

Fine
WoodWorking

Organize every corner
of your shop, p. 32



Tools & Shops

ANNUAL ISSUE

**No-compromise bench
with amazing vises**

Remarkable new tool steel

**Vintage machines bring
the past to life**

**Get a new handplane
up and running**

**Tune up
your jointer**

**Tool tests:
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Winter 2012/13 No. 230

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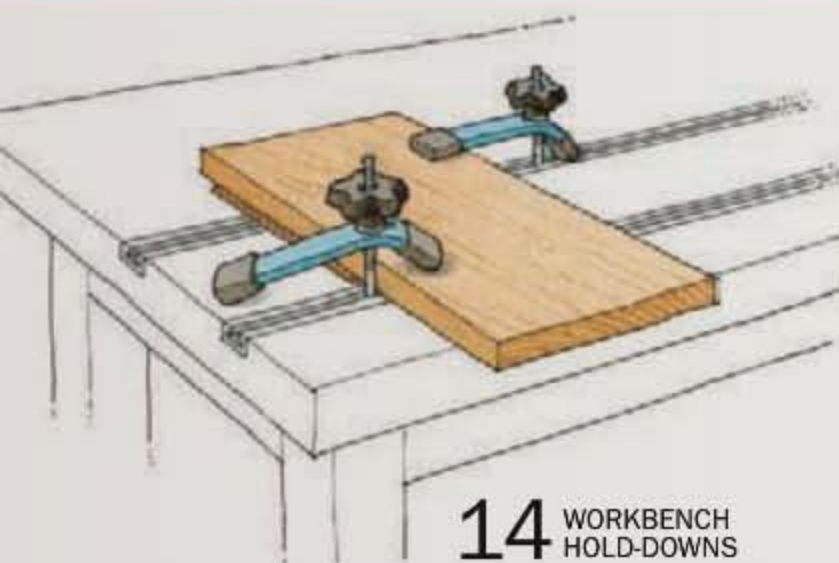


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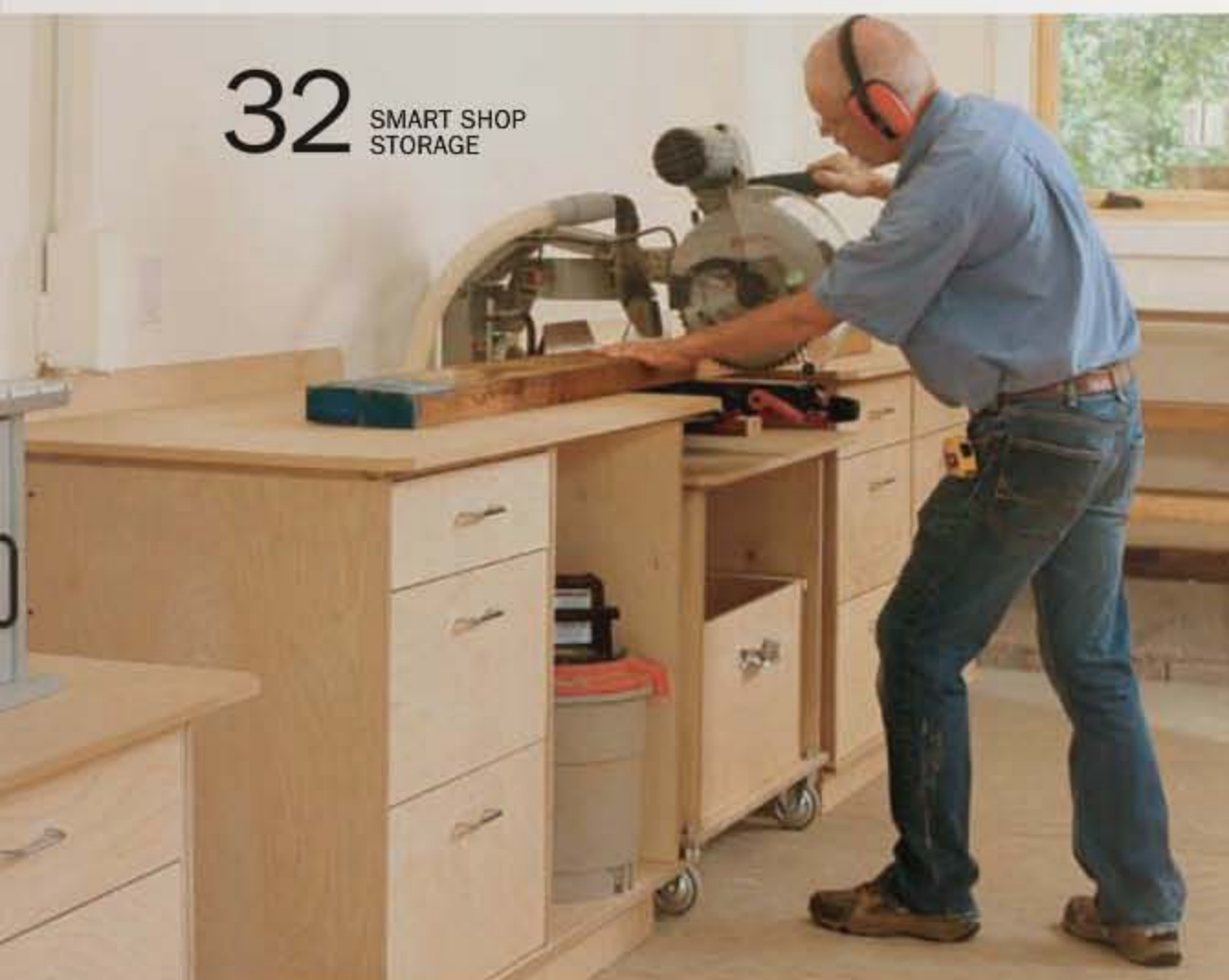
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TOOL TEST:
IMPACT DRIVERS

on the web

THIS MONTH ON **FineWoodworking.com/extras**

Visit our website to access free web tie-ins, available October 25. While you're there, don't miss our collection of free content, including tool reviews, an extensive project gallery, and must-read blogs.



VIDEO:

Supercharge Your Jointer

Today's new breed of segmented cutterheads offers woodworkers a cleaner cut with less noise and much longer life. Learn how to upgrade a conventional straight-knived cutterhead from start to finish.



VIDEO:

Handplane How-To

Furniture maker turned television host Tommy MacDonald offers tips on setting up a new handplane straight out of the box.



VIDEO:

Step into Our Shop

Fine Woodworking and its sister publication, *Fine Homebuilding*, teamed up to construct a brand-new workshop that's smart on space and big on storage. Take a guided tour for tips on how to outfit your own shop.

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VIDEO

Build a Not-So-Big Workbench

For woodworkers with limited shop space, our latest workbench video series offers a compact design that doubles as a tool storage center. Learn how to build this bench from start to finish, with tips on:

- traditional pinned mortise-and-tenon joinery
- quick-to-build box-joint drawers
- best practices for mounting a vise



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contributors

In his high-celined workshop in a former Chicago post office, **Jeff Miller** (*"Modified Roubo Is the Ultimate Workbench"*) turns out a steady stream of custom furniture with an emphasis on chairs. He also teaches extensively, both in his shop and at schools across the country. And in his spare time, he produces numerous articles and books, including *Children's Furniture Projects* and *Beds*, both from The Taunton Press. **Previous career?** "Concert trumpeter in the Singapore Symphony Orchestra" (no joke).



Tommy MacDonald (*Fundamentals: "Every handplane needs a tuneup"*) is in his third season as host of *Rough Cut with Tommy Mac* on public television. He has added a few more expert outsiders to the mix, inviting a glass-blower and letter carver, plus actor/woodworker Nick Offerman for a project using natural-edge slabs, and like any woodworker, he can't stop making improvements. After the umpteenth viewer asked about the handsome tool chest that sits behind him on the bench, he added that chest and a full-scale workbench to the slate. Check your local listings for the show.



In a one-man shop nestled among the farms and chicken coops of the "Egg Capital of the World," Petaluma, Calif., **Michael Cullen** (*Handwork: "Make a mallet"*) builds handmade furniture notable for impeccable craftsmanship, unusual textures, and whimsical details. Cullen studied both engineering and sculpture in college, and later honed his skills in traditional craftsmanship under the guidance of noted English furniture maker David Powell.

Last thing you made? "A set of small boxes."

Strangest thing you've made? "Display case for a mummified cat."

Geoff Guzynski (*"Build Your Own Spray Booth"*) has been a part-time professional craftsman in his Illinois shop, Village Woodworking, for about 10 years. Guzynski recently switched his shop to mostly metric, and says he is working faster with fewer errors because of it. He uses Sketchup for design work, but says his degree in mechanical engineering also comes in handy, such as when a customer asked him to build a granite-top pedestal table.

Favorite thing about your shop? "Everything in it is ready to go. I just open the dust-collector gate, flip a switch, and go."



For more information on our contributors, go to FineWoodworking.com/authors.

We are a reader-written magazine. To learn how to propose an article, go to FineWoodworking.com/submissions.

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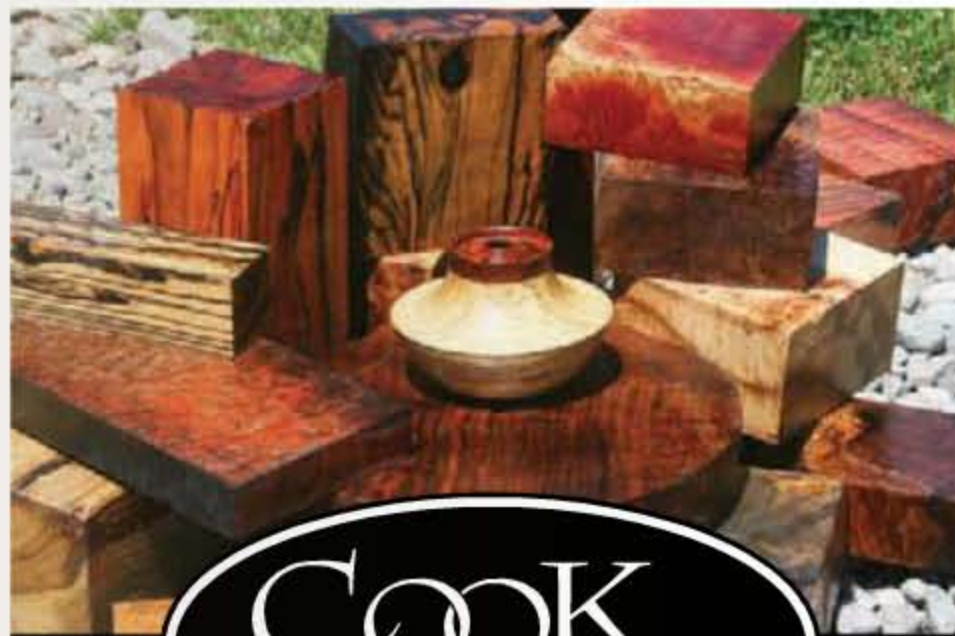
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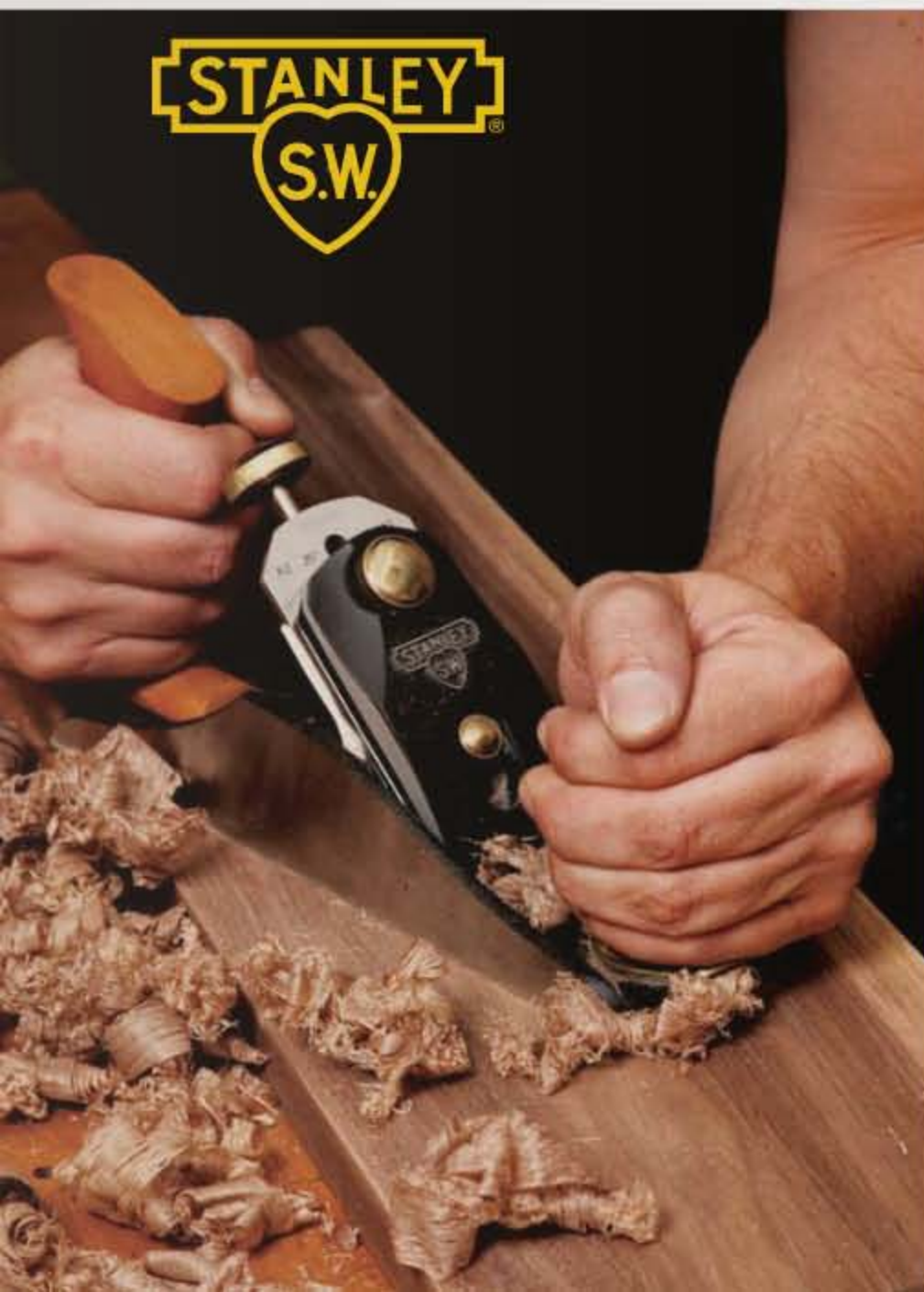


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Spotlight

FINEWOODWORKING.COM GETTING A MAJOR OVERHAUL

Your website has become frustrating to use. For one thing, the pop-up bar at the bottom makes the page jump all over the place and often makes my browser freeze.

—ELTON CROTTS, Fairfax, Va.

Editor replies: I can't disagree with you. FineWoodworking.com, while boasting a 35-year magazine archive and nearly 1,000 videos, both free and for-pay, has become unwieldy as it has grown, and is overdue for a major overhaul. And that is exactly what we are doing. Killing off that buggy bar at the bottom is only the beginning. The new FineWoodworking.com will offer more effective search and easier navigation, and automatically size itself to fit any device, from a smart phone to today's larger computer screens, along with many other improvements too numerous to list here.

We expect to roll out the new site by the holidays, so it won't be long now. I can't wait. FineWoodworking.com offers a dazzling array of content, greatly expanding the magazine's mission to inspire and inform, and it shouldn't be a chore to find what you need.

—Asa Christiana

Resources for segmented turning

Art Breese's article, "Secrets of Segmented Turning" (*FWW* #228), was a very nice introduction to this specialty. Breese mentions the Table Saw Miter Angles program (turnedwood.com) as an aid to cutting segments accurately. There is a full-featured suite of

programs at woodturnerpro.com that readers may want to try: 3D DesignPRO lets you draw a profile of a bowl or vessel and instantly see it in three dimensions, then move it to the WoodturnerPRO program to plan various types of segments or staves. LaminationPRO lets you plan cutting angles and sizes for decorative rings or borders. Craft Supplies USA sells a similar program called Woodturner Studio. SketchUp can also be used to lay out pieces for a segmented turning, and it's free. Finally, the American Association of Woodturners has an online-only chapter devoted to segmented turning, at segmentedwoodturners.org. It has a forum, a gallery of members' work, and links to other sites.

—DAVID HEIM, Oxford, Conn.



OLD

User-friendly. Our current website (left) has a fixed size, so we designed it for smaller computer monitors. The new one (below) will be much wider on bigger screens, and will optimize itself automatically for everything down to a smart phone.



NEW

Another great block plane

Your conclusions in "Tool Test: Block Planes" (*FWW* #228) generally agreed with my 50 years of experience using a variety of planes of all types. I have finally settled on a favorite block plane that you did not include in your article, the Lie-Nielsen Skew Block Plane. It is based on the Stanley No. 140, which has been out of production for many years. The plane can be had in ductile iron (\$195) or manganese bronze (\$225).

—JOE STEPHENSON, Placitas, N.M.



Editor replies: The Lie-Nielsen skew block planes are different animals than the block planes we reviewed. The skewed blade, while wonderful on tricky grain, is a bit more challenging to sharpen than the standard ones in the test. Also, its removable side and a built-in nicker turn it into a rabbeting block plane. That's why we saved it for an upcoming review of planes for trimming joinery. Stay tuned.

Fine Woodworking

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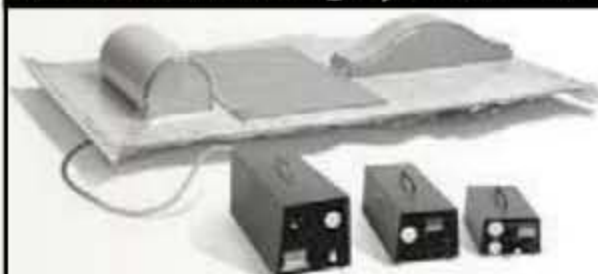
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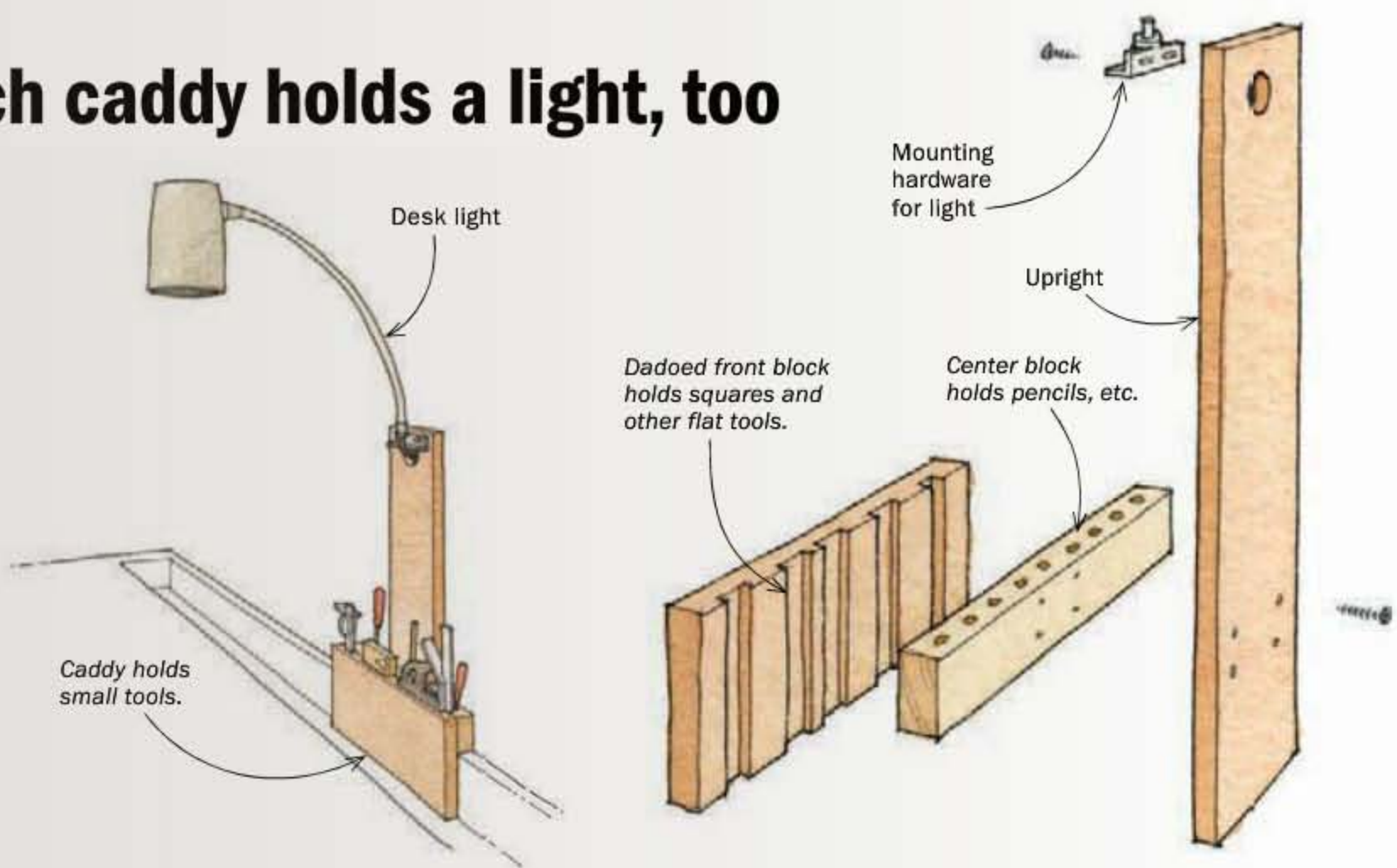
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Workbench caddy holds a light, too

Best Tip



Nick Yinger still has his very first project: a shoeshine box he built in Cub Scouts nearly 60 years ago. A retired surveyor and previous *FWW* contributor, Nick says he enjoys making furniture and improving his shop. No word on what he charges for a shine.



When I needed extra light on my workbench, I clamped a board to the back of the tool well and then clamped a work light to that. Frustrated with that arrangement, I built this fixture to hold the light and some of the tools I use most often.

The caddy has three parts: the front and middle blocks get glued together and are about 14 in. wide. The back upright is about 22 in. high. Start by thickness-planing the center block, leaving it slightly thicker than the back of the tool well. Before gluing up, drill holes along the centerline of the middle block

and near the top of the upright for the cord. Dadoes in the rear of the front face hold squares, rules, and other small tools.

Once installed, the caddy is easy to reposition or remove completely as needed.

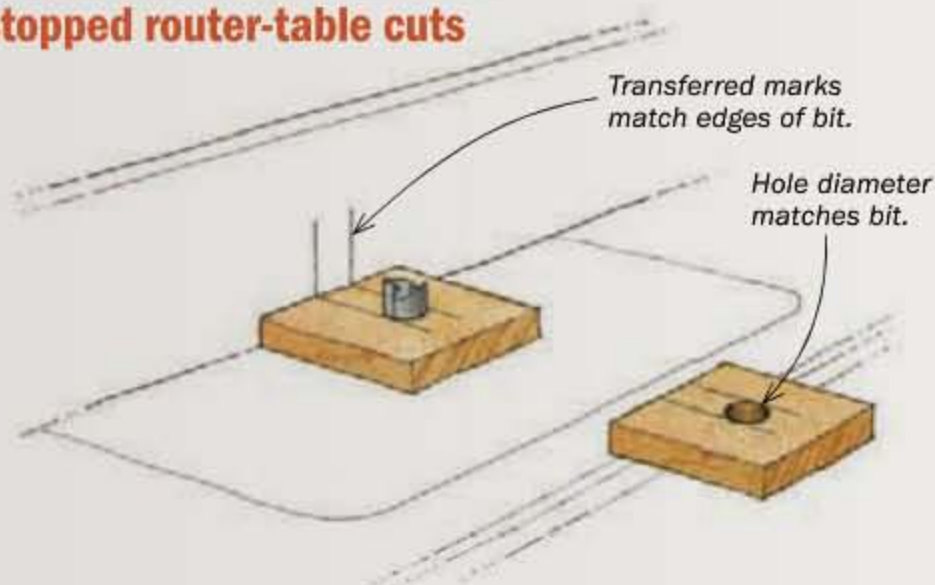
—NICK YINGER, Redmond, Wash.

A Reward for the Best Tip

Send your original tips to fwmow@taunton.com. We pay \$100 for a published tip with drawings; \$50 for one without. The prize for this issue is a Driftmaster bandsaw fence from Laguna.



Easy, accurate reference marks for stopped router-table cuts



When cutting stopped dadoes on the router table, marking the fence at the bit's leading and trailing edges will show its location in the workpiece and help you start and stop the cut in the correct places.

This jig helps place those marks accurately. Drill through a scrap of straight-edged hardwood with a Forstner bit the same diameter as your router bit. With a knife and square, mark two lines from the hole's rim to the board's edge. Place the jig over the bit and transfer the lines to the fence. Sized properly, the gauge can also help set the bit's distance from the fence.

—DAN TURNER, Robinson, Ill.

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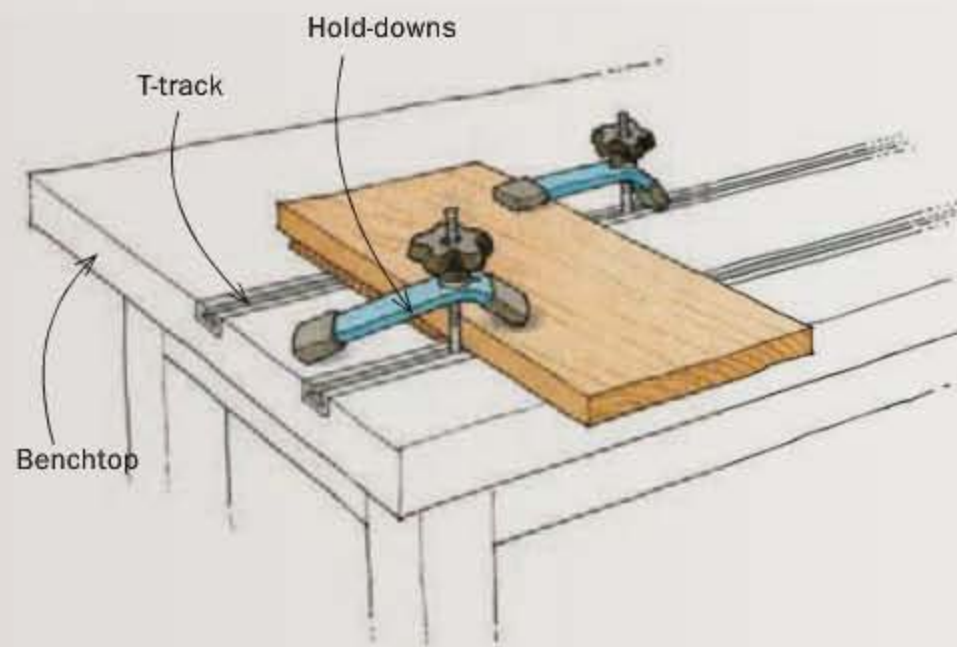
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T-track is a smart workbench accessory

Before I had a bench or worktable, I clamped pieces to my tablesaw extension to work on them. It was a poor setup.

So, when I built a worktable recently, I inserted two parallel lengths of T-track, several inches apart, in the table's surface. A hold-down in each track easily secures a panel for carving or setting inlay, or other workpieces for sawing. Rubber drawer liner between the table and workpiece prevents marring.

—BART BRINKMAN, Rathdrum, Idaho

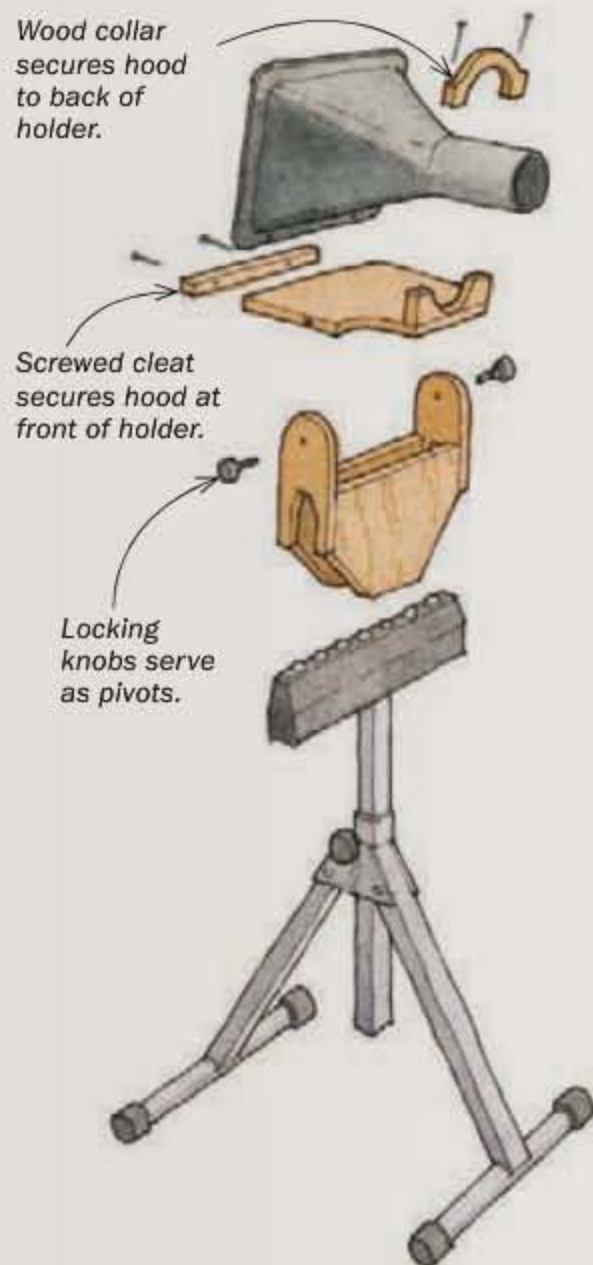
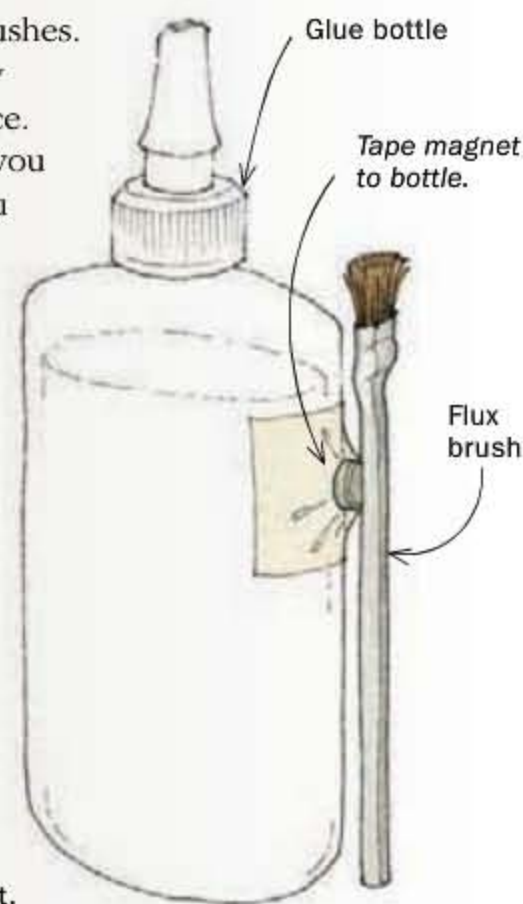


Magnetic glue-brush holder

Those little metal-handled bristle brushes sold as flux or acid brushes make great glue brushes. They spread the glue evenly and cost about a dime apiece. If you're not careful where you leave the brush, though, you can wind up with a trail of unwanted glue spots on your work or your workbench.

I solved that problem by taping a small rare-earth magnet to my glue bottle to hold the brush there temporarily during assembly. It avoids the mess and keeps the brush handy. The brushes are also reusable if you rinse them in water when you're done.

—CHIP OGG, Chittenden, Vt.



Collect dust when sanding on the lathe

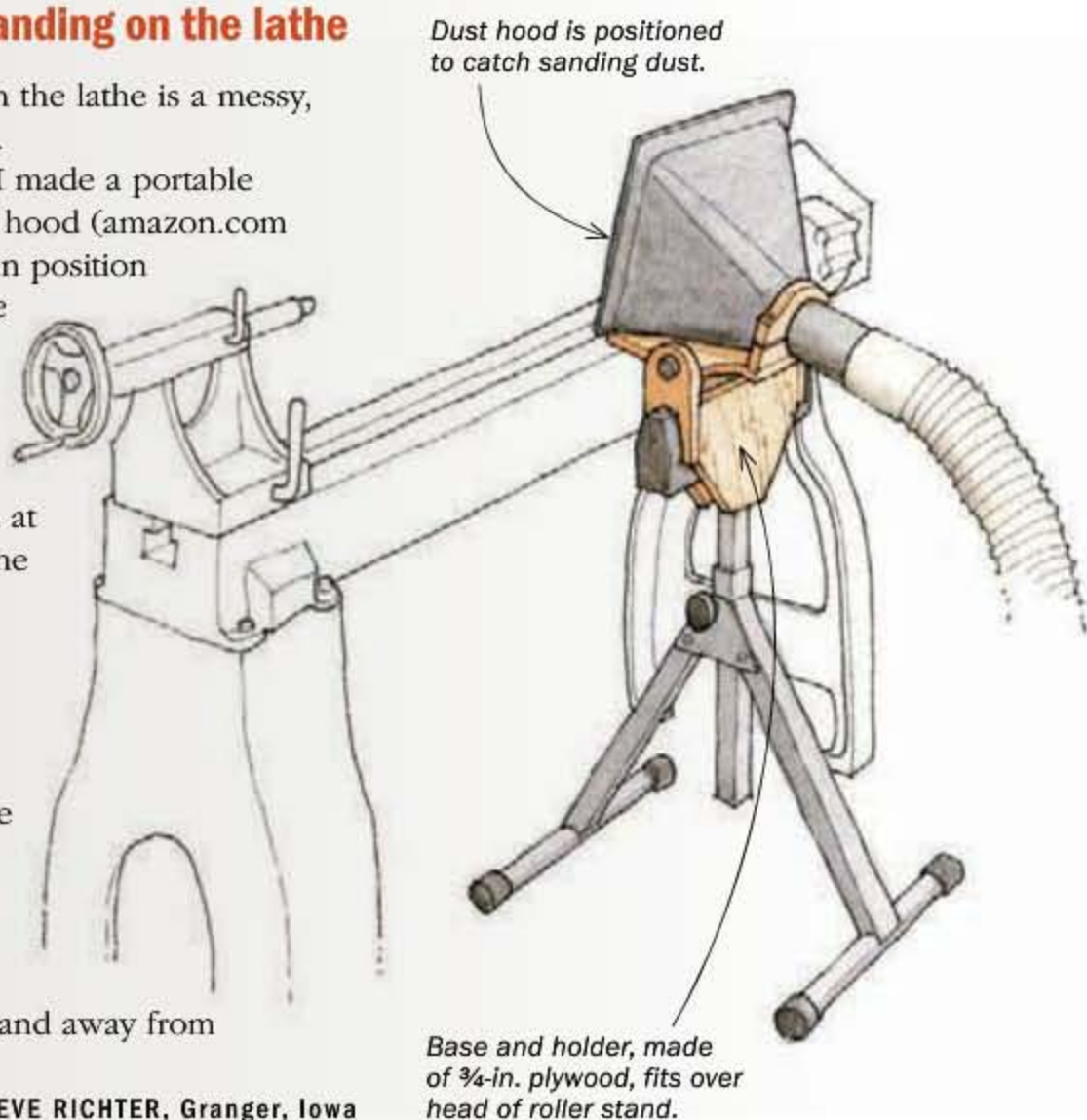
Sanding a turned piece on the lathe is a messy, potentially dangerous job.

To help catch the dust, I made a portable device with a plastic dust hood (amazon.com and rockler.com) that I can position near the work. The device sits on a shop-built base that slides snugly over my roller-support stand.

Locking knobs serve as pivots and keep the hood at the best angle to collect the most dust.

I use the device mainly for sanding at the lathe, but it also works well at the workbench when sanding small parts. I have a portable Oneida dust collector, which provides ample suction, and the fine sanding dust flows easily into the dust hood and away from my lungs.

—STEVE RICHTER, Granger, Iowa



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■ HAND TOOLS

Revolutionary tool steel has the edge over A2, O1

VERITAS HAS DEVELOPED A NEW TOOL STEEL for its line of plane blades and chisels.

Called PM-V11, the steel is a powdered metal alloy that Veritas claims holds an edge significantly longer than both O1 and A2, the most common tool steels used today. That means you won't have to sharpen a PM-V11 chisel or plane blade as often. Plus you can sharpen the steel using your favorite method—no need for special abrasives.

To verify the manufacturer's claims, I put a 2½-in.-wide bevel-up plane

blade and a ½-in. Veritas chisel through my own real-world woodworking tests.

The blade challenge

First, I compared the PM-V11 blade to a same-size A2 blade. A2 has risen in popularity in plane blades,

enough to shave hair from my arm and slice paper effortlessly.

Then I put each blade to use. To test the keenness of the blades, I first planed the edge of a 2-in.-thick cherry plank. Both blades produced shavings of 0.001 in. or less—very good performance—but the PM-V11 blade cut with less resistance, indicating a keener edge.

Next, to compare the toughness of the blades, I

“Woodworkers will definitely benefit from its durability and edge retention.”

due to its toughness.

I started the test by using my Japanese waterstones to hone each blade, working up through various grits to 13,000. In this arena, the PM-V11 blade required less work to get a highly polished edge, sharp

made up a two-pronged test. First I planed the end grain of a white-oak panel that was 1¼ in. thick and 18 in. wide. With the A2 blade, I was able to produce continuous end-grain shavings for 50 passes before the edge began to show signs of dulling. With the PM-V11 blade I was able to get a beautiful end-

grain shaving for 160 passes, making it a clear winner.

To ratchet up the heat, I resharpened and used each blade to plane the edge of a teak board that was 2 in. wide and 48 in. long. Teak is not a real hard and dense wood, but it is very abrasive and tends to wear down blades quickly. Here, I found the blades more evenly matched. With each one I was able to plane the edge 40 times. I was a little surprised at the similarity in performance, so I repeated the test and got similar results.

Turns out the PM-V11 steel sharpens easily and readily takes a keen edge, outperforming A2 in these

Dust Cobra by Oneida

\$788

Mobility kit (shown): \$59

Hoses (2½ in. dia):
\$95 (25 ft.),
\$47 (12½ ft.)

oneida-air.com

■ MACHINES

Small dust collector with a big bite

THE DUST COBRA IS A PORTABLE dust collector with good power and great filtration. The cyclone combines with a HEPA filter to contain at least 99.97% of the dust it collects down to 0.3 micron size. That's what it takes to help keep the dust in your shop at a healthy low level.

It's small (around 2 ft. square and 4 ft. tall) and quiet (measuring 75 db at 10 ft. away and a respectable 80 db at 5 ft.) but packs a

punch. Its powerful 110-volt motor draws about 11 amps after startup and creates an average flow of about 170 cubic feet per minute (cfm) at the end of a 2½-in.-dia., 25-ft.-long hose—that's two to three times the flow of a standard shop vacuum. I was curious to see how the Dust Cobra would do when connected to a 4-in. port and a serious woodworking machine. It pulled 215 cfm, enough to clear chips effectively from a 13-in. benchtop planer.



areas. In terms of durability, PM-V11 also gets the nod, but it is a closer call.

The chisel challenge

Next, to gauge the quality of the PM-V11 steel in a chisel, I compared it to five other high-quality chisels (all 1/2 in.), including the new Veritas O1 chisel (see "New chisels," right) and a high-end Japanese chisel. I put all the chisels through a series of tests that simulated the rigors of

chopping dovetails in cherry, white oak, and bubinga.

After each round I noted the quality of the blade's edge. Then I touched up the edge by lapping the back and stropping the bevel before moving on to the next board. Finally, I did a paring test in a pine board, noting the force required and the finish left on the board.

In the end, in terms of edge retention and performance, the PM-V11 chisel ranked second only to the high-end Japanese chisel, which is comparably priced.

Bottom line: The new steel is stellar

Overall, I am extremely impressed with the new PM-V11 steel from Veritas. Woodworkers will definitely benefit from its durability and edge retention. Expect to pay 20% to 30% more for it, though. Veritas is rolling out the PM-V11 steel first in its plane blades this fall, and then in chisels.

—Chris Gochmour is a professional woodworker and hand-tool expert.

The Cobra also features a pulse cleaner that removes fine dust from the filter, which helps to maintain efficiency. In our tests with a clogged filter, the pulse cleaner restored it to well above 90% of the original performance.

The Dust Cobra was not designed to be the central collector at the heart of a large shop with stationary machines, like cabinet saws and large jointers. But it is a great performer for shops with smaller machines that can be hooked up individually, such as benchtop tablesaws, jointers, and sanders.

—Bill Peck is Fine Woodworking's shop manager.

HAND TOOLS

New chisels from Veritas are worth the wait

THIS YEAR, VERITAS STARTED MAKING ITS OWN BENCH CHISELS, and I was happy to take a set for a test drive.

The chisels were flawless out of the box. The blades are made from O1 tool steel, and they are stout, registering 5/16 in. thick at the ferrules and tapering to 1/8 in. at the bevel, or tip. Their side edges have bevels that extend all the way to the chisel face, and the backs are lapped dead flat, also rare.

The blade is secured to the handle with a barbed tang. A tapered stainless-steel ferrule enhances the blade-to-handle connection. The usable blade length ranges from 4 5/8 in. (3/4-in. chisel) to 5 1/8 in. (1-in. chisel).

The maple handles, toasted brown with a caramelizing process, add tough elegance and have subtle flats that help make them comfortable to grasp and keep them from rolling off the bench.

I used the chisels to chop and pare dovetails for a set of white-oak drawers. They have a very solid feel. Mallet blows are directly transferred to the workpiece with no flex or give. The beveled side edges make it easy to clean up dovetail corners, but they are a bit sharp to the touch. I'd be inclined to dull them slightly with sandpaper.

The O1 steel was easy to sharpen to a keen edge, which held up well in my tests. Overall, the performance of the Veritas chisels is on par with the best western-style chisels in my 2008 review (FWW #200). And if you can afford the increased price, the chisels made with Veritas's new PM-V11 steel (left) would be a worthy upgrade.

—C.G.

Veritas Bench Chisels

\$295 for the set (3/4 in., 3/8 in., 1/2 in., 3/4 in., and 1 in.).
leevalley.com



■ POWER TOOLS

Powerful impact driver has convenient drilling mode

THE TI 15 HYBRID IMPACT/DRILL DRIVER is the latest tool innovation from Festool. Powered by an efficient brushless motor and fueled by a 14.4-volt, 3 amp-hour lithium-ion battery, the tool has enough get-up-and-go to drive a boatload of screws and then does double duty as a drill, simply by adding an adapter or using the included keyless chuck, both of which override the impact function. (Other impact drivers can drill, but not without going into loud, slightly rough impact mode. See "Tool Test: 18v Brushless Impact Drivers," p. 42.) Also, a variable-speed wheel is conveniently located at the base of the handle and limits the top speed, creating a more usable range for particular drilling or driving needs.

The driver features Festool's Centrotec chuck and bit holder, which holds its proprietary hex-shank bits (available at highlandwoodworking.com); plus a keyless chuck that will hold everything else. I was frustrated by the fact that I couldn't use the hex-shank bits I already own. You can remove the Centrotec chuck and insert a standard hex bit directly into the spindle, but the bit isn't locked in tightly.

Small graces make the drill nice to use: magnetic bit holders molded into



Hybrid Impact/Drill Driver by Festool

Model TI 15
\$525
festoolusa.com



Double override. To override the impact function, add the override adapter to the Centrotec chuck or simply install the keyless chuck (shown).

the handle base, a comfortable soft-grip handle, convenient belt clips on either side, and a bright green battery-level indicator. It also has a bright LED, but adding the override adapter or the keyless chuck cast a shadow where light is needed.

But these are small issues. This innovative drill is a winner. The kit includes the drill, Centrotec chuck, impact override adapter, three-jaw chuck, two batteries, a charger, and a case. If you have other C or T series Festool drills, you can skip the batteries and charger and buy the basic kit for \$350.

—Roland Johnson is FWW's go-to power-tool guy.

■ ACCESSORIES

New sanding endurance champs

THE NEW G2 SANDING DISKS FROM SHOPSMITH never seem to wear out. That's good news if you're using them; not so good if you're testing them. Thanks to my earlier evaluation of 5-in. sanding disks (FWW #222), I was the obvious (most gullible) candidate to repeat the tests on Shopsmith's newest offering. The disks come in eight grits ranging from 40 to 320. All feature a wear-resistant, plastic film backing with an aluminum-oxide abrasive and an anti-clog coating. Compared to the eight types I tested earlier, the G2 disks lasted longer and removed more material (for example, the 80-grit disk outlasted the previous test average by a factor of six!). Surface quality was uniformly good. But there's a downside: the disks are pricey and they cut slowly. When matched against the cost-effectiveness and speed ratings of the competition, the G2 disks were middle-of-the-pack performers.

—Andy Beasley lives in Colorado Springs.



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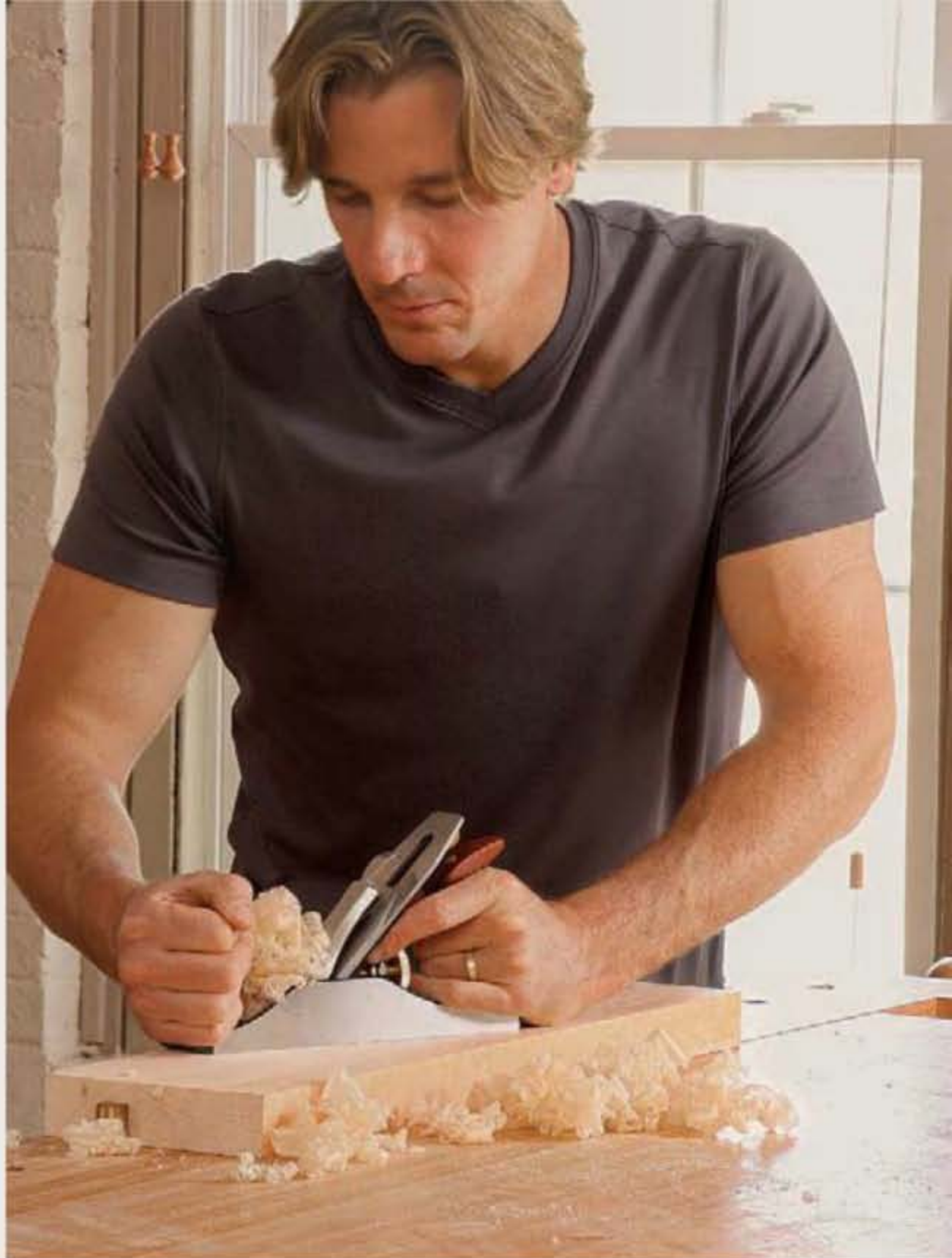
BY TOMMY MACDONALD

When I was introduced to handplanes as a working carpenter, I thought they would be ready to use out of the box. Most aren't. They need a good going over, not to mention sharpening and honing. So I got frustrated pretty quickly and just went back to my old standby: the random-orbit sander. Later, when I was a student at North Bennet Street School, I bought my first expensive new plane and made the same mistake again. That's when I learned that every handplane needs an overhaul, if only a mild one. It's the same with a new jointer, a new tablesaw, or any other piece of machinery. The great thing is that this tune-up only needs to be done once, and it pays off for many years.

Clean and deburr the parts

You'll encounter the first problem when you unwrap your new plane and find it covered with a liberal coat of oil, intended to protect it from rust during shipping. Any clean rag will do for wiping it off, but you don't have to remove all of it. A light coat will go on protecting the tool. Do take the plane completely apart: The lever cap, chipbreaker, plane blade, and even the frog need to be disassembled and wiped down. Inside you'll also usually find some metal shavings left over from machining. These are a bigger problem than the oil, since they can seriously affect the performance of the plane.

A lot of people know you need a razor-sharp blade for good performance, but you also need continuous, flat contact between the bed of the plane, the frog, the blade, the chipbreaker, and the lever cap. Planing creates a lot of pressure, and if anything is between the parts and breaks that connection, the blade will rock and vibrate, and you'll get chatter. So while all the parts are separate, feel for sharp areas and small metal burrs, and hit them with a fine file. And watch out: Very old planes might even have paint between these mating surfaces, left over from a bad rehab job. Remove it.



Take it apart and clean it



Oil, debris, and small burrs. Take the plane completely apart. On most new planes, you'll find a generous coat of oil, and most of that should go. Any cotton rag will do. Wipe off any other debris, too. Then feel around for small burrs that might interfere with the contact between all the important milled surfaces. Hit those with a fine file.

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Flatten the sole



Check it first. If you see light under your straightedge, you've got a major problem. On a flea-market find, it's worth an hour or two of sanding to level a warped sole, but a new plane should be sent back.

Last, look for major defects in machining or grinding. If the frog rocks noticeably even after you clean and deburr it, return the tool.

Tune the sole

Next, move to the sole. That is the final link in the connection between the blade and the wood, so it has to be mostly flat, especially around the mouth and roughly three-quarters of the way across the bottom. Check with a straightedge. If you see light beneath it, you have a lot of work to do, and you should consider sending the plane back, or putting it back down on the flea-market table. You could be in for as much as a half-day of sanding—not fun. But here's how to do that without making the problem worse, or ruining a sole that is good to start with.

Invest in a good straightedge; you'll need it as a woodworker. Use it to find a flat surface in your shop for jobs like flattening the sole of a plane or the back of a chisel. It could be on the tablesaw, workbench, jointer table, or wherever. Then clamp or stick sandpaper down flat on that surface (see photo, top right). Go with cloth-backed 80-grit paper, the kind used for sanding belts. It's rough enough to handle heavy work if needed, but leaves scratches that you can live with. And the cloth body will hold up longer and stay flatter than paper will.

The first step is to make lines on the bottom of the plane with a permanent marker to keep track of your progress. The very first swipe will tell you how much work you have to do. Be sure to stick with



How to flatten any plane. If the sole needs work, start by making some marks across it with a Sharpie, and then clamp part of an 80-grit sanding belt to a flat surface in your shop. To keep the sandpaper tight and flat, clamp it under wood blocks as shown and then tap them apart. When sanding, concentrate most of the pressure on your back hand, as low as possible on the plane to keep it level. Use the lines to track your progress (1) and stop when they disappear (2).



Break the edges



Light filing. Use a smooth mill file to break the edges, filing away from the sole (left). Do the inside of the mouth too (above), but very lightly so you don't widen it. Then check again for little burrs inside the plane.

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Hone the chipbreaker

Critical contact. If there are any gaps where the chipbreaker meets the blade (above), chips will find them, jamming the mouth. So hone the underside (right), making sure you maintain its negative angle for a tight seam with the blade.



light pressure throughout for even results, and keep the plane level. The critical area is all around the mouth, but you can compromise a bit at the last quarter of the sole, near the heel.

You don't need to switch to a finer grit to polish the bottom. The 80-grit scratches won't affect planing at all. Overall flatness is what counts. Before you move on, break all the edges of the sole with a fine file and then sandpaper.

Fine-tune the chipbreaker

The chipbreaker does two important jobs: It presses down on the blade right where it counts, eliminating chatter. And its beveled or curved top edge forces the chips to curl and break, as its name says, which stops little splits from running ahead of the blade and creating tearout. But it won't do either job unless it meets the blade perfectly. So, providing that the back of the blade is flat and polished (see "A Visit to the Sharpening Doctor," *FWW* #206), you are ready to tune the chipbreaker. Start with the top edge, polishing it on your honing stones or with sandpaper so chips glide over it smoothly.

The underside is the key part, so do it last. The area under the tip is milled at an angle so it meets the plane blade with a knife edge, and you usually can stick with that original milled angle, keeping the area near the tip flat on your honing stones with the rest of the chipbreaker hanging off.

Now attach the chipbreaker to the blade, put both in the plane, and get planing! You want to get the tip of the chipbreaker roughly $\frac{1}{32}$ in. from the tip of the blade. Pop the assembly into the plane, and put in the lever cap.

Finally, you might need to adjust the frog, closing the mouth of the plane, to help prevent tearout. Your plane is now operational, and it should stay that way for years. □

Tommy MacDonald is a furniture maker and the host of Rough Cut—Woodworking with Tommy Mac on public television (check local listings). He lives and works near Boston.

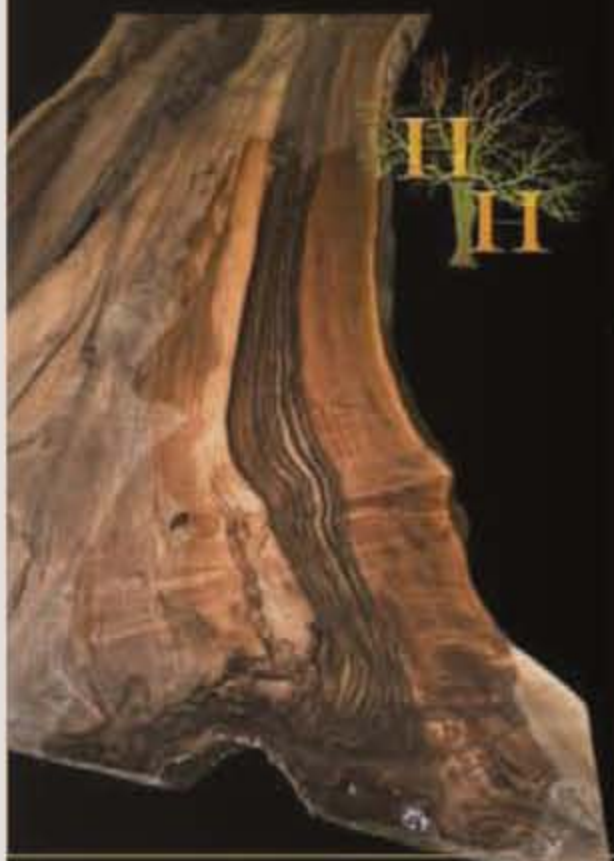
Adjust the mouth last

Fine-tune the frog. That changes the mouth opening (far right). This Bedrock-style plane is the most convenient, allowing you to adjust the frog while the blade is in place.



Good gap. For most work, you are looking for a $\frac{1}{16}$ -in. opening ahead of the blade. If you get tearout, try making the mouth tighter and taking finer shavings.

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BY MICHAEL CULLEN

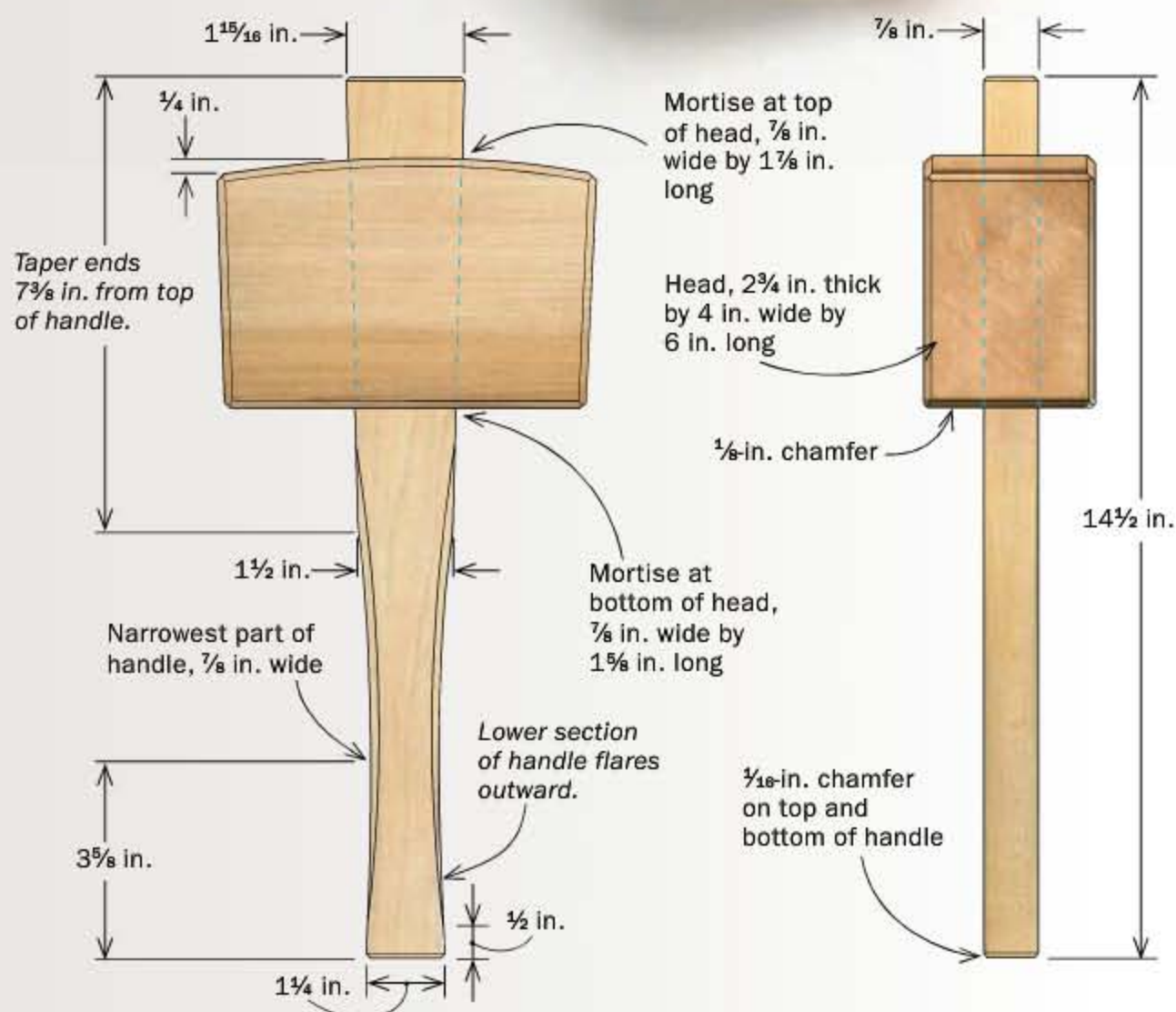
I like a stout woodworking mallet with an oversize head. Why? It lets me generate plenty of force for cleaning out a mortise or chopping dovetails, and I can also use it for delicate detail work by just choking up on the handle.

Making your own mallet is a great exercise in handwork, involving careful layout, sawing, planing, and precise joinery cuts. The reward is a mallet custom-fit to your grip, and the pleasure of having built an elegant tool that will see years of use.

Mine is a simple, two-piece design. The handle slides through the top into a mortise that's tapered perfectly to accept it. Swinging the mallet keeps the handle wedged tightly in the head, so there's no need for glue. It's solid, easy to build, and you need only a few tools to do it.

Handmade for handwork

It's important to begin with a strong, dense wood. I like hard maple because it's relatively easy to work and widely



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Start with the mallet head

SQUARE UP THE BLANK

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Flatten one face. Plane from side to side, taking even swipes. Check the face with a straightedge to make sure it's flat.



Square an edge. Rotate the block and plane the edge flat. Use a combo square to check that it's 90° to the face. If not, plane the high side.



Scribe the rest. Set a marking gauge to the final dimensions and run it along a flattened side to mark one parallel line all around the block. Then plane down to that scribed line, stopping as close to it as possible.

available, but oak or a similar hardwood will work, too. Use a 12/4 piece for the head and a 4/4 piece for the handle. Stock with rift- or quartersawn grain is best, especially for the handle, because it is more stable and less prone to breaking.

Start by rough-sawing the head and handle about 1/4 in. over length and width. Then get to work squaring the head and bringing it to final width and thickness with a No. 4 handplane. Don't bother with the ends, though, at this point.

Start with the head

It's best to make a square mortise and then add the taper. First make a pair of centerlines. Mark the mortise ends on the bottom of the head, and the locations for drilling two holes to remove the waste. Transfer the marks to the top, and mark the ends of the tapered mortise. Then scribe the mortise walls. Your final chisel cuts will start in those scribed lines.

I drill out most of the waste before squaring the mortise with bench chisels.

LAY OUT THE MORTISE

Since the ends are still rough, you'll rely on accurate centerlines for most of the layout.



Start with centerlines. Mark them carefully and carry them around the head. Then lay out the ends of the mortise, plus the extra distance for the taper.



Scribe the walls. Use a marking gauge to scribe mortise walls equidistant from each side.

CUT THE MORTISE



Clear the waste. Drill two $\frac{3}{4}$ -in. holes on your centerlines. Go halfway, flip the piece, and finish from the other side. Use a square as a visual aid to keep the bit straight.

Work about halfway into the mortise and then flip the piece to work from the other side. Once it's square, work top side up and add the taper by chiseling back toward the marked lines. I end the taper just short of the bottom of the mortise to minimize tearout.

Now cut the angled ends of the head and add the curve. Lay out the angles by marking 3 in. to each side of the centerline at the top edge and $2\frac{7}{8}$ in. at the bottom edge, and connect those marks. Saw to the line and plane the ends smooth. Mark the radius using a shopmade template. I shape the curved top by planing heaviest at the ends of the curve and easing the cuts as I work back toward the center. I finish by chamfering the edges and smoothing any tool marks with P220-grit sandpaper.

Get a handle on fitting tapers

For the handle, begin with a square piece that's a little too thick and too wide



Square the mortise first. Chop out the walls and ends from both sides, working steadily back to your scribed lines.



Check for flatness. A small rule reveals any bumps or hollows in the walls of the mortise.



Taper last. At the top, chisel out the taper by working back toward the marked lines.

FINAL TOUCHES



Saw the ends. Lay out and crosscut the angled ends. Smooth them with a handplane, and plane the curve into the top.



Add a generous chamfer. Break the edges with a handplane to help prevent splintering or chipping in use. Sand away the tool marks, if you like.

Make the handle

TAPER FOR A TIGHT FIT



Thickness first. Start with an oversize, square handle and plane the sides until it fits snugly.



Saw the tapers. Make a small crosscut at the narrowest part of the handle and then saw down into it, keeping to the waste side of the line.



Flip it to finish the job. Turn the workpiece upside down to saw the flare at the bottom of the handle.



Take long, even strokes. Plane in toward the narrow part of the handle, stopping before the sole of the plane gets lifted by the bottom.

for the mortise so you can sneak up on a final, tight fit. Tackle the thickness first, taking light, even shavings with a bench plane and testing the fit against the mortise. Stop planing when the handle just begins to slide into the head.

Lay out the handle's shape by drawing a centerline and using it to mark and draw the taper at the top end of the handle, and an inverted taper at the bottom of the handle that forms the pommel. Make a small crosscut where the tapers intersect and then saw down to it, staying close to the waste side of the lines. Clean up the cuts with a handplane.

SHAPE FOR COMFORT



Taper until it's gapless. Dry-fit the handle and keep planing the tapers until it fits perfectly. The handle should seat in the mortise without any play and the end of the handle should protrude roughly 1½ in. from the top of the head.



Contour the grip. Last, shape the grip with a spokeshave so that it feels comfortable to hold.

Dry-fit the handle inside the mortise frequently. Keep making even swipes on both sides of the taper with a handplane until it fits tightly. It's a mechanical joint, so a good fit is important.

Once the handle fits, shape the grip with a spokeshave, taking short, thin strokes to make a curve that is comfortable to hold. Chamfer the handle ends with a block plane, and finish the mallet with a thin coat of shellac and wax.

Michael Cullen is a furniture maker in Petaluma, Calif.



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Smart



BUILD YOUR OWN CABINETS

You'll get a custom assortment of drawers, plus open storage. White's clever arrangement includes a pair of fixed units with space in between for one of two rolling tool carts. An open bay in the nearest cabinet holds a shop vacuum, which can connect to any tool (router table, chopsaw) that rolls alongside.

PUT THE WALLS TO WORK

For frequently used hand tools, clamps, and hardware, the most efficient storage is in the open, close at hand. A layer of plywood makes custom holders easy to attach.



KEEP MATERIALS ORGANIZED

Your lumber stash can take over the shop if you're not careful. Sturdy, accessible racks let you keep plenty of solid stock on hand without having it in the way. Readers submitted elegantly simple solutions.



Shop Storage

A roomful of ideas for organizing your space

BY JOHN WHITE

By the time you're into woodworking seriously enough to set up your own shop, several things may have already happened, or will happen soon.

You will search catalogs, yard sales, and the Internet for tools large and small that you need, think you need, or just plain want—and you will buy them. You will bring home great-looking lumber because it is beautiful, even though you have no immediate plans for it. And someone, possibly a friend, will tell you that “you can never have too many clamps,” and you will believe that person.

Each of these things will happen repeatedly, and your space, no matter how voluminous, will soon be a cluttered mess.

This collection of my favorite storage ideas from shops I've set up, and from *Fine Woodworking's* readers, will help you keep clutter at bay. To show you how the cabinets, racks, and holders all work together, we built them all into the garage of *Fine Homebuilding's* Project House, where they will get good use.

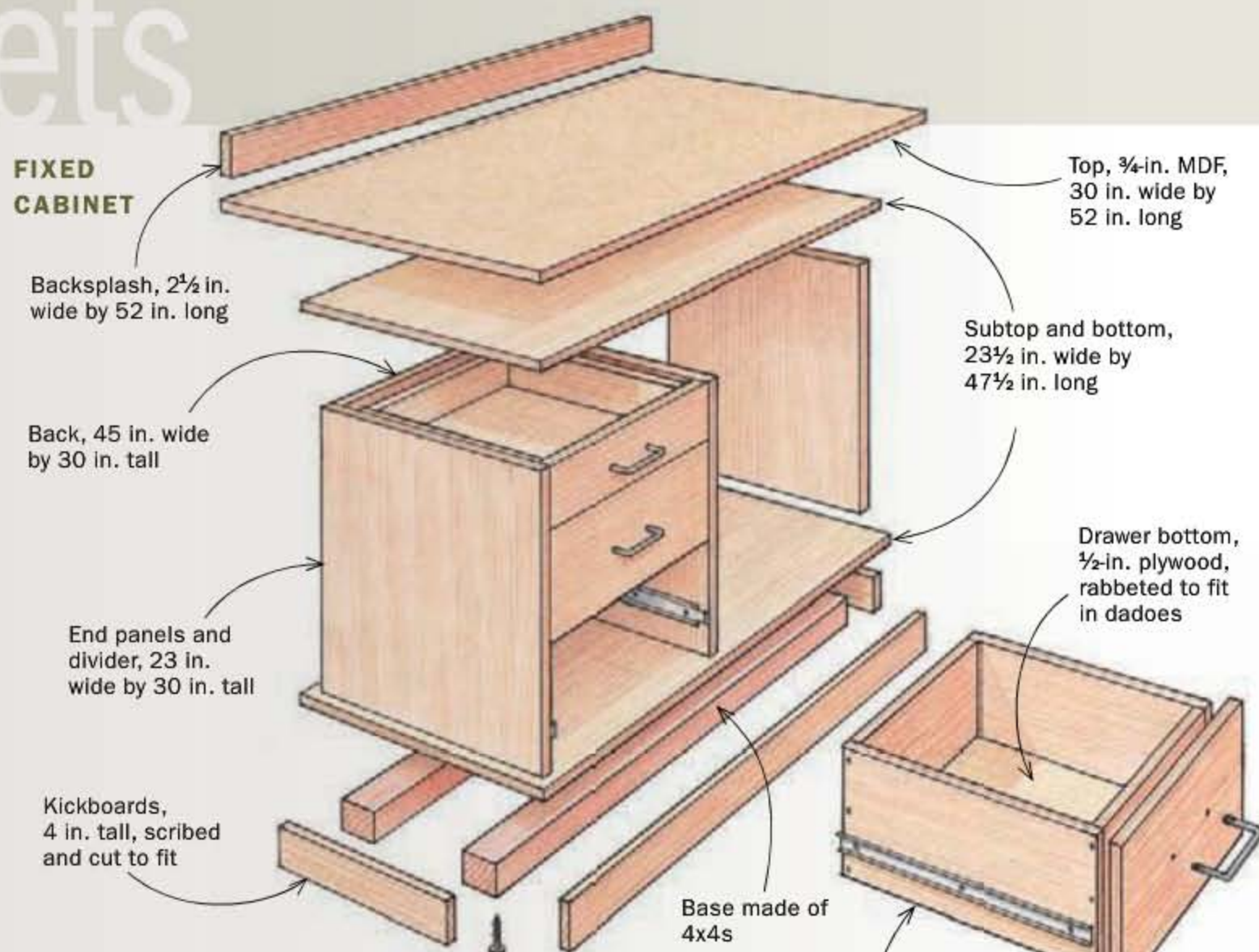
John White, a contractor and furniture maker in Rochester, Vt., is a former shop manager for Fine Woodworking.

Cabinets

Build to fit

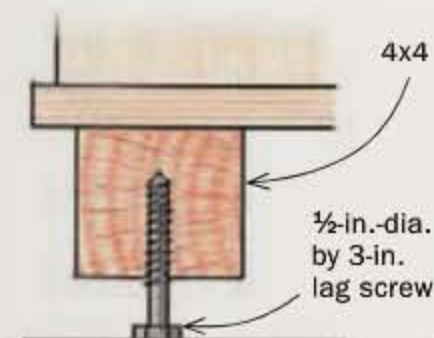
I especially like base cabinets in the shop because they provide horizontal work surfaces along with plenty of storage. For the Project House shop, I made a set of fixed and rolling cabinets (two each) that occupy most of a long wall. The fixed units create 20 square feet of countertop in addition to nearly 50 cubic feet of storage in the spaces underneath. The top rank of shallow drawers works well for smaller items, while the deeper drawers underneath can hold routers, belt sanders, biscuit joiners, and other large tools. One open cabinet provides space for a shop vacuum, and an opening in the MDF top makes it easy to connect to any tool you roll into place. A backsplash prevents anything from falling behind the cabinet.

I build shop furniture like this from $\frac{3}{4}$ -in. Baltic- or Russian-birch multi-ply. You probably won't find this at your local home center, but it's worth seeking out at a plywood or lumber dealer because it is rigid, stable, and without voids. The cabinets are sized to be cut efficiently from standard 4x8 sheets. The boxes can be assembled easily with coarse-thread drywall screws. Be sure to drill pilot and clearance holes for each screw or you'll split the plywood and lose strength. For more tips on assembling cabinetry of this type, see my article, "Best-Ever Outfeed Table," in *FWW* #202.

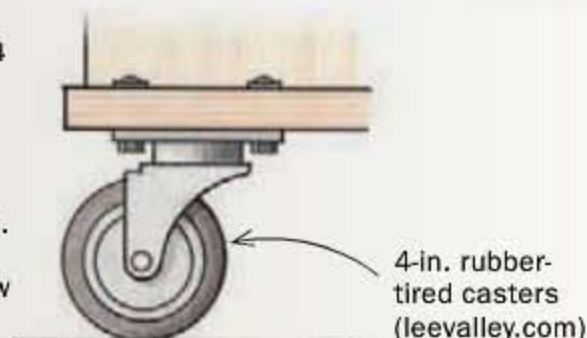


TWO FEET OPTIONS

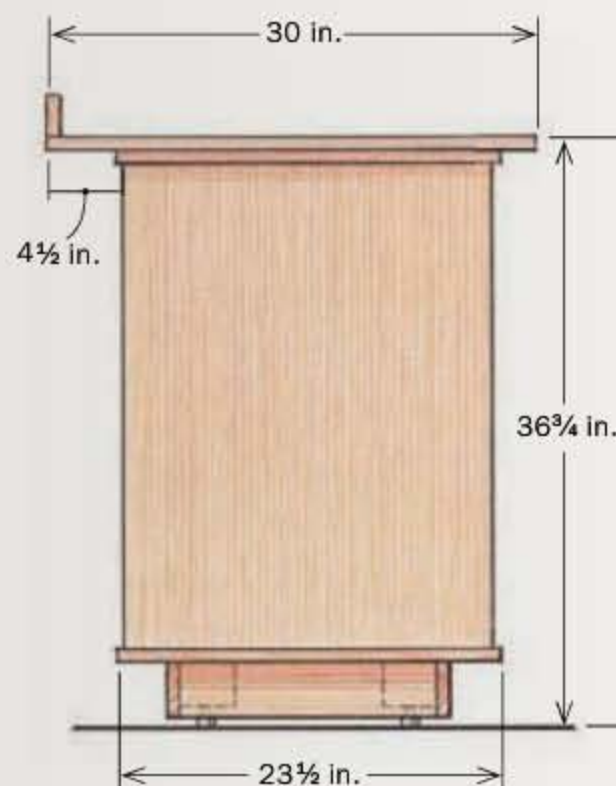
FIXED CABINET BASE



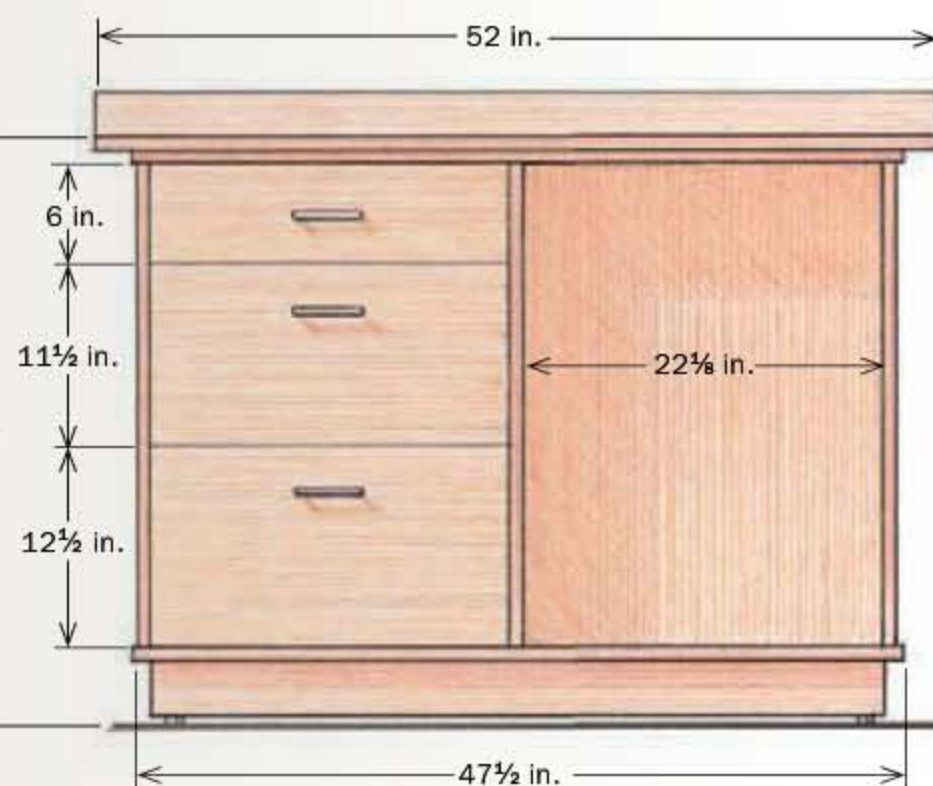
ROLLING CABINET BASE



SIDE VIEW



FRONT VIEW



Simple materials, simple joinery. With the exception of the MDF top, White built the cabinets entirely from Baltic-birch plywood. Basic butt joints, held with plenty of counter-sunk, coarse-thread drywall screws, make a sturdy box.



Two ways to meet the floor. For the fixed cabinets, White mounted the boxes on skids milled from kiln-dried 4x4s, with a ½-in. lag screw at each corner for leveling. The scrap is there to set the initial height. The rolling cabinets ride on heavy-duty casters (fixed in back, swivel in front).



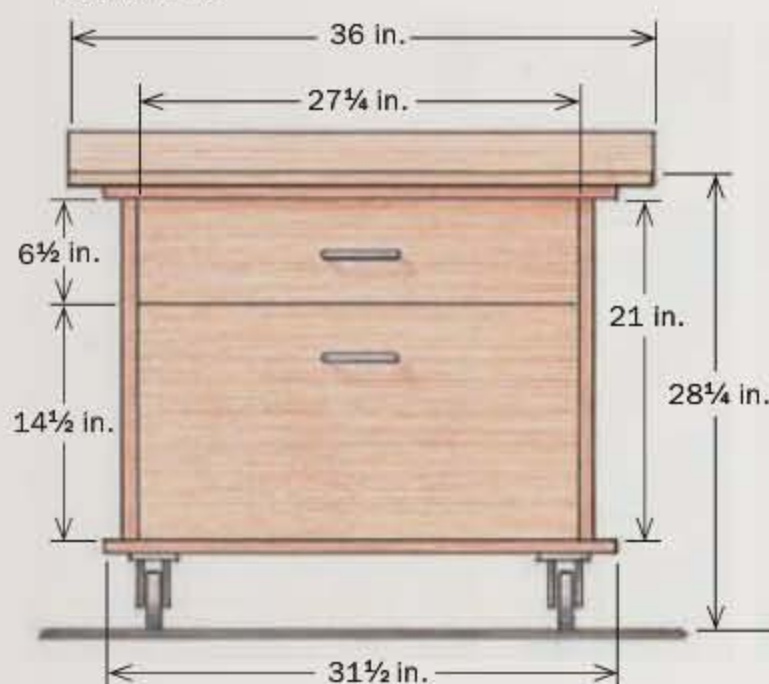
Topping it off. To the plywood subtop, White screwed a layer of ¾-in. MDF for a replaceable, low-friction surface. He had to create a large overhang in back to accommodate a protruding foundation wall, but you might not have to.

TIP

ACCURATE DRAWER INSTALLATION

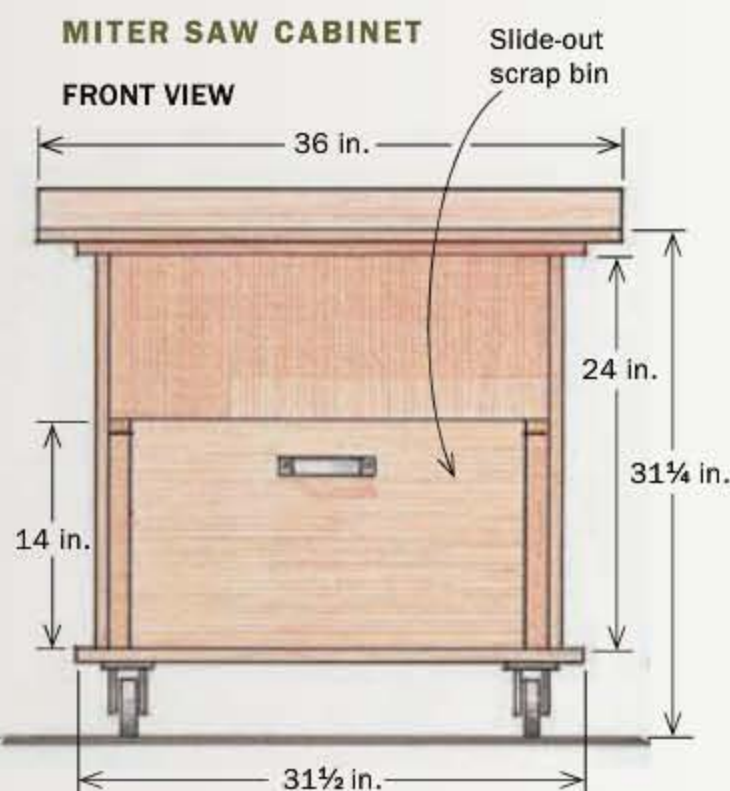
ROUTER TABLE CABINET

FRONT VIEW



MITER SAW CABINET

FRONT VIEW



White used a measured length of plywood to locate each pair of drawer slides at the correct height. This ensured that the drawer hung level, and in the right place.

Cabinets

Installation continued

Whenever possible, I like to position base cabinets on a long stretch of unbroken wall. This makes an ideal location for a chopsaw station, offering plenty of room to orient long stock for cutting, with the countertops working as long support wings.

I leave space between the fixed cabinets to accommodate a rolling tool stand. I built two of those: a low one to hold the compound-miter saw and a second to carry a benchtop router table. A benchtop planer would be another great candidate for a rolling cart. The rolling cabinets swap in and out of a central “parking space” when I’m ready to use them, and hook up in seconds to the shop vacuum that lives just next door (see opposite page).

There’s no need to anchor the fixed cabinets to the wall; they aren’t going anywhere. Once they’re in position, adjust the lag-screw feet to make sure they are level and in the same plane. Then roll the chopsaw into place and adjust the saw’s height so that its bed is level with the countertops. To do this, I measured the distance between the bed and countertops and then bolted the saw to a pair of riser blocks milled to that thickness.

LEVEL THE TOPS



Just the turn of a wrench. After moving the fixed cabinets into place, White used a long level to span the gap between them and adjusted the lag-screw feet to make sure the tops were level and coplanar.

ALIGN THE SAW



Smart riser blocks. White deliberately built the chopsaw stand low, so the tool’s height could be dialed in precisely to match the cabinet height. To do this, he measured from the saw’s bed to the countertop height (left), then mounted the saw on blocks milled to the corresponding thickness.

Change out tools in minutes



Built-in dust collection. An open cabinet bay holds a shop vacuum. The hose threads through a hole in the cabinet's top for connection to the miter saw and router table, as well as any power tools used on the countertop. A sliding bin underneath the saw collects cutoffs.



Ready to rout. The router-table cabinet is sized to put the tool's work surface at a comfortable working height. After rolling either cart into place, White secures it with two simple screen-door hooks (left).



Storage

Wall storage

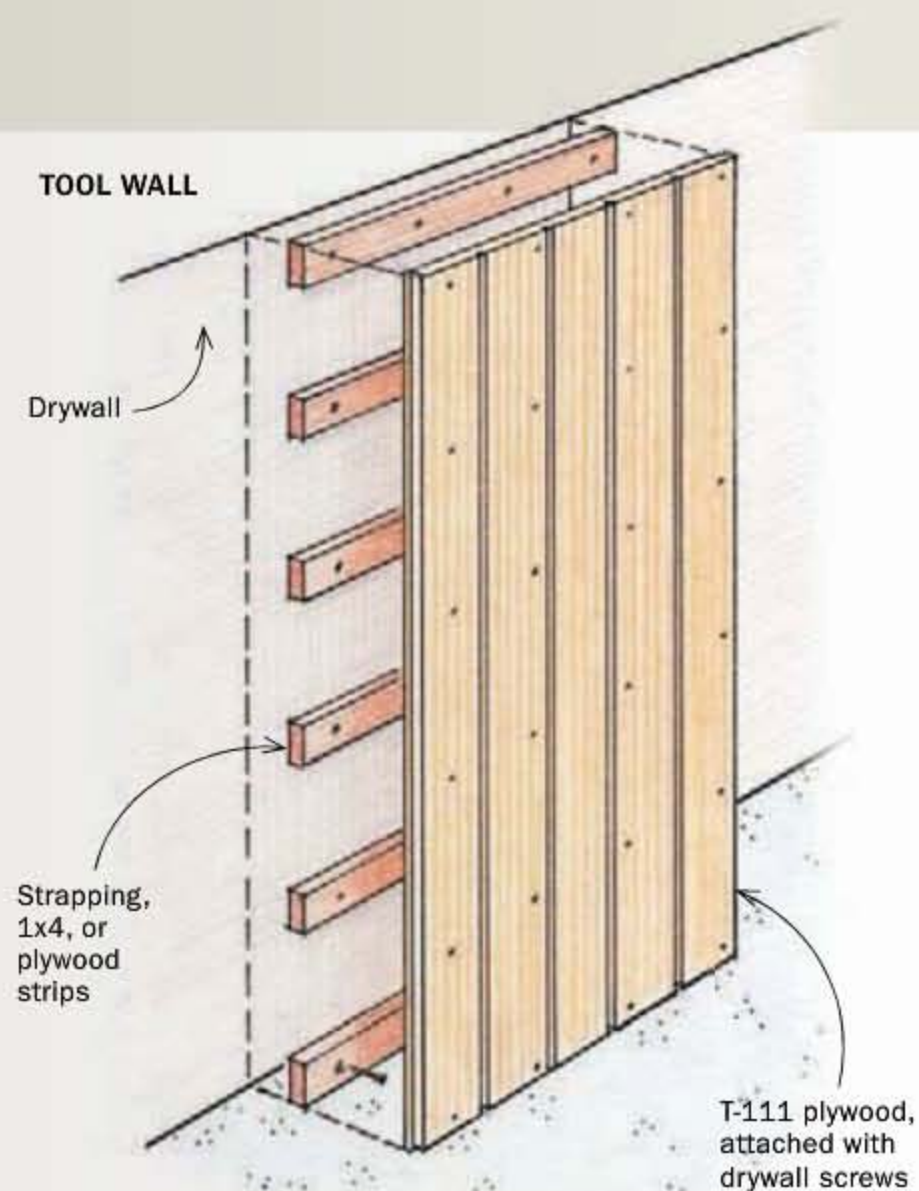
Cabinets are great for stowing tools and supplies that don't see action every day. Tools used all the time should be closer at hand.

This is especially true near the bench, where I keep chisels, saws, and layout tools in open racks on the wall. This makes them easy to find, retrieve, and stow. The same system works terrifically for clamps. A lot of woodworkers stow their clamps on a cart that rolls out of the way when not in use. For a smaller shop, it makes more sense to use open wall space.

A fast and flexible way to create this storage is by

covering the studs or wallboard with sheets of T-111 plywood (grooved siding with a roughsawn face). I like T-111 because, like any plywood, its strength means you can install tool racks anywhere, without searching for a wall stud. But I like the roughsawn look of T-111, and its surface disguises abandoned screw holes.

The plywood surface makes it easy to attach an assortment of shelves and custom holders for a wide variety of tools and clamps. And the arrangement is easy to reconfigure as your tools and needs change.



CLAMPS



Start with a sturdy backboard. White used T-111 plywood, an inexpensive exterior sheathing product, as a base for mounting tools and clamps. Battens screwed to the wall provide more attachment points for the siding and eliminate the worry of aligning seams with stud locations.



Secure, accessible storage. The plywood's strength lets you attach clamp-holders wherever you need them without worrying about anchoring them to wall studs.



Custom holders. Near the bench, White mounted an array of holders for hand tools of all kinds. For chisels, he routed dadoes of differing widths in a long board, and then added strips on the front side to keep the chisels in place. The tool walls make it easy to find, retrieve, and stow the items you need most often.

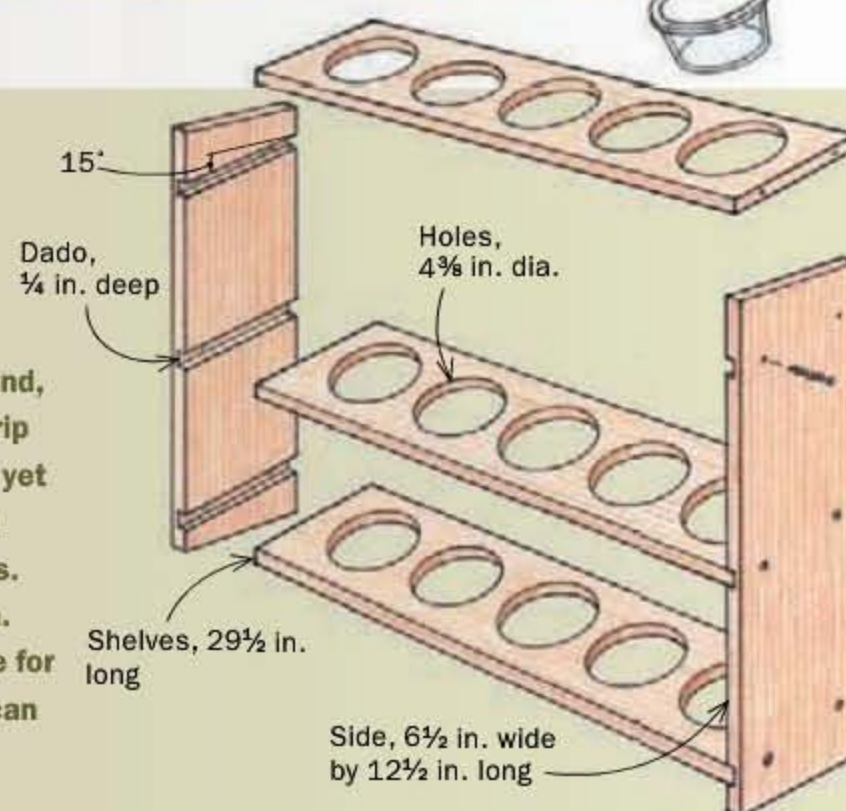


John Hartranft's design inspired this rack.

Reader tip: Handy hardware rack

Woodworkers use all kinds of fasteners and hardware, from carriage bolts to brass wood screws. It makes sense to keep a variety on hand, so you don't have to interrupt your work for a trip to the hardware store. To keep them organized yet handy, *FWW* reader John Hartranft suggested a

simple rack like this. His was drilled to hold open-top yogurt containers. I used larger deli containers, which you can buy in bulk at amazon.com. The design puts the contents on display, and the shelves provide space for labeling. Another great thing about this design is that the containers can be lifted out and carried to the work.



Grab and go. This wall-mounted hardware shelf uses deli containers to hold a variety of wood screws, nails, and dowels. The containers can be lifted out easily.



A bit for big holes. With a fly-cutter attachment for the drill press, cutting large-diameter holes is a straightforward process. Make sure the workpiece is firmly anchored to the table.

Storage

Sheet goods

continued

Because they are heavy and hard to handle, the most efficient place to store sheet goods is near the entrance where you bring them into the shop. In this shop, I placed the plywood rack right next to the twin carriage doors. And, because the tablesaw is only a couple of steps away, there won't be any trouble maneuvering through the shop with a cumbersome 4x8 sheet.

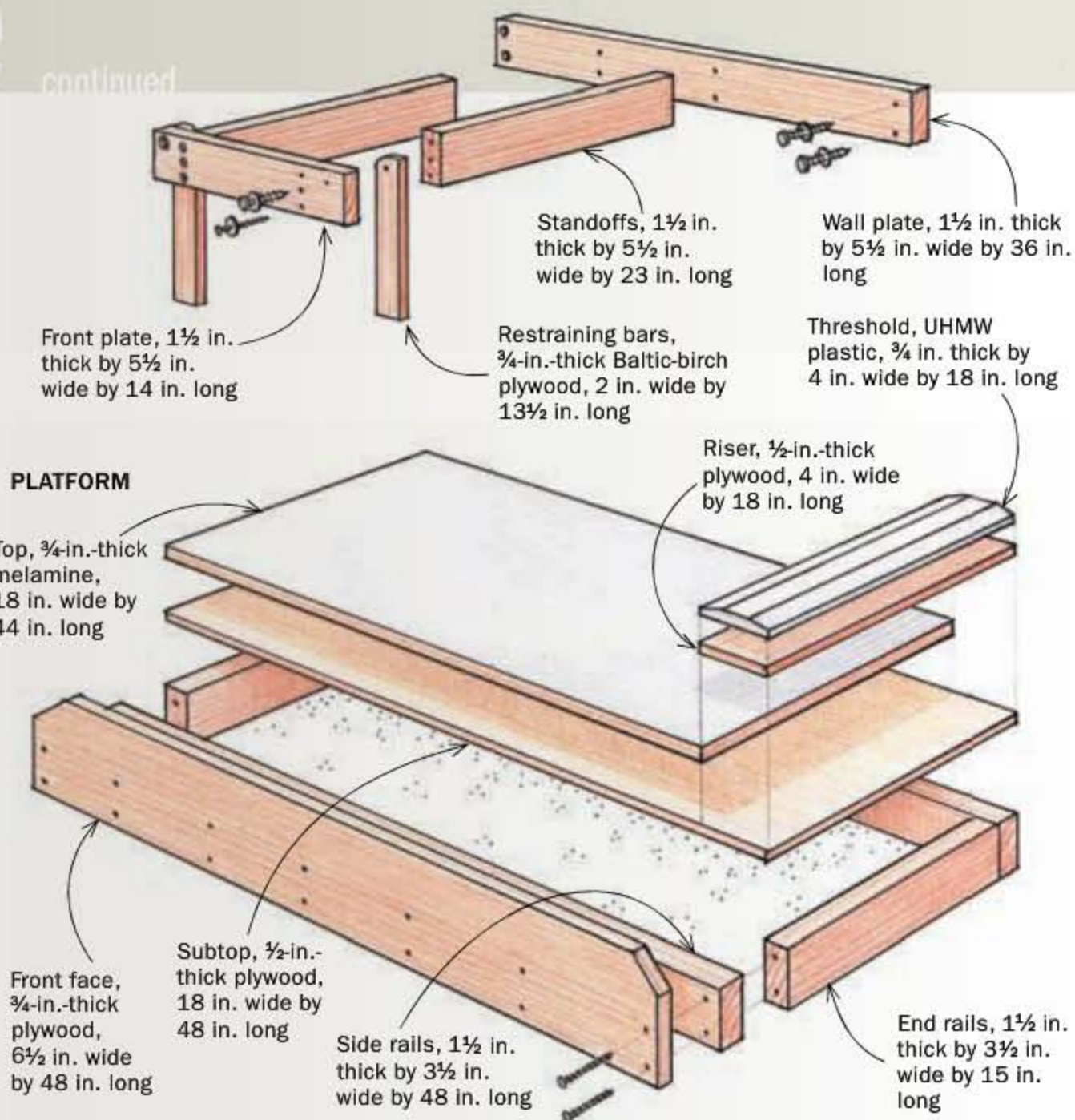
The smart vertical design was suggested by reader Karen McBride. The

Reader tip: Easy-access plywood rack



Karen McBride's plywood rack inspired this design.

rack holds the sheets between the wall and a support arm that can mount to a wall (as shown) or a ceiling joist. The support arm stops the travel of the sheet tops; this lets the user flip the sheets



Safe storage for sheet goods. The restraining bars lift out of the way for loading. A lipped platform secures the sheets at the bottom.



Take your pick. The restraining bars let you leaf through the stack to find a sheet and remove it easily without removing others.

Lumber



Rock-solid rack. A heavy-gauge steel rack, mounted to the wall studs with lag screws, can hold several hundred pounds of lumber. These brackets and standards are sold individually at leevalley.com.

forward to view and retrieve a sheet from anywhere in the pile. The bottom ends of the sheets rest on a slightly raised platform covered with melamine particleboard with a UHMW plastic strip on the open end for easy sliding in and out of the rack.

Lastly, some folks say that a shop is only as good as its lumber stash. But how good is that, really, if the stash is disorganized? The solution is to get your lumber up on a good sturdy rack. It's not much more expensive to buy one than build one, so we bought one. I put the rack along the shop's back wall, with long stock below the window and shorter boards higher up, between the back door and the back window.



Organized. To work around the window, longer boards are stored low, shorter lengths up higher.

18v Brushless Impact Drivers

Pound for pound, no cordless drill packs more punch

BY ERIC CONSTANS

Impact drivers have been widely adopted by homebuilders and contractors, and more recently by woodworkers too. They have two major advantages over traditional drill/drivers: lighter weight and much higher torque. And the impact action makes big screws seem to melt into the wood, seldom stripping their heads in the process.

A new wave of impact drivers has taken those advantages to another level. Boasting brushless motors, the new tools promise even more power and battery life in the same compact package. *Fine Woodworking* asked me to test these claims in the laboratory to see if these high-tech drills are worth their higher prices.

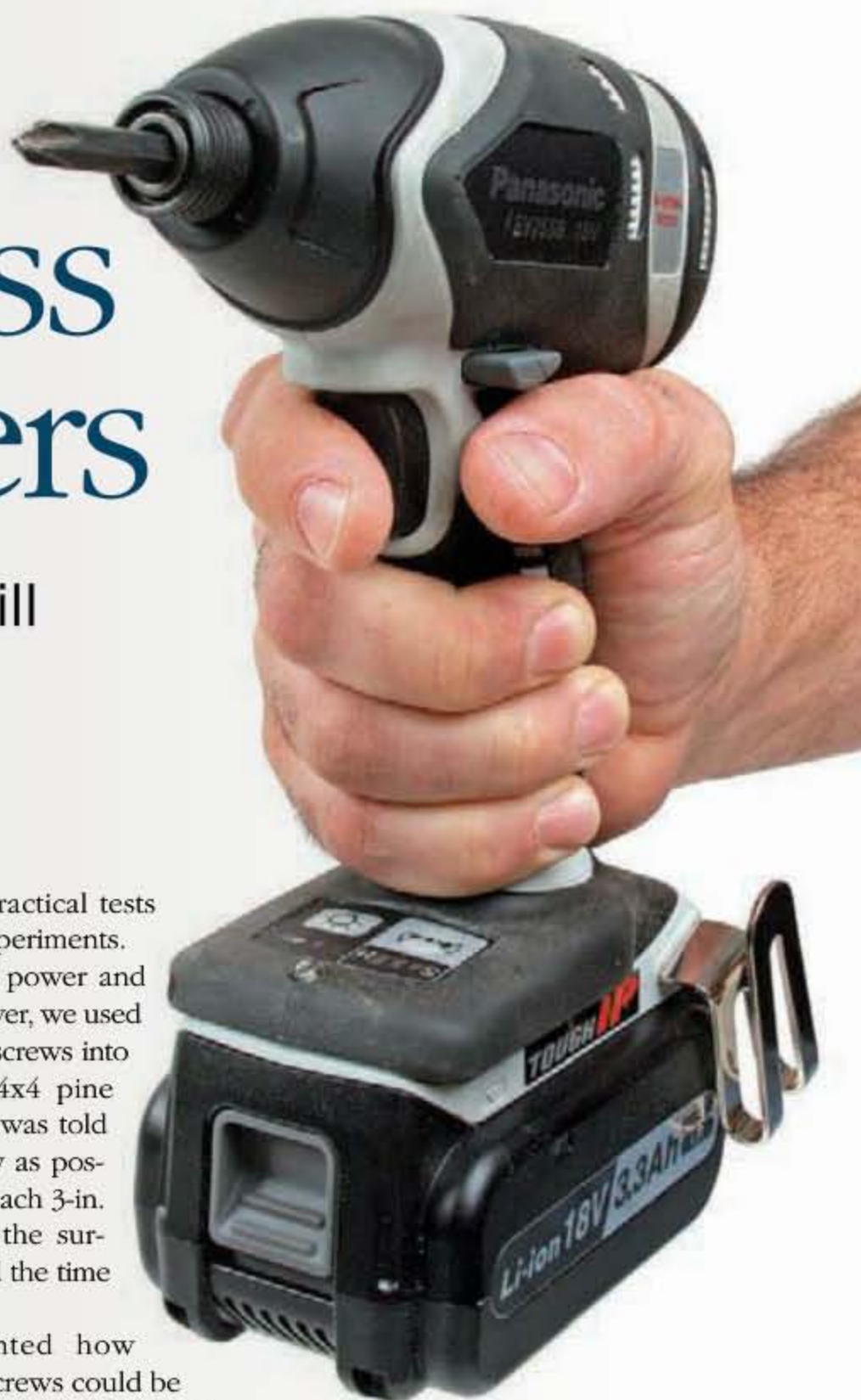
Four torture tests

As the head of a college mechanical engineering department, I'm always looking for ways that my students and I can apply our skills to real-world tasks. In conjunction with *FWW*, we came up with a good

combination of practical tests and laboratory experiments.

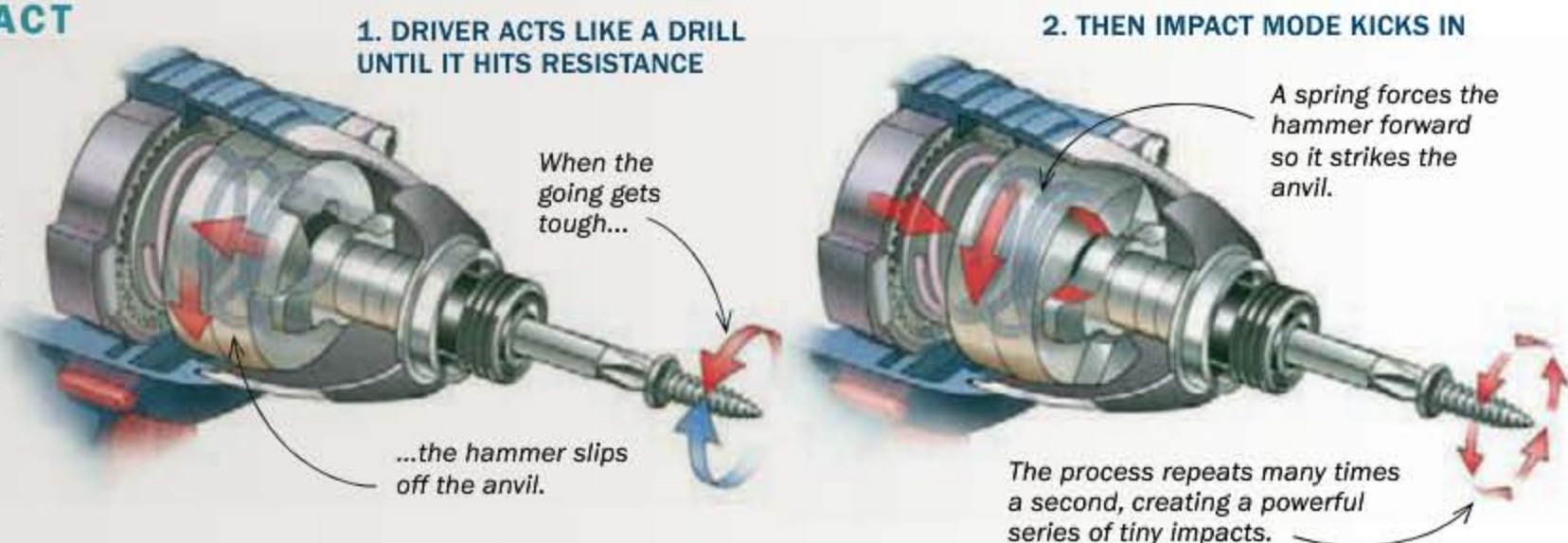
First, to test the power and control of each driver, we used it to sink 50 deck screws into pressure-treated 4x4 pine posts. Each tester was told to work as quickly as possible but to leave each 3-in. screw flush with the surface. We measured the time required.

Next we counted how many 3-in. deck screws could be sunk on a single battery charge. Obviously the longer between battery charges the better, but what this really tests is the drill's efficiency—how much power is used per screw. For the final real-world test, we measured the time it took to drill ten 1-in.-dia. holes through the same



BEHIND THE IMPACT

With its internal hammer striking an anvil up to 3,000 times per minute, the impact driver creates much more torque than a standard driver, yet is easier to control and won't strip the head of a screw (it can break it though). It's much noisier than a standard drill, so ear protection is a good idea.





THE ULTIMATE DRIVING EXPERIENCE



An 18-volt Impact driver can handle any driving task you throw at it. It has fine control for driving smaller screws into a shop jig (far left), enough punch to drive big lag bolts deep into wall studs when hanging a lumber rack (left), and enough run time to drive scores of screws in a major remodeling job (below).

pressure-treated posts. We used self-feeding spade bits (a new one for each driver) to ensure an equal feed rate for each test.

Mechanical power is the product of torque and speed. We measured each drill's steady torque by constructing a winch apparatus and using the drivers to raise an adjustable load to a height of 10 ft. The apparatus has a built-in tachometer, which we used to measure speed. It bore a slight resemblance to a guillotine and generated quite a few comments from students and faculty. In fact, it is a primitive dynamometer—a device used for measuring the power output of a motor.

As a final test, we measured the peak torque of the drivers by tightening a 1/2-in.-13 nut onto a bolt through a steel plate and observing the setting on a torque wrench



IT DRILLS HOLES BIG AND SMALL

An Impact driver's quick-change chuck only works with hex-shank drill bits (right), but adapter chucks (below right) will handle the rest of your bit collection. We recommend the type designed for Impact drivers. They held all types of bits securely in our tests, even huge Forstners in hardwood. Big bits activated the Impact mode, which was a little rough but very powerful.





Up she rises. To gauge each drill's sustained torque, Constans and his students built the "guillotine" and used it to see how much weight the tool could lift.

required to loosen the nut, which adjusts in 60-in./lb. increments.

Amazing stamina and strength

Our testing revealed just how powerful impact drivers can be. When we started the nut/bolt tightening torque tests, we used an aluminum plate instead of steel. After a few tests, we found that the heads of the bolts had been pulled into the plate, creating their own hexagonal holes in the process. When we used a washer under the bolt heads, the plate itself began mushrooming out around the washers. Maybe that's why my gearhead friends told me

that good mechanics never tighten nuts with an impact driver—only loosen them.

In the stamina test of screws driven on a single battery charge (which also tests efficiency), the Panasonic was the most efficient, sinking 129.4 screws per amp-hour. It also sank 50 screws in the shortest time.

All of the impact drivers took approximately the same time to drill ten 1-in.-dia. holes. This is perhaps to be expected, since the torque requirement was relatively low and all of the drivers spin at similar speeds.

In terms of sustained torque, the Panasonic was able to lift the heaviest weight on the "guillotine." When tightening the

nut onto a bolt through a steel plate, the Makita produced the most peak torque—a jaw-dropping 1,260 in.-lb. In reality, each driver generated more than enough torque to overtighten the nuts, more than enough for any woodworking or carpentry task.

Which impact driver is best?

We choose the Panasonic EY7550 as Best Overall. It sank enough screws on a single charge to build a very large deck, or to assemble an absurd number of cabinets using pocket screws. It had the highest sustained torque of any of the drivers, and was also the quickest at driving screws.

HOW ENGINEERS HAVE FUN

Working with his mechanical-engineering students, the author devised a brutal series of tests. Not shown here is the test for peak torque, which involved driving large bolts into steel and then loosening them with a torque wrench.



Drive till you drop. To gauge battery life, students measured how many 3-in. screws each driver could sink into pressure-treated pine on a single charge.



Speed drills. In two other tests, they recorded how fast each tool could drill 10 1-in.-dia. holes through a 4x4 post, and drive 50 more of the 3-in. screws.



Model	Street price	Battery amp-hours	Screws driven	Time for 50 screws (min.)	Time for 10 holes (min.)	Sustained torque (in.-lb.)*	Peak torque (in.-lb.)
DeWALT DCF895C2	\$250	1.5	185.5	5:27	2:23	68.04	1,140
DeWALT DCF895L2 (Same except battery)	\$320	3.0	375	3:43	2:17	68.04	1,020
HITACHI WH18DBDL	\$300	3.0	291	6:25	2:20	68.04	1,080
MAKITA LXDT08	\$285	3.0	290	5:36	2:29	45.78	1,260
PANASONIC EY7550	\$390	3.3	427	4:14	2:06	73.60	1,080

*The only way to measure was in broad increments, hence the identical numbers in some cases.

The DeWalt DCF895 is actually a 20-volt tool, and had the second-highest efficiency of the bunch, right behind the Panasonic. Also, it is the only driver offered with a 1.5 amp-hour battery. The DCF895C2 has almost all the power of its 3.0-amp-hour brother, in a more compact, lower-priced package, and plenty of run-time for wood-working, making it our Best Value choice.

Also worth mentioning is the Makita LXDT08. Its fit and finish were superb, and it generated the highest peak torque. □

Eric Constans is the chair of mechanical engineering at Rowan University, Glassboro, N.J.



THE BRUSHLESS ADVANTAGE

To see whether brushless impact drivers are really stronger and run longer, we tested brushed impact drivers from DeWalt and Makita that were nearly identical to their brushless cousins. The DeWalt brushed drill's run time was 12% shorter, its sustained torque 33% less, and its peak torque was the same. The figures for the Makita were 24%, the same, and 10%.

Modified Roubo Is

Most woodworkers build only one workbench. I've had the luxury of building seven so far. Why so many? Partly because I need extra benches in my shop for teaching classes. But also because I love having benches that excel at holding different kinds of work.

With all the different benches and vises in my shop, I thought I'd experienced about everything in the realm of workbenches. But a year ago I built a small bench to test out two new vises from BenchCrafted that had caught my eye—one a leg vise and the other a wagon vise (see Tools & Materials, *FWW* #225). Both are based on traditional designs but updated with wheel-style handles and acme threads, and built to exceptional standards of quality. For all-around work-holding, these vises were a revelation. They held more securely and were easier to adjust than any other vises I've used. Spin the wheel with one finger and the vises closed on a workpiece with a convincing thunk. They were also easier to install than many other vises. Before I'd had the use of the new bench for a month, it had become my favorite, and I decided that I needed to make a full-size version using BenchCrafted vise hardware.

Powerhouse vises left and right

The bench I built is a modified Roubo-style with a very heavy top and a beefy base. What makes it a Roubo (André Jacob Roubo was a French cabinetmaker in the 1700s who wrote an influential treatise on woodworking) is the massive size, the blocky legs flush to the front edge of the benchtop, and the leg vise, a centuries-old style with a huge jaw that offers superb clamping pressure and lots of space for the

State-of-the-art vises take it to another level

BY JEFF MILLER

workpiece. To function properly, a leg vise requires that the front edge of the benchtop be in the same plane with the front face of the leg.

The vise screw is 8 in. below the surface of the bench, allowing the vise to accommodate very large workpieces, with the vise jaw, leg, and edge of the bench



the Ultimate Workbench



WAGON VISE

Strong vise, solid benchtop. Based on a traditional design, the BenchCrafted wagon vise provides benchdog clamping without a large movable jaw to compromise the integrity of the top. The vise can also be used to clamp boards vertically (right).



LEG VISE



A leg vise with leverage. Another take on an old design, BenchCrafted's new leg vise is versatile, powerful, and silky smooth in use. To keep the jaw parallel to a workpiece, you place a pin in one of a series of holes in the parallel guide (left).



SEE IT IN MOTION



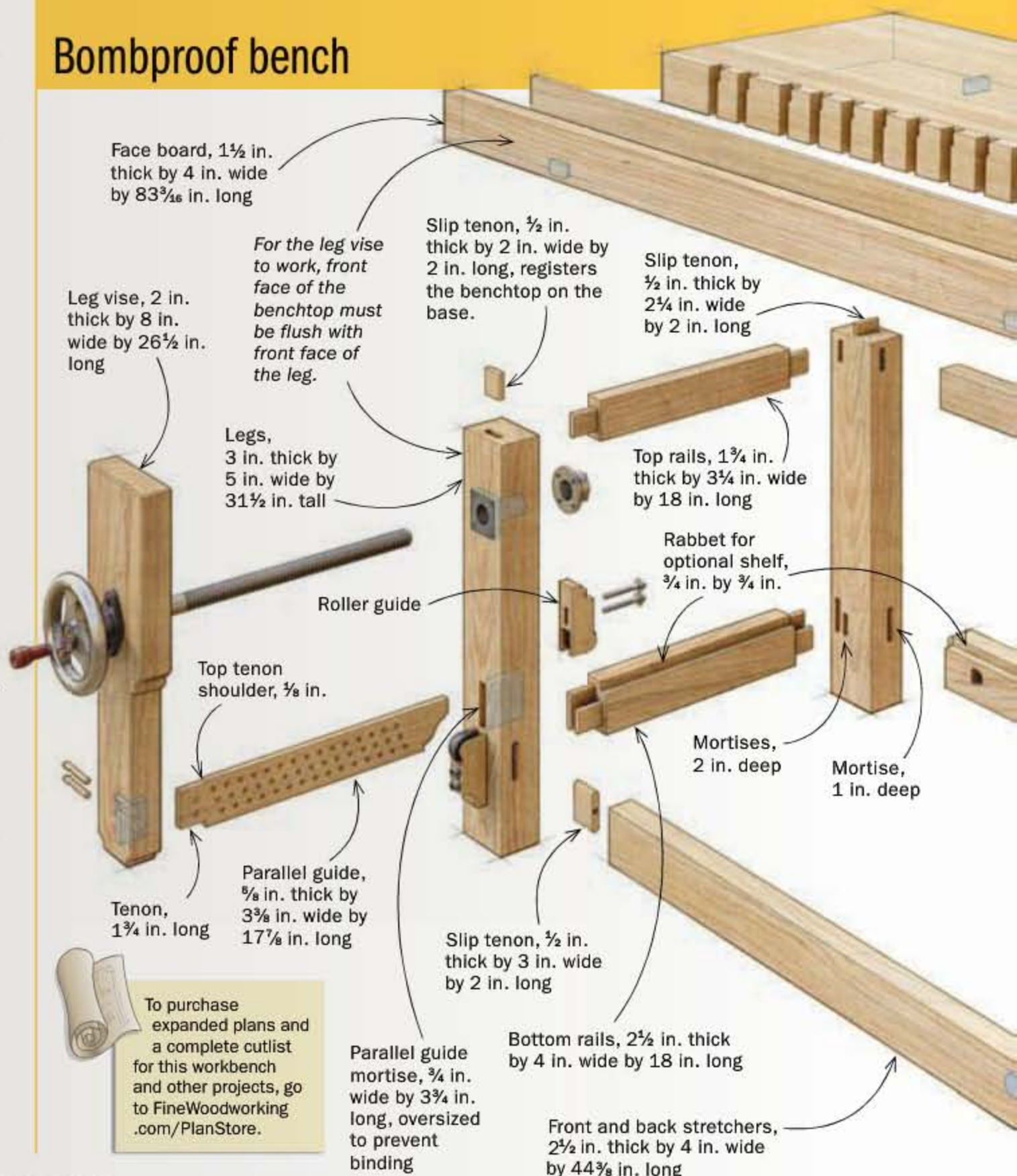
providing a solid grip unmatched by other vises. However, to do so, the leg vise incorporates an adjustable “parallel guide” at the bottom that must be set to roughly the thickness of the workpiece with a removable pin. The extra step takes a little getting used to, but the results are well worth it. BenchCrafted will soon have a new version of the leg vise available, at a higher price, with a scissor mechanism that will eliminate this step.

At the right end, in place of a standard tail vise, is the wagon vise—basically a sliding block with a benchdog that rides in a slot in the top. The huge advantage of this style of vise is that while providing tenacious clamping action for workpieces on the benchtop, the wagon vise has no tail that can loosen up, sag, or vibrate. This makes a big difference in how secure your work feels on the bench. Also, when you’ve used a wagon vise for a while, you will no longer avoid using the front right section of your workbench—it will be just as firm and flat as the rest of the top. Suddenly, you have the whole bench at your disposal.

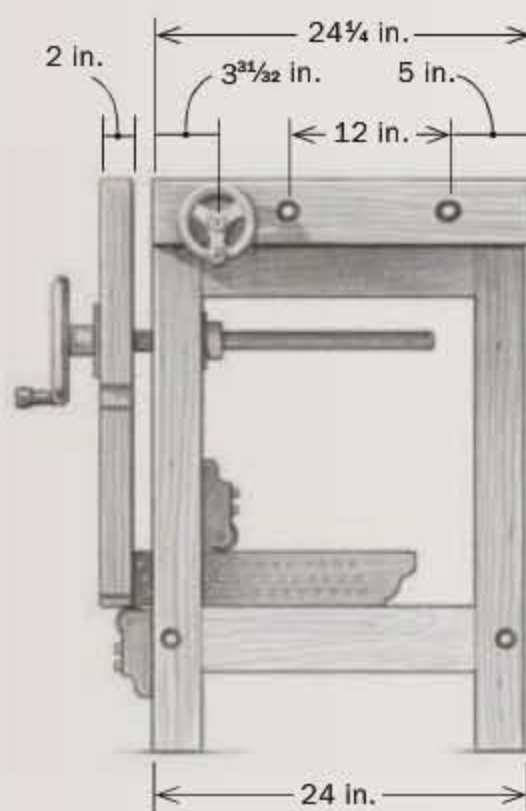
One thing you give up when you install a wagon vise is the ability to clamp very large and thick workpieces, such as bedposts, in the vertical position, the way you can with a traditional tail vise. The wagon vise gives you something in return, however: a slot in the benchtop where you can clamp tall boards up to 4 in. wide and 1¾ in. thick, for dovetailing, for example.

Although the BenchCrafted vise hardware

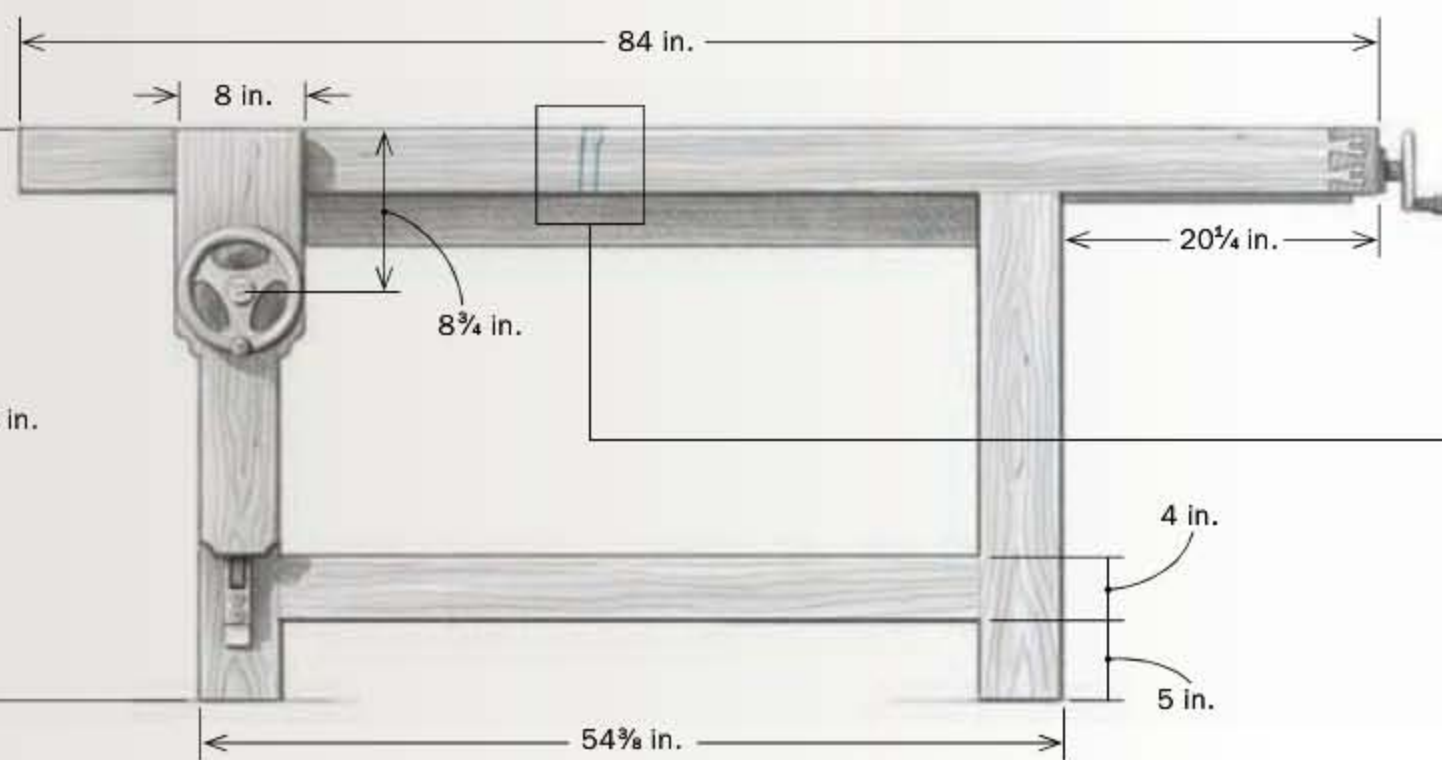
Bombproof bench

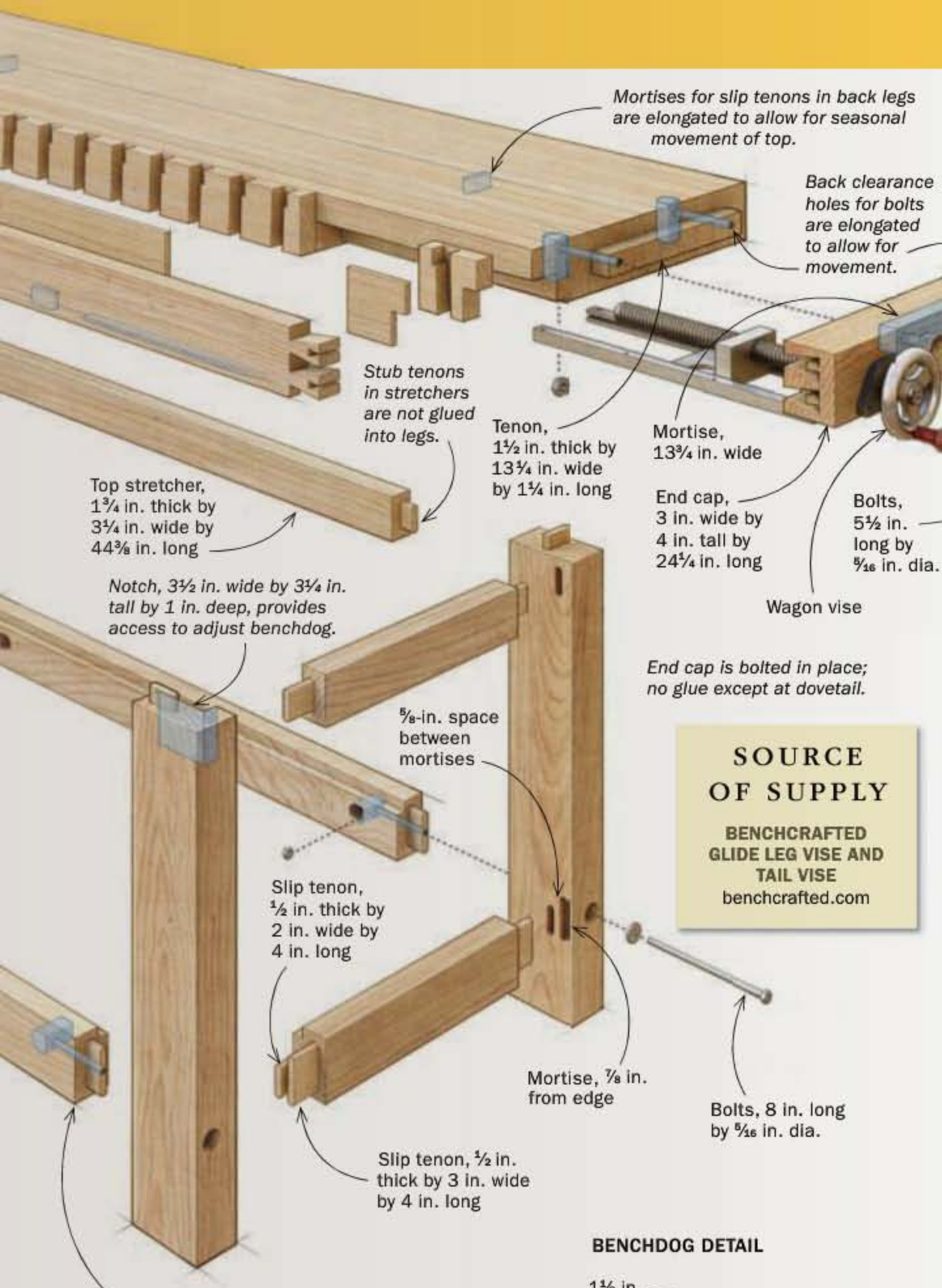


END VIEW



FRONT VIEW

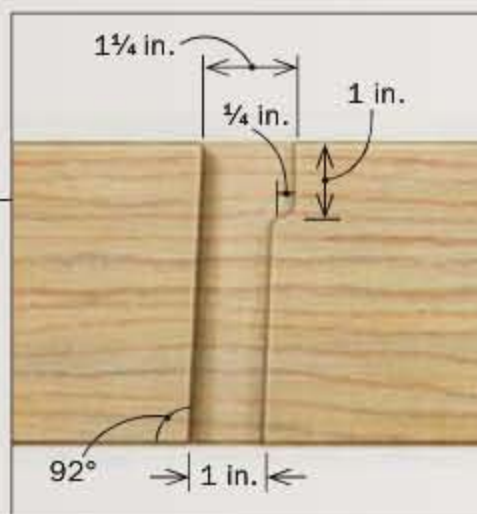




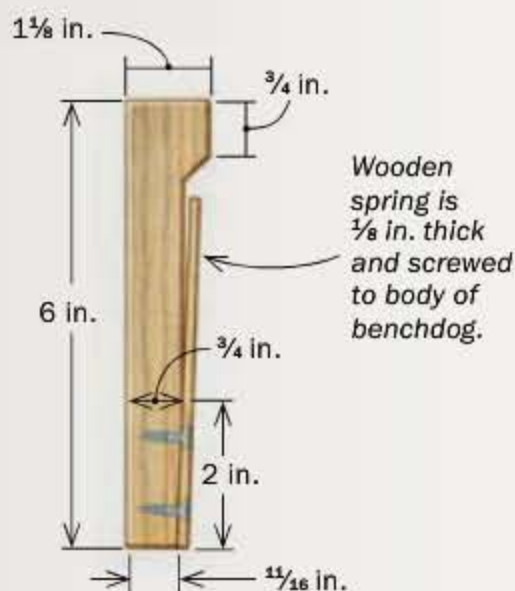
SOURCE OF SUPPLY

**BENCHCRAFTED
GLIDE LEG VISE AND
TAIL VISE**
benchcrafted.com

DOG HOLE DETAIL



BENCHDOG DETAIL



does not come with printed instructions, there are excellent installation manuals on the manufacturer's website (which you can print out), along with a library of videos and a FAQ (frequently asked questions) section. The information they supply is so extensive and well presented that I've included just a few pointers about the vise installations in this article and instead focused on building the bench suited to these two superb vises.

Beefy top welcomes handwork

Weight is the key to a stable bench, especially one that will be used frequently for handplaning and chisel work, and in keeping with the uncompromising nature of the vises, I decided to make the top of the bench a solid slab 4 in. thick by 24 in. wide by 84 in. long—about 165 lb. of ash. After milling flatsawn 8/4 stock, I ripped boards a bit over 4 in. wide and stood them on edge to glue them together, giving me a very stable, quartersawn slab.

You could save some wood and make a portion of the top thinner. You can even hide that fact if you add an end cap to the leg vise end of the bench. But the weight and thickness are an advantage, helping keep the bench very stable even during aggressive work. And having a top of consistent thickness makes clamping down workpieces simpler.

The top has four main components: the main section, the dog-hole board, the face board, and the end cap. I started with the main section. At 4 in. thick by 21 in. wide by 7 ft. long, it is a beast. I decided to glue it up in three 7-in.-wide subassemblies to make the glue-ups more manageable.

Even so, it helps to work with a glue that has an extended open time, so you have more than a few minutes to get each section assembled. To keep the boards in alignment during the glue-up, I used hand-screw clamps at either end, working from one side to the other and tweaking as necessary. I get a very flat result with this method, but if you're inclined you can cut biscuit joints to keep the boards in register—don't glue the biscuits, since they are just serving to ensure good alignment.

After the glue cured, I ran the three subassemblies through the jointer and planer

How to tame a massive top



DIVIDE AND CONQUER

Three stage glue-up. Miller made the 21-in.-wide main section of the benchtop in three 7-in. subassemblies, giving him better control of the glue-ups. He used hand-screw clamps to keep the boards aligned (above).

Machining a major workpiece. Before gluing the three subassemblies together, Miller jointed them flat and square. He used infeed and outfeed supports to aid the process (right).

It's a cinch. The three subassemblies came together in the final glue-up of the main section of the benchtop (below). Clamps top and bottom evened out the pressure. Clamps on the ends aligned the sections.



PARTS OF THE BENCHTOP

Main section comprises three subassemblies.

Flatsawn boards glued face-to-face create a very stable quartersawn slab.

End cap

Dog-hole strip

Face board

Recess, $2\frac{5}{16}$ in. wide by $2\frac{1}{16}$ in. deep by $16\frac{1}{4}$ in. long

First two boards in front subassembly are notched before glue-up to create recess for wagon vise.

and glued up the complete main section of the top. Again I used hand-screw clamps during the glue-up to bring the three sections into the same plane, but a few biscuits could perform the same function.

Creating the rest of the benchtop

The best way to make square dog holes is by routing slots across one board and gluing a thinner board to it. Before cutting the slots with a router jig, I wasted away most of the wood with a dado set on the tablesaw. Because the dog holes were to be 2° off vertical, I tacked a slightly angled temporary fence to the bed of a crosscut sled to make the dado cuts.

Gluing the slotted board to its facing piece is a little tricky. The boards are floppy, and should be glued against a flat surface—I used the main section of the top. Spread the glue carefully to avoid squeeze-out inside the dog holes. The end cap has a large mortise to accept the tenon on the right end of the benchtop. It's easy to rout the slot for the mortise using a plunge router and an auxiliary fence. To support the router throughout the cut, I left the end cap a few inches overlong on both ends.

Trim and tenon the top

I made a simple cuff jig that works both for cutting the bench to length with a circular saw and for milling the big tenon that will mate with the end cap. The jig provides fences across the top and bottom that are



exactly in register. If you need to adjust the alignment of the fences after screwing the jig together, give it a pass over the jointer.

After cutting the bench to length, I used the cuff jig and a straight bit to rout the large tenon on the end of the top. I cut back both tenon ends with a handsaw and cleaned up the shoulder with a shoulder plane.

Then I put the end cap in place and marked and cut the back end of it flush to the back edge of the benchtop. To see where to cut the end cap at the front, I slid the face board in place and marked along its outside face.

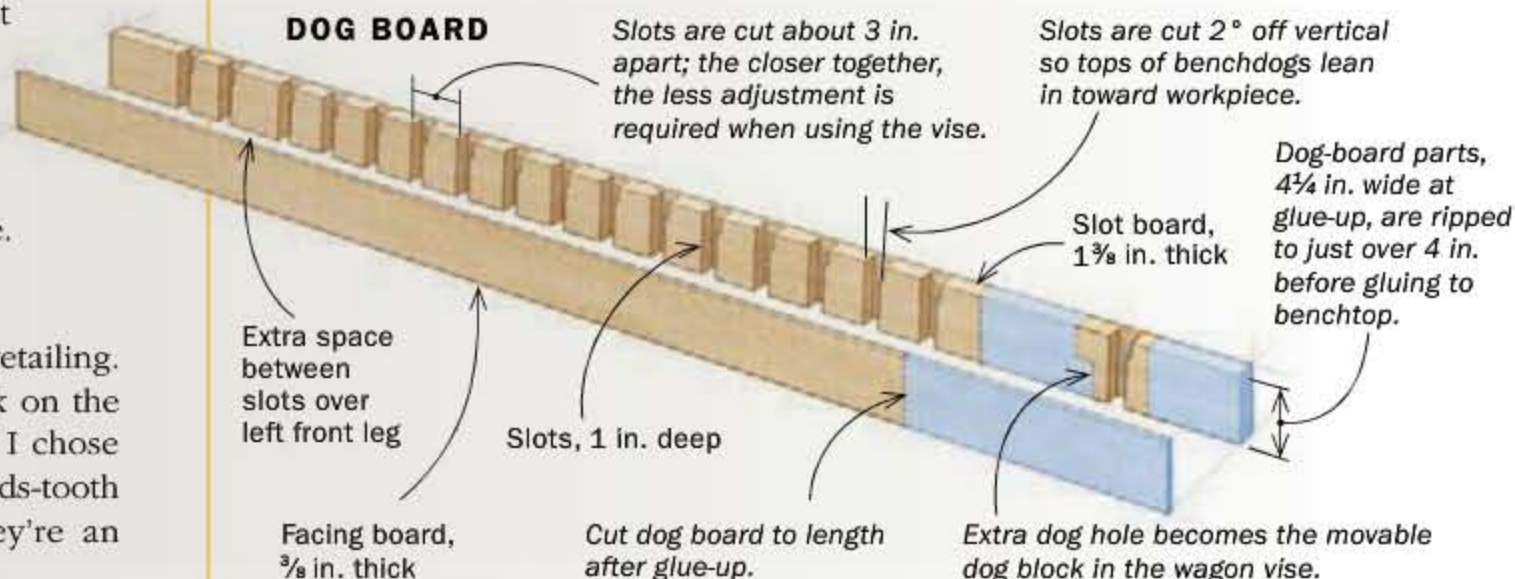
Do the dovetails

Now I was ready to do the dovetailing. It's the signature bit of handwork on the bench, and for a little extra flair I chose to use double-dovetails—or hounds-tooth dovetails as they're called. They're an

SQUARE DOG HOLES MADE EASY



Dado and rout. After plowing out most of the waste with a dado set, Miller used a jig and router with a rub collar to create the benchdog slots. Then he added a facing board to close off the holes.

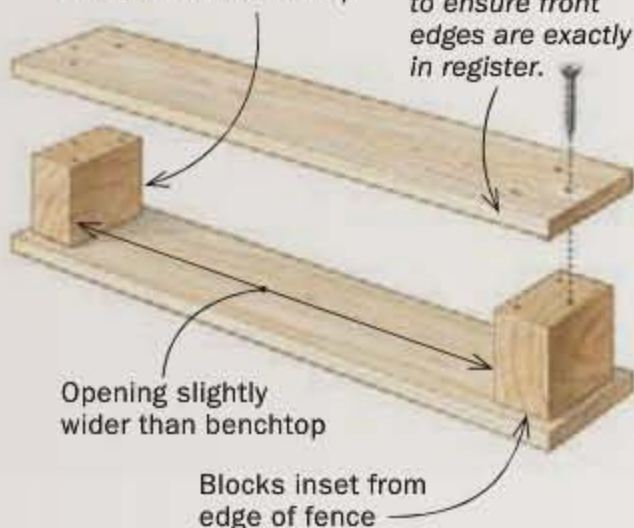


Save the extra dog hole. When the glue was dry, Miller cut the dog board to length. He used the extra dog hole (above) to make the moveable dog block for the wagon vise. Then he glued the dog board to the benchtop and planed it flush.

CUFF JIG

Spacer blocks, same thickness as benchtop

After assembly, jig can be passed over the jointer to ensure front edges are exactly in register.



ONE JIG, TWO USES



Big crosscut, big tenon. Miller's cuff jig gives him perfectly aligned fences above and below. He used it to cut the benchtop to length with a circular saw (left), cutting halfway through from each face. Then he moved the jig and used it with a router (right) to cut the massive tenon that will mate with the end cap.



Face board and end cap go on together



Tails first. Miller used the bandsaw (with a support stand to keep the long workpiece level) to cut the tails in the face board. The rabbet visible below the tails (above) provided better registration (right) when Miller marked the pins on the end cap from the tails.



A lot of chopping. Although Miller started excavating the pins with a trim router, most of the wood had to be removed by hand.



Dry-fit the end cap. The end cap is fitted to the tenon and bolted in place through oval clearance holes (above) to allow for seasonal movement of the top. With the cap in place, Miller used the Bench-Crafted template to mark it for the wagon vise handle hardware (right); then he removed the end cap and took it to the drill press.



Online Extra

After assembly, Miller flattened this benchtop with handplanes. To see how, go to FineWoodworking.com/extras.

added challenge, but they provide more strength plus pizzazz. I cut the tails in the face board at the bandsaw with a support behind me to keep the 7-ft.-long board flat on the table. Using the bandsaw (vs. a handsaw) makes it easy to keep the sides of the tails square. I used the bandsaw to nibble away the waste between the tails, then cleaned up to the scribed base lines with a chisel. I cut away the waste to the outside of the tails on the tablesaw.

With the tails finished, I scribed the pins from them with a knife. I used a combination of hand sawing, routing, and chiseling to cut the half-blind pins. To clean out the waste, I worked the chisels in all directions—with the grain, against it, and across it.

Don't assemble yet

It's best to mark and drill the end cap for the wagon vise screw hardware before

Glued and bolted. At final assembly, Miller bolted the end cap back onto the benchtop with no glue on the tenon. He glued the face board to the front of the top and to the end cap at the dovetail.

Tips for installing the wagon vise



Bridge the gap. A wide sub-base screwed to the router provided the support so Miller could rout accurate grooves for the two wagon vise rails, working with the benchtop upside down.

final assembly of the top. With the end cap bolted in place, I used the paper template provided by BenchCrafted to locate the holes, then unbolted the end cap and took it to the drill press.

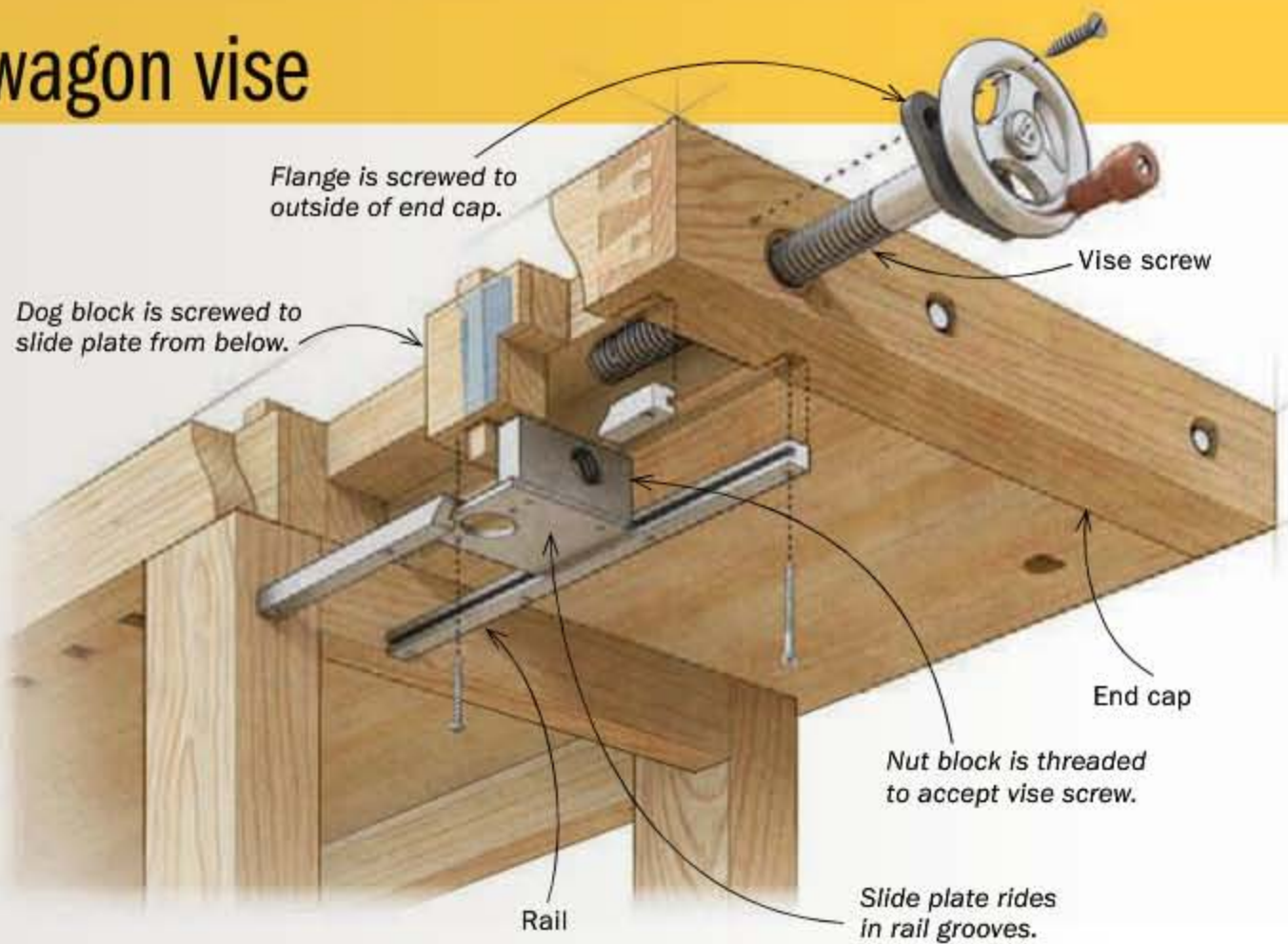
Similarly, it's much easier and more accurate to drill the holes and rout the mortises in the left front leg and the leg vise's jaw before the base is assembled. All the holes are better cut at the drill press, and cutting the through-mortise for the parallel guide in the left front leg (which is 3 in. thick), if done with a router, requires working from both the inside and outside faces of the leg.

Mating the base to the benchtop

Because the leg vise relies on having the benchtop flush with the front face of the legs, the precise location of the benchtop on the base is essential. I used slip tenons in the tops of the legs to keep the base and top in register. I glued the tenons into the legs but left them dry in the top. Once the base was glued up, I inverted it on the underside of the benchtop and used squares and straightedges to locate it exactly. Then I scribed around the tenons and routed mating mortises in the underside of the top. I made the rear mortises oversize in length by $\frac{1}{4}$ in. to permit the top to expand and contract.

Final flattening

When it comes time to level and smooth the top of a bench, I do the job with

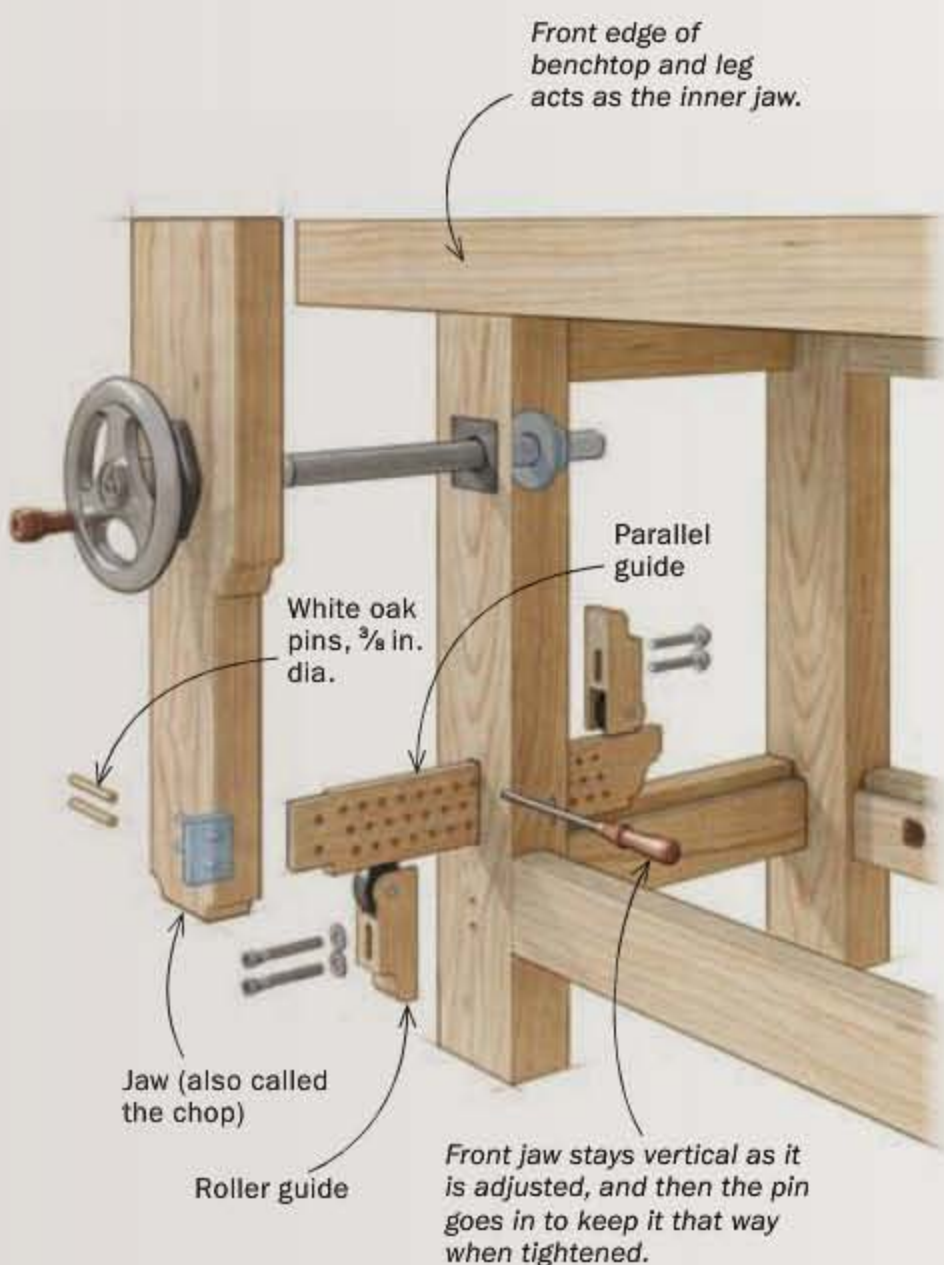


Two rails in one plane. To ensure that the wagon vise operates smoothly, its rails must be perfectly parallel and lie in the same plane.



Drop in the dog block. With the benchtop flipped right side up, Miller fitted the dog block into its slot and fastened it to the moving plate with a screw from below. The nut block reinforces it well in use.

Keys to a solid leg vise



handplanes. It takes some elbow grease, but it's not terribly difficult. If you're not inclined for the workout, you could always outsource the flattening to a shop with a thickness sander. Either way, it's an important step in the process. The flatter the benchtop, the better you'll like your bench, knowing that you can count on it as a reference surface.

I start by planing directly across the top at 90° to the grain direction. You could use winding sticks and straightedges to check your progress, but the planing itself gives plenty of indication of where the low and high spots are.

Then I switch to working the top at a 45° angle. I cover the top completely, then work it at 45° the other way. Lastly, I switch to planing with the grain, taking much lighter shavings for these final passes.

I want it dead flat, but I don't fuss about getting a furniture-quality surface. It's a workbench, after all, and I want to hurry up and put it and those two new vises to use. □

Jeff Miller works wood in a converted post office in Chicago. He teaches woodworking there and around the country.



Drill before assembling the base. After using a Forstner bit to drill a hole through the leg-vise jaw for the vise screw, Miller used the same bit as a transfer punch to mark the front leg for drilling.



Base and top must be flush. For the leg vise to work properly, the front leg must be flush with the front of the benchtop. With the base aligned, Miller marked the position of the slip tenons in the leg tops so he could rout mating mortises in the benchtop.



Correcting overbite. With the top flattened and the bench fully assembled, Miller marked the vise jaw so he could remove it and cut it flush with the benchtop.

Bandsaw Fences

An aftermarket model can work wonders

BY ASA CHRISTIANA



The bandsaw can be the most valuable tool in the shop, making a wider variety of cuts than a tablesaw can, and more safely. But most woodworkers struggle with theirs and never tap its true potential. For perfect resaw cuts, smooth curves, and precise joinery, start by reading Michael Fortune's articles on bandsaw setup and technique, beginning with "Five Tips for Better Bandsawing" (*FWW* #173).

And then check your bandsaw's rip fence. If your saw is equipped with a stock fence, see if it does all the things that the winning aftermarket fences on the following pages can do, and think about upgrading. Like tablesaw miter gauges, some stock

fences are an afterthought. Also, if you've been clamping a board to the table to act as a fence, it's time to burn it and buy a better one. There are plenty of solid aftermarket models out there.

For this review, I focused on systems that will mount onto a variety of 14-in. bandsaws. That's the size you'll find in most woodworkers' shops, and if you know how to set it up properly (see "The right way to beat drift," p. 59), it is plenty of machine for almost anyone. But many of these fences will also work on 16- or 18-in. saws and some are available in a larger size.

I attached everything except the big Laguna Driftmaster (see "Laguna Driftmaster is a different animal," p. 59) to our classic Delta



Kreg does the important things well

Kreg Precision Bandsaw Fence (KMS 7200)

\$107
rockler.com

The Kreg fence system is an excellent value. It goes on any saw easily, even saws bigger than 14 in. It adjusts nicely in every direction, moves well, locks securely at the same angle every time, and has a very accurate and readable rule system. Its extruded aluminum fence is a clever right-angle design, strong yet thin, so it doesn't steal as much throat capacity as some others. It has two T-slots for solid attachment of a tall fence, and a low-profile position. It can also be slid backward for rough ripping.



Adjustments are a cinch. Nylon cap screws adjust the fence for squareness to the table.



Slots for a tall fence. Two T-slots mean you can attach an auxiliary fence and it will stay aligned.



Built-in ruler. With a nicely adjustable and easily readable cursor, you can leave your tape measure in your pocket.



Versatile fence. The Kreg fence can be flipped easily to a low profile (left), which allows you to use a push stick on thin rips, and it can be pulled backward to let rough boards move without binding (right).



Grizzly does all that and more

**Grizzly Resaw Fence Complete
for 14-In. Bandsaws (H7587)**

\$140
grizzly.com

This Grizzly fence system, also designed to fit a wide variety of bandsaws, is easily the best in the lot. It does everything the Kreg does, but it one-ups the Kreg with even smoother sliding action and an even better fence. The extrusion switches more easily from tall to low-profile, and its tall side is much taller, nearly 6 in., meaning you won't have to bother adding an auxiliary fence for resawing. And the extrusion can be taken off completely, leaving only the narrow cast-iron part of the fence for added ripping capacity. My only quibble is the location of the lock lever, which made my hand bump into long workpieces sometimes.



Smooth slider. The sliding and locking action is great, and the cursor is precise.



Quick changeover. The fence extrusion switches in seconds to its low-profile mode (left), or comes off altogether (right) for added rip capacity.



14-in. saw, taking notes on how the fences would attach to other types of saws I know of. I also tested, but ultimately left out, the Jet and Delta aftermarket fences, which require significant metalwork to fit other makers' machines. However, they both are solid performers.

By the way, some systems include a single-point resaw attachment, but I ignored them (again, see "The right way to beat drift").

What can a fence do for you?

Resawing asks the most of your rip fence, so that is a good place to start. For an accurate cut, you'll need a taller fence than usual, at least half as tall as the board you are slicing. If your 14-in. bandsaw has a riser block, it will make a 12-in. resaw cut, so for all these rip fences except the 6-in.-tall Grizzly, you'll need an easy way to attach an auxiliary fence.

Of course, the fence must be parallel to the blade horizontally so it doesn't wander, and vertically so you get an even slice. And you need the fence to stay put, with no movement and very little flex as you press against it. It also should come off easily, either to make a cut that uses the full throat depth, or to move the fence to the right of the blade to align it with the miter slot.

And last, there are a few features that are just plain convenient. Although you can rely on your tape or ruler to position the fence each time, it is nice to have an accurate measuring system on the guide rail, with an adjustable, easy-to-read cursor.

The best rip fences, for tablesaw and bandsaw, do two other cool things. One is switching to a low-profile orientation, which lets you fit a push stick between the blade and fence when making thin rips. Another is sliding toward you so the fence ends at the blade. This is great for ripping boards to rough size, where the two halves sometimes bow and bind against a full-length fence. And you thought a bandsaw's rip fence was just a glorified straightedge!

Two clear winners

Once I had set up and squared up all the fences, the standouts were obvious. The Kreg Precision Bandsaw Fence, at \$107, does everything you need, and the Grizzly Resaw Fence Complete, at \$140, adds a measure of convenience. Either one will make you a better and happier woodworker.

Asa Christiana is editor of Fine Woodworking.

Rest of the field

Accusquare MB Bandsaw Fence (415688)

\$150
woodcraft.com



With a design very similar to the EZ Square (below), this is a solid fence with a few design flaws. If the fence is to the left of the blade, it is impossible to take it off the saw without removing its guide rail completely, which is tedious. I could live with that, but I also found it difficult to lock the fence reliably in a vertical square position. This is because the center clamping bolt is set too low so the fence rocks on it rather than sitting solidly on its plastic guide disks.



Not so vertical. Because it rocks on its guide rail, the fence doesn't always lock square to the table.

EZ Square

\$150
ptreeusa.com



Like the Accusquare (above), this fence locks solidly but is difficult to remove from the saw. You have to loosen the nuts that hold the guide rails in place in order to slide them over. Another problem is the low-friction plastic strip built into the fence. It sticks out a bit from the aluminum extrusion, lowering its effective height to 2 in., and at the same time making it difficult to add a tall fence. Also, the self-adhesive rule was printed in the wrong direction.



Something's askew. With its T-slot located just above a plastic insert that protrudes slightly, this fence pulls an auxiliary fence off vertical.

Excalibur Universal Bandsaw Rip Fence System (90-075)

\$150
acmetools.com



The Excalibur, made by General International, is a very solid fence with some unique advantages. It is among the easiest to attach and adjust, comes in three sizes, and will fit any saw on the market. Also,



its ball-bearing rollers give it the slickest sliding action. But its guide mechanism has too much slack, and the fence pivots up to $\frac{1}{8}$ in. as you lock it in place, making it hard at times to align the blade with a mark on a workpiece or measuring tape.

Setup can be tricky. The fence pivots as you lock it down, making it difficult to line up precisely.

Woodhaven 7280 Bandsaw Fence

\$150
woodhaven.com



The Woodhaven's fence is the only one that locks in the back and front. This makes it the most solid of all, but is also the source of its main drawback: It does not lock at the same angle each time. Its movement is also herky-jerky as you adjust it, and depending on which way you happen to be pushing, the fence can lock down crooked enough to make the blade wander, ruining the cut. It also lacks a ruler system.



Lots of measuring. With clamping points front and back, movement is jerky and the fence won't lock square every time.

Two magnetic fences have same problem



Magswitch Dual-Roller Guide Attachment, plus Starter Kit

\$100

mag-tools.com

Although the Magswitch resaw system is assembled from components while the Carter is ready to go as is, the two fences are very similar in design, and their main asset—powerful magnets that lock them to the saw table with the turn of a knob—is also their undoing. With no way to keep the fence in proper alignment, you are forced to put a square on the front edge of the saw table each time you adjust the fence, or measure to the miter slot in two places.



Carter Magfence II

\$100

carterproducts.com

Laguna Driftmaster is a different animal



Laguna Driftmaster

\$495

lagunatools.com
(avail. Jan. 2013)

Laguna launched its first Driftmaster bandsaw fence five years ago. We tested an updated version, available in January 2013, which has improved components and features—easier attachment and setup, a beefier lead screw (acme threads), and no interference with a bandsaw's lower door. It is a big, industrial tool, with a large dial that swings the tall fence quickly to any drift angle and a long screw that micro-adjusts the fence (a knob disengages it for big fence moves). I change blades when mine dull and begin to drift, but if I



had an industrial shop, with a big bandsaw dedicated to resawing, the Driftmaster would let me run big blades longer even when the drift angle changes.

Dial in the drift. No fence makes it easier to adjust the fence for blade drift, even to an extreme angle.

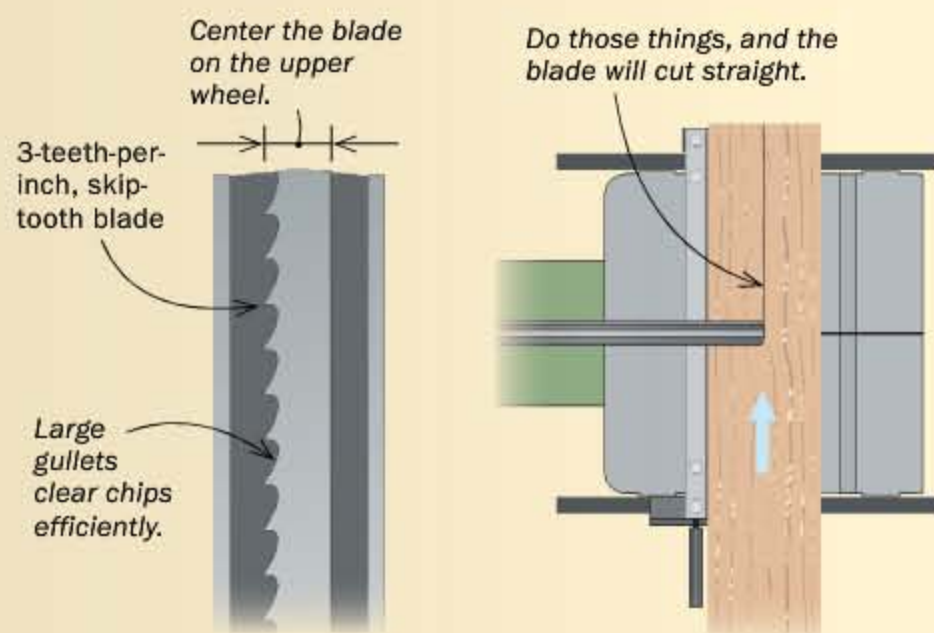
The best way to beat drift

The hot item on bandsaw fences these days is a single-point attachment for resawing. This pivot point lets you adjust a board's angle on the fly to match the blade's "drift." It is a bad fix for a series of misunderstandings about bandsaw setup. You don't want to have to guess at the drift angle, and you won't be able to get consistent cuts by constantly pivoting against a single point. The fact is, a bandsaw blade doesn't have to drift at all. Here's why so many do. For one, they have too many teeth, and therefore smaller gullets that can't effectively clear the chips from a tall resaw cut. Also, when blades dull, they tend to cut more on one side than the other. And last, the upper wheel on a bandsaw is crowned, so the key is to have the blade centered on it. I learned these tips from Michael Fortune, and they have worked on every bandsaw he and I have run across. Try them and you'll be amazed. By the way, you won't need that super-high blade tension that is so popular.



Single-point fence is a bad fix. It allows for drift adjustment on the fly, but cuts are inconsistent.

USE A COARSE BLADE AND CENTER IT



Alignment is easy. With the right blade and setup, you can just adjust the fence once, lining it up with the saw's miter slot, and leave it like that.

Lee Valley Turns 35

Go behind the scenes
at a trailblazing tool company

BY JONATHAN BINZEN

Since producing its first tool—a dovetail marker—in 1982, Lee Valley has earned a reputation for designing and manufacturing the most innovative hand tools on the market. The company's Veritas honing guides, marking gauges, grinding jigs, and bevel-up handplanes, to name just a few, represent evolutionary leaps forward, and have garnered numerous awards from this magazine and others.

I'd always been curious about Lee Valley, and especially about how their Veritas tools are designed and made, so this past summer, on the eve of their 35th anniversary, I took a trip up to Ottawa to visit the company offices and manufacturing plant.

I knew the basic Lee Valley facts: It was founded by Leonard Lee in 1978, and it sells woodworking, gardening, and cooking tools worldwide through handsome catalogs, a well-designed website, and 15 retail stores in Canada. I also knew that Lee Valley retails tools from

Great leaps forward

All the tools in Lee Valley's Veritas line have some aspect that is original. Some have incorporated innovations that changed the way people work wood. Clockwise from right: Veritas's power tenon cutters, Mark II honing guide, wheel marking gauge, NX60 premium block plane, low-angle block plane, bevel-up smoother, and grinder tool rest.



hundreds of other manufacturers, as well as producing its own brands. The flagship Veritas line—which includes designs dating back to that original dovetail marker—represents only a fraction of the tools in the Lee Valley woodworking catalog. Yet it is Veritas tools that have made the company's name among woodworkers.

The first stop on my tour was the office of Robin Lee, who took the reins from his father, Leonard, in 2002 (see “Founding Father,” p. 63). When I asked Robin Lee what distinguished Veritas tools from the others Lee Valley makes, he said that to wear the Veritas name, a tool has to be made in North America—the vast majority are made in their own factory—and must have unique features. Often those features are patented. Veritas doesn't do reproductions, he said. That creates a contrast between Veritas and Lie-Nielsen, for example, another company whose hand tools have received armfuls of *FWW* editorial awards. But Lee has nothing but respect for Thomas Lie-Nielsen, whose high-end hand tools stay closer to vintage originals. “Woodworking is complementary,” Lee says. If someone buys a tool from Lie-Nielsen, “that's good for us. That customer is buying into what we all do. Tom's classical, and we're jazz—there's room for both.”

Learning from the past

Veritas tools express a forward-looking design philosophy, but Robin Lee's office also revealed a deep connection to our tool-making past. Along one wall was an old hardware-store cabinet, its drawers and shelves filled with vintage tools. As he pulled out a few—a Stanley 45, a couple of 19th-century nail-pullers, a barrel-stave saw—Lee explained that they were drawn from Lee Valley's ever-growing collection.

Then he took me to see the collection, which is housed in a high-ceilinged space that once held a basketball court. After decades of acquisition by both of the Lees, the collection now contains some

20,000 individual tools. As we walked among the metal shelves, Lee stopped to describe the function, patent history, and provenance of tool after tool. Within a few paces we had passed a saddlemaker's hammer, a planemaker's bench, a broommaker's vise, a typesetter's plane, and seemingly every marking gauge Stanley has ever made. Some of the tools are acquired for their rarity, Lee explained, but most are not. Some are included as examples of a particular mechanism, others to add another variation on a common tool. When a company like Record goes out of business, Lee said, “We will archive their whole product line.”

Tools from the collection are featured on the cover of the annual Lee Valley woodworking catalog, as well as on the company's calendars. But the most important function of the archive, Lee said, is as “a physical library for our tool designers.”

When I first met with the Veritas design team—three designers and a team leader—the collection came up in conversation right away. Steve Jones, who has designed some of Veritas's most futuristic tools, including the new premium block planes, echoed Robin Lee, saying, “Every project starts with existing tools. We pull them from the collection and see what was done. The challenge is not to reject what was good in the past.”

Best of the old and new

A line of joinery saws launched in 2008 provides a good example of Veritas's characteristic combination of new ideas, cutting-edge manufacturing, and elements of traditional function.

The heart of the new saw is its innovative spine, which is injection-molded right over the blade. Having the appearance of plastic but the heft of metal, the spine is powdered stainless steel in a polymer resin binder, with glass fiber added for strength. It took the team many months to find the right material and the right



THE VALUE OF VINTAGE

Old tools beget new ones. Robin Lee, president of Lee Valley, shown here with the company's extensive collection of vintage tools, says old tools are the starting point for new designs. Lee helps assemble catalog covers using tools from the company's trove.



BIRTH OF A TOOL: FROM VINTAGE TO VERITAS

The Veritas side rabbet plane followed a typical design process.

1. FOREFATHER

Close study of this plane, the Record 2506, was the starting point for the design.



2. ROUGH DRAFT IN WOOD

Designer Terry Saunders began the new design with quick prototypes in wood. A handplane knob gave way to modeling clay as he considered handle designs.



3. RAPID PROTOTYPE IN PLASTIC

As he developed the design in CAD, Saunders "printed out" a series of full-scale models with a rapid prototype machine, letting him test the look, feel, and functionality of the tool.



4. FINAL PRODUCT

Like many Veritas tools, the side rabbet plane shares DNA with vintage versions but incorporates significant innovations.



manufacturing process, but in the end they came upon a solution that was not only technically effective but also cost-effective.

And that was essential, because although Robin Lee admires the higher-end tools on the market, he tries to steer Veritas toward the middle, halfway between the boutique and the mass-produced. These saws weren't going to be cheap—they retail for around \$70—but they would be half the price of their higher-end competitors. What Veritas is trying to do, Lee says, is "produce tools that make people say, 'How did they make it for that cost?' We want to make affordable tools that last a lifetime."

A high-tech material was fine for the saw's spine, but the handle would be made of wood. And its design came directly out of the tool collection. The designers picked 20 or so old joinery saws, lined them up, and did a test: Which handle feels best? They picked two, averaged their contours, and scaled them up about 10% for today's bigger hands. Presto.

Jones, who designed the new saws, pointed out that most of Lee Valley's customers are weekend woodworkers. "Our goal," he said, "is to make professional results more easily achievable by amateurs." The designers wanted this to be a "gateway tool," one suited to woodworkers just getting into cutting joinery by hand. "If they can't get the saw started smoothly, they're never going to get an accurate cut," Jones said. So he relaxed the rake on the saw's teeth, with the result that "our dovetail saw cuts a little bit slower than some, but it starts much more easily."

Where ideas come from

Rick Blaiklock, director of Veritas research and development, has a running list with some 100 new tools his team might pursue. The ideas come from all directions, he said, some from the designers themselves and some from Robin Lee, who is "the one with an ear to the ground." Lee taps the large and vocal Lee Valley customer base, which lets the company know, Lee says, "what they like, what they don't like, what they're looking for, and what they can't find." At many companies, he says, "the feedback link is broken. We listen."

Lee Valley keeps the door open to outside inventors, and pays a royalty for tools they decide to manufacture.

In 1996, Paul Ruhlmann, a shop teacher in Cambridge, Mass., with an interest in rustic furniture, traveled up to see Leonard Lee and show him his idea for a tenon cutter that could be chucked into a brace. Lee liked the tool right off, and the two signed a deal that day. With some modifications to the original tool, Veritas has been producing the line of tenon cutters at a good clip ever since.

The design process

Designers Steve Jones and Terry Saunders showed me their workstations, where tools go from rough concept to full-blown design. The first sketches of a new tool are still sometimes made on paper, but very early on the designers switch to computers, working in a 3-D CAD program called Pro/Engineer. As soon as the designer has a workable 3-D model on the computer, he makes the leap to a physical prototype. To demonstrate how that process goes, the designers walked me back to their testing workshop and project storage space.

On shelves in the project storage area were scores of boxes containing models and prototypes, false starts and finished products for every current Veritas tool, one tool to a box. Pull out the box for a tool designed 10 years ago, and you'd see mockups and models and prototypes in all sorts of materials, some fashioned quickly by the designers themselves, others highly accurate full-scale examples of the finished product made in wood by patternmakers.

These days, however, a pair of rapid prototyping machines have put the patternmakers out of work. Affectionately referred to as Hal and Dave, the machines can turn a computer-generated drawing file into a full-featured, full-scale, physical model overnight. Standing about the size of a vending machine and working like a cross between an ink-jet printer and a hot-melt glue gun with a brain, the machines deposit a continuous ribbon of melted plastic, gradually building the prototype from the bottom up in a series of thin layers. The machines use different colors and densities of plastic, some tough enough to be drilled and tapped and put to work.

Developing a tool can consume hundreds or thousands of hours, and the sooner you can go from a drawing to a physical prototype the better, Jones says. "No matter how well you've envisioned the tool,

ABOVE AND BEYOND

Consistency and refinement are built into the manufacturing process.



How flat is that? Using a dial gauge, machinist Scott Shelley checks the flatness of a jointer plane that he's been milling. Multiple checks are built into the manufacturing process in the Veritas machine shop.

Better blades. Veritas, which makes all its own blades, laps them dead-flat on this machine, which has a grooved, cast-iron table. The blades are pinned under iron weights and bathed in a 600-grit slurry.



you're always going to discover something when you hold it in your hands."

Quality control equals reputation

After my visit with the design team, I toured the manufacturing plant, just a short walk up the road. In the machine shop, with its enormous grinders, milling machines, and metal lathes, I witnessed nearly as many steps involving inspection and quality control as machining. And once the tools left the machine shop, they passed through multiple checks in the assembly and packing area. For planes, the first is a comprehensive examination of features critical to use and a visual inspection for even the smallest scratches or casting flaws. When the plane moves on to assembly, it gets a functional test as well as another visual one, and then before it goes into a box it gets a final visual check.

Online Extra

FWW Editor Asa Christiana, a former machinist, also toured the plant. Check out his blogs at FineWoodworking.com/extras for more pictures and video from the Veritas manufacturing process.

At the end of two very full days, I saw Robin Lee once more in the Lee Valley retail store down the block from the main office. As we stood among the workbenches where customers can try out tools, I asked him how Veritas fits into the bigger picture of Lee Valley. "It's not where you make your money," he said, "but it's where you make your reputation. Profit's nice, too, but the Veritas line is really about advancing the art, advancing knowledge, and demonstrating competence." □

Jonathan Binzen is a senior editor.



Hand tools hand-assembled. After leaving the machine shop, the tools are assembled, tested for functionality, and inspected for defects before being boxed up and shipped off.



Founding father

Leonard Lee was looking for an adze and a broadax. He wanted to build a log cabin as a summer house for his family, but he couldn't find the traditional tools of the craft. It was the mid-1970s and Lee, who grew up on a remote, rock-strewn farm well off the power grid in western Canada, was living in the Ottawa Valley and working for the government, running a division of the Department of Trade. A fine job for someone, but not Lee, who found the bureaucracy infuriating.

Thinking he might start his own business, Lee began spending evenings and weekends making and selling woodstoves with help from his wife and his 15-year-old son, Robin. Reflecting on the difficulty he'd had finding traditional hand tools, he thought, "that's a market someone should be serving." Before long, Lee had left his government post and launched Lee Valley Tools, which mailed its first catalog in the fall of 1978. The company produced its first tool four years later. These days, Lee Valley has 850 employees and over 6,500 products in its woodworking catalog.

Tune Up Any Jointer

How to align the tables and knives for flawless results

BY ROLAND JOHNSON

Get it straight

Jointer tables must be parallel for boards to come out straight, and a long straightedge or carpenter's level is how you check.



The thought of tuning up a jointer intimidates many woodworkers. So they play a waiting game, tolerating poor performance or dull, nicked knives until the jointer's shortcomings can't be ignored.

What many folks don't realize is it's not that difficult to get your jointer in top-notch shape. There are two keys to a smooth-running jointer:

tables that are perfectly parallel (actually, coplanar) and sharp knives that are set to the identical height. A jointer with sagging tables won't cut correctly no matter how sharp the knives are. Likewise, perfectly aligned tables won't make dull knives work better. You need to check and fix both, or your jointer will never flatten or square anything properly.

That process can take a little bit of time and effort, but it can be done with tools you probably already have. To check the tables, I use a long straightedge but a high-quality box level works just fine, too. To set the knives, I use a block of wood and a pencil. Barring major problems, most woodworkers can get their jointer tables righted and their knives

replaced in about an hour.

And a couple of equally simple upgrades will make knife-changing even faster. If you want to stick with knives, disposable kits can be installed in minutes. If you want a serious upgrade, segmented cutterheads forgo knives in favor of carbide inserts that hold their edge far longer and can be changed in a minute or two.

No matter what, start with jointer tables that are dead flat and perfectly parallel.

Tables first

A jointer's infeed and outfeed tables must sit in the exact same plane. Otherwise, a board can rock or pivot as it moves over the cutterhead, resulting in a board that isn't perfectly flat or square. It's best to check

the tables before replacing the knives because you'll have to raise the outfeed table, which you normally wouldn't do after the knives are set. If there is a problem, it should be fixed before installing new knives.

First, check the infeed and outfeed tables separately to see that they are flat and straight. I do this by raising each table to its highest position and laying

a straightedge on top of it to look for gaps of light. Examine both sides, the middle, and the corner-to-corner lengths, to see if there's any wind. If you see gaps thicker than about two sheets of paper, consult the manufacturer about whether the table needs to be flattened or replaced.

To check whether the tables are parallel, I use a 50-in.-long

straightedge (Veritas 50-in. aluminum, \$85, leevalley.com), long enough to span a good amount of both tables. Place the straightedge to bridge the cutterhead, and check the middle, sides, and diagonals for gaps.

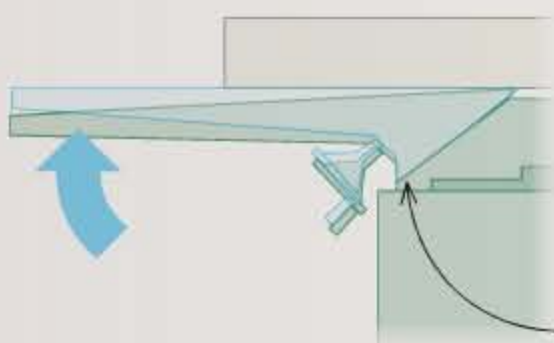
Occasionally, jointers sag at an end or corner. To fix this, you need to raise or lower the position of the table on the

JOINTERS WITH WAYS

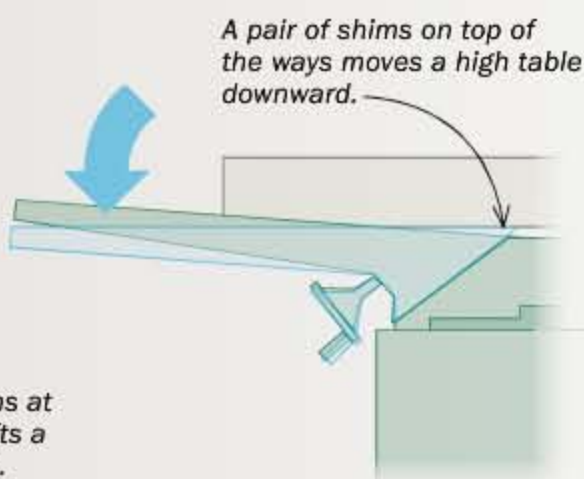
Traditionally, jointer tables ride up and down on sliding dovetails of sorts, called ways. Adjusting them is easier than you might think.

SHIM THE OUTFEED TABLE

You rarely need to move this table, so the shims will stay put there.



A pair of shims at the bottom lifts a sagging table.



A pair of shims on top of the ways moves a high table downward.

Start with the gibs. If you see misalignment, try just loosening and retightening the gib on both tables. It's often enough to fix any sagging, lifting, or twist.



Shopmade shims. Use 0.005-in.-thick pieces of brass, which are easily cut with scissors and are available at most hobby shops.



Insert tab here. Loosen the gib, insert shims between the ways, and retighten.

Parallelogram beds are different

Repositioning tables is easier on a parallelogram design because each corner can be raised or lowered by rotating a bushing that connects the table to the base. To move the table evenly, make the same adjustment on each side.



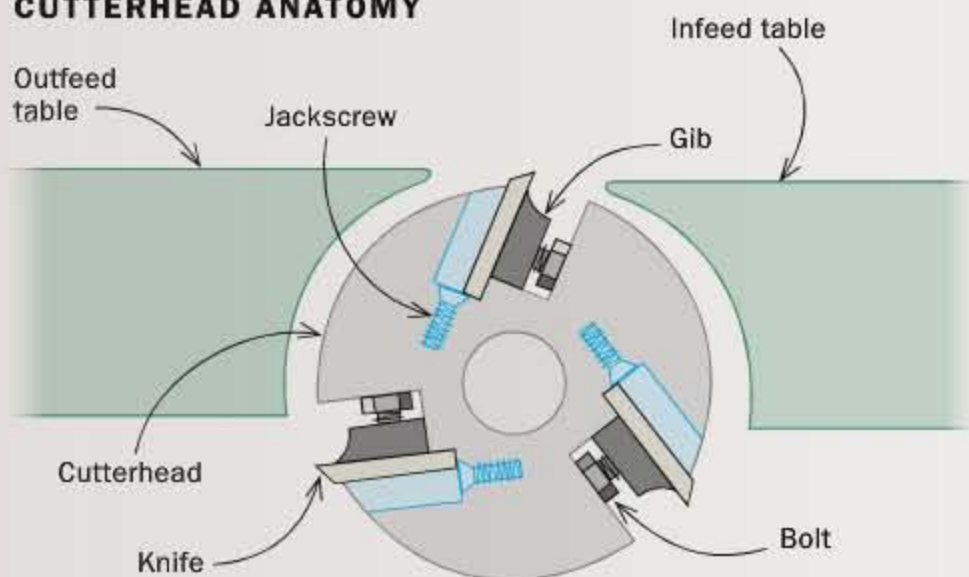
Rotate just a little. Raise or lower a corner of the table by first loosening a set screw and rotating the eccentric bushing with a wrench or screwdriver (above). Use the detents or your own marks as reference (below).



Set the knives

With a clean cutterhead and a fresh set of knives roughly in place, use Tage Frid's classic board trick to quickly get every knife cutting at the same height.

CUTTERHEAD ANATOMY



jointer base until any gaps disappear. Making that adjustment depends on whether the jointer is a parallelogram design, or one with dovetailed ways.

On a dovetail-way jointer, use thin metal shims to adjust only the outfeed table. Except for setting the knives, the outfeed is rarely moved, so the shims are less likely to shift or fall out. Before adding shims, I loosen and retighten the metal

strip, known as the gib, that sits in the ways. Often this will release tensions in the mechanism that can shift the table back in place and eliminate the need for any shimming.

Determine where to shim by sighting underneath the straightedge, then loosen the gib to slip shims between the ways. Short shims on both sides of either end of the way will raise or lower the table. A long shim centered on the sagging side of the way will fix winding. Snug the gib and keep checking and shimming until the outfeed table is coplanar with the infeed table.

On a parallelogram jointer, you can adjust either table. Just raise or lower the tables by loosening a set screw and turning an eccentric bushing or similar adjustment that connects the table to the base.

1 MAKE A CLEAN START

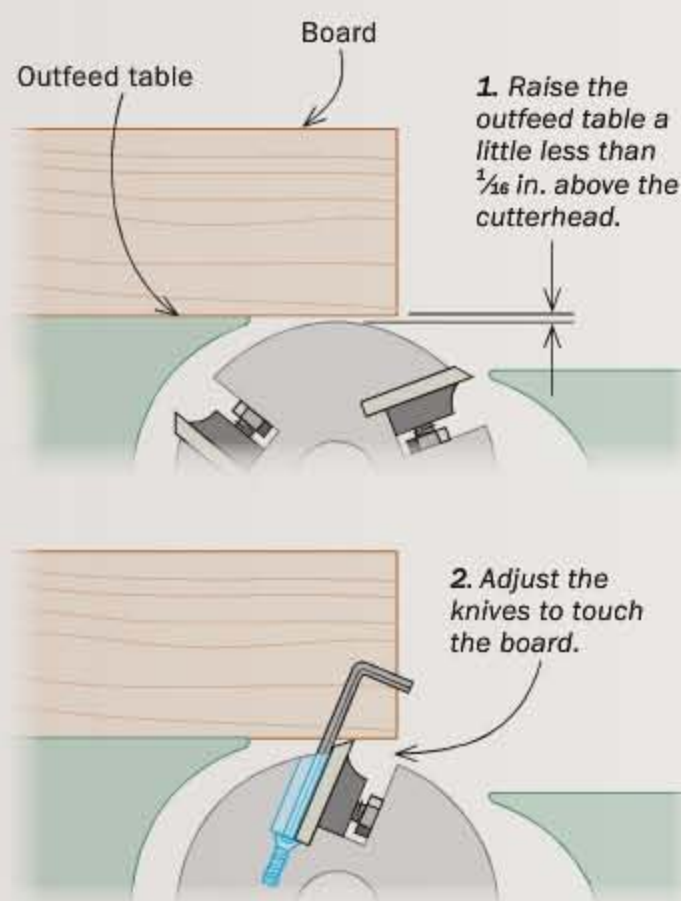


Brush out the grime. Use a thick bristle brush and a bit of degreaser to remove caked-on crud that can interfere with setting the knives.



Flatten the gib. Use a diamond plate or fine-grit sandpaper stuck to a flat surface to flatten the gib's face and help it grip the knives evenly.

2 GET THEM CLOSE



Work off the outfeed. With the table raised, use the jackscrews to adjust the height of the knives so that each one just grazes a board when the cutterhead is rotated by hand.

3 USE THE BOARD TRICK TO FINE-TUNE THEM

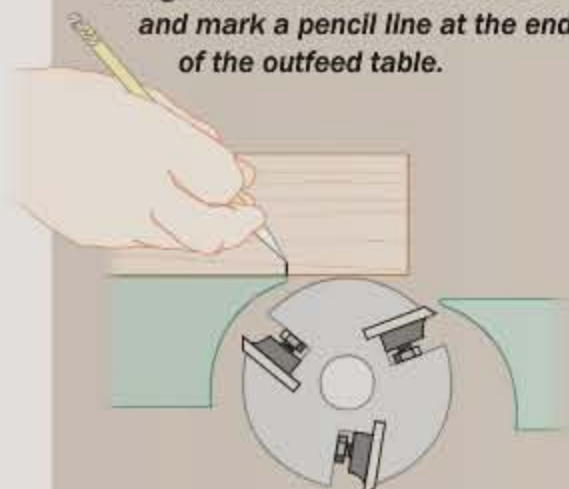
MAKE THE SETUP BOARD

Get low. Dropping the outfeed just a bit gives clearance for the knives to pick up and drag a board a short distance. You'll use that distance to calibrate the height of each knife.

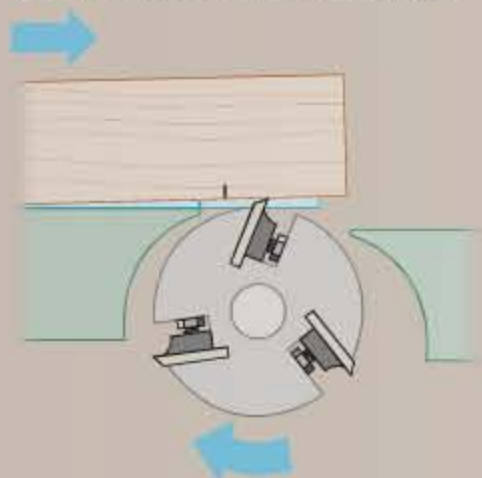
Lower outfeed table roughly $\frac{1}{32}$ in. below previous setting.



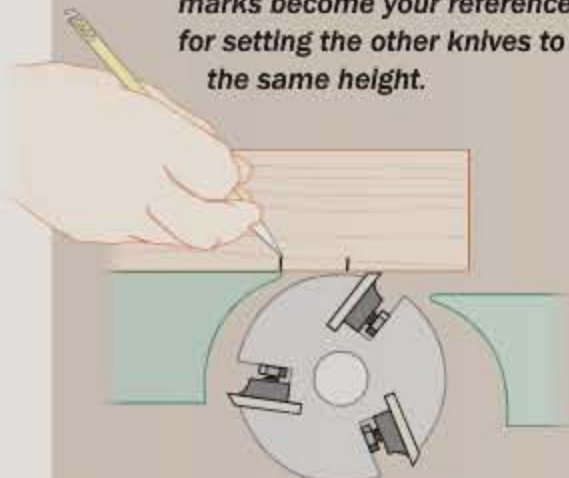
Mark the overhang. Hang a straight board over the cutterhead and mark a pencil line at the end of the outfeed table.



Hand-rotate the cutterhead. Let the knife drag the board forward.



Mark the drop. The two marks become your reference for setting the other knives to the same height.



Work to the lines. Start at the same mark to check the height of the other end of the knife (above), adjusting the jackscrews (left) until the board moves the correct distance. Then do the same at both ends of the other knives.

the surface of the cutterhead, or about half the thickness of a knife. That distance determines how far the knives stick out of the cutterhead, and creates a reference surface for setting the knives.

Then remove the knives and install a fresh set. On most jointers, the knives are held in place by a metal gib with a series of bolts that push against the slot in the cutterhead and keep everything wedged in place. Loosen the bolts to pop out the gib and knife, and install a new knife the same way.

Get each knife close to its final height, hang a board with

a straight edge over the end of the outfeed table, and adjust the jackscrews until each knife barely touches the board when rotating the cutterhead. Tighten the gibs enough to keep the knives firmly in place until they're set.

Shopmade setting jig

Most jointer knives can be set precisely with a sharp pencil and a straight board. The basic technique is to lower the outfeed table, hang the board over the end, and hand-rotate the cutterhead so that it picks up the board and drags it a short distance. By marking where the

Set the knives continued

BEST BET FOR SPRING-LOADED CUTTERHEADS

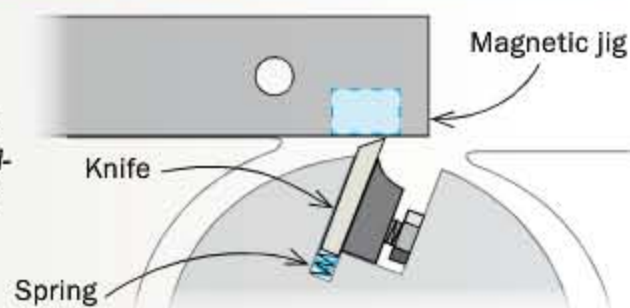


Magnetic jointer jig
No. 34099
rockler.com
\$32

Spring-loaded knives don't stay put, so the board trick won't work. But a magnetic knife-setting jig is just the thing.



Loosen and retighten.
The jig keeps knives locked in perfect position while you retighten the gib.



Simplify knife changes with disposable blades



If you don't want to spend time setting knives, disposable blade kits from Esta-USA can be installed and set in minutes. The knives snap into a tabbed holder that sits in the pocket of the cutterhead. The tabs register off the top of the cutterhead so each knife sticks out the same distance, eliminating the need to adjust it. The knives are double-edged, but can't be sharpened. Kits for an 8-in. jointer with three knives cost \$270 (\$35 for just the knives).

Snap them together. Attach the knives to the holder and drop the whole assembly into the pocket of the cutterhead.



Pre-set stops. Tabs on the holder ensure the knives stick out equally.

board meets the end of the outfeed table before and after dragging, the board becomes a story stick that can be used to set every knife to the same height.

To set the other knives, just line up the first mark on the end of the outfeed table and rotate the cutterhead. When the board drops, check that the second mark falls exactly at the end. If not, raise or lower the knife using the jackscrews, and keep checking with the board until it does. Repeat the procedure for both ends of each knife, then lock down the gibs once everything's set.

Now, raise the outfeed table so that it's perfectly flush with the highest point in the rotation of the knives, which is known

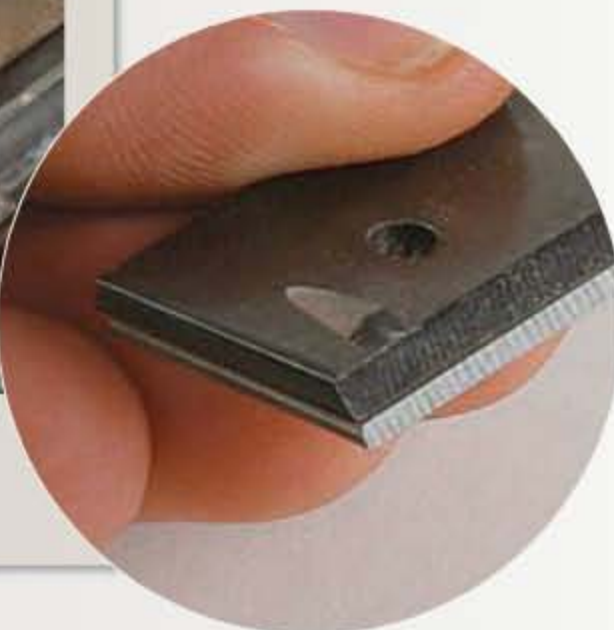
as top dead center. I do this by extending the straightedge over the cutterhead. Raise the table so that the knives barely miss it as you hand-rotate the cutterhead.

Magnetic jig for springs

On a cutterhead that has springs instead of jackscrews, a magnetic jig works better because it compresses the knives down into position. Magnetic jigs also work on cutterheads with jackscrews, but in either case, you'll need to make a scribe line on the outfeed table before using the jig.

Find top dead center on the cutterhead, and then mark the fence where the tip of the knife lines up. Place the jig on the outfeed table, aligning the front mark on the jig with the mark on the fence. The jig will have a second mark on the rear of its bar; use it to locate and scribe a line squarely across the outfeed table. Now, whenever the jig is placed on the outfeed table, the mark in the front shows top dead center. Set each knife so it touches the jig at that point.

To install new knives, place the jig on the outfeed table and align the mark, then ro-



Or trade up for a cutting-edge cutterhead

Segmented cutterheads are taking the woodworking world by storm. Upgrading will give your jointer an edge that lasts 20 times longer than traditional knives, and takes only a minute to pivot and refresh. And for highly figured or dense woods, they cut much better than regular knives. Installation varies with the cutterhead and the machine, but in general the only special tool required is a \$25 bearing puller (amazon.com) and a piece of PVC pipe.

You'll start by removing the old cutterhead and pulling the bearings. Then you'll stand the new cutterhead on end and tap on the bearings with the PVC. If you're worried about this step, a machine shop, mechanic, or anyone with an arbor press can do it. Then it's just a matter of reinstalling the new cutterhead, reattaching the pulleys, and adjusting the outfeed table.

Segmented cutterheads start at around \$330, but you'll save money and time over the long term because the edges last so much longer.

tate the head until a knife is directly under the top-dead-center mark. Loosen the gib so that the springs push the knife against the jig, while the magnets pull the jig tight to the table. Then retighten the gib to lock the knife in position.

After everything's locked up and dialed in, the outfeed table should be perfectly in place, and you'll be ready to joint boards flawlessly. □

Contributing editor Roland Johnson is a woodworking machinery expert who lives outside Minneapolis.



Online Extra

To watch Johnson install a segmented cutterhead in an 8-in. jointer, go to FineWoodworking.com/extras.



1 EASY TO INSTALL

Out with the old, in with the new. The cutterhead and bearing housing should come out as a single piece (1). Start by pulling the housing (2) and bearings off the old cutterhead. Tape the new head to avoid cutting your hand, and then tap on the bearings (3). A PVC pipe helps spread out the force from the hammer blows when reattaching the bearing housing (4).



Build Your Own Spray Booth

Get a pro-style setup at a fraction of the cost

BY GEOFF GUZYNSKI



Double duty. When not in use as a spray booth (left), the area in the garage is wide enough to park a car in (above), or store woodworking equipment on wheels.

Once you've learned to spray a finish, you'll never pick up a brush or cloth again. First of all, it's quick: You can completely finish a large project in one day. Then there's the quality: Finishes designed for spraying dry quickly, so dust is less likely to settle in them. With practice, you can spray a finish that's so good it doesn't need rubbing out. But first you need a place to spray.

My shopmade booth is modeled after a commercial-style, cross-flow model, something I've wanted for a long time but could never afford. It cost less than a quarter of the \$4,000 to \$5,000 price of a commercial booth and didn't take long to put together.

Good airflow determines the location

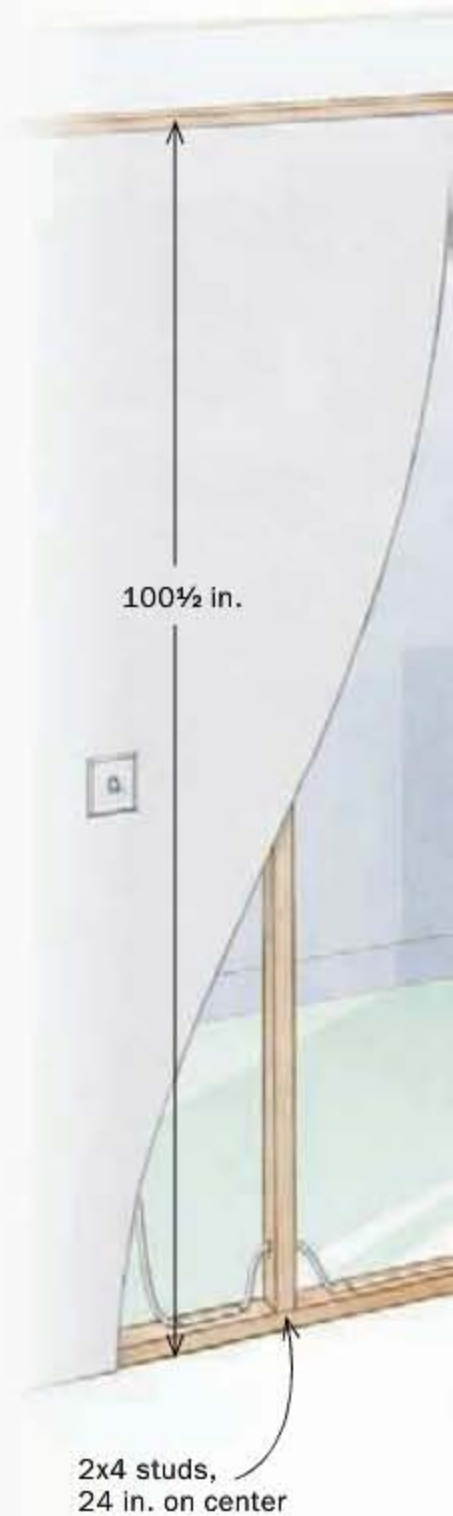
The first decision is where to build this large chamber. There are two considerations, space and airflow. I put mine in the back of my detached garage, and because the booth is 9 ft. wide, like a standard parking space,

there is just enough room to park a car in it. But even if you build the booth in your shop, it doesn't have to be wasted space because you can use it to store a lumber cart or any machinery on a mobile base.

You need a source for the large volume of fresh air to feed the booth. I simply open the garage door, directly opposite the booth. If you're pulling air from the house, you will need to open several windows or doors to supply the volume of air needed for good cross-flow. You'll also need an opening for the exhaust air at about waist height. This can either be an existing window or a hinged door cut in the siding like mine.

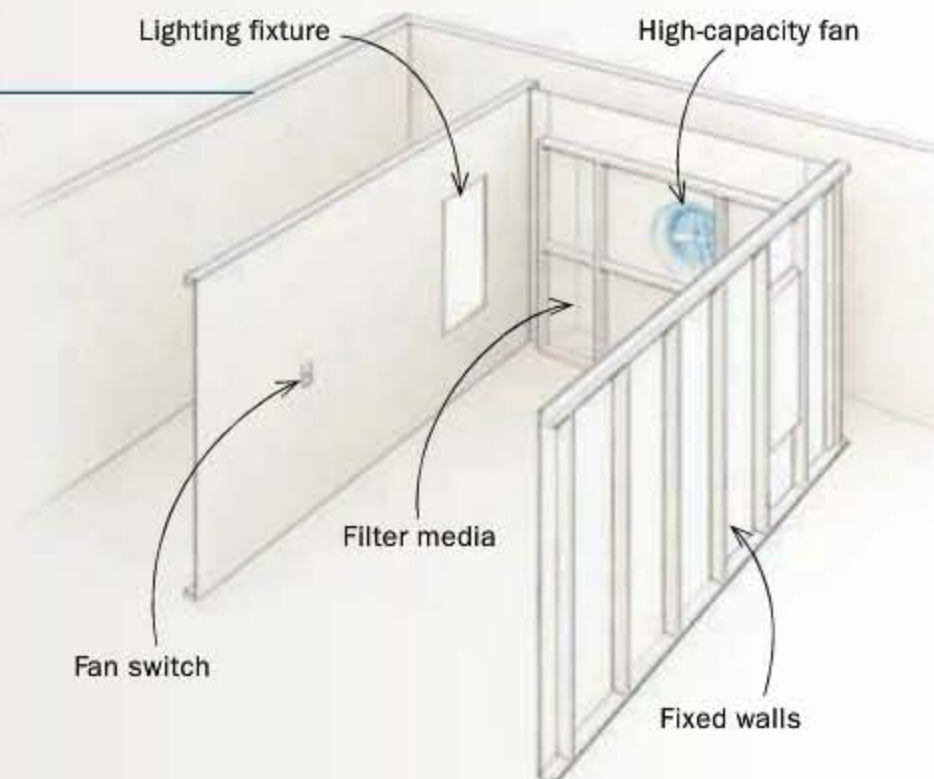
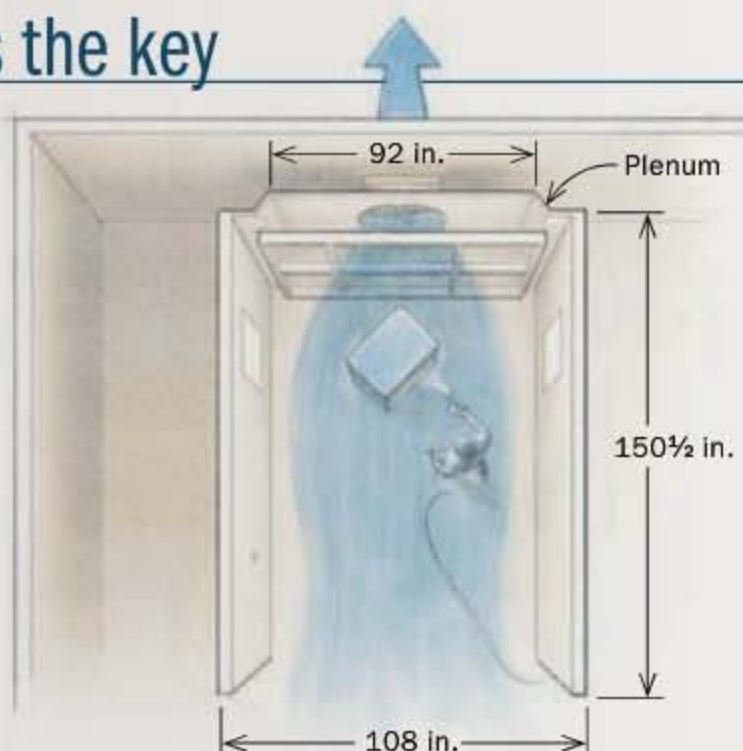
A bellmouth improves the fan's efficiency

The heart of any spray booth is the fan, which draws large volumes of air quickly past the workpiece, pulling away overspray and fumes. A household box fan is nowhere near powerful enough, nor are most whole-house extraction fans. The 24-in.-dia. propeller that I



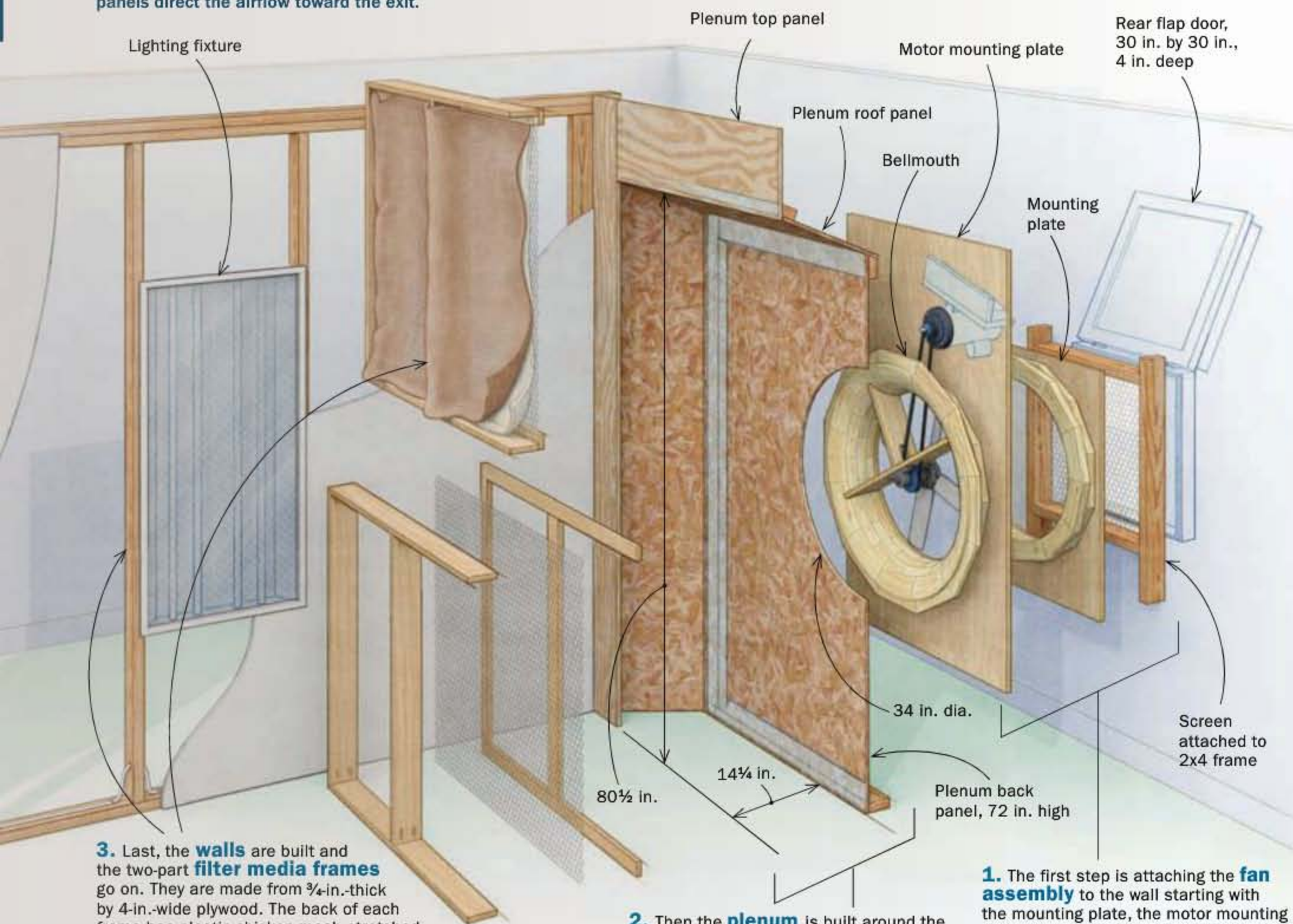
Cross-flow is the key

A high capacity, 24-in. fan at the back of the booth expels the waste air through a flap door cut into the end of the building. Fresh air enters the front of the booth, picks up overspray, and deposits it on the filter before passing through the fan.



ANATOMY OF A SHOP-BUILT BOOTH

A critical component of the booth is the plenum, which is the area between the back of the filter media and the fan. Its sloped roof and rear side panels direct the airflow toward the exit.



3. Last, the **walls** are built and the two-part **filter media frames** go on. They are made from 3/4-in.-thick by 4-in.-wide plywood. The back of each frame has plastic chicken mesh stretched across it to support filter media, which covers the front of the frame.

2. Then the **plenum** is built around the fan assembly. All parts are sheathed with 1/2-in.-thick oriented strand board (OSB), but any type of sheet good works fine.

1. The first step is attaching the **fan assembly** to the wall starting with the mounting plate, the motor mounting plate, and finally the bellmouth. See p. 72 for detail.

Build the bellmouth

To allow the air to flow smoothly to the fan, Guzynski recommends building a kind of funnel known as a bellmouth.



Glue up the rings. The fan housing is made from six rings. Each one has 12 sections butt-joined. That means each end is cut at 15°.



Spin and rout. Attach a piece of thin plywood to the back of the ring and drill a small hole in the center. Register the hole on a metal rod set in a wood block to rout the inside round.

Rough-shape the curve. Use the same setup to cut steps on the inside of each ring and an outside rabbet on the top ring (shown). This reduces the waste you'll need to grind away.

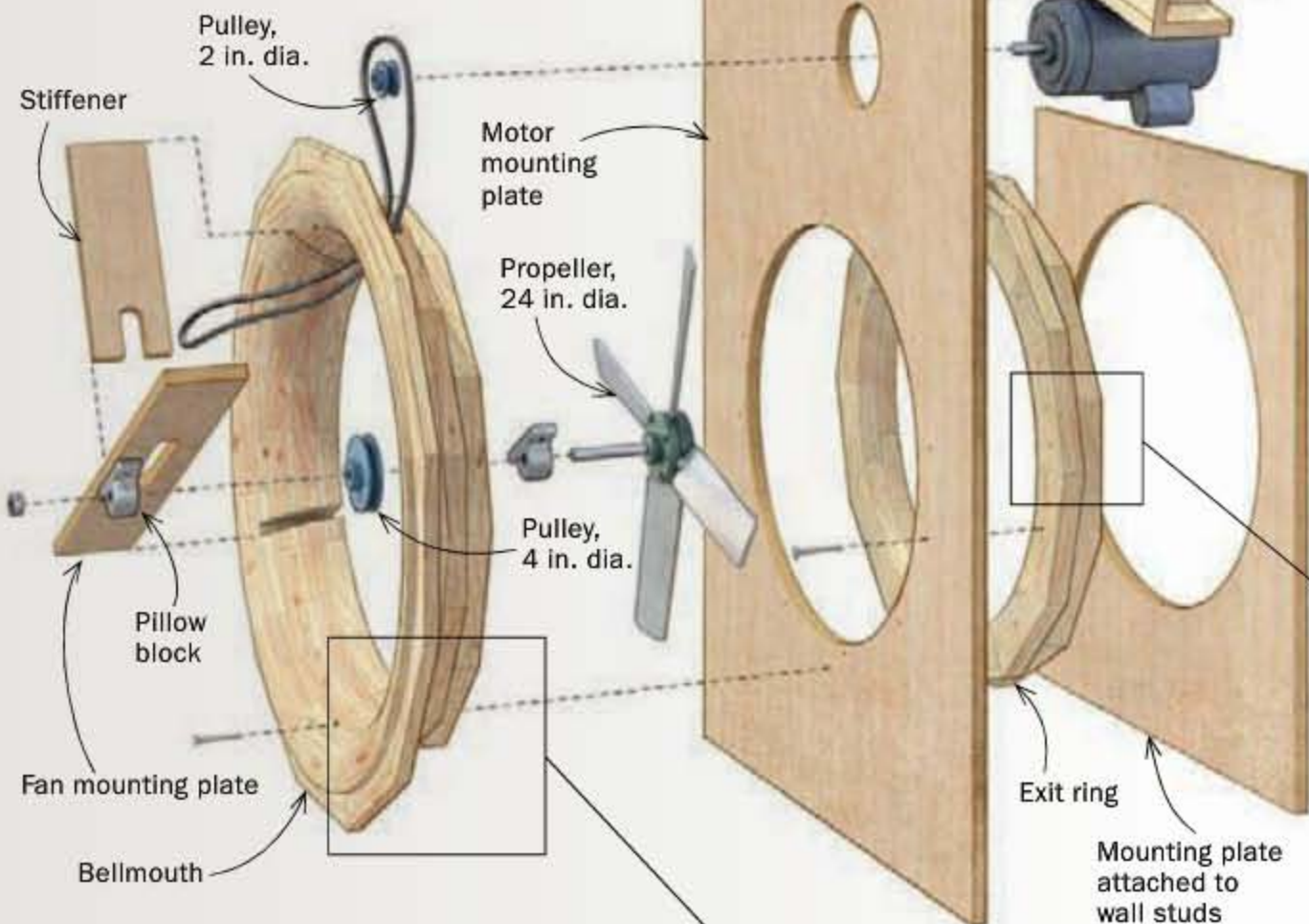


Smooth the curve. After gluing the rings together, shape the steps into a flowing bell-mouth curve using an angle grinder. By attaching the pivot point to the end of a bench, it can be spun as the work progresses.



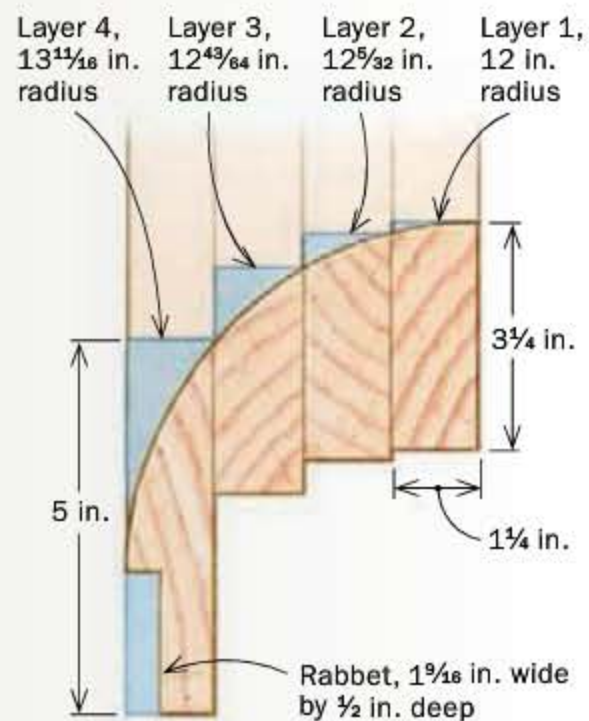
BELLMOUTH AND FAN ASSEMBLY

The lower three layers of the bellmouth and the two layers of the exit ring are all 12-sided rings made from 2x4 lumber milled to 1 1/4 in. thick by 3 3/4 in. wide. The top layer of the bellmouth is made from 12 pieces of 2x6 lumber milled to 1 1/4 in. thick by 5 in. wide.



CROSS-SECTION OF THE BELLMOUTH

Each ring of the bellmouth is roughed out on the router table using a 1/2-in. straight bit. Multiple steps cut into the rings every 1/4 in. or so reduce the work required to smooth the contours later. After you stack and glue the rings, fair the steps to a smooth curve using a grinder or rasp.

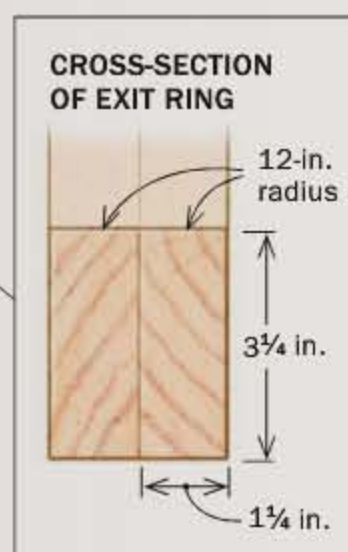


Add the fan

A mounting plate holds the fan in the center of the bellmouth.



Find the center line. The first step in attaching the fan-mounting plate is to find the center line of the bellmouth (left). Use a template to mark the sides of the two mortises for the mounting plate (above). You need to offset the mortise by the distance from the center of the fan to the bottom of its mounting bushings (see **Attach the fan**, below).



chase, combined with a $\frac{3}{4}$ -hp motor, has far more power than even the largest whole-house fans.

Air doesn't flow smoothly around sharp corners, so I created a funnel-shaped opening known as a bellmouth to hold the fan. Using remilled, dry construction lumber, I made two 12-sided rings for the exit ring and four for the bellmouth. Because the rings get progressively larger, the segment length is different for each ring. The largest ring is made using 2x6 lumber but the rest use 2x4 lumber.

Since I lack a lathe that can handle 30-in.-dia. turnings, I mounted each ring on a sheet of scrap plywood with a center pivot hole and spun it on the router table to turn the narrowest part of the ring from faceted to round. I used a straight bit, adjusting it to cut reference notches at several points through the thickness of each ring. The notches make it easy to know how much material to remove when smoothing the bellmouth after all the rings are glued together.

Glue up the exit ring and the bellmouth one layer at a time, offsetting the butt joints. Once it's dry, fair the bellmouth. I used an angle grinder but you could use a rasp. Leave final smoothing of the exit ring that will be adjacent to the fan blades until after a dry-fit because the tip clearance should be less than about $\frac{1}{8}$ in. for maximum efficiency.

Carefully cut dados in the bellmouth for the jack-



Attach the fan. With the fan-mounting plate and its stiffener in their mortises, place the fan's jack bushings on the plate so the fan is centered in the opening, and mark the location.



Cut the mortises. Use a handsaw to define the mortise's sides, then drill out the waste with a Forstner bit and clean up with a chisel.



Belt hole. Drill an elongated hole in the bellmouth for the fan belt to pass through.

SOURCES OF SUPPLY

GRAINGER.COM

$\frac{3}{4}$ hp motor. Guzynski used one from an old contractor saw, but you can buy one for \$300 (No. 5K117) or a totally enclosed fan-cooled one for \$370 (No. 6K123).

24-in. fan, No. 3GTG4, \$130

30-in.-wide roll of filter media, No. 6B835, \$64

ROBOTMARKETPLACE.COM

$\frac{5}{8}$ -in.-dia. keyed jackshaft (SH-x-1000 VW)

Pair of 5-in.-bore SBPP pillow block bearings (No. MB-SBPP202-10); 2-in.-dia. and 4-in.-dia. A-series pulleys with $\frac{5}{8}$ -in. bore. Guzynski needed a 2:1 ratio because the motor is 3,450 rpm and the propeller is 1,725 rpm.

A-series belt, No. VB-A62

Lumber, drywall, screws, lighting, about \$350

Abrasives for angle grinder: Weiler 36 grit (No. 30828) and 80 grit (No. 30832)

Finish assembling the fan

It is easier to do this on the floor of your shop than on the wall of the booth.



Set it on the floor. Place the mounting plate on the floor followed by the exit ring, the motor-mounting plate, and the bellmouth.

shaft mounting plate and stiffener. Attach the fan and cut the belt-access hole in the bellmouth so that it is roughly in line with the pulley.

Screw the exit ring to the mounting plate that you'll later screw to the wall. Then screw the motor-mounting plate to the exit ring, and the bellmouth to the plate. Check the clearance of the fan blades and, if necessary, adjust the opening size or fan placement. Now stretch the belt tight and mark on the motor-mounting plate the location of the motor's pulley. From there, cut a circle for the front of the motor and attach a stand to the back side of the motor-mounting plate to support the motor.

Build the rest of the booth

My fan is 24 in. dia. and my wall framing is 16 in. on center, so I carefully laid out the location so that I would only have to cut one stud. The fan can be up to 8 in. off center in the booth if necessary. Since the exhaust flap is in a gable end, I didn't add a header because the studs are not bearing the weight of the roof.

Attach the fan unit to the wall in stages. Next is the plenum, the area that forms a kind of lean-to at the back between the fan and the filters. To build the back wall of the plenum around the fan, I fastened a 2x4 bottom plate to the floor, 1/2 in. behind a



Check for clearance. For maximum power, you want the fan blades to be no farther than 1/8 in. from the sides of the exit ring. Now screw down the jack bushings.



Locate the motor. Pull the fan belt tight and draw the curve on the motor-mounting plate. This is the rough location of the motor pulley and hence the motor.



Mount the motor. Drill a hole in the motor-mounting plate a little larger than the diameter of the motor. Attach the motor to its stand, pull the motor until the belt is tight, and screw the stand to the back of the motor-mounting plate.

Assemble the booth

It is easiest to work from the back forward.



Ring the exit. Attach the mounting plate with the exit ring to the 2x4 studs that surround the exhaust air opening.



Add the motor. Screw the motor-mounting plate to the exit ring. The front of the motor and its pulley protrude through the plate.



On goes the fan. Attach the bell-mouth and fan to the motor-mounting plate with long screws.



Add the sheathing. Sheets of 1/2-in.-thick OSB form the back of the plenum.



Finally the filters. Filter material (to catch the overspray) is attached to two frames that stack one on top of the other in front of the fan.

plumb line from the face of the bellmouth, then completed the frame and covered it with 1/2-in.-thick oriented strand board (OSB). Use screws so the assembly can be removed easily for fan maintenance. Then screw the angled side and top walls of the plenum to the front. Put foam gasketing where you might have air leakage.

Filter media, lights, action—The side walls and ceiling are simple partition walls, framed 24 in. on center to save lumber. The two filter media frames stack on one another and are screwed in place so they'll be easy to change.

I made an insulated, hinged exit door for the outside of the building that I prop open when I'm ready to spray. I added a screen to keep fingers out of the fan and a flap to prevent wind from blowing in through the exit door when

the fan is off, and blowing dry overspray off the filters onto the workpiece.

The booth pulls a constant flow of air past the project between 1 and 2 ft. per second, so overspray has almost no chance to roughen a finish. In warm, dry weather, I leave the garage door and the exhaust door open when I'm spraying. When it's 50°F or less, I open the doors, spray for a few minutes, then close them most of the way and let the furnace reheat the shop.

With the generous lighting, I can see defects and judge coating thickness much more reliably now. Add the ability to finish year-round, and you can understand why the booth is so valuable. □

Online Extra

To read and learn more about spraying solvents, risk versus reality, go to FineWoodworking.com/extras.

Geoff Guzynski is a professional furniture maker near Chicago. His website is village-woodworking.com.

readers gallery

VINTAGE MACHINERY: NEW LIFE FOR OLD IRON

There are many advantages to buying vintage woodworking machines. First, you often can get an industrial-quality tool for pennies on the dollar, compared to its modern counterpart. You get a lot of cast iron, which makes for a heavy-duty piece of equipment that won't transmit vibrations like the composites or lighter metals used in contemporary machinery. That translates to better results. It's also hard to deny the beauty of vintage machines, crafted in an era when over-the-top flourishes and high design were critical to capturing the attention of would-be buyers. But there's a trade-off. It takes some effort and know-how to get these old machines back into working order. To many woodworkers, rebuilding machinery has become an addiction all its own, a fact I learned this summer while trying to fix up my 1940s-era drill press. Websites like vintagemachinery.org, owwm.org, and others have a vast array of old manuals, repair guides, and discussion forums to help those willing to give these old soldiers a new lease on life. Here's a sample of what's possible—from mega-machines to practical choices for a small home shop.

—KEN ST. ONGE, associate editor



AFTER



BEFORE

SHANE WHITLOCK

Perry, Utah

1923 Crescent Universal Wood-Worker (Model No. 108)

This early take on a combo machine originally comprised a 26-in. bandsaw, 12-in. jointer, 12-in. tilting-top tablesaw, $\frac{3}{4}$ -in. shaper, and a borer, although the borer was long ago removed from this particular machine. A 7½-hp, three-phase motor powers everything through a belt-driven lineshaft that allows each machine to work simultaneously, or one at a time. After dismantling and sand-blasting the parts, Whitlock polished every nut and bolt and replaced all 200 of its steel washers with brass versions that he turned himself. He also poured new babbit bearings for the drive mechanism, bandsaw, jointer, shaper, and tablesaw. He even polished and painted the pulleys and hand-stitched new leather belts before painting the machine satin black with gold pinstripes. A veteran of numerous machine restorations, Whitlock said the toughest thing to do with this heavier-than-a-ton Crescent was move it around. Fortunately, he won't have to: It's now on display in the lobby of the former lumber mill where it was used originally.

JACK FORSBERG

Ottawa, Ont., Canada

1950s-era Wadkin PK tablesaw

With its 18-in. blade and sliding table, this unique British-made tablesaw was geared toward patternmakers, engineering firms, and other industries with a need to dimension large timbers. Although these saws were discontinued in the 1960s, the Wadkin PK has safety devices and creature comforts sought after in contemporary saws, such as a true riving knife, an overarm blade guard, and the ability to add a zero-clearance insert to the sliding table. Forsberg, an English machinery enthusiast with a workshop full of Wadkin equipment, said he spent years looking for one before winning this saw for \$100 in an auction at a large furniture company. The machine got a complete rebuild and paint job, including the hand-painted machine tags and cast letters. Forsberg also reworked and polished all of the handles and added a brass and rosewood fence and a tenoning jig of his own design.



AFTER

BEFORE



Auction score. Forsberg bought his dream saw for \$100 in an auction at one of Canada's older furniture-making companies.



Designed for big cuts. The huge cast-iron sliding table allows the saw to crosscut thick slabs up to 36 in. wide.



WILLIAM THOMAS

Rindge, N.H.

1910-1915 Crescent Angle Bandsaw

Thomas spent three years meticulously restoring this bandsaw to resemble something close to what came out of Crescent's factory just before the start of World War I. After repairing the dovetailed ways that attach the table to the saw, Thomas, a professional furniture maker, fabricated replacement parts, including the two giant wheel guards he made from wood. The lettering on the upper guard was reproduced and cut with the help of students in a high school shop class. Although the angle bandsaw was originally marketed to boat builders, this one was being used in a small cabinet shop in central Massachusetts when Thomas found it. He uses it for ripping, resawing, and other general shop tasks.

BARRY WILLIS

Cumming, Ga.

1936 Delta 14-in. drill press (Model No. 1302)

It took Willis about \$230 and four weekends to restore this “Slo-Speed” benchtop drill press, which he found through a Craigslist ad. After putting new bearings in the 1/4-hp motor and replacing the chuck, he filled a few holes in the table with pipe plugs and epoxy before re-machining it. He also polished all of the metal parts and finished off the machine by painting it white. Although he restored the drill press to showroom shape, Willis uses it regularly in his home shop.

Diamond in the rough. Willis paid \$100 for this rusty but still working drill press.



AFTER



KEN LEWELLYN

Hendersonville, Tenn.

1945 Delta Unisaw (1 hp)

Lewellyn is a self-described weekend warrior who had wanted a nice tablesaw for a long time but didn’t do enough woodworking to justify its cost. That changed when he needed a big saw to build a new dining-room table. He drove 250 miles to Verona, Ky., to pick up this saw after seeing an ad on Craigslist. To restore it, he removed every nut and bolt, and cleaned, painted, or polished every component before reassembling it. He also replaced the belts, bearings, and anything else that appeared worn or broken. Lewellyn spent about \$1,000 and two months of work restoring it, and he credits the message board and online publications of owwm.org and vintagemachinery.org for helping him to get it done. “The great thing about old machines is that everything can be accessed and replaced, [and] a lot of the hardware can be purchased at the local hardware store,” he said.





BENOIT CÔTÉ

Saint-Hubert, Que., Canada

1949 General Jointer (Model No. 180)

This 37-in.-long, 6-in.-wide jointer, which is powered by a ½-hp motor, was built in the Drummondville factory near Côté's home. He spent about 200 hours restoring the machine, which has a rare cast-iron base that helps it to run almost vibration-free. He disassembled it and sandblasted or stripped the parts before priming and painting the jointer based on an original factory color scheme. He started with a dark gray enamel, followed by a light spray of Stone Grey Rust-Oleum and a coat of semi-clear varnish sealer. Côté also polished the tables and machined surfaces, and swapped out the bearings, knives, and V-belts before reassembling the machine and putting it to use.

DAN SWARTZ

New Sewickley Township, Pa.

1950 Boice Crane Bandsaw (Model No. 2309)

Swartz bought this 14-in. bandsaw for \$75 at a garage sale in the 1980s, but didn't have to rebuild it until last year when the bearings and tires started to show their wear. He installed new bearings and transmission seals before repainting it and polishing the hardware and other metal. He also added a light inside the upper wheel housing (an original accessory), and replaced the power cord and the drive belt. All told, he spent about 80 hours restoring the machine, not including the time spent at the computer reproducing new decals from photos of other machines he found online. The relatively cheap restoration was a great deal, he said. The heavy steel-plate construction and copious amounts of cast iron, plus the new bearings and tires, make for very smooth cuts.



KENNETH CARY FALK

Camas, Wash.

1968 Delta/Rockwell scrollsaw (Model No. 40-440)

Falk found this 40-440 scrollsaw on Craigslist during a trip through Seattle. The saw, which dates to 1968, has a 24-in. throat and ¾-hp motor with variable speed control. Falk likes the older saw because it has a lot more cast iron than newer models, with all the advantages that extra mass brings. Falk replaced the pulley and motor bearings, changed the oil and gaskets in the oil bath, and repainted it white and hammered bronze using a few cans of Rust-Oleum. He also added a maple top and shelf to the base.

Simple glue-up table rides sawhorses

Q: Can I use sawhorses to hold furniture during glue-up? I'm worried that my furniture won't be square because the sawhorses aren't flat or even.

—DON STEVENS, Cleveland, Ohio

A: SAWHORSES WILL WORK IN A PINCH. Even if the floor isn't level or the piece rocks a little, they won't cause you to have out-of-square glue-ups, as long as you've cut square joinery, clamped appropriately, and checked everything for square as you go. But they're not the most user-friendly glue-up helpers.

Assembling furniture on them is tricky because they don't give you any surface area to support the work, so you have to balance it carefully to prevent it from falling. You also don't have a convenient place to keep clamps and glue, which can make the process more scattered. Finally, the open area under the horses lets the glue drip onto your floor.

A better way is to put a glue-up table on top of those horses. It doesn't have to be fancy, or even permanent. You can make a sawhorse-mounted table from plywood or even an old hollow-core door, both of which can be stored against a wall. I have a dedicated glue-up table that is about 28 in. wide and 96 in. long. It's the perfect size for just about all the furniture I build, and I'd recommend something similar for a makeshift version.

—Christian Becksvoort is a contributing editor.



New life for an old door. The table should be long enough to glue up panels for case sides or tabletops. A hollow-core door is perfect because it is stable and lightweight.



Quick-to-make clamp holders. Dadoed wood strips keep clamps in place for panel glue-ups.



Ask a question

Do you have a question you'd like us to consider for the column? Send it to Q&A, *Fine Woodworking*, 63 S. Main St., Newtown, CT 06470, or email fwqa@taunton.com.

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Modify a chisel for cleaner cornering

Q: I can't get my bench chisels to fit into the corners of dovetails when I'm chopping waste. Do I need different chisels?

—MIKE LOVE,
Indianapolis

A: A LOT OF BENCH CHISELS have beveled sides that end in flat sidewalls. They don't pose a problem for most woodworking tasks, but they do make it difficult to get into the tight corners of dovetails. There are a couple of ways to get around that problem.



Rough corners. The flat edges of some chisels make it hard to pare into corners without damaging the sides of dovetails.

The easiest is to carefully grind the edges, extending the angles so the flats disappear. Angled sides will let you get right into corners, and you only need to grind the first inch or so. Go slowly and dip the tool in water to avoid overheating. Then polish the sides on fine sandpaper or a sharpening stone.

You could also buy a Japanese chisel specially designed for dovetails. They have a triangular cross-section with no flats. As an added benefit, the harder steel of the Japanese tool takes a keener edge and makes paring a joy. A $\frac{1}{4}$ -in. dovetail chisel is available from japanwoodworker.com for \$61.

—Michael Pekovich
is FWW's art director.



Refine the edges. Grinding away the flat (above) gives you clearance to make clean corner cuts. The first inch or two (left) leaves enough room for clean paring.



Or get a new chisel. The triangular shape of Japanese dovetail chisels is well-suited to tight spaces.

Tension bandsaws without a gauge

Q: My small bandsaw has no tension gauge. How can I tell if I've tightened the blade enough?

—JIM MITCHELL,
Raleigh, N.C.

A: EVEN IF YOUR BANDSAW has such a gauge, it is probably inaccurate. That's OK, as you can still find the proper tension just by pressing on the blade.

Unplug the saw and raise the guides to their highest position. Then adjust the tension and press on the blade as shown at right. This is more than enough tension for a sharp bandsaw blade. If you still get blade drift or bad cuts after that, you need a new blade or a coarser one (3 tpi is right for woodworking).

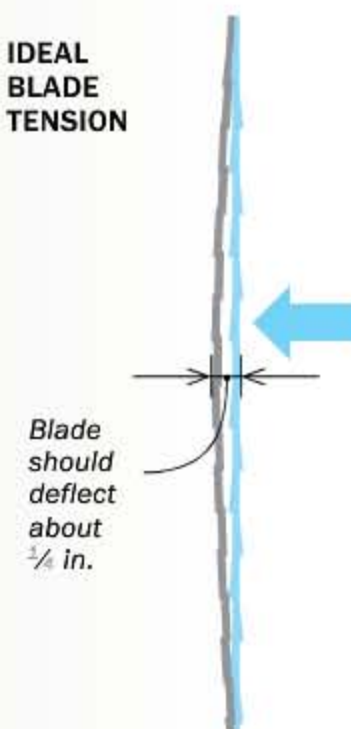
This method works for any 14-in. bandsaw or smaller, and blades up to $\frac{1}{2}$ in. wide.

—Michael Fortune is a
contributing editor.



Finger tip. With the guides raised all the way, press in the middle of the blade. If you can deflect the blade $\frac{1}{4}$ in. without your fingertip turning white, the tension is good.

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TENSION



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 $\frac{1}{4}$ in.

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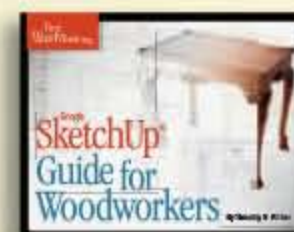
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Brushless motors

NEW MOTOR TECHNOLOGY IS SPURRING OTHER CHANGES TO POWER TOOLS

BY MARK SCHOFIELD

Electric motors have to be one of the most reliable machines ever made. A few years ago, I picked up an old metal jigsaw at a tag sale. The owner apologized that it hadn't been used since her husband had passed away 30 years earlier. I plugged it in and away it went, just like new. So why would anyone want to replace this tried-and-tested motor with one that's more complicated and costs more to make? In a word, efficiency.

In his test of impact drivers (see pp. 42–45), Eric Constans compared nearly identical brushed and brushless models to see if the brushless type deserved the marketing hype. He found that brushless drills do indeed run longer than brushed-motor drills on a single battery charge (but the difference isn't quite as big as advertised).

While working with Constans on his article, I talked to a lot of engineers at various power-tool companies and realized that the introduction of brushless motors is connected to two other changes in tool technology. Lithium-ion batteries are also evolving, as are the electronics that govern the trigger, motor, and battery.

Electric motors are simple

One reason electric motors are so reliable is that they are pretty simple. The force behind all electric motors—both brushed and brushless—is the attraction between two sets of magnets. In a normal brushed motor, fixed magnets surround spinning electromagnets. The electromagnets receive power by means of carbon brushes that rub against a segmented cylinder called a commutator. Carbon, in the form of graphite, is used because it conducts electricity well, yet slides easily over the commutator. However, graphite is relatively soft so the brushes wear out over time and need to be replaced.

Other drawbacks of brushes are the drag they create and the sparking caused as they cross from one segment of the commutator to another. Both reduce the efficiency of the motor.

How brushless is different

In a brushless motor, the positions of the magnets are reversed, with fixed electromagnets surrounding conventional magnets. Because the electromagnets don't move, the power can be supplied directly without the use of brushes. There is no friction or arcing, so the motor is more efficient. What

CONVENTIONAL MOTOR

In a traditional brushed motor, fixed magnets surround spinning electromagnets. Electricity from the cord or battery is transferred to the electromagnets via carbon brushes. The key is the commutator, which switches the electromagnets, pulling them along the fixed ones.

The changing polarity of the **electromagnets** pulls them along the fixed magnets.

Carbon brushes conduct electricity from the battery to the commutator.

The **commutator** transfers the electricity to ever-changing sections of the electromagnets.

Fixed magnets surround the electromagnets, providing the magnetic field for the electromagnets to push and pull against.

Brushes rub. This creates drag. Power is also lost in the form of sparks as the contact point switches from one section of the commutator to the next.

makes the motor more complicated, and adds to the cost, is a microcontroller that reverses the direction of the current every fraction of a second.

Although first invented in the 1960s, brushless motors didn't become commercially viable until the 1990s with the growth of sophisticated and cheap electronic controls. If you're a fan of radio-controlled cars, you'll already appreciate brushless motors for their compact size, their lack of friction at high rpm, and the greater battery range they can accommodate. Cooling fans in computers almost all use brushless motors because they run cooler and the lack of sparking means no electronic interference.

The delay in getting brushless motors into woodworking tools has been a combination of scaling up their size, dealing with the high peak loads these tools need to handle, and seeing if the market will pay more for a tool, particularly in a depressed economy.

A friend to lithium-ion

The brushless motor's microcontroller can be programmed to react to changes in speed and load by changing the timing of those current reversals. It turns out that this electronic control is also vital for getting the best out of lithium-ion batteries.

When lithium-ion batteries were introduced into woodworking tools, they were hailed as a breakthrough. Seven years later, several tool companies admit that early versions of the batteries left a lot to be desired and that customers ended up finding faults that should have been uncovered in the lab. I'm not the only woodworker annoyed to find that my battery suddenly couldn't be charged. As

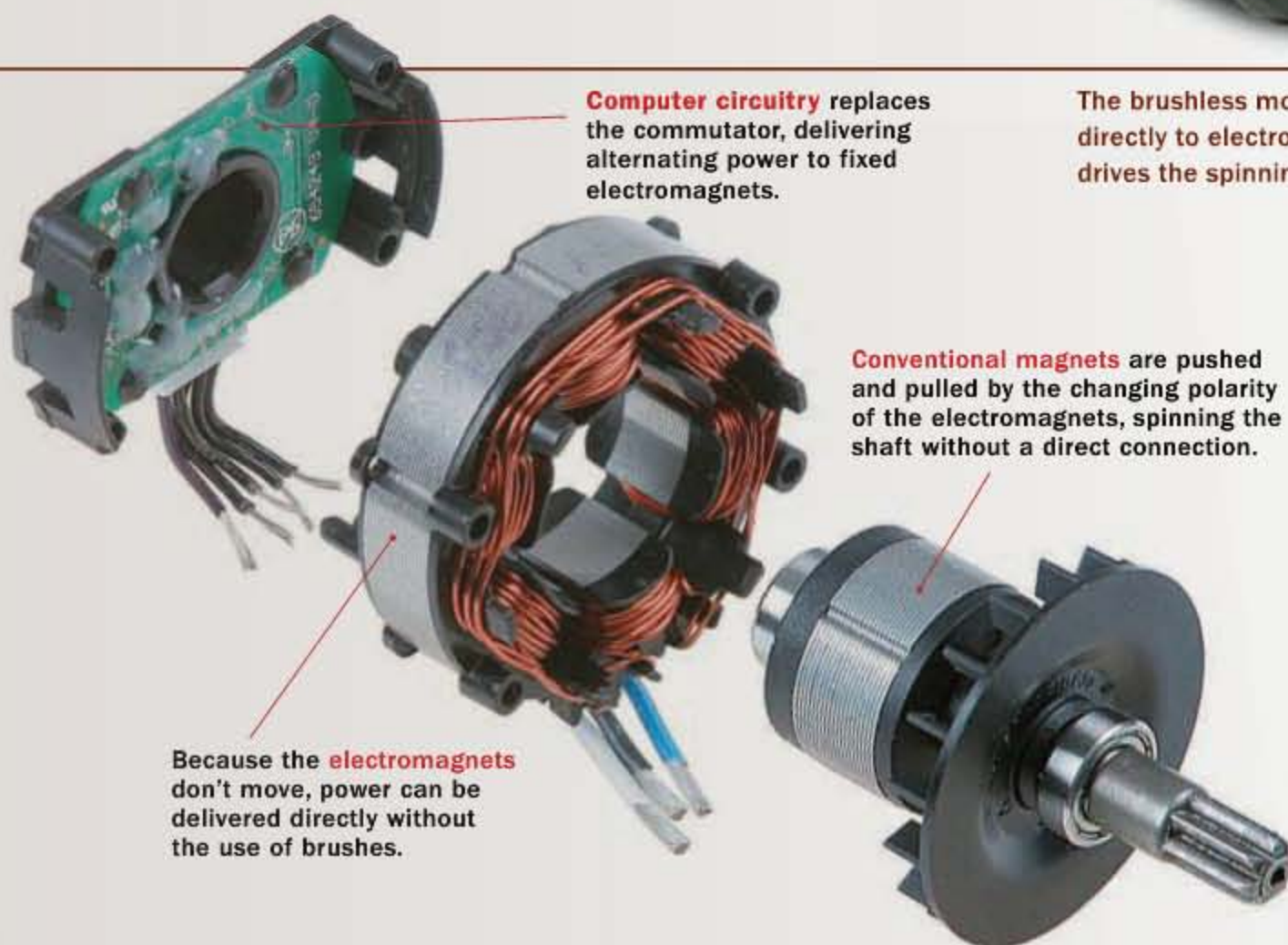
The battery has a chip, too. Lithium-ion batteries have a computer circuit board that controls the draw, preventing the cells from being over-taxed and permanently damaged.



BRUSHLESS TECHNOLOGY

Computer circuitry replaces the commutator, delivering alternating power to fixed electromagnets.

The brushless motor is the best of all worlds. Electricity is delivered directly to electromagnets with no power loss, while magnetism drives the spinning shaft with no friction.



Because the **electromagnets** don't move, power can be delivered directly without the use of brushes.

Conventional magnets are pushed and pulled by the changing polarity of the electromagnets, spinning the shaft without a direct connection.



No touching parts. The shaft on a brushless motor spins more freely, unhindered by the drag of brushes.

a closer look continued

one engineer said, “It’s a finicky technology and lithium-ion has to be managed far more than NiCd [nickel-cadmium].”

All lithium-ion batteries require some kind of computer chip in the battery itself or in the tool’s switch to monitor the draw from the battery. Without this electronic control, you could burn out the battery in seconds and it might even catch fire.

The fact that both the brushless motor and the battery require electronic control has spurred manufacturers to create far more sophisticated circuits that optimize the draw from the battery, the output of the motor, and the overall run time. These changes should also increase the lifespan of the battery.

It makes more sense to put brushless motors in cordless tools where their efficiency will directly result in longer run time.

Why impact drivers are leading the way

All that said, with the exception of Festool, manufacturers have been fairly slow to introduce brushless technology into woodworking. A few years ago, Porter-Cable introduced a low-profile, 5-in.-dia. random-orbit sander. The shape of the brushless motor allowed the sander to be much shorter and more stable than other sanders. However, the brushless motor’s efficiency wasn’t really a factor because the sander was corded.

Since then almost all the other brushless tools have been cordless drills, and in particular, impact drivers. It makes sense to put brushless motors in cordless tools where their efficiency will directly result in longer run time. Impact drivers are an even better fit. First, according to manufacturers, they have been the fastest-growing segment of the drill market over the last five years. Second, they are popular in Japan where a lot of



Beyond cordless? Manufacturers’ initial forays into brushless motor technology have been confined mainly to cordless tools. So far the only other brushless woodworking power tools have been Festool’s high-end offerings and Porter-Cable’s low-profile sander.

development work on brushless motors was done. And finally, the way impact motors work means that they automatically limit peak draw from the battery at around 50 amps, while a conventional drill can pull over 200 amps. This means the electronic control of battery power doesn’t have to be quite as sophisticated on an impact driver.

Manufacturers were coy about what other tools might receive brushless motors. They are waiting to see how well the drills are received, how price-sensitive the market is, and how the construction sector recovers. I would expect to see brushless motors in a wider range of drills over the next year or so, but the brushless, corded router could be a few years off. In the meantime I recommend the current brushless drills, particularly if you draw down a battery or more a day. However, look for the longest warranty you can find on both tool and battery. □

Eric Constans, chair of mechanical engineering at Rowan University, Glassboro, N.J., helped with this article. Mark Schofield is the former managing editor.

HEAD-TO-HEAD COMPARISON

While testing brushless impact drivers for a separate article (see pp. 42–45), we also tested the conventional brushed models of the same tools where available. The brushless motors offered distinct advantages in both run time and torque.



TYPE	BRUSHED IMPACT DRIVERS	BRUSHLESS IMPACT DRIVERS
AVG. SCREWS PER AMP-HR.	90.5	110.2
AVG. PEAK TORQUE (IN.-LB.)	1,080	1,200
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how they did it

Moving the craft forward

BY JONATHAN BINZEN

Much of the pleasure of chairmaking, Peter Galbert says, depends on using the right tools. To get a tool that sings rather than groans, Galbert often makes his own. He's made everything from adzes and reamers to mallets and branding irons. Most of the time he hews close to traditional designs, but on occasion Galbert innovates, as with the tools on this page. And although he usually makes tools for himself, he does make some for sale. You can find his travisher and caliper—and plans for the ingenious head of his shaving horse—on his website, petergalbertchairmaker.com, where he also posts a lively and informative blog.



No more dumbhead. A ratchet design raises the IQ of the work-holding device—known as the dumbhead—on Galbert's shave horse. What he calls the “smarthead” adjusts in an instant for workpieces of various thicknesses without changing the position of the treadle, which means the user's legs are never over-extended or jammed up.



Ravishing travisher. Galbert finds that even a travisher made in rosewood wears quickly on the bottom, so he screws a brass sole plate to the walnut body of the travishers he makes.



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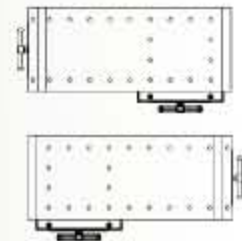


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House of Windsor

When Windsor chairmaker Peter Galbert and his wife, Sue, first entered the old house for sale in Sterling, Mass., they experienced déjà vu. The layout was identical to their last house, which Peter built in upstate New York. Then, as Peter climbed up to the attic, where the hand-hewn chestnut timberframe was exposed, he heard the owners telling Sue that the house had been built in 1801—by a Windsor chairmaker. The chair shop, they said, had stood across the road until it collapsed in the 1950s, and its weathered siding now paneled the walls of the carriage house (which Peter had already sized up as a great little shop). Soon after moving in, Peter discovered that it wasn't just the house that had a history of chairmaking. In the early 1800s, the small town of Sterling ranked as one of the state's leading producers of seating. In 1820 alone, its 23 chair shops cranked out some 70,000 Windsors. Welcome home, Peter. Better get to work.

—Jonathan Binzen



Chairmaking legacy. In the early 1800s, Newton Burpee built Windsor chairs (right) in his water-powered shop (above) in Sterling, Mass.



Old house, new Windsors. Peter Galbert lives in the house Burpee built in 1801 (right), and builds chairs like this settee (left) in the attached carriage house.



Photos, except where noted: Jonathan Binzen; left: Dana Duke



How They Did It Galbert makes innovative tools, too. Turn to p. 90 to see some of them.

Audio Slide Show Galbert gives a guided tour of his shop and his chairs at FineWoodworking.com/extras.