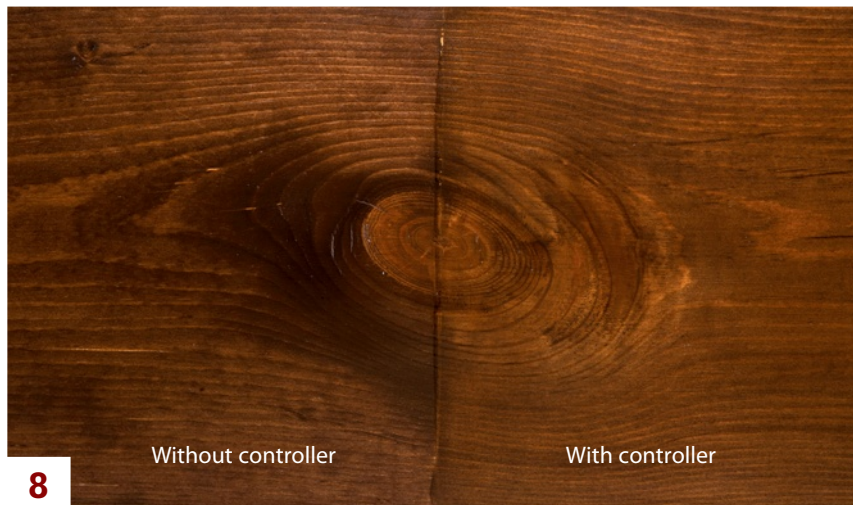
Because Application method No. 2 works for both water-based dyes and oil-based stains, they can be used to create extra depth or to match colors by adding color in layers (**Photo 10**). Start by applying a water-based dye and let it dry. This dye will not do any additional sealing, so the wood will still soak up more dye or an oil-based stain just as it would have before the dye was applied. 🛠️



Kevin Southwick

is a wood-finishing specialist and furniture restorer/

conservator in Minneapolis. Visit southwickfurnitureconservation.com to learn more.

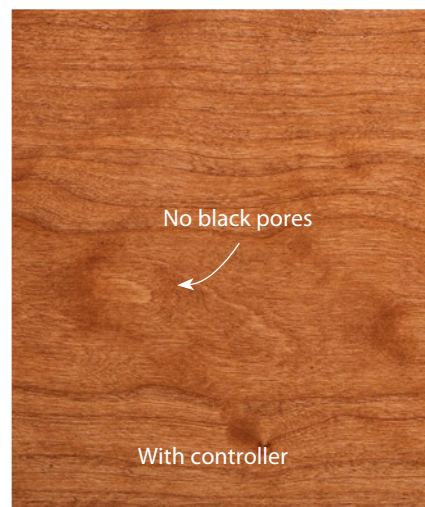


8

Knots add interesting figure rather than dark, unsightly blotching when a stain controller is applied before staining.



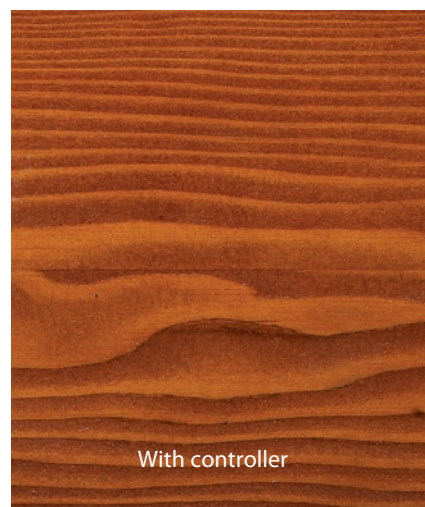
9



Stain controller helps to create a natural aged color on cherry by eliminating the tiny black pores that always appear when dark stain is applied on the raw wood.



10



Applied in layers over stain controller, water-based dye and oil-based gel stain can be used to create a convincing old-wood "patina" on soft woods such as pine and fir, which are notoriously blotch-prone.

The *Design in Wood* Exhibition

A short history of the largest juried woodworking show in America.

by John Lavine



PHOTO BY JOHN LAVINE

IF YOU WANT to show your woodworking to the public, either for personal satisfaction or for income as a professional, then you are always on the lookout for galleries and exhibitions that feature woodworking. A good turnout for a local gallery show might start with a few hundred people attending an opening event, followed by a steady but small stream of viewers over the show's three- or four-week run. A museum show measures its success in larger numbers, up to 10,000 viewers perhaps. With luck, your piece might make it into a magazine, through an article that covers the show, which could push the number of viewers to 20- or 30,000.

Now, consider the prospect of showing your work to 100,000 people or more—and not in a catalog or magazine, or on a computer screen, but live and up close. If you think such an audience is a pipe dream, read on. This is the story of *Design in Wood*, the largest annual juried woodworking exhibition in the country.

*Winning an award—
especially for the first time—
encourages show participants
to keep at it and enter again.*

A card table soapbox

The story begins in 1981, when Lynn Rybarczyk, a part-time San Diego woodworker who was looking around for opportunities to exhibit, got the notion to approach the Southern California Exposition—now known as the San Diego County Fair—about including a woodworking show. The

Expo already had a Flower and Garden Show, a Gem Show, and a Photography Show, so it was open to the possibility of adding a woodworking show; all that was needed was a local group to sponsor it.

With that in mind, Rybarczyk and two fellow woodworkers—Chuck Masters and Brian Murphy—set up a card table in front of The Cutting Edge, a woodworking store that was just opening

its doors in San Diego, and began signing up members for a club and show. The first meetings, held at the elementary school where Rybarczyk taught, were small. But the next spring 35 members of the fledgling San Diego Fine Woodworkers Association (SDFWA) entered 100 pieces—juried



RICHARD OTSU
Pair of Mandarin Ducks
2000 Best in Show
Tupelo, poplar
12" x 22"

HENRY BIKHAZI
Oliver Cromwell
2006 Best in Show
Boxwood, pau marfin, ebony, holly
lemonwood
39" x 43" x 19"

MIKE JACKOFSKY
Natural Edge Hollow Form
2009 First Place, Wood Turning
Box elder
13" x 12" dia.



down to 45 due to space limitations—in the first annual *Design in Wood* exhibition at the county fair.

The old county fair

The San Diego County Fair was founded in 1880 as a small agricultural fair, but as produce and livestock became an increasingly important part of California's economy, the fair grew in size and stature. Horse racing soon became associated with the fair, since farmers who competed for the best produce and livestock also wanted to know who owned the fastest horse. When the state legislature legalized betting on horse races at county fairs in 1933, the economic future of the San Diego County Fair was set.

A permanent fairground was established at Del Mar, on the north side of San Diego, and today the Del Mar Fairgrounds has year-round activity, an annual operating budget of over \$50 million and hundreds of full-time employees.

The early shows

Lynn Rybarczyk and Chuck Masters were co-superinten-

dents for the first exhibition and Chuck Masters for the next four. Each was a relatively small show of 30 to 40 pieces on pedestals, gathered from the local woodworking community. These early exhibitions garnered praise for the quality of the work on display, but there was not much growth, and after the fifth year the fair informed the organization that they had to either raise the level of the exhibition or lose it. At that point SDFWA passed the baton to Pat Edwards, a local furniture maker who specialized in traditional work and was also keenly interested in the process of woodworking.

Explosive growth

Edwards' first change was to make the exhibition more dynamic by introducing activities similar to those he had seen at Old Sturbridge Village and other historic recreations of traditional craft communities. The *Design in Wood* exhibition added a traditional 19th-century cabinetmaker's shop filled with antique hand tools. Edwards had recently repaired a 100-year-old children's school chair and suggested that SDFWA members could build 50



CRAIG THIBODEAU
Gardenia Sideboard
 2007 Best in Show
 Wenge, anigre, maple, ebony, pau ferro, boxwood, poplar, holly
 36" x 72" x 16"

PHOTO BY CRAIG CARLSON

PAUL SCHURCH
Tilt-Top Table
 2002 Best of Show Award
 Laurel, black pear, bronze
 30" x 42" dia.



SUE SPRAY
The Cube Rocker
 2009 First Place, Art Furniture
 Spalted curly maple,
 spalted claro walnut
 25" x 34" x 39"



of these chairs in the shop during the fair's run and give them to charities. Edwards also invited carvers, turners, modelers, and other local groups to give demonstrations. This gave fair visitors a reason to linger at the exhibition or return to view the varied activities throughout the day. As superintendent, Edwards had an unlimited number of free tickets to the fair, which he could offer to volunteers in exchange for their work at the exhibition—a great incentive, since the fair was a popular family activity and the tickets were a valuable commodity.

Edwards also developed the exhibition by expanding the jurying and awards categories. He described the process like this: "The year I started I had a budget of \$750, but I soon learned that as a fair superintendent I could get a bigger budget if I could justify it. So I built up the exhibition each year, and after nine years I had a budget of \$40,000. I created 16 different categories with three awards

in each category. With a lot of chances to win a cash prize, we very quickly had several hundred entries."

The combined strategy brought in more participants and more viewers. Over 100 volunteers from SDFWA—whose membership numbers well over one thousand—produced the children's chairs; another couple hundred helped out in other ways such as building display cases and platforms and staffing the exhibition during fair hours. A steady cadre of members kept returning each year to make up the show committee.

In 1995, Pat Edwards passed the superintendent's job and chairmanship of the committee to Bob Stevenson. The exhibition continued its growth under Stevenson, with some notable improvements. A 7,500 sq. ft. exhibition hall was built on the fairground specifically for *Design in Wood*. Stevenson expanded the number of categories to 24, with five awards in each category. In addition, he established sponsored awards from local guilds and mer-

At Design in Wood, awards are given in 24 categories and prize money totals more than \$22,000.

KORY ZUSSMAN

Woman's Dressing Table

2011 First Place, Traditional Furniture
Mahogany, amboyna burl, rosewood,
ebony, ivory, mirror, brass, leather
60" x 54" x 22"



FRANK ANDREWS

Ready for Liftoff

2012 First Place, Wood Turning
Marblewood, ebony, holly, maple
13" x 6" dia.



STEVEN WHITE

Twin-Drawer Hall Table

2005 Excellence in Design
Elm, ash, walnut
34" x 54" x 18"



chants, as well as from a number of major magazines including *American Woodworker*, bringing the total prize money to more than \$22,000.

The number of entries has also grown under Stevenson, hovering consistently around 350 and topping 400 a few years ago. The 2012 *Design in Wood* exhibition received 362 pieces from 202 woodworkers. Besides the increasing number of pieces, another change has been in the demographics of those who show their work. Over the years, *Design in Wood* entries have expanded from local to state to national, and this year the show became international, with entries from Puerto Rico and Australia.

Steve White makes his living on a combination of commission and spec work. "My work tends to be very contemporary and I think of *DIW* as leaning more toward traditional work," he says. "Still, I've entered three or four times over the past seven years. One year the two pieces I entered won three top prizes, and one of them sold at the end of the show."

Craig Thibodeau has entered the show every year since 1999. "It's the number one marketing tool for me," he says.

"I've had sales every year since I began entering—one year I generated nearly \$40,000 of work directly from the show."

"The whole idea of the exhibition," says Stevenson, "was to have a place for people to show their work and get some recognition. At one point the SDFWA looked into acquiring gallery space in town, but we just couldn't see any way to support it. The exhibition, it turns out, is so much better. It's a bigger draw at the fair each year, and this year there were over one-and-a-half million people who came to the fair during those 24 days. We have no way to count, but even if a fraction of those people came through our show ... " That's an amazing evolution for a woodworker's notion of 30 years ago.

Visit sdfwa.com to see award winners from the past 15 *Design in Wood* exhibitions and for information about the 2013 *Design in Wood* exhibition. 📖

John Lavine has been involved in woodworking for more than 30 years as a maker, teacher, writer and editor. John was editor of *Woodwork* magazine from 1997 to 2008.

8 Ways to Make Tenons

A quick guide to their pros and cons.

by Brad Holden



MANY PIECES of old handmade furniture owe their long life to mortise and tenon joints. There are many other ways to join wood, such as using dowels, biscuits or pocket screws, but none of them are as strong or durable as well-designed, well-executed mortises and tenons.

When you're making these joints, mortises usually come first. Tenons are made second, to fit the mortises. It's much easier to adjust the size of a tenon to fit a mortise than the other way around.

You can make mortises by hand, using a chisel, or by machine, using a drill press, plunge router or hollow-chisel mortiser. The goal is pretty sim-

ple: Mortises are simply rectangular holes with parallel, plumb sides that are relatively smooth and even. Some mortises have square corners; others have round corners.

Tenons are more complicated. Their cheeks (the surfaces that go into the hole) must be straight, smooth and parallel. But most importantly, the cheeks must be the correct distance apart; that is, the tenon must be the right thickness and width to fit the mortise. There's not much room for error: For the glue to hold, the total gap between a tenon and its mortise shouldn't exceed the thickness of a sheet of paper—about .003".

Then there's the matter of shoul-

ders (the part of the joint that butts up to the area around the mortise). They have to be straight, square and parallel, which also requires a high degree of accuracy.

I've made tenons lots of different ways over the years, searching for a magic bullet that would deliver quick, precise results every time. Although I've come to favor a few methods, each one I've tried has its pros and cons. I've concluded that no single method is best—there is no magic bullet. I'll summarize what I've learned, so you can judge for yourself what method might be best for your shop, your skills and your projects.

1

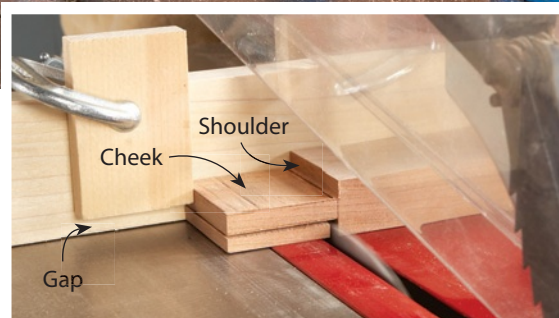
Bandsaw

A bandsaw is pretty good for cutting a tenon's cheeks, but not accurate enough for cutting its shoulders. While it's possible to saw the cheeks freehand, you'll get much better results—a straighter cut—if you use a rip fence. Also, use a stop block to make sure you don't cut too far.

Making a tenon to an exact thickness on a bandsaw is a bit fussy, because many rip fences are hard to adjust in small increments. It's also hard to shave off a thin slice from a tenon that's too thick, unless your blade is super-sharp.

Your best bet is to cut a tenon a hair fat, then cut its shoulders on the tablesaw. (See the inset at right. Note the gap under the stop block, which keeps the offcut from getting trapped.) Use a rabbet plane or a hand router to reduce the tenon's thickness until it fits correctly.

Bottom Line: Consider using the bandsaw when you have only a few tenons to cut. Setup is fast and easy, but planing each tenon to fit requires a little extra time and a lot of skill.



2

Tenoning Jig

This is an excellent method for cutting cheeks—the cuts are straighter and smoother than ones made on a bandsaw. Of course, you'll have to use a second setup on the tablesaw to cut the joint's shoulders, as shown above.

While you can make a tenoning jig yourself (most types straddle the saw's fence), commercial jigs work quite well. They generally cost less than \$100.

This method is so accurate that little or no fitting should be required. Most jigs have a micro-adjust for dialing in the position and thickness of the tenon. I prefer to use a spacer for determining the tenon's thickness, rather than adjust the jig. These jigs also allow you to tilt the work side to side or front to back in order to cut angled tenons; that's hard to do with most of the other methods listed here.

Tenoning jigs do have two important limitations, however. First, the tenon's maximum length is about 3-1/2", the deepest cut you can make on the tablesaw. Second, if the pieces you cut are more than about 3' long, the setup might get top heavy.

Bottom Line: A tenoning jig is a good choice for production runs—particularly for chairs, where tenons are often angled.



See the complete plans for a shopmade tenoning jig, plus a comparison of commercial jigs, at AmericanWoodworker.com/WebExtras



3 Dado Set

This is my favorite power-tool method. It's accurate and relatively easy to set up. Best of all, it cuts cheeks and shoulders at the same time.

You'll need a good quality stacked dado set—one that cuts a flat bottom. You'll also need a modified or upgraded miter gauge that doesn't have any play in the miter slot. If you don't have one, you could make a dedicated tenoning sled with two runners.

While it's tempting to use the saw's fence as a stop to determine the tenon's length, this is not a safe practice. The workpiece could catch on the fence and twist. It's better to clamp a stop block to the miter gauge's fence.

Since you're flipping the piece over to dado both sides, its end must be perfectly square for this method to work. If the end isn't square, the shoulders won't line up.

Adjusting the thickness of a tenon simply involves raising or lowering the dado set. I usually cut one side of all the tenons first, then fine-tune the dado set's height before cutting the opposite sides. Another virtue of this method is that your workpiece can be virtually any width or any length; supporting it is not a problem.

There is a potential downside to this method: It ties up your saw. You won't be able to rip or crosscut a board while the saw is set up for cutting tenons.

Bottom Line: This is an excellent method for cutting most tenons, but you must have a good-quality dado set and a tight-fitting miter gauge.



The Beadlock System



The Domino System

4 Loose Tenons

Loose tenons are like rectangular dowels—they fit into mortises cut in both of the mating pieces. You need only saw butt joints on the ends of rails, which simplifies calculating the lengths of the rails and eliminates fussing with shoulders—there aren't any. There are many ways to make these mortises and their loose tenons; here are three I've found useful.

- You rout the mortises with a plunge router and a homemade or commercial jig. You make the tenon stock yourself, shaping its edges with a roundover bit to fit the mortises' rounded ends. One limitation: Most jigs sit on the end of a rail; if the rail is over 4' in length, this can be very awkward.

- You *drill* the mortises guided by a commercial jig—the Beadlock, from Rockler—and either use the manufacturer's tenon stock or make your own using a special router bit. The mortises are essentially a set of overlapping holes, which works surprisingly well. You don't need to use a chisel to clean up the mortises or buy any special tooling—an ordinary drill does it all. A basic jig costs about \$30.

- You use a portable machine—the Domino, from Festool—that works like a horizontal plunge router. You buy the tenon stock from the manufacturer. These machines come in two sizes, for large or small joints. They work extremely well and cost from \$875 to \$1,250.

Bottom Line: This method is easier than others because you don't have to cut shoulders, just butt joints. If you use a commercial system, you don't have to fit the tenons, either—their accuracy is built in.

5

Dual Blades

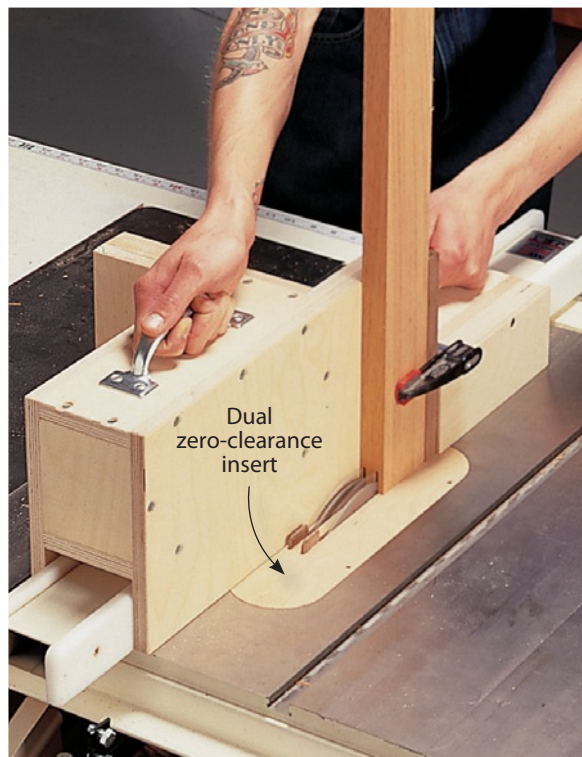
Using two blades equal in diameter, you cut both cheeks at the same time with a tenoning jig. The blades are separated by a spacer sized to fit your mortise, so you don't have to fit the tenons each time you set up the jig. Of course, you must saw the shoulders in a second setup.

You can use a commercial tenoning jig or make your own, as shown here. Using both outer blades of a dado set works well, but their depth of cut is limited. I strongly recommend using a dedicated zero-clearance insert so the workpiece is supported at all times.

Accurately spacing the blades is the key to this method. Start with a plywood disc that's as thick as the mortise is wide, and the same diameter as your arbor washer—this gets you close. Then add playing cards or paper shims until you achieve an exact fit. Save the spacers as a set for re-use the next time you cut tenons.

As with using a tenoning jig and a single blade, there is a potential downside to this method: It ties up your saw.

Bottom Line: This is a really slick setup, particularly when you have a lot of tenons to cut. Shop-made spacers determine the thickness of the tenons, which shouldn't require fitting.



6

Hand Tools

This method requires more skill than any other, but with good, sharp tools and practice, you can rival the accuracy of any machined surface. Basically, you saw each tenon oversize, then shave it to fit. The process is slow, but I've found it very rewarding.

You'll need a marking gauge (a wheel-type gauge is OK, but the combination of a mortising gauge and a knife gauge is more convenient), a backsaw or dozuki saw, and a number of chisels. To fit the tenons, you'll need a rabbet plane or—better yet—a router plane.

Cutting accurate shoulders is the tough part. I scribe them first with a knife gauge, deepen the gauge line by paring into it with a chisel (making a valley for the saw to start in), then saw the rest of the way.

Using a rabbet plane to fit a tenon's thickness can work OK, but a router plane automatically keeps the tenon's cheeks parallel and even. It's amazingly accurate.

Bottom Line: Hand tools are slow, but can deliver machine-like perfection. There are no limitations to the tenon's dimensions and the tenon can be angled, too.





7 Router Jig

Some commercial jigs, such as the Leigh Super FMT (shown above), allow you to cut cheeks and shoulders at the same time. The plunge router basically follows a template mounted on top of the jig to produce a tenon that won't require any fitting—its size is predetermined.

You can also use the jig to cut mortises of a predetermined size, so everything automatically matches up. The jig makes tenons with rounded sides, so no further shaping is required to fit the mortises.

Of course, the range of mortise and tenon sizes is limited by the capacity of the jig and the length of the bit. You can also make multiple tenons and some types of angled tenons.

Learning how to use the jig requires reading the manual and closely following its directions. Once you're set, you'll get very accurate results. If you don't use the jig very often, it may take you awhile to figure out how the jig works the next time around. For me, the downside of using any router jig is that it's a noisy and dusty operation.

Leigh makes two FMT jigs, the Super (about \$500) and the Pro (about \$1,000). You supply the router.

Bottom Line: A good commercial jig will make both mortises and tenons—and the tenons will not require fitting.

8 Router Table

Similar to using a dado set or router jig, this method cuts both cheeks and shoulders at the same time. There are virtually no limitations on the length and width of the tenon or the size of the workpiece. If you already have a router table and a coping sled, you don't need any specialized equipment. Add this all up and you can see why using a router table has become one of my favorite methods for making tenons.

Setup does require some trial and error work, however. You have to adjust the height of the bit each time you make tenons in order to get them to fit correctly. I use a large-diameter rabbeting bit to minimize the number of passes necessary to cut a tenon's full length.

A coping sled is a must. If you make your own, it should have a hold-down for the workpiece, a backer strip to prevent blow-out and robust handles, for safety. I use a commercially-made sled that also has an adjustable miter bar, which runs in the router table's miter slot. The sled can't wobble, so the tenon's shoulders are always straight. (The sled I prefer, shown above, is from Infinity. With the miter bar, it costs about \$180.)

Bottom Line: The router table method makes cheeks and shoulders at the same time, so only one setup is necessary. It won't tie up your saw.

17 Tips for Working Metal

Every woodworker should know how to cut, file, drill and tap metal. Here are some basic smarts.

by Richard Tendick

Draw Filing Makes the Smoothest Surface

Pushing a file sideways or at an oblique angle makes a smoother surface than pushing it straight ahead. Weird, but true.

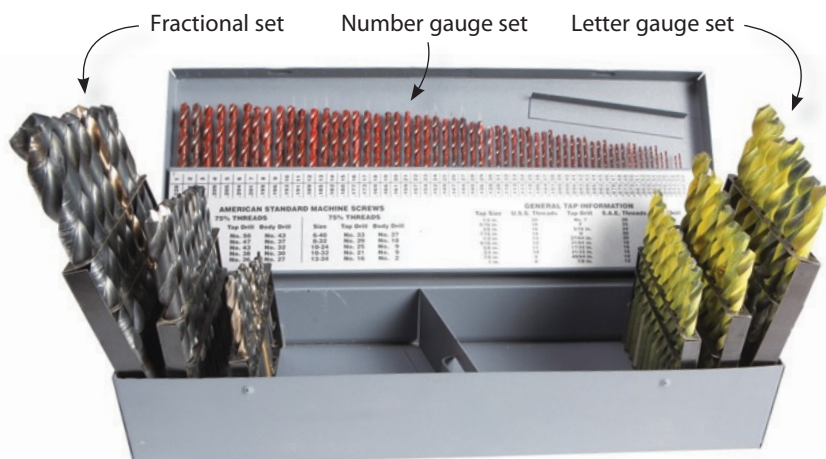
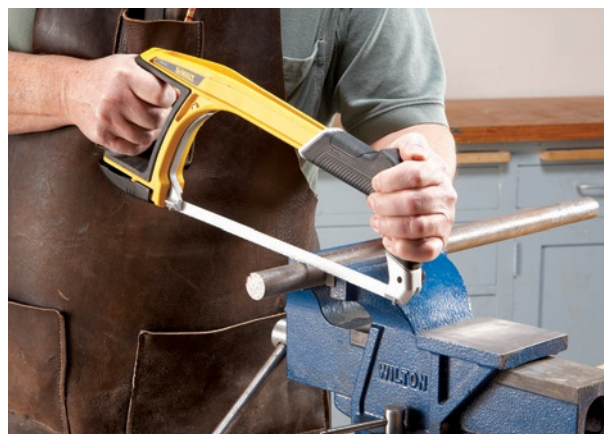
This technique is called draw filing. The waste falls off as little metal spirals, rather than chips. Draw file any surface that must be smooth, such as the edge of a scraper.



Slow, Powerful Strokes Do the Trick

A hacksaw is a very handy tool—if you know how to use it. Hold the saw with two hands and take long, slow strokes. Use plenty of downward pressure on the forward stroke (the direction the teeth are facing). Relieve the pressure on the return stroke—this helps the teeth last longer.

Speaking of teeth, run your fingers over them before you start sawing. If they feel dull, replace the blade. Using a new blade saves lots of time and energy. It's money well spent.



Pick the Right Bit

For all you tool junkies, you can honestly tell your spouse that you need not one, but three sets of drill bits: a fractional set, a number gauge set and a letter gauge set.

The number and letter sets basically fill in the gaps between the fractional bits. They're particularly useful when drilling holes for tapping threads, where the precise diameter of the hole is very important. Most taps require a hole made by a specific number or letter gauge drill bit.

All of these bits are easy to mix up, however. To keep them straight, spray paint the number and letter sets different colors.



Use Plenty of Cutting Oil

When drilling steel, keep the bit lubricated with cutting oil. This makes the job go faster and reduces wear on the bit.

If you're drilling brass or aluminum, use a thin oil such as kerosene or mineral spirits. You don't need any oil at all when you're drilling cast iron—small deposits of graphite in the metal provide sufficient lubrication.

Whatever metal you're drilling, start out with a relatively small bit. Work your way up through a series of larger diameter bits. In the end, progressively changing bits actually saves time.



Start a Hole With a Center Punch

Whenever you're drilling a hole in metal, begin by creating a dimple with a center punch. This cavity allows the drill bit to start precisely where you want it to. Without the dimple, the bit will probably skitter across the surface before it begins to bite.

The smaller the bit's diameter, the more important it is to use a center punch. Chucked in a drill press, a small bit may skitter, flex and start off center if it's not properly guided by a dimple. This can result in a hole that's out of square or a broken bit.



Lubricate a Bandsaw Blade

It's safe and easy to cut brass and aluminum with a bandsaw and a regular woodworking blade. Using a miter gauge, you can make a very straight cut. Be sure to use a 4 tpi blade with hardened teeth. A blade with finer teeth is likely to clog up; an inexpensive, spring-steel blade without hardened teeth will dull quickly.

Before you cut, turn on the saw and hold a piece of paraffin wax against the blade. (Paraffin is sold as canning wax in grocery stores.) Creating a slick surface on the blade helps prevent its gullets from clogging up with metal shavings.



Use a Crimping Tool

When you join two pieces of dust collection ductwork, use a crimping tool to make one piece fit inside another. Crimping slightly reduces the diameter of the ductwork, so two pieces can easily slide together.

A crimping tool doesn't cut the metal—it just bends it. It has five interlocking blades, three on one side of the tool and two on the other. When you crimp, place the three blades on the outside of the duct.



Transfer Punches Mark Exact Centers

Let's say you've drilled a hole in one object in order to fasten it to another. How do you locate the exact center of that hole on the second piece? You use a transfer punch—a rod with a sharp point on its end.

Don't pound on the punch, however. It's too soft. Just tap it, then use a center punch to enlarge the dimple.

Transfer punches come in a set. (You'll probably want a punch for every size hole you're likely to drill.) Fractional, number, or letter gauge sets are available.



File Only on the Push Stroke

It takes practice to file a surface and keep it flat. Apply equal, downward pressure with both hands and put your body weight into the stroke.

Unlike sandpaper, a file only cuts on the forward stroke. When the stroke is finished, lift the file off the workpiece and return it to the starting position. Dragging the file back over the workpiece will prematurely dull the file's teeth.

If a file is shiny with wear and cuts slowly, replace it. A worn file is about as useful as spent Kleenex.



Always Use a Ball Peen Hammer

Never use a claw hammer to strike a steel chisel or a punch. If you do, there's an unpleasant possibility that a piece of the hammer's rim may flake off and go flying.

The head of a claw hammer has a soft center and a brittle rim. The head of a ball peen hammer has a consistent hardness throughout; it's designed for striking steel.



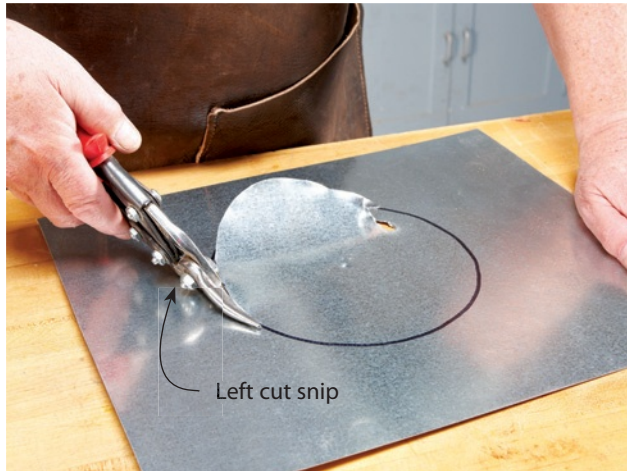
Single-Flute Countersinks Are Best

Countersinks come in two different types: multi-fluted and single flute. In my experience, a single-flute countersink usually leaves the smoothest surface. Whichever one you use, set your drill or drill press to a very low speed for the best results.

Countersinks also come in different chamfer angles, to fit different types of screws. Most American flathead screws require an 82° chamfer; metric screws use a 90° chamfer.

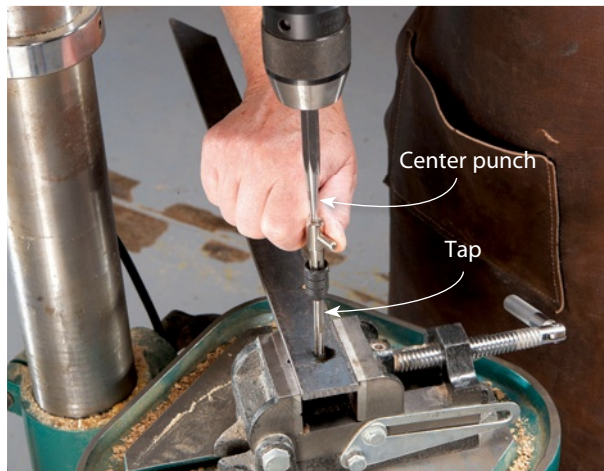
Three Snips Make a Set

Aviation snips can be very handy for cutting sheet metal when installing a dust collection system. Easier on the hands than regular tin snips, they have a compound action that increases the tool's mechanical advantage. Aviation snips come in three styles: left cut, right cut and straight. To be ready for any situation, it's best to have all three.



Left cut snips are used for cutting curves that arc to the left, as shown below. Right cut snips are for curves that arc to the right. Both of these snips will also cut straight, but straight snips are easier to track along a straight line.

The handles of all three snips are usually color-coded: red for left, green for right and yellow for straight.



Use a Drill Press to Keep a Tap Straight

A tap should be held precisely vertical to the workpiece and should not wobble as you turn it. This is very hard to do by hand, but easy to accomplish with a drill press. The drill press doesn't turn the tap; you do that by hand. While you're turning the tap, you apply downward pressure on its end using the machine's feed lever.

Here's how you set it up. After drilling the hole for the tap, lower the table and tighten a center punch in the machine's chuck. Be sure that the punch is centered on the hole. Most tap wrenches have a dimpled end; lower the punch into the dimple to steady the tap—then have at it.



Files Require Two Accessories

A set of files is incomplete without two additional items: a file card and a handle for each tool. The file card is basically a stiff wire brush. Use it to clean a file's teeth after every few strokes. A clean file works much more efficiently than one clogged up with metal waste.

A handle has two purposes. First, it enables you to put more downward pressure on the tool. Second, and most importantly, it prevents the file's tang from piercing your palm if, for some reason, the file hangs up when you're pushing it.

Most files come without a handle because handles are meant to be reusable. When a file wears out, pull the handle from the file's tang and slide it onto a new file. Tap the end of the handle on a bench to seat it.

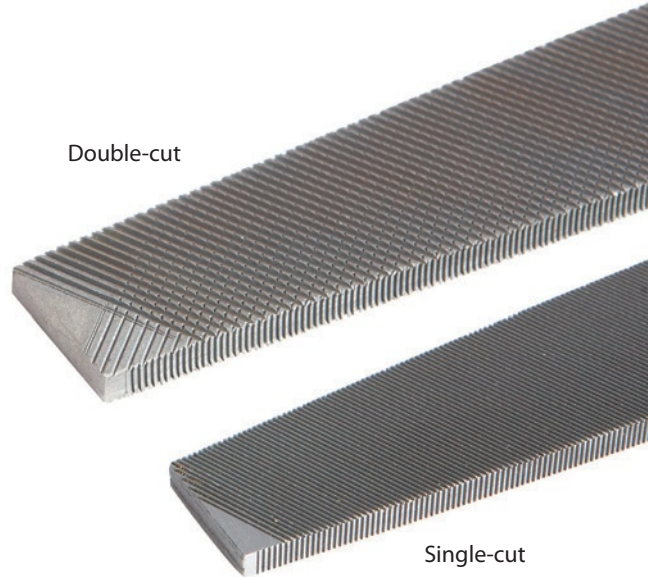


Snips That Won't Deform a Duct

Duct snips are the best tool to use for cutting dust collection ductwork. Standard snips will deform the metal on one side of the cut, making it difficult to join the duct to another straight piece or to a fitting. Duct snips leave both sides of the cut flat and undamaged.

Duct snips work by removing a 1/8" wide strip of metal, so they're actually making two cuts at the same time. In order to do this, they have three blades. Two of them are stationary and are placed above the duct. A 1/8" wide moveable blade, which sits between them, rises up from inside the duct as you squeeze the tool's handle.

To get started, draw a line around the duct and drill two or three connected holes on the line. Insert the snip's lower jaw into the holes and start cutting.



Double-Cut Files Are More Aggressive

Metalworking files have either single rows of teeth or two rows of teeth that are crisscrossed. The two types are commonly called single-cut and double-cut files, respectively. You can easily tell which is which by looking at the end of the file. It's a good idea to have at least one of each.

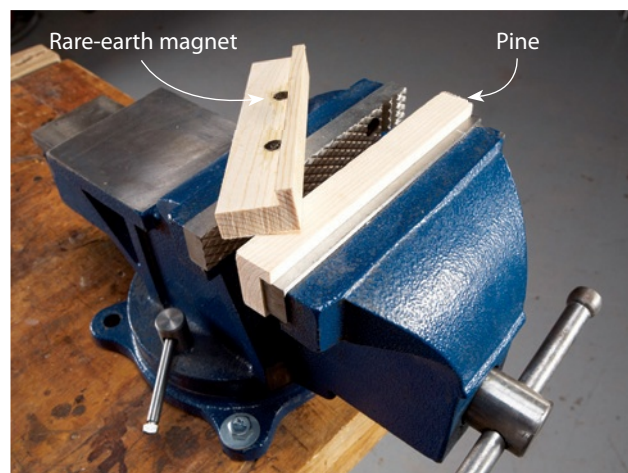
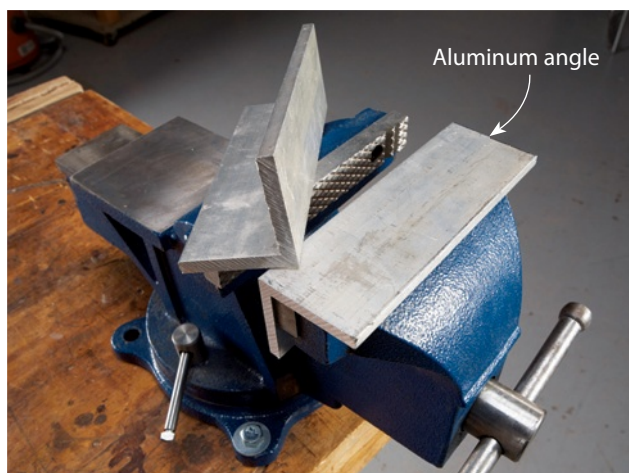
Double-cut files remove metal relatively fast but leave a rough surface. Single-cut files cut slower and leave a smoother surface. If you have a lot of metal to remove, start with a double-cut. If the surface must be smooth, finish with a single-cut.

Make Jaw Protectors

A machinist's vise is an essential tool for working metal. You can permanently mount it on a bench or bolt it to a piece of plywood that you can clamp to the bench. Mounting the vise on plywood enables you to store the vise when you don't need it or when it gets in the way of your work.

A machinist's vise has corrugated, non-slip jaws to

hold a piece of metal for sawing, filing or bending. When you need to hold something that might be damaged by the jaws, such as the shank of a router bit or a length of threaded rod, use jaw protectors made from aluminum angle or pieces of pine. Pine, which is easy to crush, helps hold a round object better than a harder material.



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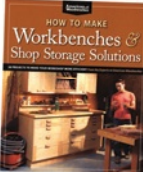
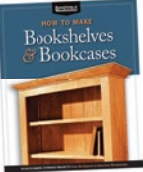
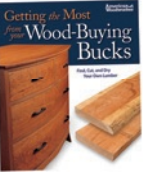
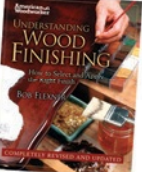
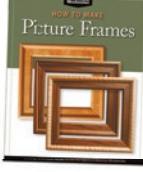
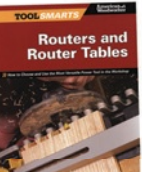
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One-Coat Coverage

I'D JUST FINISHED building new frame-and-panel doors for my kitchen cabinets and knew the stain would really make the grain pop. I laid the first door on my workbench, with the newly opened can of stain next to it. I could see the results were going to be terrific as soon as I started brushing. But while swiveling the door to reach the far corner, I inadvertently pushed the can of stain right off the bench. Like Wile E. Coyote, the can seemed to hang in the air for a second before falling to the concrete floor. It landed slightly on edge, and the stain shot up like a geyser, drenching me, my tools, the bench, the walls and the floor. I can't promise the same coverage for someone else, but one quart of #303 cherry stain is enough to cover my shop.

Dave Grubaugh



Out on a Limb

WHILE DESIGNING a curved bar for my house, I decided to make the bar rail from one continuous piece of wood. It took some searching, but I found a tree limb with the desired bend—on a tree that was about to be removed.

I asked the foreman if he could fell the tree without damaging the limb. “We ain’t lumberjacks,” he scoffed. “We just knock ‘em down with a ‘dozer. If you want that limb, you better get it now.” It was dark by the time I cut off the limb and got it home, so I

didn’t bother to examine it. I just leaned it up on the side of the garage where my wife parks her car.

I was fixing breakfast the next morning when my wife came back from the garage with her hands on her hips. “So—who’s Julie?” she asked pointedly. “I don’t know,” I replied, mystified. “Well, there’s a tree limb next to my car with a big heart carved in it that says ‘I love Julie.’” Uh-oh. It may be time for a stack of my patented smiley-face pancakes!

Roy I. Steele



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